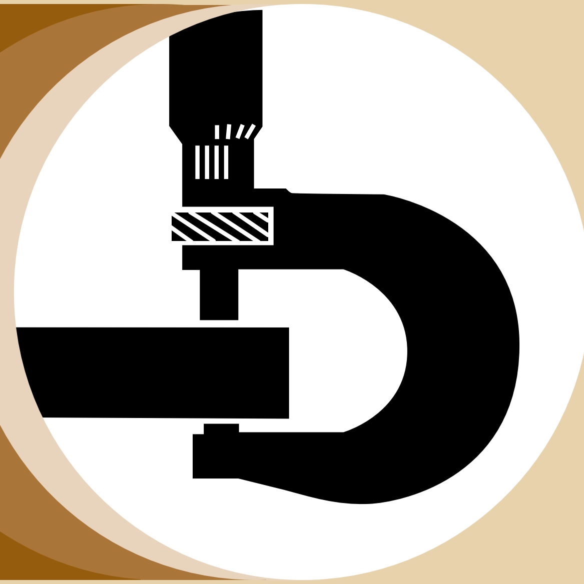
Series 300
3029 (—499999),4039
4045, 6059 and 6068
Diesel Engines



COMPONENT TECHNICAL MANUAL

For complete service information also see:

Alternators and Starting Motors.........	CTM77
OEM Engine Accessories...................	CTM67

Deere Power Systems Group
CTM8 (07JAN99)
LITHO IN U.S.A.
ENGLISH

JOHN DEERE

DEERE POWER

Introduction

FORWARD

This Component Technical Manual (CTM8) covers the recommended repair and test procedures for the following Series 300 Liter Engines:

- 3029 (179 cu. in.) (S.N. —499999) Engines produced in Saran, France.
- 4039 (239 cu. in.) Engines produced in Dubuque, Iowa and Saran, France.
- 6059 (359 cu. in.) Engines produced in Dubuque, Iowa and Saran, France.
- 4045 (276 cu. in.) Engines produced in Dubuque, Iowa and Saran, France.
- 6068 (414 cu. in.) Engines produced in Dubuque, Iowa and Saran, France.

NOTE: For more information on the Saran-built engines as used in European products, refer to CTM3274. For earlier 300 Series cubic-inch engines (3179, etc.), see CTM4.

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

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

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

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

This manual is divided in two parts: repair and operation and tests. Repair sections (03-40) contain necessary instructions to repair the component. Operation and tests sections (100-115) help you identify the majority of routine failures quickly.

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

Before beginning repair on an engine, clean the engine and mount on a repair stand. (See Group 03.)

This manual contains SI Metric unit of measure followed immediately by the U.S. customary units of measure.

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

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

CALIFORNIA PROPOSITION 65 WARNING
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

DPSG,OUO1004,270 –19–20JUL98–1/1

JOHN DEERE DEALERS

The changes listed below make your CTM obsolete. Discard CTM 8 dated 23FEB95 and replace with this new manual. Also, copy these pages and route through your Service Department.

GROUP 01

- Updated engine model designation chart.
- Updated serial number plate information.

GROUP 02

- Updated engine application chart.
- Updated engine oil and coolant application guidelines.

GROUP 04

- Updated sealant application guidelines.

GROUP 05

- Revised valve clearance adjustment procedure.

GROUP 10

- Revised procedure for removal and installation of cylinder liners.
- Added specifications for 32 mm piston pin.

GROUP 15

- Revised procedure and specifications for removal and installation of vibration damper to include available options.
- Revised specifications for flywheel installation.
- Revised procedure for removal and installation of rear oil seal and wear sleeve.
- Revised crankshaft grinding guidelines.

GROUP16

- Revised timing gear backlash specifications.
- Revised procedure for removal and installation of camshaft and gear.
- Revised procedure for removal and installation of front plate.
- Revised procedure for removal and installation of idler gear shafts and bushings.
- Revised procedure for transfer of front plate timing mark.
- Revised timing gear cover installation specifications.

GROUP 20

- Added remote oil filter repair procedures.
- Revised procedure for replacement of oil pickup tube.
- Revised oil pan retaining cap screw specifications.

GROUP 25

- Revised water pump pulley-to-pump housing specifications.

GROUP 30

- Added recommendations for turbocharger use.

GROUP 35

- Revised specifications for injection pump drive gear retaining nuts.
- Revised procedure for inspecting valve adjusting mechanism.
- Revised procedure for assembly of fuel injection nozzles.

GROUP 40

- Added new Group 40 covering removal and installation of starting motors and alternators.

GROUP 100

- Revised altitude performance specifications.

DPSG,OUO1004,162 –19–06JUL98–1/2

- Revised dynomometer test specifications.
- Revised engine break-in procedure.
- Added engine oil consumption information.

GROUP 105

- Added engine cranking speed test.

GROUP 110

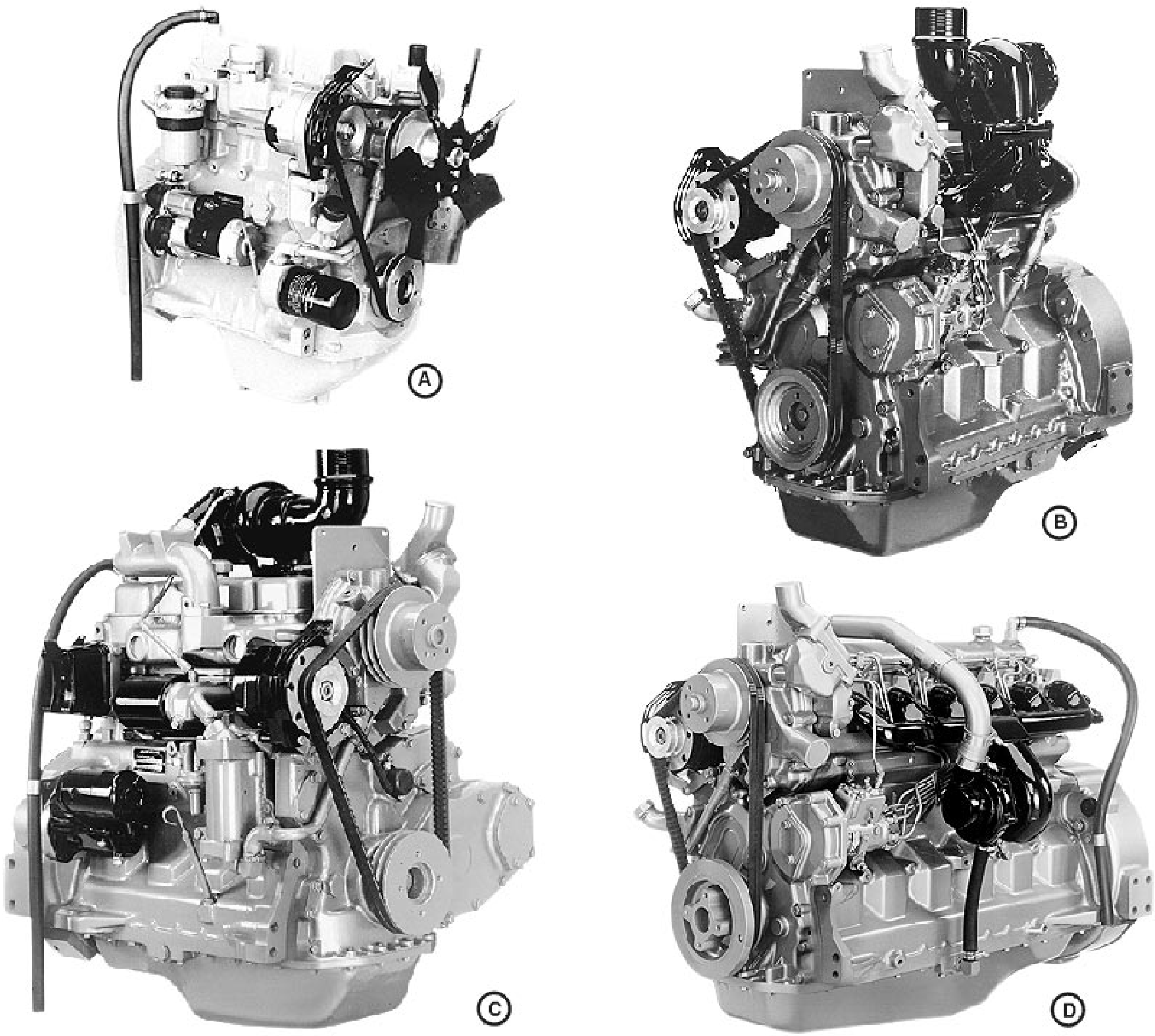
- Added turbocharger oil seal leak test.
- Added intake and exhaust restriction check.
- Revised turbocharger boost specifications.

GROUP 115

- Revised fuel injection pump specifications.
- Added procedure for using TIMETRAC as a tachometer.
- Added fuel shut-off solenoid test (Lucas pumps).
- Revised theory of operation on primary fuel filter.
- Added theory of operation on final fuel filter.
- Added fuel supply quality check.
- Added air in fuel test.
- Added restricted fuel return line check.

DPSG,OUO1004,162 –19–06JUL98–2/2

ENGINE IDENTIFICATION VIEWS



RG9472 –UN–12NOV98

A—3029D B—4039T C—4045T D—6068T

DPSG,OUO1004,480 –19–07NOV98–1/1

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.

INDX

3029/4039/4045/6059/6068 Diesel Engines

Contents

Continued on next page

Continued on next page

Continued on next page

Continued on next page

Continued on next page

Continued on next page

Page

HANDLE FLUIDS SAFELY—AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227 –UN–23AUG88

DX,FLAME –19–04JUN90–1/1

PREVENT BATTERY EXPLOSIONS

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

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

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

TS204 –UN–23AUG88

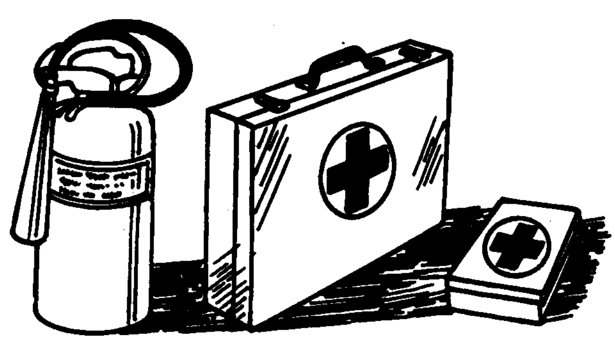
DX,SPARKS –19–03MAR93–1/1

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

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



TS291 –UN–23AUG88

DX,FIRE2 –19–03MAR93–1/1

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:

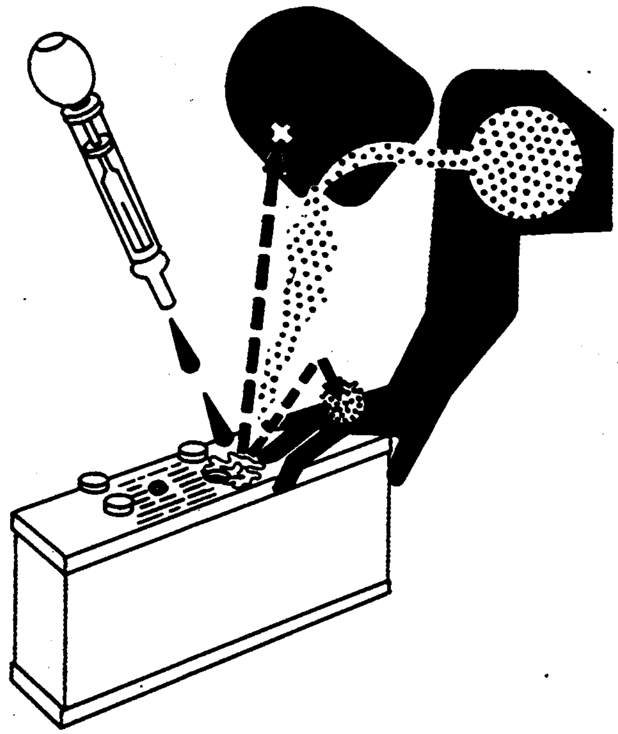
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

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:

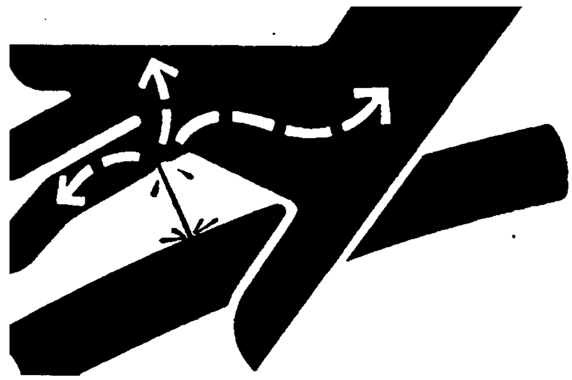
1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 2 L (2 quarts).
3. Get medical attention immediately.



TS203 –UN–23AUG88

DX,POISON –19–21APR93–1/1

AVOID HIGH-PRESSURE FLUIDS



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

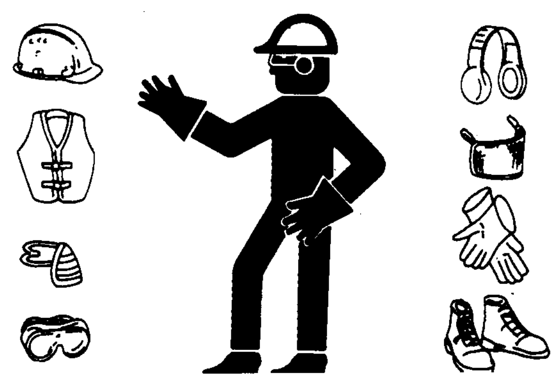
Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

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.

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.

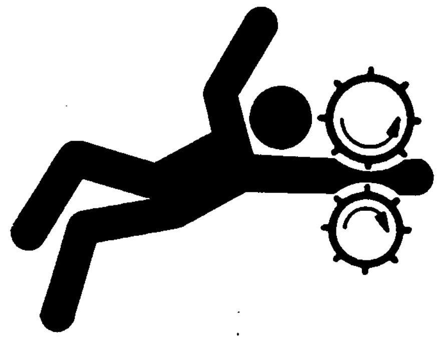
Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

DX,WEAR –19–10SEP90–1/1

SERVICE MACHINES SAFELY

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

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



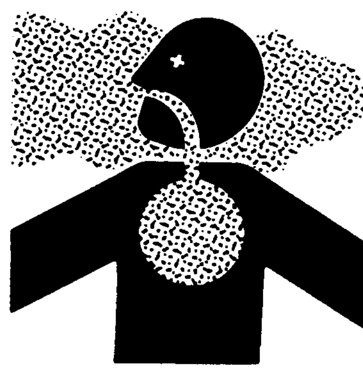
TS228 –UN–23AUG88

DX,LOOSE –19–04JUN90–1/1

WORK IN VENTILATED AREA

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

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



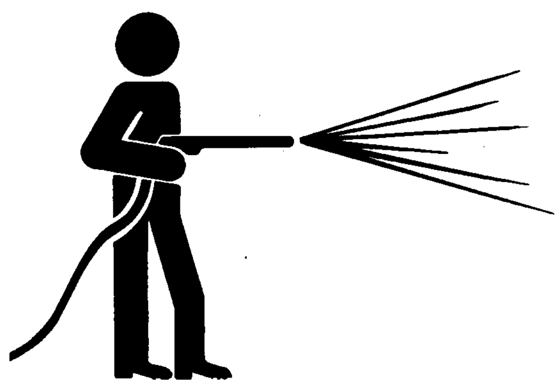
TS220 –UN–23AUG88

DX,AIR –19–04JUN90–1/1

WORK IN CLEAN AREA

Before starting a job:

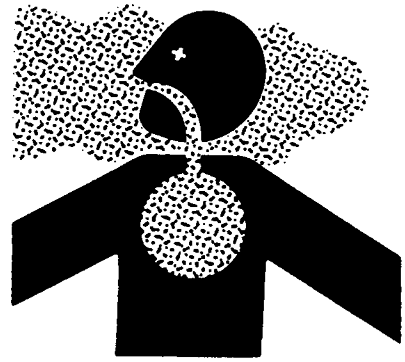
- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; do not attempt shortcuts.



T6642EJ –UN–18OCT88

DX,CLEAN –19–04JUN90–1/1

REMOVE PAINT BEFORE WELDING OR HEATING



TS220 –UN–23AUG88

Avoid potentially toxic fumes and dust.

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

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.

DX,PAINT –19–03MAR93–1/1

AVOID HEATING NEAR PRESSURIZED FLUID LINES

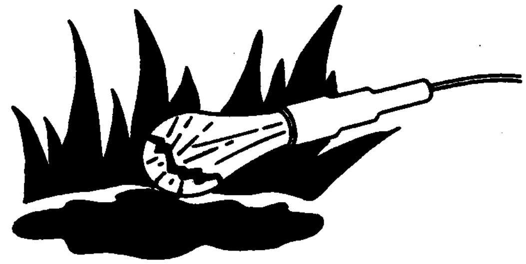
TS953 –UN–15MAY90

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.

DX,TORCH –19–03MAR93–1/1

ILLUMINATE WORK AREA SAFELY

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



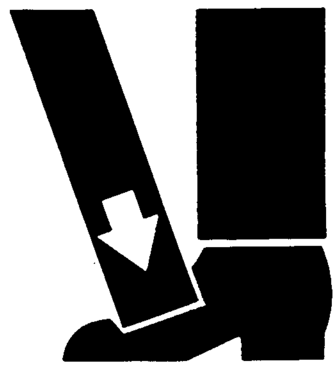
TS223 –UN–23AUG88

DX,LIGHT –19–04JUN90–1/1

USE PROPER LIFTING EQUIPMENT

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

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



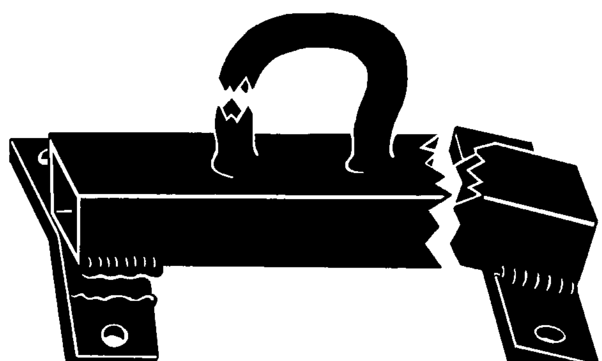
TS226 –UN–23AUG88

DX,LIFT –19–04JUN90–1/1

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

LX1016749 –UN–01JUL97

DPSG,OUO1004,101 –19–28APR98–1/1

PRACTICE SAFE MAINTENANCE

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

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

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

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

Disconnect battery ground cable (-) before making adjustments on electrical systems or welding on machine.

TS218 –UN–23AUG88

DX,SERV –19–03MAR93–1/1

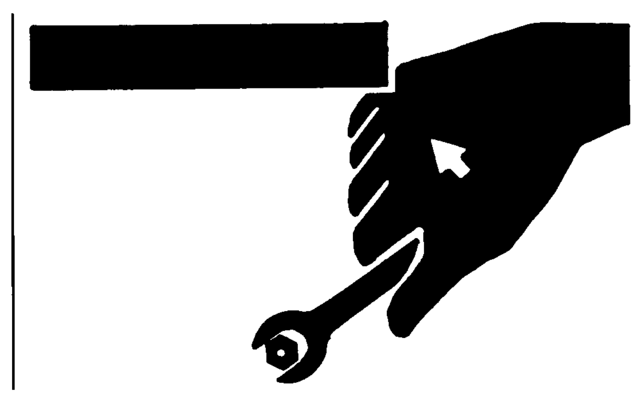
USE PROPER TOOLS

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

Use power tools only to loosen threaded parts and fasteners.

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

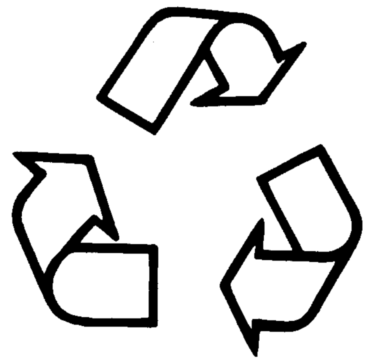
Use only service parts meeting John Deere specifications.



TS779 –UN–08NOV89

DX,REPAIR –19–04JUN90–1/1

DISPOSE OF WASTE PROPERLY



TS1133 –UN–26NOV90

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.

DX,DRAIN –19–03MAR93–1/1

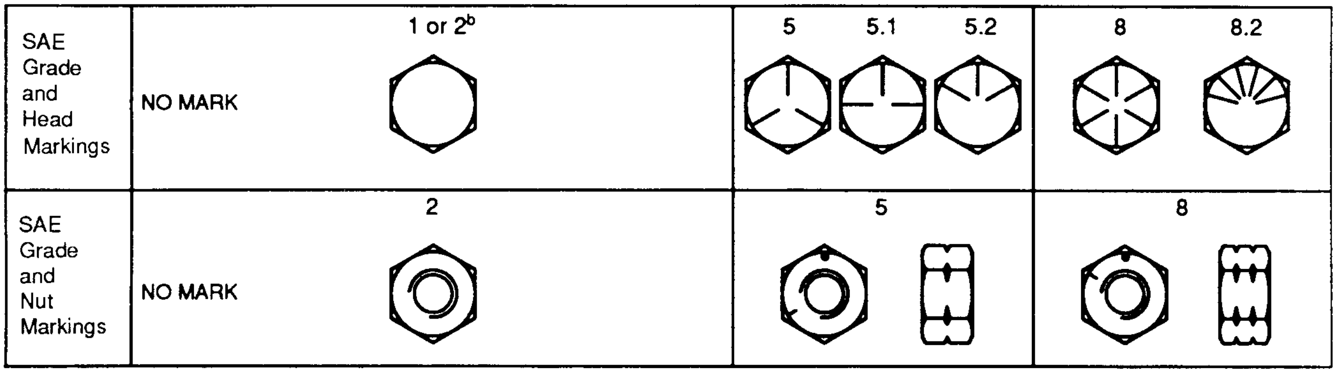
LIVE WITH SAFETY

TS231 –19–07OCT88

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

DX,LIVE –19–25SEP92–1/1

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES



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

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

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

[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.*

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.

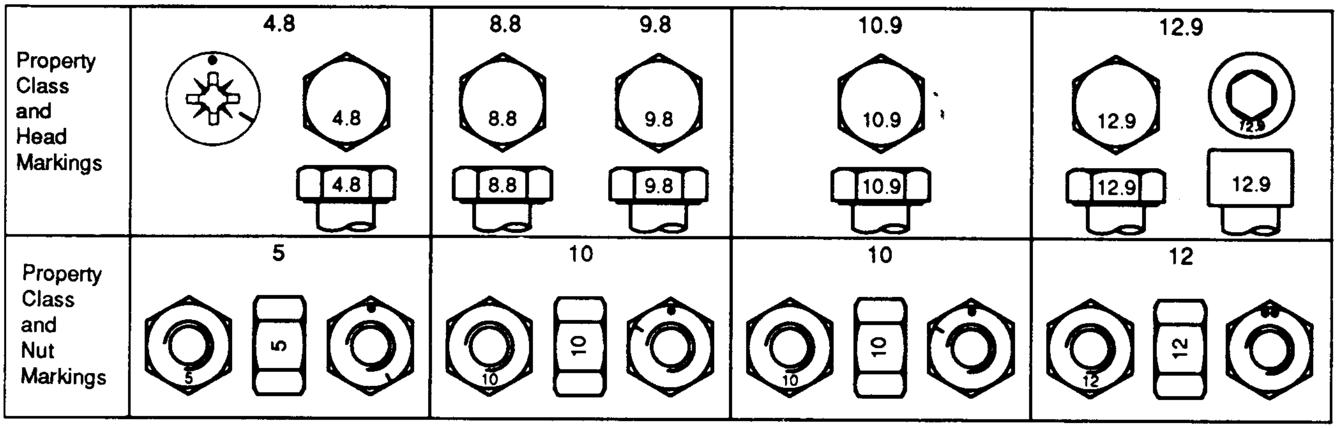
Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

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.

TS1656 –19–02APR97

DX,TORQ1 –19–20JUL94–1/1

METRIC BOLT AND CAP SCREW TORQUE VALUES



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

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

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

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

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

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

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

TS1657 –19–02APR97

DX,TORQ2 –19–20JUL94–1/1

ENGINE MODEL DESIGNATION

John Deere Engine Model—3029, 4039, 6059, 4045, and 6068 Engines.

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

4039TF001 Engine	
4	Number of cylinders
3.9	Liter designation
T	Aspiration code
F0	User code
01	Application code
Aspiration Code	
D	Naturally aspirated
T	Turbocharged
A	Turbocharged and Air-to-Coolant Aftercooled
User Factory Code	
J0	Argentina
LV	Augusta (Georgia)
DW	Davenport (Iowa)
N0	Des Moines (Iowa)
T0	Dubuque (Iowa)
H0	Harvester (Moline, Ilinois)
CE	Iberica (Spain)
L0	Mannheim (Germany)
PE	Torreon (Mexico)
F0	OEM
E0	Ottumwa (Iowa)
RW	Waterloo Tractor (Waterloo, Iowa)
W0	Welland (Canada)
Z0	Zweibrucken (Germany)
Application Code	
00, 01, 02, etc.	Code for specific application

CTM8,GR01,1 –19–07FEB95–1/1

ENGINE SERIAL NUMBER PLATE INFORMATION

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

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:

T06059T000000
T0 .... Factory producing engine
6059T .... Engine model designation
000000 .... Sequential serial number
Factory Code
T0 .... Dubuque, Iowa
CD .... Saran, France
Engine Model Designation
6059T .... Definition explained previously. (See ENGINE MODEL DESIGNATION earlier in this group.)
Sequential Number
000000 .... 6-digit sequential serial number

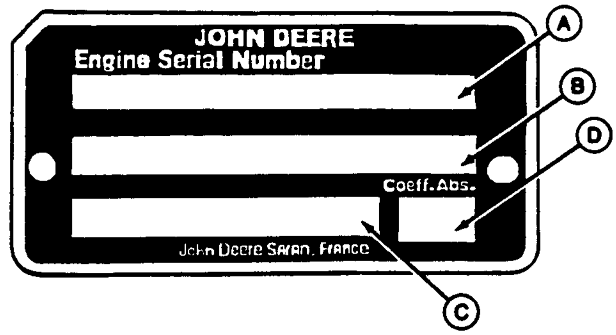
Engine Application Data (B and C)

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

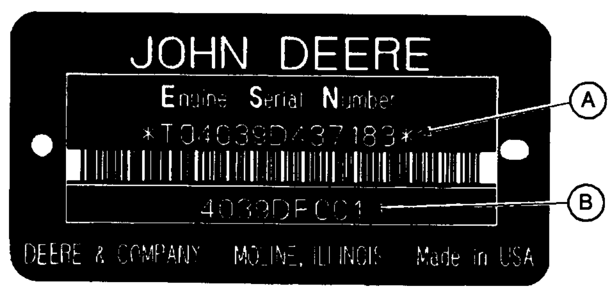
Coefficient of Absorption (D) - (Saran built engines only)

The third line of information on some Saran serial number plates contains the coefficient of absorption value for smoke emissions.

RG5620 –UN–12APR90



RG5610 –UN–09JAN90



RG7025 (CV)

RG7025 –UN–30SEP94

A—Engine Serial Number
B—Engine Application Data
C—Engine Application Data
D—Coefficient of Absorption

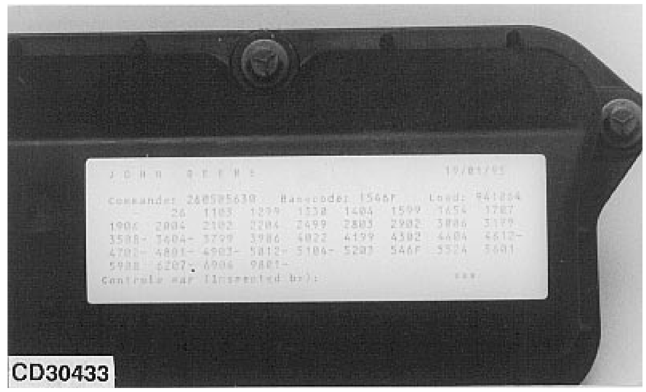
CTM8,GR01,2 –19–27DEC94–1/1

OEM ENGINE OPTION CODE LABEL

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

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

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



CD30433 –UN–10MAY95

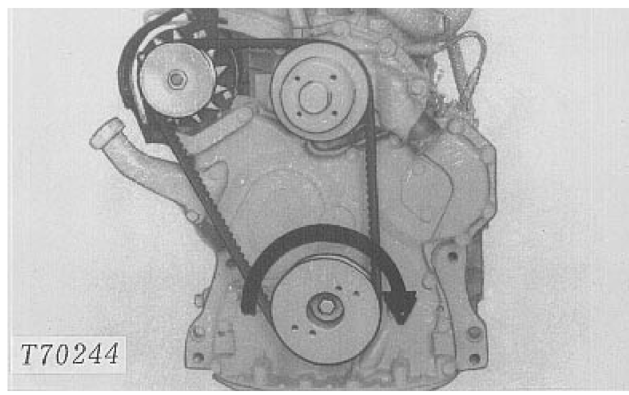
DPSG,OUO1004,482 –19–07NOV98–1/1

ENGINE REFERENCES

Direction of crankshaft rotation: Clockwise rotation when viewed from water pump end.

Engine front reference: The water pump end is the "front" of the engine.

Engine side references: "Right-hand" and "left-hand" sides are determined by facing the flywheel end (rear) of the engine.



T70244 –UN–07MAR95

DPSG,OUO1004,483 –19–07NOV98–1/1

ENGINE APPLICATION CHART JOHN DEERE AGRICULTURAL EQUIPMENT

Machine Model Number	Engine Model
COMBINES	
9400	T06068HH001
COTTON PICKER/STRIPPER	
9930 (P.I.N. 6001—)	T06059TN002
7445 (P.I.N. 8001—)	T06059TN002
7450	T06059TN002
SELF-PROPELLED SPRAYER	
6000	T04039DN003
6100	T04039TN001
6500	T04039TN001
6600	T04039TN001
6700	T04045TN050
6700S	T04045TN050
TRACTORS	
5200	CD3029DLV01
5300	CD3029DLV02
5400	CD3029TLV01
5400N	CD3029TLV01
5500/5500N	CD4039TLV01
6100	CD4045DL002
6200	CD4039TL004
6200L	CD4039TL004
6300	CD4039TL007
6300L	CD4039TL007
6400	CD4045TL002
6400L	CD4045TL002
6500/6500L	CD4045TL004
7200	T06059TRW01
7400	T06068TRW02
7600	T06068TRW01
WINDROWERS	
3340	T04039DE001
3840	T04039TE001

CTM8,GR01,4 –19–27DEC94–1/1

ENGINE APPLICATION CHART
JOHN DEERE CONSTRUCTION EQUIPMENT

Machine Model Number	Engine Model Number
BACKHOE LOADERS	
210C	T04039DT001
210C Series I	T04039DT002
210D	T04039DT007
300D	T04039DT007 T04039DT010
310C	T04039DT003 T04039TT001
310D	T04039DT008 T04039DT011 T04039TT002 T04039TT003
315C	T04039DT003 T04039TT001
315D	T04039DT008 T04039DT011 T04039TT002 T04039TT003
410C	T04045DT001 T04045TT002
410D	T04045DT005 T04054TT010
510C	T04045TT003
710C	T06059TT001

Continued on next page
DPSG,OUO1004,267 –19–19JUL98–1/3

Machine Model Number	Engine Model Number
4-WHEEL DRIVE LOADERS	
344E	T04045DT002
344G	T04045TT017
444E	T04045TT004
444G	T04045TT016
544BH	T06059TDW07
544E	T06059TDW02
544EH	T06059TDW03
544ER Military	T06059TDW04
544G	T06059TDW08
544GH	T06059TDW07
624E	T06068TDW04
624EH	T06068TDW05
624G	T06068TDW09
624GH	T06068TDW10
CRAWLERS	
400G	T04039DT005
450G (—840460)	T04045DT004 T04045DT006 T04045TT005
450GTC (—840460)	T04045TT013
455G (—840460)	T04045DT004 T04045TT005
550G (—840460)	T04045TT006
550GTC (—840460)	T04045TT014
555G (—840460)	T04045TT007
650G (—840460)	T04045TT007
650GTC (—840460)	T04045TT015
655B	T06068TT001
750B	T06068TT001
750C (—831371)	T06068TT007
755B	T06068TT002
755B Military	T06068TT004

Continued on next page DPSG,OUO1004,267 –19–19JUL98–2/3

Machine Model Number	Engine Model Number
EXCAVATORS	
70D	T04039DT004
290D	T04039DT006
290E	T04045DT007
490D	T04045DT003
490E	T04045TT009
495D	T04045 TT008
590D	T04045TT008
595D	T04045TT008
690D	T06068TDW03
690E	T06068TDW07
790E	T06068TT005
MOTOR GRADERS	
570B	T06059DDW01 T06059TDW01
670	T06068TDW02
672B	T06068TDW02
SKIDDERS	
440D	T04045TDW02
540D	T04045TDW01
540E	T04045TDW03 T06059TDW06
548E	T04045TDW03 T06059TDW06
640D	T06068TDW01
640E	T06068TDW06
648E	T06068TDW06
FELLER BUNCHERS	
643D	T06068TT003
653E	T06068TT008
693D	T06068TDW03 T06068TDW08
846A/B	T06068AT001
FORK LIFTS	
482C	T04039DT001 T04039DT002

DPSG,OUO1004,267 –19–19JUL98–3/3

ENGINE APPLICATION CHART OEM APPLICATIONS

Saran Engines

CD3029DF	CD3029DF161	CD4039TF	CD6059DF003
CD3029DF001	CD3029DF162	CD4039TF001	CD6059DF031
CD3029DF005	CD3029DF163	CD4039TF002	CD6059TF
CD3029DF031	CD3029DF164	CD4039TF003	CD6059TF001
CD3029DF032	CD3029DF165	CD4039TF004	CD6059TF002
CD3029DF033	CD3029TF120	CD4039TF005	CD6059TF004
CD3029DF034	CD3029TF121	CD4039TF006	CD6059TF005
CD3029TF	CD3029TF123	CD4039TF031	CD6059TF006
CD3029TF001	CD3029TF160	CD4039TF032	CD6059TF007
CD3029TF002	CD3029TF161	CD4045DF	CD6059TF008
CD3029TF031	CD3029TF162	CD4045DF001	CD6059TF031
CD3029TF032	CD3029TF163	CD4045DF031	CD6068DF
CD3029TF033	CD4039DF	CD4045TF	CD6068DF001
CD3029DF120	CD4039DF001	CD4045TF001	CD6068TF
CD3029DF121	CD4039DF002	CD4045TF002	CD6068TF001
CD3029DF122	CD4039DF004	CD4045TF003	CD6068TF002
CD3029DF123	CD4039DF005	CD4045TF031	CD6068TF003
CD3029DF124	CD4039DF006	CD6059DF	CD6068TF004
CD3029DF128	CD4039DF031	CD6059DF001	
CD3029DF160	CD4039DF032	CD6059DF002	

Dubuque Engines

T04039DF	T04039TF003	T04045TF031	T06059TF005
T04039DF001	T04039TF004	T04045TFM01	T06059TF006
T04039DF002	T04039TF005	T06059DF	T06059TF007
T04039DF004	T04039TF006	T06059DF001	T06059TF008
T04039DF005	T04039TF031	T06059DF002	T06059TF031
T04039DF006	T04039TF032	T06059DF003	T06068DF001
T04039DF031	T04045DF001	T06059DF031	T06068DFM01
T04039DF032	T04045DF031	T06059TF	T06068TF001
T04039DFM01	T04045TF	T06059TF001	T06068TF002
T04039TF	T04045TF001	T06059TF002	T06068TF003
T04039TF001	T04045TF002	T06059TF003	T06068TF004
T04039TF002	T04045TF003	T06059TF004	T06068TFM01

DPSG,OUO1004,268 –19–19JUL98–1/1

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

ENGINE BREAK-IN OIL

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

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

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

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

- API Service Classification CE
- ACEA Specification E1

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

IMPORTANT: Do not use 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 –19–10NOV97–1/1

DIESEL ENGINE OIL

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

John Deere PLUS-50® engine oil is preferred.

If John Deere PLUS-50®engine oil and a John Deere oil filter are used, the service interval for oil and filter changes may be extended 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.

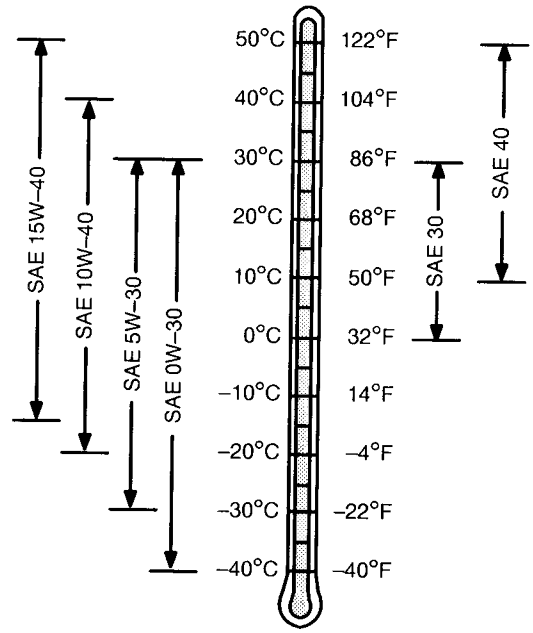
John Deere TORQ-GARD SUPREME® oil is also recommended.

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%.



TS1647 –UN–14MAR96

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

DX,ENOIL –19–18MAR96–1/1

ALTERNATIVE AND SYNTHETIC LUBRICANTS

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

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

Consult your John Deere dealer to obtain information and recommendations.

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

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

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

DX,ALTER –19–18MAR96–1/1

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®

T104220 –UN–03OCT96

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

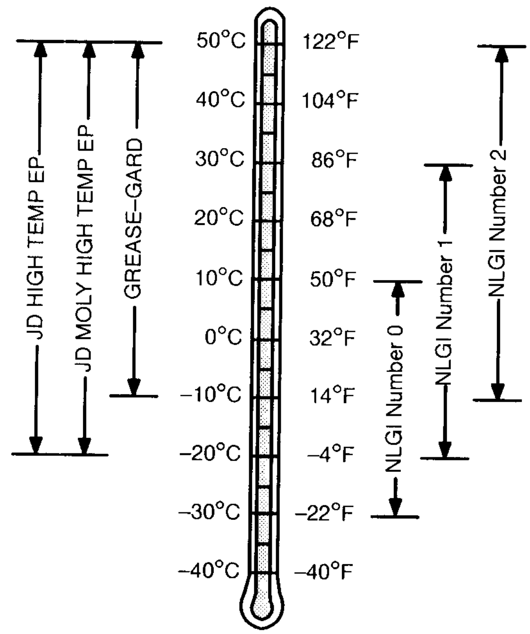
GREASE

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.



TS1654 –UN–14MAR96

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 36 months or 75,000 miles 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 24 months or 50,000 miles of operation.

COOL-GARD is a trademark of Deere & Company.

RG,02,JW7721 –19–01DEC97–1/1

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

RG,02,DT7036 –19–29OCT97–1/3

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.

RG7276 –UN–05DEC97

John Deere Liquid Coolant Conditioner

Continued on next page

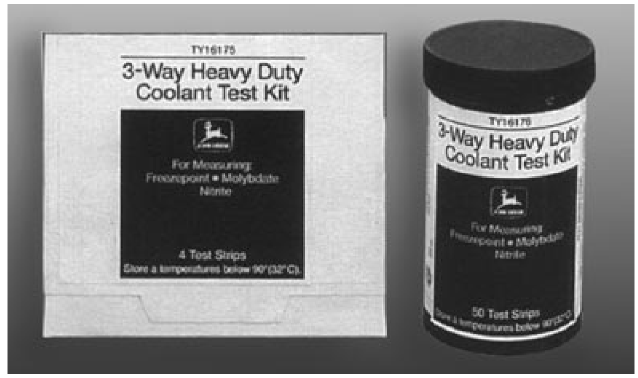
IMPORTANT: Check inhibitors between drain intervals every 6 months or 30,000 miles at low speed operation service interval or 12 months or 25,000 miles at normal operation service interval. Replenish inhibitors by the addition of a supplemental coolant additive as necessary.

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. See TESTING DIESEL ENGINE COOLANT and REPLENISHING SUPPLEMENTAL COOLANT ADDITIVES (SCAs) BETWEEN COOLANT CHANGES, as described later in this group.

RG,02,DT7036 –19–29OCT97–3/3

TESTING DIESEL ENGINE COOLANT



RG7297 –UN–05DEC97

RG7397 –UN–05DEC97

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 6 month/15,000 mile low speed operation or 12 month/25,000 mile normal operation intervals and whenever excessive coolant is lost through leaks or overheating to ensure the necessary protection.

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.

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.

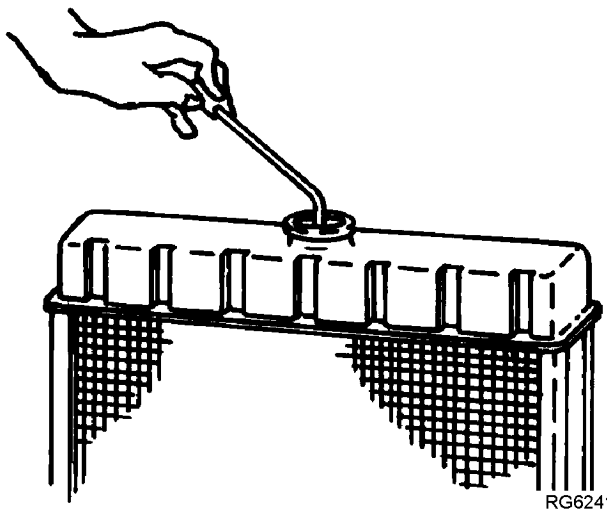
COOLSCAN™

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

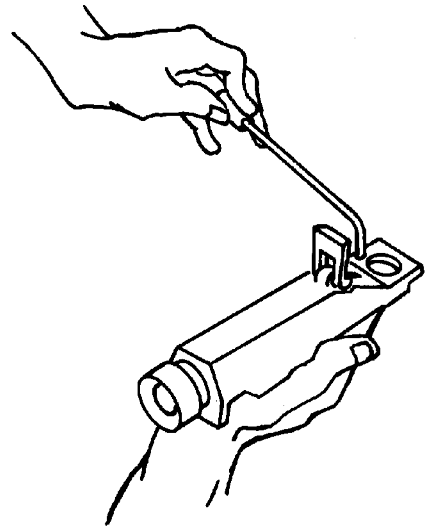
CoolScan is a trademark of Deere & Company.

RG,02,JW7722 –19–01DEC97–1/1

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



RG6241 RG6261 –UN–08DEC97



RG6262 RG6262 –UN–05DEC97

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 6 months or 15,000 miles at low speed operation service interval or 12 months or 25,000 miles at normal operation service interval 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

FLUSH AND SERVICE COOLING SYSTEM

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

TS281 –UN–23AUG88

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 registered trademark of FLEETGUARD.
RESTORE PLUS is a registered trademark of FLEETGUARD.

Continued on next page

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.

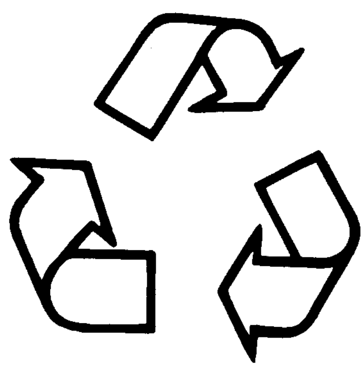
Air must be expelled from cooling system when system is refilled. Loosen plug in side of thermostat housing to allow air to escape when filling system. Retighten plug when all the air has been expelled.

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



TS1133 –UN–26NOV90

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.

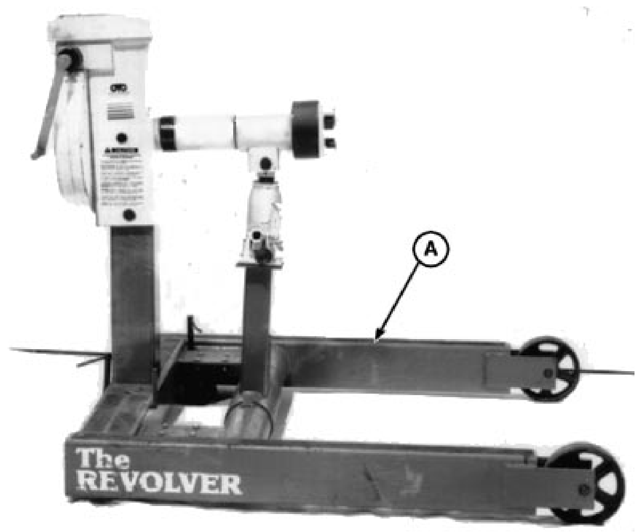
Do not pour waste onto the ground, down a drain, or into any water source.

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

RG,01,DT7032 –19–29OCT97–1/1

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.



RG4929 –UN–05DEC97

A—Engine Repair Stand

S11,2000,EM –19–08MAR94–1/1

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 SAE Grade 8 or higher socket head cap screws must be used to mount adapters or engine. Use LOCTITE® 242 Thread Lock and Sealer on cap screws when installing lifting straps on engine. Tighten cap screws to 170 N•m (125 lb-ft).

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.

To avoid an unsafe off-balance load condition, 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 low and the possibility of tipping low.

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

LOCTITE is registered trademark of Loctite Corporation.

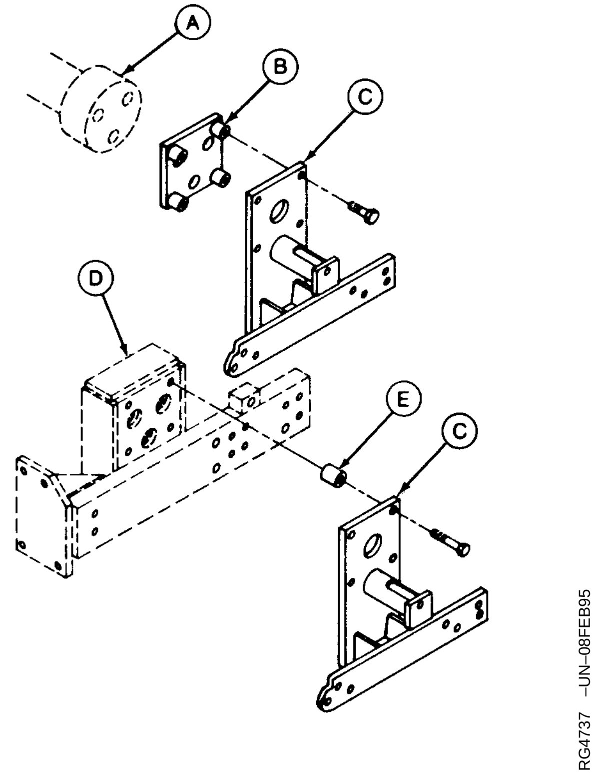
S11,2000,DZ –19–14SEP94–1/1

INSTALL 300 SERIES ADAPTERS ON REPAIR STAND

1. Attach the D05226ST Special Adapter (B) to mounting hub (A) of the engine repair stand using SAE Grade 8 socket head screws. Tighten screws to 135 N•m (100 lb-ft).

2. Attach D05225ST Engine Adapter (C) to the special adapter, using four 5/8-11 x 2 in. SAE Grade 8 cap screws. Tighten screws to 135 N•m (100 lb-ft).

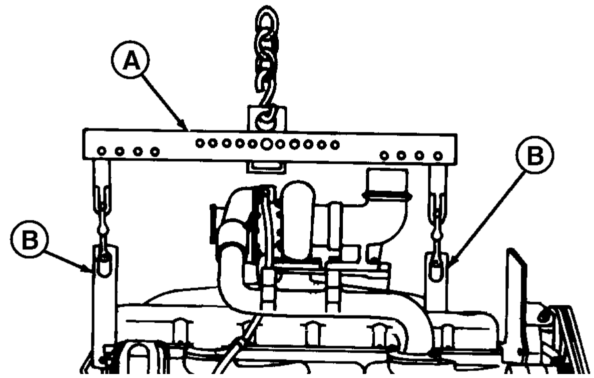
NOTE: The D05225ST Engine Adapter can be attached directly to the No. 60581 Engine Adapter (D) which is required for mounting 400 Series Engines. Use four No. 204897 Spacers (E) and four 5/8-11 x 3-1/4 in. SAE Grade 8 cap screws. Tighten screws to 135 N•m (100 lb-ft).



A—Hub
B—D05226ST Special Adapter
C—D05225ST Engine Adapter
D—No. 60581 Adapter
E—No. 204897 Spacer (4 used)

S11,2000,EA –19–07FEB95–1/1

ENGINE LIFTING PROCEDURE



A—Lifting Sling
B—Straps

CAUTION: The only recommended method for lifting the engine is with JDG23 Engine Lifting Sling and safety approved lifting straps that come with engine. 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.

1. Attach the JDG23 Engine Lifting Sling (A, or other suitable sling) to engine lifting straps (B) and overhead hoist on floor crane.

NOTE: If engine does not have lifting straps, they can be procured through service parts network or made locally. Use of an engine lifting sling (as shown) is the ONLY APPROVED method for lifting engine. However, if a sling is not on hand, engine can be lifted by chain(s) attached to lifting straps and overhead hoist.

2. Carefully lift engine and slowly lower to desired location.

RG,03,JW7723 –19–01DEC97–1/1

CLEAN ENGINE

1. Cap or plug all openings on engine. If electrical components (starter, alternator, etc.) are not removed prior to cleaning, cover with plastic and tape securely to prevent moisture from entering.

2. Steam-clean engine thoroughly.

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.

RG,01,DT7047 –19–29OCT97–1/1

MOUNT ENGINE ON REPAIR STAND

On engines equipped with a low-profile turbocharger, remove turbocharger before attaching engine to repair stand.

NOTE: See next module for illustration of an engine that has been mounted on repair stand.

3029 Engines

Use No. 202557 Spacer at hole (A) and No. 202558 Spacer at hole (B). Mount engine-to-adapter using the cap screws listed below at the hole locations as shown:

- Hole A—9/16-12 x 4-1/2 in.
- Hole B—9/16-12 x 4-1/2 in.
- Hole E—9/16-12 x 1-1/2 in.

4039 and 4045 Engines

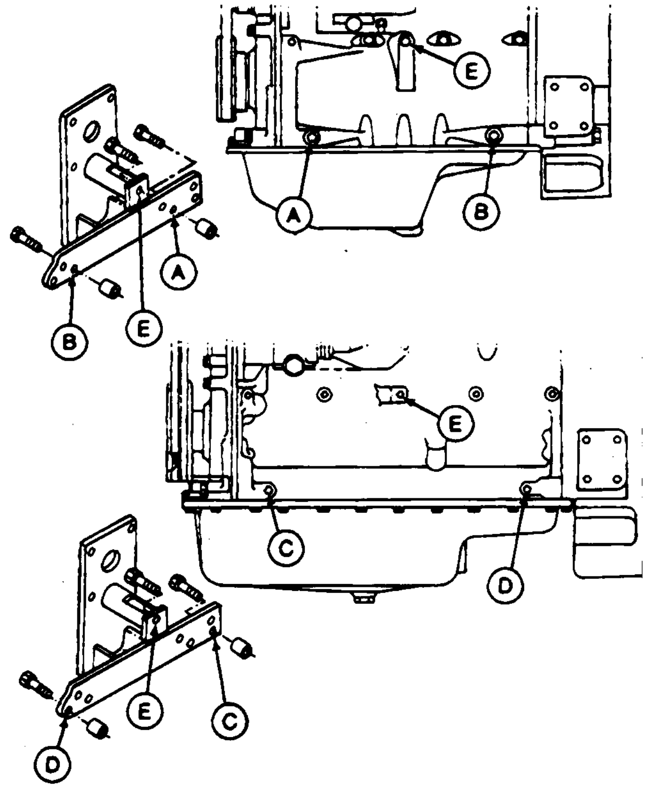
Use No. 202557 Spacer at hole (C) and No. 202558 Spacer at hole (D). Mount engine-to-adapter using the cap screws listed below at the hole locations as shown:

- Hole C—9/16-12 x 4-1/2 in.
- Hole D—9/16-12 x 4-1/2 in.
- Hole E—9/16-12 x 1-1/2 in.

6059 and 6068 Engines

Use No. 202555 Spacer both at hole (C) and hole (D). Mount engine-to-adapter using the cap screws listed below at the hole locations as shown:

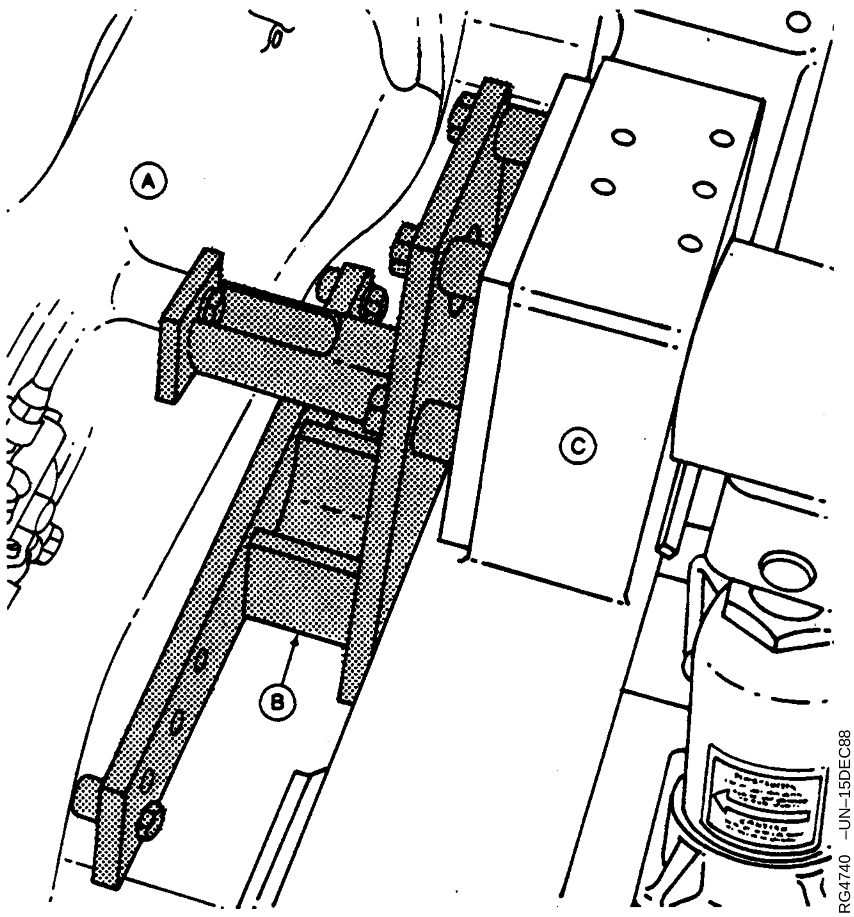
- Hole C—9/16-12 x 2 in.
- Hole D—9/16-12 x 2 in.
- Hole E—9/16-12 x 1 1/2 in.



RG4739 –UN–15DEC88

Continued on next page

CTM8,GR03,1 –19–20AUG92–1/2



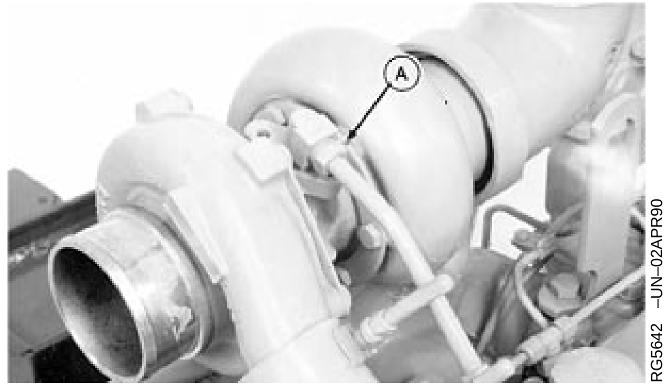
A—Engine
B—Engine Mounting Adapter
C—Repair Stand

NOTE: Spacers are furnished with the D05225ST Engine Adapter. If spacers have been lost, make from pipe to following sizes:

Spacer No.	Size
202555	25 mm OD x 17 mm lg. (1 in. OD x 0.66 in. lg.)
202557	25 mm OD x 73 mm lg. (1 in. OD x 2.87 in. lg.)
202558	25 mm OD x 79 mm lg. (1 in. OD x 3.12 in. lg.)

CTM8,GR03,1 –19–20AUG92–2/2

DISCONNECT TURBOCHARGER OIL INLET LINE



A—Oil Inlet Line

1. Drain all engine oil and coolant.

IMPORTANT: When servicing turbocharged engines on a rollover stand, turbocharger oil inlet line (A) must be disconnected before rolling engine over. Failure to do so may cause a hydraulic lock upon starting engine. Hydraulic lock may cause severe engine damage.

Hydraulic lock occurs when trapped oil in the oil filter housing drains through the turbocharger, into exhaust and intake manifolds, and cylinder head. After starting the engine, trapped oil in the manifold and head is released into the cylinder(s) filling them with oil causing hydraulic lock and severe engine damage.

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

RG,CTM8,G05,13 –19–28SEP94–1/1

ENGINE DISASSEMBLY SEQUENCE

The following sequence is suggested when complete disassembly for overhaul is required. Refer to the appropriate repair group for removal, inspection and repair of individual engine components.

1. Mount engine on a safety approved repair stand. (Group 03.)
2. Drain coolant and oil. Perform John Deere OILSCAN® and CoolScan™ analysis. (Group 02.)
3. Remove fan belts, and fan. (Group 25.)
4. Remove alternator. (Group 40.)
5. Remove turbocharger (if equipped) and exhaust manifold. (Group 30.)
6. Remove rocker arm cover and vent tube. If Option Code label is located on rocker arm cover, be careful not to damage label. (Group 05.)
7. Remove water manifold or thermostat housing. (Group 25.)
8. Remove oil cooler piping and water pump. (Groups 20 and 25.)
9. Remove dipstick, oil filter, oil cooler, and adapter housing (if equipped). Discard standard-flow oil cooler if oil is contaminated. (Group 20.)
10. Remove oil pressure regulating valve assembly. (Group 20.)
11. Remove fuel filter, fuel supply pump, and fuel line. (Group 35.)
12. Remove injection lines, injection pump, and injection nozzles. (Group 35.)
13. Remove starting motor. (Group 40.)
14. Remove rocker arm assembly and push rods. Keep rods in order. (Group 05.) Check for bent push rods and condition of wear pad contact surfaces on rockers.
15. Remove cylinder head. Check piston protrusion. Verify piston height selection. (Groups 05 and 10.)
16. Remove cam followers. Keep followers in order. (Group 05 and 16.)
17. Remove flywheel and flywheel housing. (Group 15.)
18. Remove oil pan. (Group 20.)
19. Remove crankshaft pulley. (Group 15.)
20. Remove timing gear cover. (Group 16.)
21. Remove oil pump drive gear, outlet tube, and pump body. (Group 20.)
22. Remove oil deflector, timing gears, and camshaft. Perform wear checks. (Group 16.)
23. Remove balancer shafts. (Group 16.)
24. Remove engine front plate. (Group 16.)
25. Remove oil by-pass valve (3029, 4039, 6059, and "common lube" 4045 and 6068 engines). (Group 20.)
26. Stamp cylinder number on connecting rod. Remove pistons and rods. Perform wear checks with PLASTIGAGE® (Group 10.)

OILSCAN is a trademark of Deere & Company.
CoolScan is a trademark of Deere & Company.
PLASTIGAGE is a trademark of DANA Corp.

Continued on next page

RG,CTM8,DX148 –19–07FEB95–1/2

27. Remove crankshaft and main bearings. Perform wear checks with PLASTIGAGE®. (Group 15.)

28. Remove cylinder liners and mark each one with cylinder number. (Group 10.)

29. Remove piston cooling orifices. (Groups 10 and 15.)

30. Remove balancer shaft bushings and camshaft bushing (if equipped). (Group 16.)

31. Remove cylinder block plugs and serial number plate when block is to be put in a "hot tank". (Group 10.)

32. Clean upper and lower liner bores with nylon brush. (Group 10.)

33. Measure cylinder block. (Groups 10, 15, and 16.)

PLASTIGAGE is a trademark of DANA Corp.

RG,CTM8,DX148 –19–07FEB95–2/2

SEALANT APPLICATION GUIDELINES

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

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

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

TY9370 6 mL tube/T43512 50 mL tube

- Plugs and fittings: fuel filter base, fuel transfer pump, intake manifold, cylinder block (oil galley), and oil filter base housing (4045 and 6068 engines).
- Cap screws: vibration damper/pulley, injection pump access cover, electronic tachometer cover, oil filler inlet, flywheel, fuel transfer pump, oil cooler housing-to-cylinder block (open holes only), timing hole cover and idler gear.
- Oil pressure sending unit
- Front plate studs and set screw plugs.

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

TY9371 6 mL tube/T43513 50 mL bottle

- Studs: water pump-to-cylinder block, injection pump-to-front plate, exhaust manifold-to-turbocharger.
- Mechanical tachometer drive gear
- Oil filter nipple

LOCTITE® 277 Plastic Gasket (High Strength) (red):

T43514 50 mL bottle

- Steel cap plugs: cylinder block, cylinder head, and water pump
- O-ring adapter for oil pump outlet tube
- Nipples and elbows which are pressed into place, water pump housing, and oil cooler cover.

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

TY6304 50 mL bottle

- Flywheel housing-to-cylinder block
- Flywheel housing-to-oil pan
- Front plate gasket, oil filler neck gasket and timing gear cover gasket
- Front plate/timing gear cover-to oil pan
- Dipstick nipple threads

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

TY9374 6 mL tube/TY9375 50 mL tube

- Pipe plugs: cylinder block (water manifold), thermostat housing, air intake manifold, water pump, flywheel housing (drain).
- Dipstick tube threads
- Injection pump governor cover fitting (fuel return)
- Threaded nipples and elbows in water pump housing
- Temperature sending unit
- Oil pan (drain hose, drain valve, and elbow drain fitting)
- Connectors: turbo line, turbo drain, and water return-to-cylinder block (4045 and 6068).
- Adapter fitting and plug for turbo lube on dual oil filter base

LOCTITE is a registered trademark of the Loctite Corp.
TEFLON is a registered trademark of the DuPont Corp.

Continued on next page

- Air heater threads.

LOCTITE® 17430[1] Superflex Sealant (Form-In-Place Gasket):

TY16021 1.69 oz tube

Injection pump cover and pump timing gear cover ONLY when traditional gasket is not available.

LOCTITE® 609 Retaining Compound (green):

TY15969 50 mL bottle

Wear ring-to-crankshaft

PERMATEX® AVIATION (Form-A-Gasket No. 3):

TY15934 8 oz tube

(OR)

PT569 NEVER-SEEZ® COMPOUND:

PT569 227g brush/PT506 453g spray

Cap Screws: exhaust manifold and turbine housing-to-center housing.

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

[1]Use DD14928 Sealing Compound Kit when servicing an engine within the European Market/Service Area. Follow manufacturer's directions on package when using and storing sealant.

RG,CTM8,DX150 –19–21FEB95–2/2

ENGINE ASSEMBLY SEQUENCE

The following assembly sequence is suggested when engine has been completely disassembled. Be sure to check run-out specifications, clearance tolerances, torques, etc. as engine is assembled. Refer to the appropriate repair group when assembling engine components.

1. Install all plugs and serial number plate in cylinder block (if removed). (Groups 10 and 15.)
2. Install piston cooling orifices. (Group 10.)
3. Install new balancer shaft bushings and a new camshaft bushing (if equipped). (Group 16.)
4. Install cylinder liners without O-rings. Measure liner height. Install liners with O-rings. (Group 10.)
5. Install main bearings and crankshaft. PLASTIGAGE® bearings. (Group 15.)
6. Install flywheel housing, rear oil seal, and flywheel. (Group 15.)
7. Install pistons and rods. Measure piston protrusion. (Group 10.)
8. Install oil by-pass valve (3029, 4039, 6059, and "common lube" 4045 and 6068 engines). (Group 20.)
9. Install front plate. (Group 16.)
10. Install balancer shafts. Check end play. (Group 16.)
11. Install oil outlet tube, O-ring in block, and oil pump. (Group 20.)
12. Install injection pump. (Group 35.)
13. Install camshaft, timing gears, and oil deflector. (Group 16.)
14. Time all gears with No. 1 cylinder at TDC compression stroke. (Group 16.)
15. Install timing gear cover. Install new front seal. (Group 16.)
16. Install oil pan. (Group 20.)
17. Install oil pressure regulating valve. (3029, 4039, 6059, and "common lube" 4045 and 6068 engines.) (Group 20.)
18. Install cam followers in same order as removed. (Group 16.)
19. Install cylinder head gasket, cylinder head, push rods, and rocker arm assembly. (Group 05.)
20. Install starting motor. (Group 40.)
21. Install injection nozzles (with new seals) and injection lines. (Group 35.)
22. Install fuel filter, fuel supply pump, and fuel lines. (Group 35.)
23. Install oil cooler, new oil filter, and dipstick. (Never clean or reuse a contaminated standard-flow oil cooler.) (Group 20.)
24. Install water manifold or thermostat housing and thermostats. (Group 25.)
25. Install exhaust manifold and turbocharger. Prelube the turbocharger. (Group 30.)
26. Install water pump and hoses. (Group 25.)
27. Install crankshaft pulley or vibration damper. (Group 15.)

PLASTIGAGE is a trademark of DANA Corp.

Continued on next page

28. Install alternator. (Group 40.)

29. Install fan and fan belts. (Group 25.)

30. Adjust valves and install rocker arm cover. (Group 05.)

31. Install vent tube.

32. Fill engine with clean oil and proper coolant. (Group 02.)

33. Perform engine break-in and standard performance checks. (Group 105.)

CTM8,GR04,2 –19–09FEB95–2/2

ESSENTIAL TOOLS

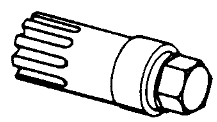
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,338 –19–09SEP98–1/16

Flywheel Turning Tool JDE83

Used to rotate flywheel on engines with 142-tooth flywheel ring gear and a 26.5 mm (1.04 in.) ID flywheel housing guide bore diameter.

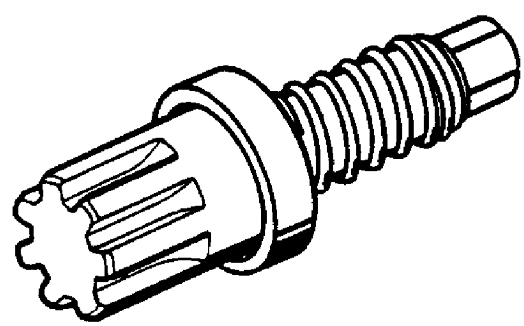


RG6251 –UN–22JUL92

DPSG,OUO1004,338 –19–09SEP98–2/16

Flywheel Turning Tool JDG820

Used to rotate flywheel on engines with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) ID flywheel housing guide bore diameter.



RG7056

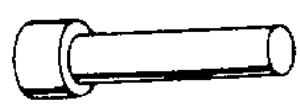
RG7056 –UN–05DEC97

DPSG,OUO1004,338 –19–09SEP98–3/16

RG5068 –UN–05DEC97

Timing Pin JDE81-4

Lock engine at TDC.



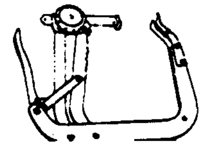
RG5068

Continued on next page

DPSG,OUO1004,338 –19–09SEP98–4/16

RG5070 –UN–23AUG88

Valve Spring Compressor JDE138

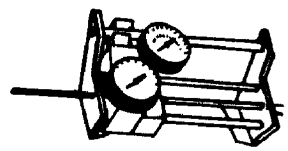


Used to compress valve springs when removing and installing valves.

DPSG,OUO1004,338 –19–09SEP98–5/16

RG5061 –UN–05DEC97

Spring Compression Tester D01168AA



RG5061

Test valve spring compression.

DPSG,OUO1004,338 –19–09SEP98–6/16

RG5084 –UN–23AUG88

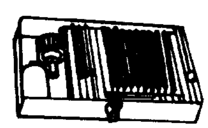
Nozzle Bore Cleaning Tool JDE39

Clean injection nozzle bores in cylinder head.

DPSG,OUO1004,338 –19–09SEP98–7/16

RG5064 –UN–05DEC97

Valve Guide Knurler Kit JT05949



RG5064

Knurl valve guides.

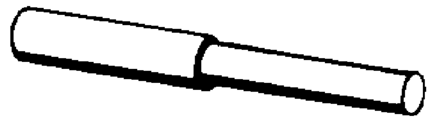
Continued on next page

DPSG,OUO1004,338 –19–09SEP98–8/16

RG5065 –UN–05DEC97

Valve Seat Driver JDG676

Use with JDG675 Adapter to install intake and exhaust valve seat inserts in cylinder head.

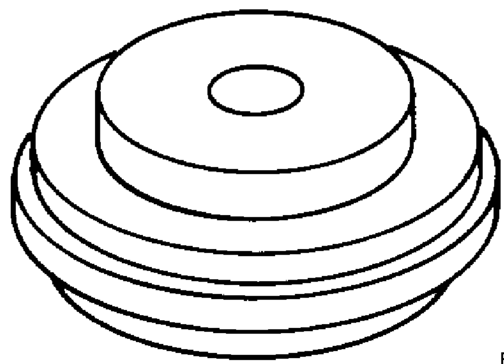


RG5065

DPSG,OUO1004,338 –19–09SEP98–9/16

Valve Seat Insert Installing Adapter. JDG675

Use with JDG676 Pilot Driver to install intake and exhaust valve seat inserts.



RG5240

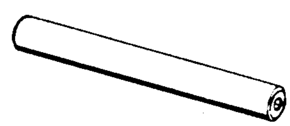
RG5240 –UN–05DEC97

DPSG,OUO1004,338 –19–09SEP98–10/16

RG5612 –UN–12APR90

Valve Stem Seal Installer JDG678

Use to install valve stem seals.

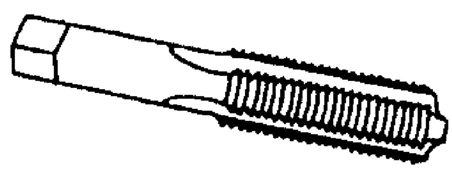


DPSG,OUO1004,338 –19–09SEP98–11/16

RG5100 –UN–05DEC97

Tap JDG680

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



RG5100

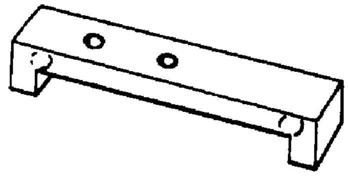
Continued on next page

DPSG,OUO1004,338 –19–09SEP98–12/16

RG7029 –UN–05DEC97

Height Gauge. . . . . JDG451 or KJD10123

Used with a dial indicator to measure valve recess in cylinder head. Also used to measure piston and liner height.



RG7029

DPSG,OUO1004,338 –19–09SEP98–13/16

RG6246 –UN–05DEC97

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

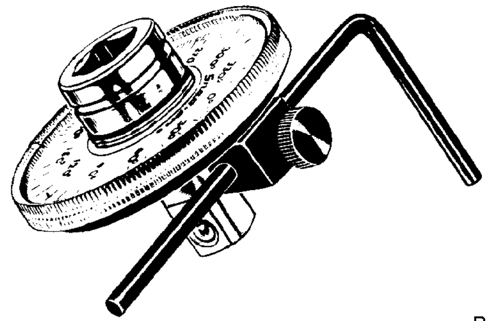
Use with JDG451, KJD10123 or magnetic base to measure valve recess in cylinder head and piston and liner height.

RG6246

DPSG,OUO1004,338 –19–09SEP98–14/16

Torque Angle Gauge JT05993

Used to TORQUE-TURN flanged-head cylinder head and connecting rod cap screws.



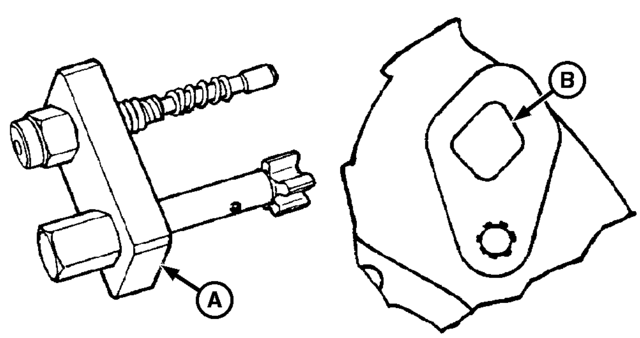
RG5698

RG5698 –UN–05DEC97

DPSG,OUO1004,338 –19–09SEP98–15/16

Flywheel Turning Tool JD281A

Used on engines with 142 tooth flywheel ring gear and a diamond shaped tool guide bore (B) in flywheel housing. Tool (A) has it’s own spring loaded timing pin which threads into flywheel housing.



RG9455 –UN–02SEP98

DPSG,OUO1004,338 –19–09SEP98–16/16

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,OUO1004,339 –19–09SEP98–1/8

Crankshaft Front/Rear Rotation Adapter. JDG966

Rotate crankshaft from front and rear with flywheel removed.

DPSG,OUO1004,339 –19–09SEP98–2/8

Valve Inspection Center

Check valves for out of round.

DPSG,OUO1004,339 –19–09SEP98–3/8

Precision “Bevelled Edge” Straightedge D05012ST

Check cylinder head flatness.

DPSG,OUO1004,339 –19–09SEP98–4/8

Plastic Brush

Clean valve guides.

DPSG,OUO1004,339 –19–09SEP98–5/8

End Brush D17024BR

Remove carbon on valve seats.

Continued on next page

DPSG,OUO1004,339 –19–09SEP98–6/8

Heavy-Duty Seat Grinder JT05893

Grind valve seats.

DPSG,OUO1004,339 –19–09SEP98–7/8

Eccentrimeter D11010KW

Measure valve seat runout.

DPSG,OUO1004,339 –19–09SEP98–8/8

OTHER MATERIAL

Number	Name	Use
AR44402 (U.S.)	Valve Stem Lubricant	Lubricate valve stems.

DPSG,OUO1004,340 –19–09SEP98–1/1

CYLINDER HEAD AND VALVES SPECIFICATIONS

Item	Measurement	Specification
Intake Valve Clearance Checking (Rocker Arm-to-Valve Tip) (Engine Cold)	Clearance	0.31—0.38 mm (0.012—0.015 in.)
Exhaust Valve Clearance Checking (Rocker Arm-to-Valve Tip) (Engine Cold)	Clearance	0.41—0.48 mm (0.016—0.019 in.)
Intake Valve Clearance Adjustment (Rocker Arm-to-Valve Tip) (Engine Cold)	Clearance	0.36 mm (0.014 in.)
Exhaust Valve Clearance Adjustment (Rocker Arm-to-Valve Tip) (Engine Cold)	Clearance	0.46 mm (0.018 in.)
Rocker Arm Adjusting Screw Jam Nut	Torque	27 N•m (20 lb-ft)
Intake Valves	Lift (At 0.00 mm (in.) Clearance)	11.56—12.37 mm (0.455—0.487 in.)
	Wear Limit	11.13 mm (0.438 in.)
Exhaust Valve	Lift (At 0.00 mm (in.) Clearance)	11.28—12.12 mm (0.444—0.477 in.)
	Wear Limit	10.85 mm (0.427 in.)
Rocker Arm Assembly		
Spring Tension at 46 mm (1.81 in.) Compressed Height	Spring Tension	18—27 N (4—6 lb-force)
Spring Compressed Height	Height	46 mm @ 18—27 N (1.81 in. @ 4—6 lb force)
Shaft	OD	19.99—20.02 mm (0.787—0.788 in.)
	Wear Limit	19.94 mm (0.785 in.)
Shaft Support ID	Maximum ID	20.17 mm (0.794 in.)

Continued on next page

DPSG,OUO1004,341 –19–09SEP98–1/4

Item	Measurement	Specification
Bore	ID	20.07—20.12 mm (0.790—0.792 in.)
	Wear Limit	20.17 mm (0.794 in.)
Camshaft Follower	OD	31.61—31.64 mm (1.245—1.246 in.)
Intake Valves	Recess in Cylinder Head	0.61—1.11 mm (0.024—0.044 in.)
	Worn Limit	1.63 mm (0.064 in.)
Exhaust Valve	Recess in Cylinder Head	1.22—1.72 mm (0.048—0.068 in.)
	Worn Limit	2.26 mm (0.089 in.)
Valve Springs		
Spring Free Length 0 N (0 lb-force)[1]	Height	54.0 mm (2.125 in.)
Spring Compressed 240—280 N (54—62 lb-force)	Height	46.0 mm (1.81 in.)
Spring Compressed 590—680 N (133—153 lb-force)	Height	34.5 mm (1.36 in.)
Intake Valve Head	OD	46.47—46.73 mm (1.830—1.840 in.)
Exhaust Valve Head	OD	42.37—42.63 mm (1.668—1.678 in.)
Intake Valve Stem	OD	7.864—7.884 mm (0.3096—0.3104 in.)
Exhaust Valve Stem	OD	7.848—7.874 mm (0.3090—0.3100 in.)
Valve Face Runout	Maximum Valve Face Runout (Intake and Exhaust)	0.038 mm (0.0015 in.)

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

Continued on next page

DPSG,OUO1004,341 –19–09SEP98–2/4

Item	Measurement	Specification
Valves	Face Angle	29.25° ± 0.25°
Cylinder Head Flatness	Maximum Acceptable Out-of-Flat: For Entire Length or Width	0.08 mm (0.003 in.)
	Maximum Acceptable Out-of-Flat: For Every 150 mm (5.90 in.)	0.03 mm (0.001 in.)
Cylinder Head Thickness and Finish	New Cylinder Head Thickness	104.87—105.13 mm (4.129—4.139 in.)
	Minimum Acceptable Thickness	104.24 mm (4.104 in.)
	Combustion Face Surface Finish (Surface Grind Only) (AA)	0.7—3.2 micrometers (31—125 micro-in.)
	Maximum Wave Depth	0.012 mm (0.0005 in.)
	Maximum Material Removal for Resurfacing	0.76 mm (0.030 in.)
Valve Guide Bore (New)	ID	7.912—7.938 mm (0.312—0.313 in.)
Valve Guide-to-Valve Stem (New)	Clearance	0.05—0.10 mm (0.002—0.004 in.)
	Wear Limit	0.15 mm (0.006 in.)
Valve Seat Grinding	Angle	30°
	Width	1.50—2.00 mm (0.059—0.079 in.)
	Maximum Runout	0.08 mm (0.003 in.)
Cylinder Liner Height Above Block	Height	0.030—0.100 mm (0.001—0.004 in.)
Cylinder Liner Height Difference At Nearest Point of Two Adjacent Liners, or Within a Single Liner	Maximum Permissible Height Difference	0.05 mm (0.002 in.)
Cylinder Head Cap Screws		
Step 1-Initial Torque	Torque	100 N•m (75 lb-ft)
Step 2-Second Torque	Torque	150 N•m (110 lb-ft)
Step 3-Verify Torque (After 5 Minutes)	Torque	150 N•m (110 lb-ft)

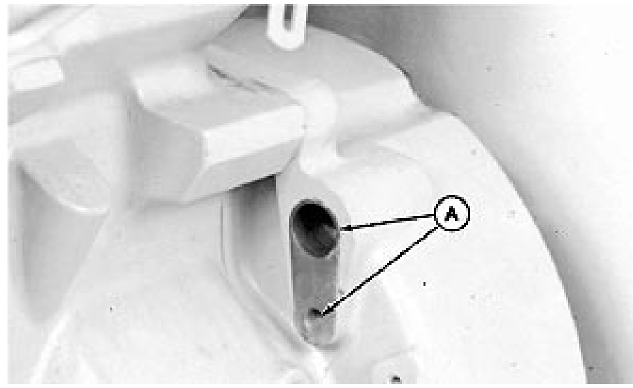
Continued on next page

DPSG,OUO1004,341 –19–09SEP98–3/4

Item	Measurement	Specification
Step 4-Torque Turn	Torque Turn	Tighten each screw an additional 60°± 10° (See TORQUE-TURN METHOD FOR PROPER TORQUE next in this group.)
Rocker Arm Support Cap Screws	Torque	47 N•m (35 lb-ft)
Rocker Arm Cover Cap Screws	Torque	11 N•m (8 lb-ft) (96 lb-in.)

DPSG,OUO1004,341 –19–09SEP98–4/4

CHECK AND ADJUST VALVE CLEARANCE



A—Timing Holes

CAUTION: To prevent accidental starting of engine while performing valve adjustments, always disconnect NEGATIVE (—) battery terminal.

IMPORTANT: Valve clearance MUST BE checked and adjusted with engine COLD.

1. Remove rocker arm cover and crankcase ventilator tube.

IMPORTANT: Visually inspect contact surfaces of valve tips and rocker arm wear pads. Check all parts for excessive wear, breakage, or cracks. Replace parts that show visible damage.

Rocker arms that exhibit excessive valve clearance should be inspected more thoroughly to identify damaged parts.

2. Remove plastic plug or cover plate from engine rotation/timing holes (A).

NOTE: Some engines are equipped with flywheel housings which do not allow use of an engine flywheel rotation tool. These engines may be rotated from front nose of engine, using JDG966 Crankshaft Rotation Tool.

3. Using JDE83 or JDG820 Flywheel Turning Tool, rotate engine flywheel in running direction (clockwise viewed from front) until No. 1 cylinder is at “TDC” Compression stroke.

   If No.1 cylinder rocker arms are loose, the engine is at No. 1 “TDC” Compression.

   If No. 1 cylinder rocker arms are not loose, rotate engine one full revolution (360°) to No. 1 “TDC” Compression.

   Insert JDE81-4 Timing Pin in flywheel.

Continued on next page

DPSG,OUO1004,247 –19–13JUL98–1/6

4. With engine lock-pinned at “TDC” of Number 1 piston’s compression stroke, check valve clearance to following specifications. (Use sequence for 3, 4 or 6-cylinder engines as outlined on following pages.)

Intake Valve Clearance Checking (Rocker Arm-to-Valve Tip) (Engine Cold)—Specification

Clearance .... 0.31—0.38 mm (0.012—0.015 in.)

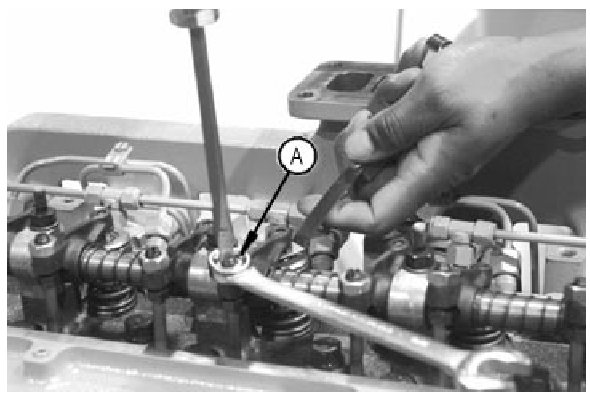
Exhaust Valve Clearance Checking (Rocker Arm-to-Valve Tip) (Engine Cold)—Specification

Clearance .... 0.41—0.48 mm (0.016—0.019 in.)

DPSG,OUO1004,247 –19–13JUL98–2/6

NOTE: The procedure below outlines the proper procedure and specifications for valve clearance adjustment. See the following pages for the correct sequence for adjusting the valves.

5. If valves need adjusting, use the following valve clearance adjustment procedure and specifications. Loosen the locknut (A) on rocker arm adjusting screw. Turn adjusting screw until feeler gauge slips with a slight drag. Hold the adjusting screw from turning with screwdriver and tighten locknut to specifications. Recheck clearance again after tightening locknut. Readjust clearance as necessary.



A—Adjusting Screw and Jam Nut

Intake Valve Clearance Adjustment (Rocker Arm-to-Valve Tip) (Engine Cold)—Specification

Clearance .... 0.36 mm (0.014 in.)

Exhaust Valve Clearance Adjustment (Rocker Arm-to-Valve Tip) (Engine Cold)—Specification

Clearance .... 0.46 mm (0.018 in.)

Rocker Arm Adjusting Screw Jam Nut—Specification

Torque .... 27 N•m (20 lb-ft)

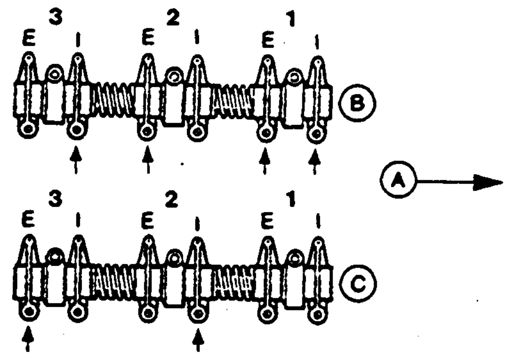
Continued on next page

DPSG,OUO1004,247 –19–13JUL98–3/6

3-CYLINDER ENGINE

NOTE: Firing order is 1-2-3.

1. Using JDE81-4 Timing Pin, lock No. 1 piston at TDC compression stroke (B).
2. Adjust valve clearance on No. 1 and 2 exhaust valves and No. 1 and 3 intake valves.
3. Turn crankshaft 360°. Lock No. 1 piston is at TDC exhaust stroke (C).
4. Adjust valve clearance on No. 3 exhaust valve and No. 2 intake valve.



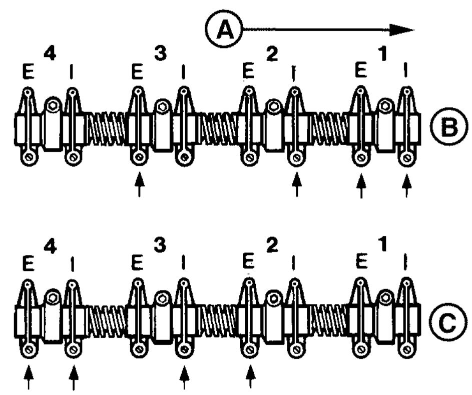
A—Front of Engine
B—No. 1 Piston at TDC Compression Stroke
C—No. 1 Piston at TDC Exhaust Stroke
E—Exhaust Valve
I—Intake Valve

DPSG,OUO1004,247 –19–13JUL98–4/6

4-CYLINDER ENGINE:

NOTE: Firing order is 1-3-4-2.

1. Lock No. 1 piston at TDC compression stroke (B).
2. Adjust valve clearance on No. 1 and 3 exhaust valves and No. 1 and 2 intake valves.
3. Turn crankshaft 360°. Lock No. 4 piston is at TDC compression stroke (C).
4. Adjust valve clearance on No. 2 and 4 exhaust valve and No. 3 and 4 intake valves.



A—Front of Engine
B—No. 1 Piston TDC Compression
C—No. 4 Piston TDC Compression
E—Exhaust Valve
I—Intake Valve

Continued on next page

DPSG,OUO1004,247 –19–13JUL98–5/6

6-CYLINDER ENGINE:

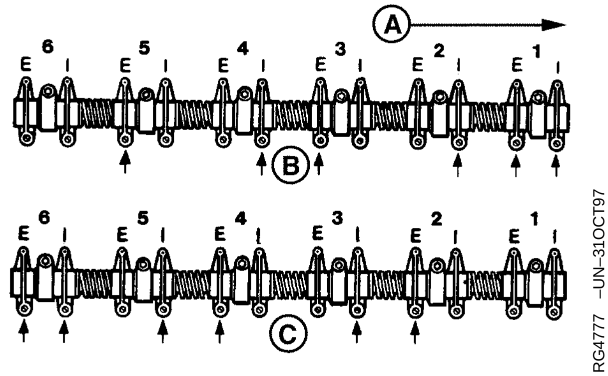
NOTE: Firing order is 1-5-3-6-2-4.

1. Lock No. 1 piston at TDC compression stroke (B).

2. Adjust valve clearance on No. 1, 3 and 5 exhaust valves and No. 1, 2, and 4 intake valves.

3. Turn crankshaft 360°. Lock No. 6 piston is at TDC compression stroke (C).

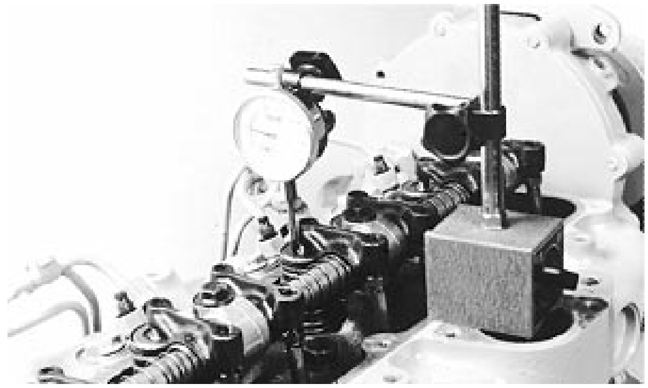
4. Adjust valve clearance on No. 2, 4 and 6 exhaust valve and No. 3, 5, and 6 intake valves.



A—Front of Engine
B—No. 1 Piston TDC Compression
C—No. 6 Piston TDC Compression
E—Exhaust Valve
I—Intake Valve

DPSG,OUO1004,247 –19–13JUL98–6/6

MEASURE VALVE LIFT


RG6308 –UN–03AUG92

IMPORTANT: For a more accurate measurement, measure valve lift at 0.00 mm (in.) rocker arm-to-valve tip clearance.

NOTE: Measuring valve lift provides an indication of wear on camshaft lobes and cam followers or push rods.

1. Remove rocker arm cover.

2. Lock No. 1 piston at TDC compression stroke.

3. Set rocker arm-to-valve tip clearance to 0.00 mm (in.) for:

   - No. 1 and 2 exhaust and No. 1 and 3 intake valves on 3-cylinder engines.
   - No. 1 and 3 exhaust and No. 1 and 2 intake valves on 4-cylinder engines.
   - No. 1, 3, and 5 exhaust and No. 1, 2, and 4 intake valves on 6-cylinder engines.

   See CHECK AND ADJUST VALVE CLEARANCE earlier in this group for engine valve locations.

4. Place dial indicator tip on top of valve spring retainer or rotator. Preload indicator tip and set dial at 0.0 mm (in.).

5. Remove timing pin from flywheel and manually rotate engine one full revolution (360°) in running direction using appropriate flywheel turning tool.

6. Observe dial indicator reading as valve is moved to full open. Record maximum reading and compare with specifications given below.

Intake Valves—Specification

Lift (At 0.00 mm (in.) Clearance)	11.56—12.37 mm (0.455—0.487 in.)
Wear Limit	11.13 mm (0.438 in.)

Continued on next page

DPSG,OUO1004,246 –19–13JUL98–1/2

Exhaust Valve—Specification

Lift (At 0.00 mm (in.) Clearance) .... 11.28—12.12 mm (0.444—0.477 in.)
Wear Limit .... 10.85 mm (0.427 in.)

7. If valve lift on all valves is within specifications, adjust valve lash to specified clearance. (See CHECK AND ADJUST VALVE CLEARANCE earlier in this group.)

   If valve lift on one or more valves is not within specification, remove and inspect entire valve train and camshaft.

8. Rotate engine one full revolution (360°). Lock engine at:

   - TDC No. 1 exhaust stroke for 3-cylinder engines.
   - TDC No. 4 compression stroke for 4-cylinder engines.
   - TDC No. 6 compression stroke for 6-cylinder engines.

9. Set rocker arm-to-valve tip clearance to 0.0 mm (in.) for:

   - No. 3 exhaust and No. 2 intake valves on 3-cylinder engines.
   - No. 2 and 4 exhaust and No. 3 and 4 intake valves on 4-cylinder engines.
   - No. 2, 4, and 6 exhaust and No. 3, 5, and 6 intake valves on 6-cylinder engines.

10. Repeat steps 4—7.

DPSG,OUO1004,246 –19–13JUL98–2/2

REMOVE CYLINDER HEAD

In 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: Hot exhaust system components can cause serious burns. After operating engine, allow exhaust system to cool before working on engine.

Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove radiator filler cap only when the cap is cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

1. Drain all engine oil and coolant.

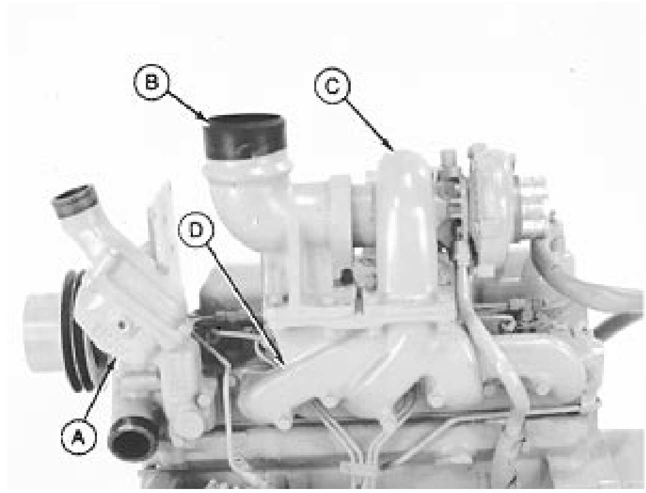
NOTE: On engines equipped with a low-profile turbocharger, remove turbocharger before attaching engine to repair stand.

2. Remove air inlet adapter and intake manifold. (See Group 30.)

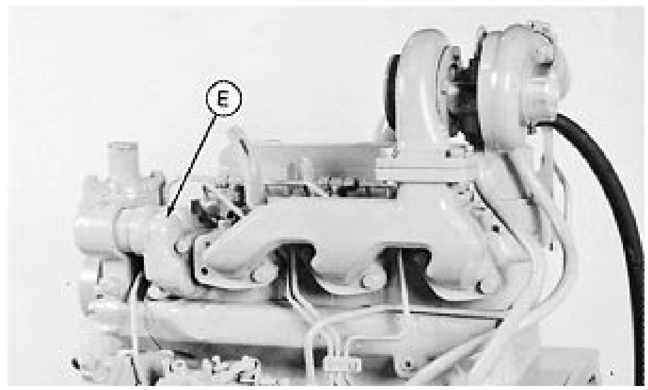
3. On turbocharged engines, disconnect turbocharger oil inlet line at turbocharger. Remove turbocharger (C), exhaust elbow (B), and exhaust manifold (D) as an assembly. On naturally aspirated engines, remove exhaust manifold. (See Group 30.)

4. Remove thermostat housing (A) or water manifold (E). (See Group 25.)

5. Remove fuel filter and housing assembly. (See Group 35.)



RG5657 –UN–12APR90

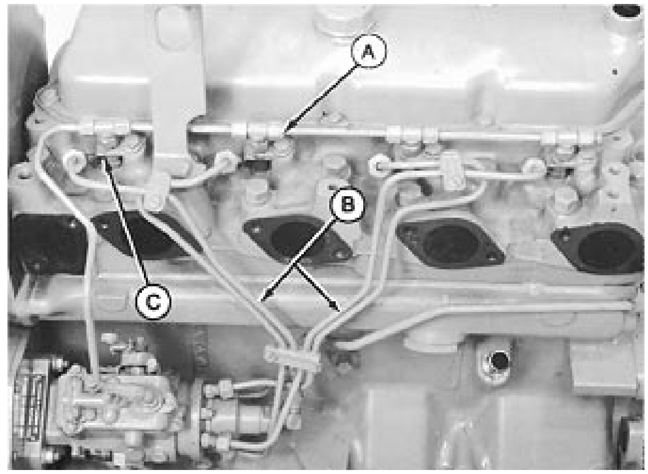


RG6309 –UN–03AUG92

A—Thermostat Housing
B—Exhaust Elbow
C—Turbocharger
D—Exhaust Manifold
E—Water Manifold

Continued on next page RG,CTM8,G05,14 –19–24SEP92–1/6

6. Remove fuel leakoff line (A) and fuel delivery lines (B) as an assembly. Remove fuel injection nozzles (C). (See Group 35.)

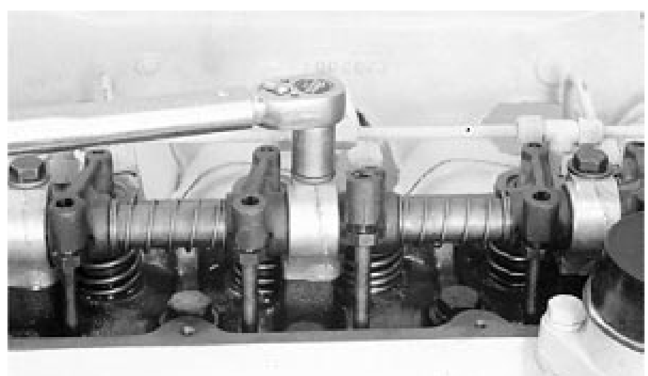


A—Fuel Leak-Off Line
B—Fuel Delivery Lines
C—Fuel Injection Nozzles

RG,CTM8,G05,14 –19–24SEP92–2/6

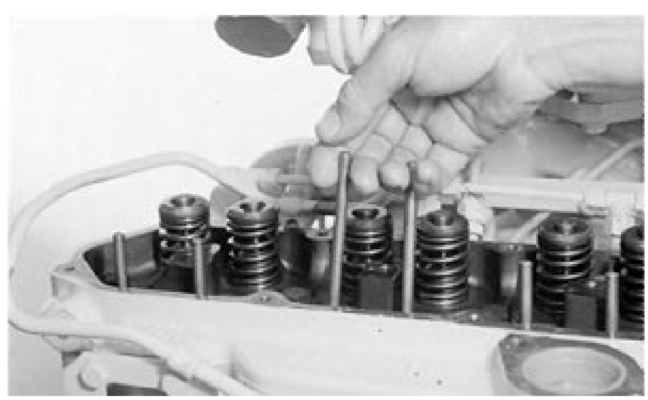
NOTE: Loosen all rocker arm adjusting screws before removing rocker arm assembly.

7. Remove rocker arm assembly.



RG,CTM8,G05,14 –19–24SEP92–3/6

8. Remove all push rods and identify for reassembly in the same location.

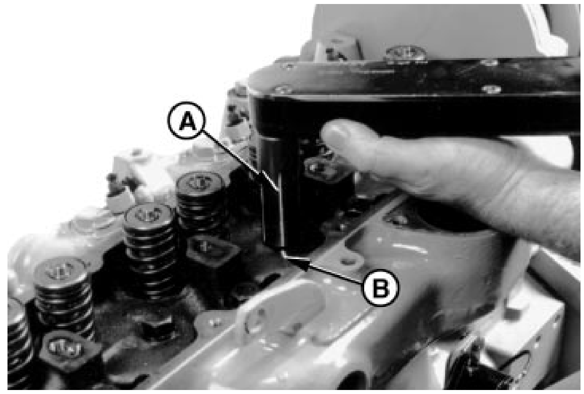


Continued on next page RG,CTM8,G05,14 –19–24SEP92–4/6

9. If a cylinder head gasket failure has occurred, check and record torque on each cylinder head cap screw before removing.

   Make a reference mark (in-line) on socket (A) and cylinder head surface (B). Loosen cap screw at least 1/2 turn. Retighten cap screw (using a torque wrench) until reference marks align and record torque.

10. Remove all cylinder head cap screws.



RG6310 –UN–03NOV97

A—Socket
B—Head Surface

RG,CTM8,G05,14 –19–24SEP92–5/6

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

11. Lift cylinder head from block. If cylinder head sticks, use a soft hammer to tap cylinder head.

12. Remove head gasket. Inspect possible oil, coolant, or combustion chamber leaks. Also, check for evidence of incorrect head gasket being used.

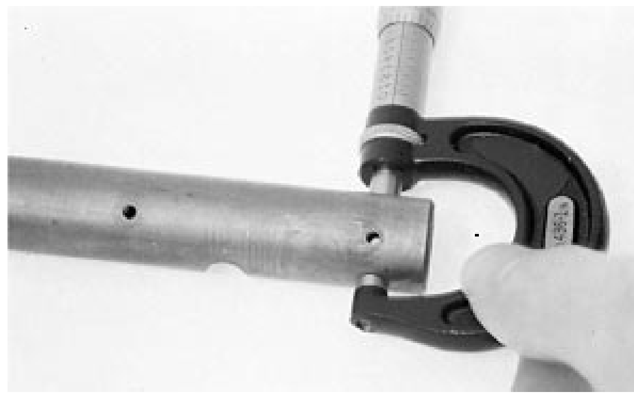
NOTE: Do not rotate crankshaft with cylinder head removed unless cylinder liners are secured with cap screws and large flat washers. (See MEASURE CYLINDER LINER STANDOUT [HEIGHT ABOVE BLOCK] later in this group.)

RG5650 –UN–12APR90

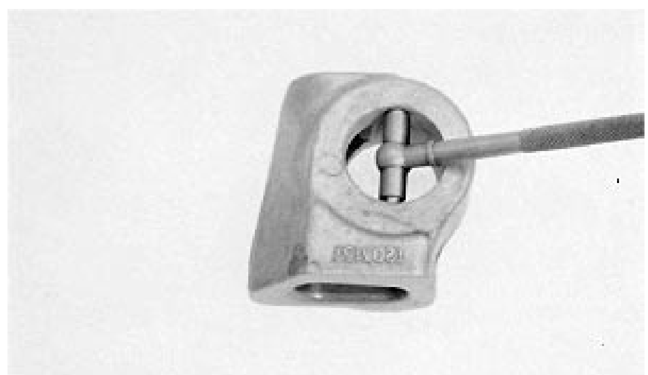
RG,CTM8,G05,14 –19–24SEP92–6/6

DISASSEMBLE AND INSPECT ROCKER ARM ASSEMBLY

T81234 –UN–01NOV88



T81235 –UN–09NOV88



T81236 –UN–09NOV88

T81237 –UN–09NOV88

1. Remove plugs and bowed washers from rocker arm shaft.
2. Disassemble and inspect all parts for wear or damage. Replace any parts that are damaged or not within specifications.

Spring Tension at 46 mm (1.81 in.) Compressed Height—Specification

Spring Tension .... 18—27 N (4—6 lb-force)

Spring Compressed Height—Specification

Height .... 46 mm @ 18—27 N (1.81 in. @ 4—6 lb force)

Shaft—Specification

OD .... 19.99—20.02 mm (0.787—0.788 in.)
Wear Limit .... 19.94 mm (0.785 in.)

Shaft Support ID—Specification

Maximum ID .... 20.17 mm (0.794 in.)

Bore—Specification

ID .... 20.07—20.12 mm (0.790—0.792 in.)
Wear Limit .... 20.17 mm (0.794 in.)

RG,CTM8,G05,19 –19–16SEP92–1/1

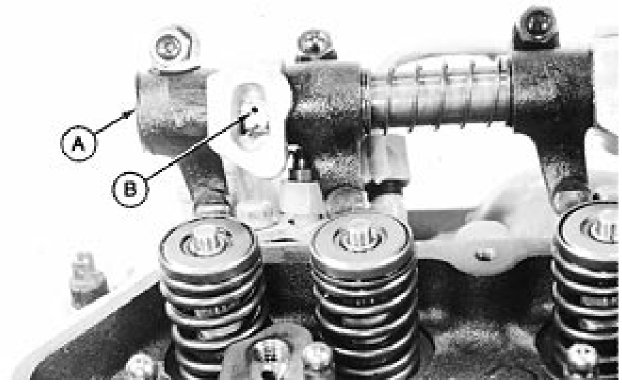
ASSEMBLE ROCKER ARM ASSEMBLY

1. Lubricate shaft OD, rocker arm bores, and rocker arm supports with clean engine oil.

IMPORTANT: The oil supply hole (B) on the rocker arm shaft must be toward the flywheel end of the engine.

2. Assemble springs, rocker arms, and rocker arm supports onto shaft in the same location as removed from.

3. Install bowed washers and new end plugs (A) firmly in end of shaft.



A—End Plugs
B—Oil Supply Hole

RG,CTM8,G05,23 –19–16SEP92–1/1

INSPECT, MEASURE, AND ASSEMBLE CAMSHAFT FOLLOWERS

1. Remove and clean camshaft followers. Label for reassembly in same location.

Continued on next page

RG,CTM8,G05,25 –19–16SEP92–1/2

2. Measure camshaft follower OD. If camshaft follower OD is less than specified, install a new follower.

Camshaft Follower—Specification

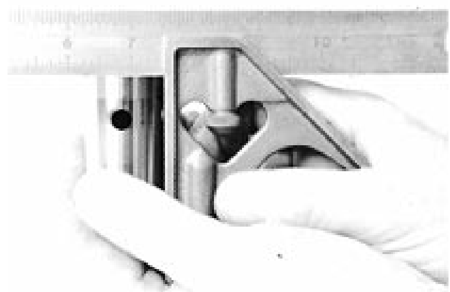
OD .... 31.61—31.64 mm (1.245—1.246 in.)

3. Check crown on follower face. If flat or concave, replace follower and check camshaft lobes for wear. (See Group 16).

4. Measure camshaft follower bore in block and determine if clearance is within specification. (See Group 10.)

5. Lubricate camshaft followers in clean engine oil and install in same bore from which removed.

T81239 –UN–09NOV88



RG6312 –UN–03AUG92

RG,CTM8,G05,25 –19–16SEP92–2/2

CHECK VALVE RECESS IN CYLINDER HEAD

Measure and record valve recess (A) using a depth micrometer or magnetic base dial indicator. Measurements must be made a maximum of 3.0 mm (0.12 in.) in from edge of valve head.

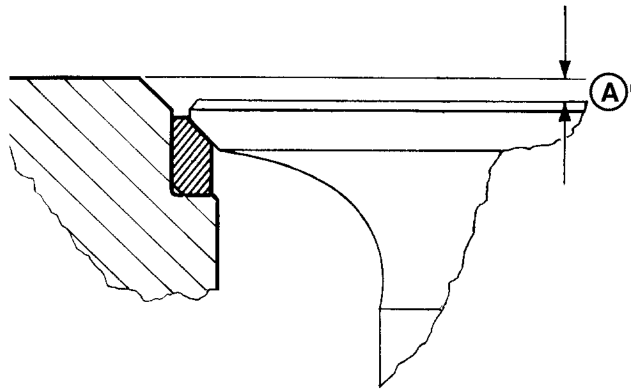
Intake Valves—Specification

Recess in Cylinder Head	0.61—1.11 mm (0.024—0.044 in.)
Worn Limit	1.63 mm (0.064 in.)

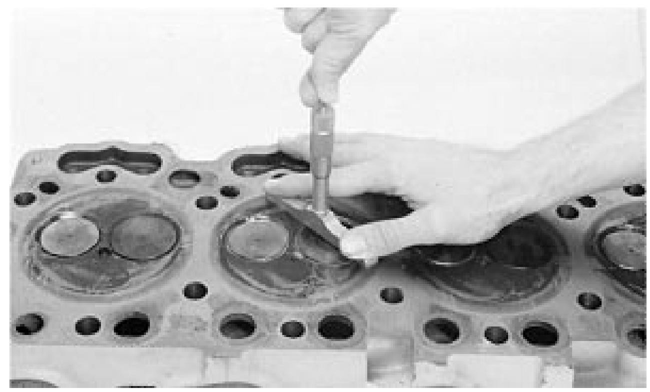
Exhaust Valve—Specification

Recess in Cylinder Head	1.22—1.72 mm (0.048—0.068 in.)
Worn Limit	2.26 mm (0.089 in.)

Install new valves or inserts, as necessary, to obtain proper valve recess. Grind valve seat inserts as required. (See REMOVE VALVE SEAT INSERTS later in this group).



RG4756 –UN–31OCT97



T81869 –UN–07NOV88

A—Valve Recess

RG,CTM8,G05,27 –19–27DEC94–1/1

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.
- Cocked 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.
- Bent push rods.
- 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 Recession:

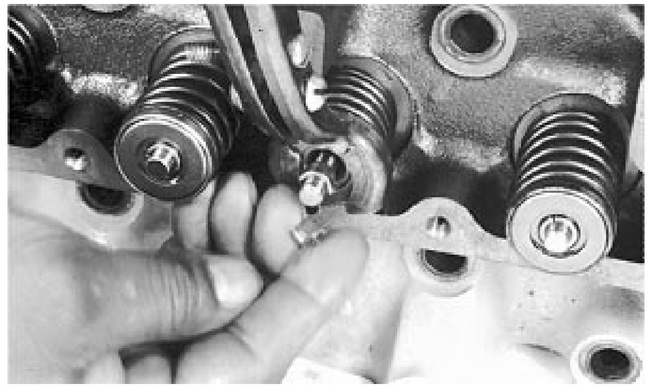
- Worn valve guides.
- Bent valves.
- Debris passed through valve train.

RG,CTM8,G05,28 –19–08MAR94–1/1

REMOVE VALVE ASSEMBLY

NOTE: A small magnet may be used to aid in removal of valve keepers.

1. Using JDE138 Valve Spring Compressor, compress valve springs far enough to remove keepers.



RG5655 –UN–12APR90

RG,CTM8,G05,29 –19–16SEP92–1/2

2. Release spring tension and remove valve rotator and valve spring.

3. Remove valves from cylinder head.

NOTE: Identify all parts for assembly in same location.

4. Remove valve stem seals (if equipped) from valve guide tower.

NOTE: All engines are equipped with valve stem seals, except Dubuque-built 4039 and 4045 naturally aspirated "D" engines below Engine Serial Number (—304490) and selected Dubuque-built 4045, 6059, and 6068 turbocharged "T" engines below Engine Serial Number (—335978).

RG6401 –UN–21AUG92

RG,CTM8,G05,29 –19–16SEP92–2/2

INSPECT AND MEASURE VALVE SPRINGS

RG2732 –UN–04DEC97

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.

Spring Free Length 0 N (0 lb-force)[1]—Specification

Height .... 54.0 mm (2.125 in.)

Spring Compressed 240—280 N (54—62 lb-force)—Specification

Height .... 46.0 mm (1.81 in.)

Spring Compressed 590—680 N (133—153 lb-force)—Specification

Height .... 34.5 mm (1.36 in.)

RG7427 –UN–21MAY98

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

RG,CTM8,G05,31 –19–08FEB95–1/1

INSPECT VALVE ROTATORS

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

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

T91224 –UN–28OCT88

RG,CTM8,G05,32 –19–16SEP92–1/1

CLEAN VALVES

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

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

IMPORTANT: Any carbon left on the stem will affect alignment in valve refacer if valves need to be refaced. Do not use 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.

RG,CTM8,G05,33 –19–08MAR94–1/1

INSPECT AND MEASURE VALVES

1. Clean and inspect valves, valve stems, stem tips, and retainer lock groove (A). Replace valves that are worn or damaged.

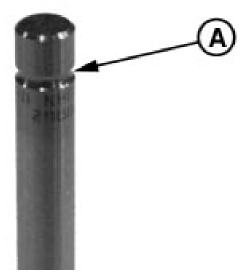
   Measure valve head OD and compare to following specifications.

Intake Valve Head—Specification

OD	46.47—46.73 mm (1.830—1.840 in.)

Exhaust Valve Head—Specification

OD	42.37—42.63 mm (1.668—1.678 in.)



A—Retainer Lock Groove

Continued on next page

DPSG,OUO1004,248 –19–13JUL98–1/3

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

Intake Valve Stem—Specification

OD .... 7.864—7.884 mm (0.3096—0.3104 in.)

Exhaust Valve Stem—Specification

OD .... 7.848—7.874 mm (0.3090—0.3100 in.)

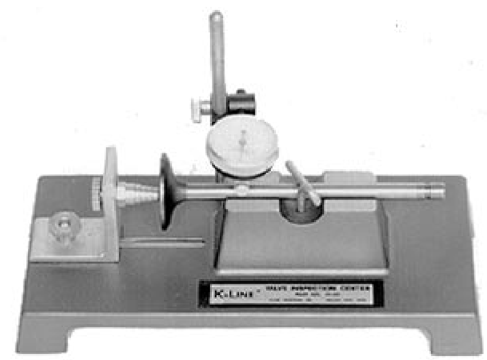
RG7430 –UN–23NOV97

DPSG,OUO1004,248 –19–13JUL98–2/3

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

Valve Face Runout—Specification

Maximum Valve Face Runout................................ 0.038 mm (0.0015 in.)
(Intake and Exhaust)



RG4234 –UN–05DEC97

DPSG,OUO1004,248 –19–13JUL98–3/3

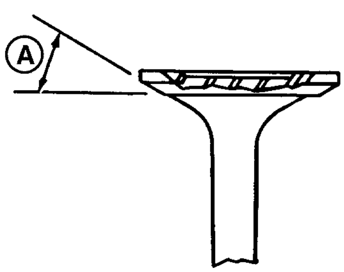
GRIND VALVES

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.

Reface serviceable valves to specified angle (A).

Valves—Specification

Face Angle .... 29.25° ± 0.25°



RG4755 –UN–31OCT97

A—Valve Face Angle

DPSG,OUO1004,249 –19–13JUL98–1/1

INSPECT AND CLEAN CYLINDER HEAD

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. Scrape gasket material, oil, carbon, and rust from head. Use a powered wire brush to clean sealing surfaces.

3. If front plate is present on cylinder head, remove prior to dipping head in chemical hot tank.

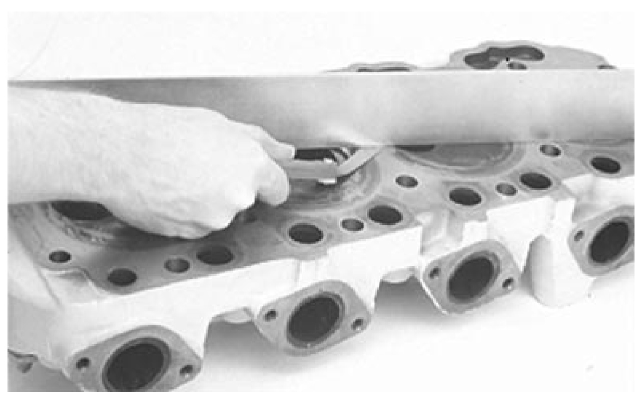
IMPORTANT: Be sure to remove all plugs before cleaning head, as parts can be damaged or destroyed by hot tank solutions.

4. Clean cylinder head in a chemical hot tank, or with solvent and a brush.

5. Dry with compressed air and blow out all passages.

RG,CTM8,G05,37 –19–27DEC94–1/1

CHECK CYLINDER HEAD FLATNESS



RG7645 –UN–23NOV97

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

Cylinder Head Flatness—Specification

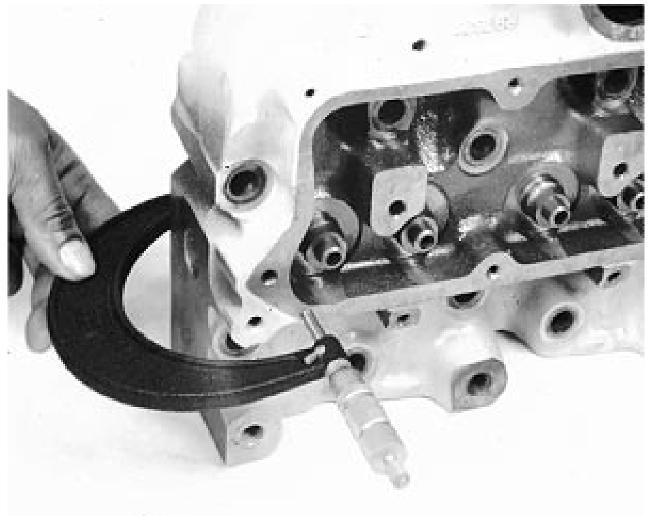
Maximum Acceptable Out-of-Flat: .... 0.08 mm (0.003 in.)
For Entire Length or Width
Maximum Acceptable Out-of-Flat: .... 0.03 mm (0.001 in.)
For Every 150 mm (5.90 in.)

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

DPSG,OUO1004,253 –19–14JUL98–1/1

05
30

MEASURE CYLINDER HEAD THICKNESS



RG5651 –UN–12APR90

Measure head thickness from valve cover gasket rail-to-combustion face.

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

When resurfacing cylinder head, remove ONLY what is necessary to restore flatness.

Cylinder Head Thickness and Finish—Specification

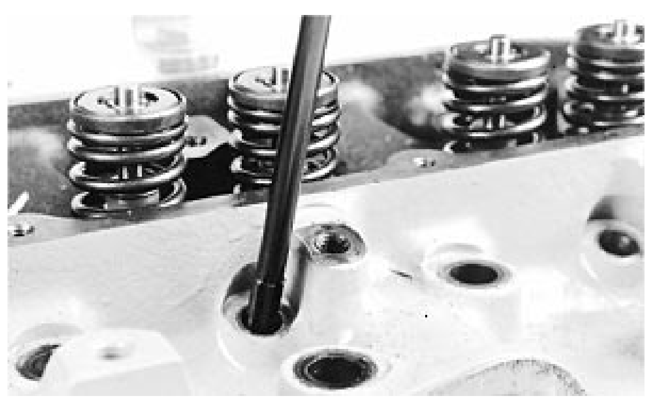
New Cylinder Head Thickness	104.87—105.13 mm (4.129—4.139 in.)
Minimum Acceptable Thickness	104.24 mm (4.104 in.)
Combustion Face Surface Finish (Surface Grind Only) (AA)	0.7—3.2 micrometers (31—125 micro-in.)
Maximum Wave Depth	0.012 mm (0.0005 in.)
Maximum Material Removal for Resurfacing	0.76 mm (0.030 in.)

IMPORTANT: After resurfacing cylinder head, check for flatness as described earlier. Also check surface finish on combustion face of head.

Measure and record valve recess in cylinder head. (See CHECK VALVE RECESS IN CYLINDER HEAD earlier in this group.)

DPSG,OUO1004,250 –19–13JUL98–1/1

CLEAN INJECTION NOZZLE BORES



RG6317 –UN–03AUG92

IMPORTANT: Always turn the tool clockwise through the bore, even when pulling back. This will prevent premature wear on the tool.

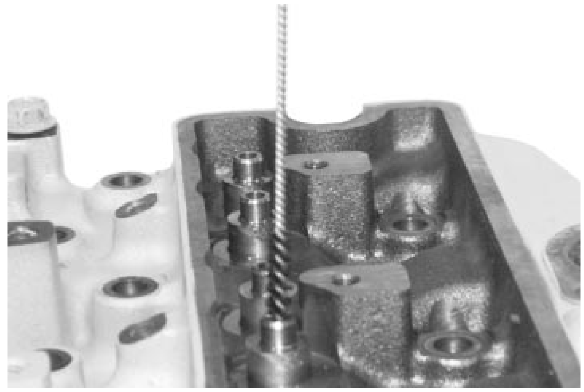
Clean carbon deposits from nozzle bores with JDE39 Nozzle Bore Cleaning Tool. Blow debris from bore with compressed air.

DPSG,OUO1004,251 –19–13JUL98–1/1

CLEAN VALVE GUIDES

Clean valve guides before inspection or repair, with a plastic brush.

NOTE: A few drops of light oil or kerosene will help clean the guides.



RG7434 –UN–23NOV97

RG,05,DT7356 –19–11NOV97–1/1

MEASURE VALVE GUIDES

Using a telescopic gauge, measure valve guide wear.

Valve Guide Bore (New)—Specification

ID .... 7.912—7.938 mm (0.312—0.313 in.)

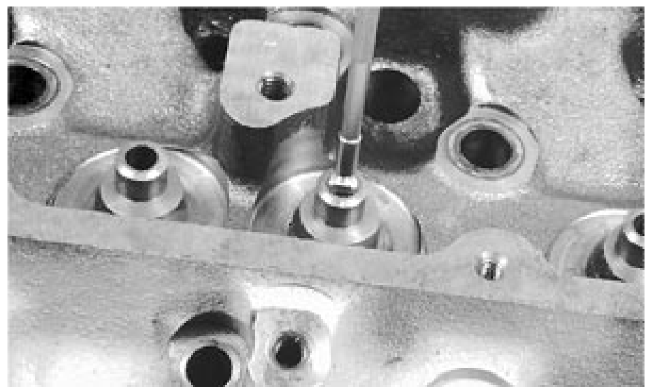
Valve Guide-to-Valve Stem (New)—Specification

Clearance .... 0.05—0.10 mm (0.002—0.004 in.)
Wear Limit .... 0.15 mm (0.006 in.)

If valve guide oil clearance exceeds the wear limit, but is less than 0.20 mm (0.008 in.), valve guides can be knurled.

If valve guide clearance is over 0.20 mm (0.008 in.), install valves with oversize stems. Valve guides can be knurled and then reamed to fit oversize valve stems.

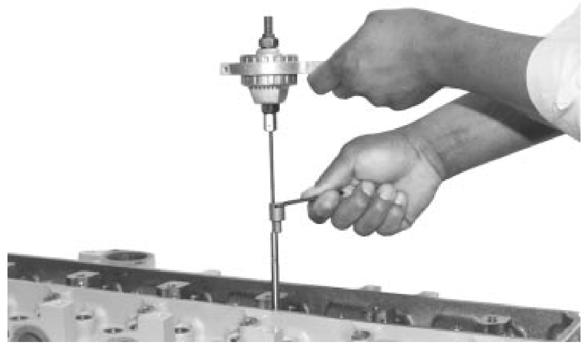
NOTE: Valves are available with 0.38 mm (0.015 in.) or 0.76 mm (0.030 in.) oversize stems.



RG5652 –UN–12APR90

DPSG,OUO1004,252 –19–13JUL98–1/1

KNURL VALVE GUIDES


RG7437 –UN–23NOV97

IMPORTANT: Valve guide knurling should only be done by experienced personnel familiar with equipment and capable of maintaining required specification.

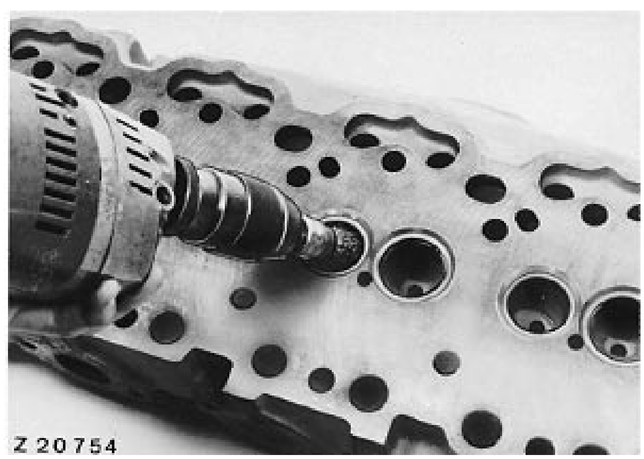
ALWAYS knurl valve guides before reaming to assure proper valve guide-to-stem clearance.

1. Use JT05949 Valve Guide Knurler Kit to knurl valve guides. Use kit exactly as directed by the manufacturer.

2. After knurling, ream valve guide to finished size to provide specified stem-to-guide clearance.

RG,05,DT7354 –19–11NOV97–1/1

CLEAN AND INSPECT VALVE SEATS



Z20754 –UN–25MAY89

1. Use an electric hand drill with D17024BR End 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,CTM8,G05,44 –19–28SEP94–1/1

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.

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

1. Using JT05893 Heavy Duty Seat Grinder Set, grind valve seat inserts to the following specifications:

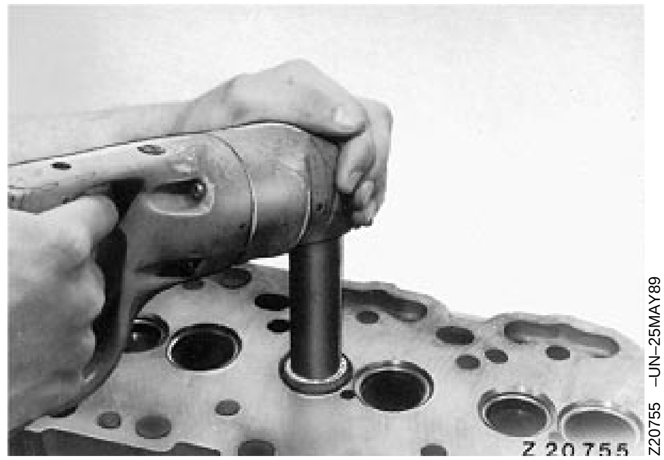
Valve Seat Grinding—Specification

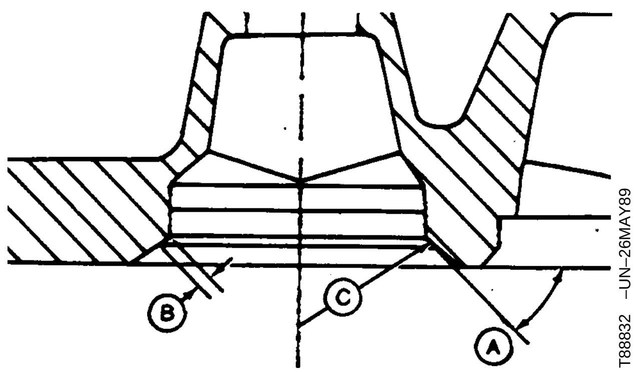
Angle	30°
Width	1.50—2.00 mm (0.059—0.079 in.)
Maximum Runout	0.08 mm (0.003 in.)

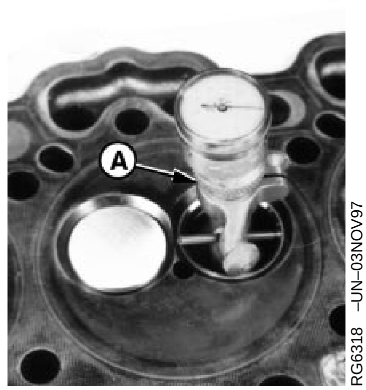
2. Use a vernier caliper or scale to measure seat width. If valve seat is too wide, reduce the width with a narrowing stone.

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.

3. Use a new or refaced valve and blueing to check contact between valve seat and face. If valve does not seat properly, use D11010KW Eccentrimeter (D) to check valve seat runout. Replace valves and inserts as necessary.







A—Valve Seat Angle
B—Valve Seat Width
C—Valve Seat Runout
D—D11010KW Eccentrimeter

Continued on next page

4. Use a new or refaced valve to check valve recess in cylinder head after grinding. (See CHECK VALVE RECESS IN CYLINDER HEAD earlier in this group.)

IMPORTANT: Blend or radius all sharp edges after grinding valve seats for a more effective valve face-to-seat seal.

RG,CTM8,G05,45 –19–08FEB95–2/2

REMOVE VALVE SEAT INSERTS

IMPORTANT: Be careful not to damage cylinder head when removing valve seats. Valve seat removal should only be done by experienced personnel familiar with procedures.

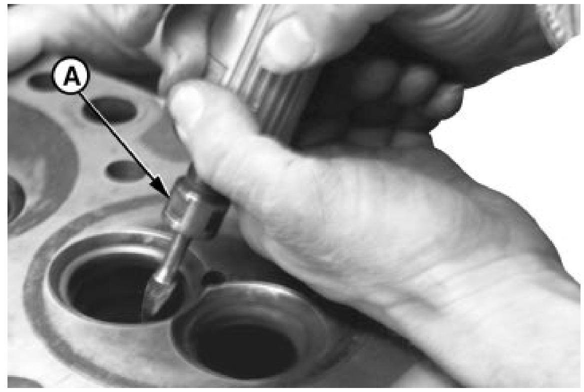
DO NOT use an oxy-acetylene torch to remove valve seat inserts, as it alters the hardness of the cylinder head.

Valve seat inserts are made of sintered (powdered) metal. Remove inserts by one of the following methods:

Continued on next page RG,05,DT7352 –19–11NOV97–1/4

RAISING BURR ON VALVE SEAT INSERT

1. Using a carbide deburring tool, (A) raise a burr (B) on bottom of valve seat insert.



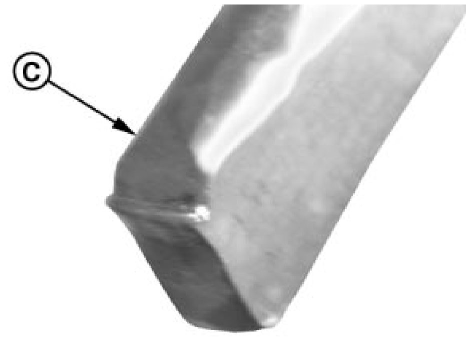
RG7816 –UN–13NOV97

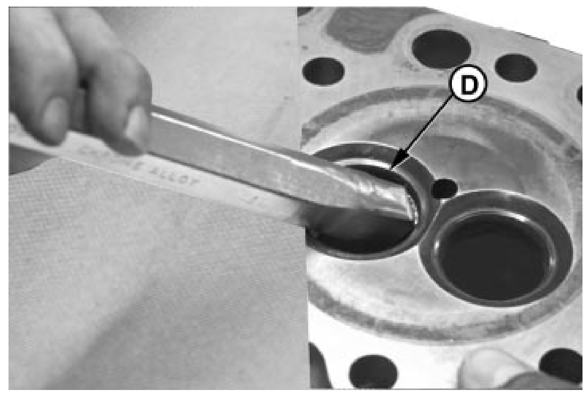
RG7817 –UN–13NOV97

A—Deburring Tool
B—Burr

Continued on next page RG,05,DT7352 –19–11NOV97–2/4

2. Protect surface of cylinder head with cardboard or cloth. Using a chisel with special ground end (C), tap handle of chisel with hammer until valve seat insert (D) comes loose.





C—Special Ground Chisel
D—Valve Seat Insert

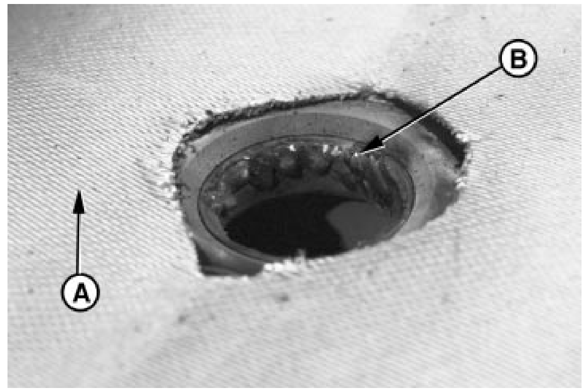
Continued on next page RG,05,DT7352 –19–11NOV97–3/4

USING AN ARC WELDER

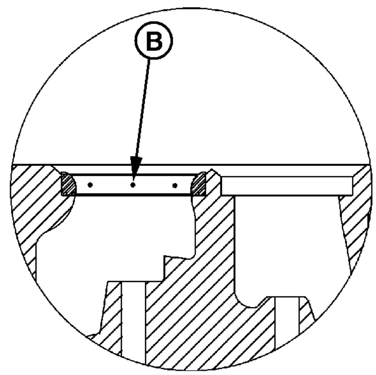
1. Protect the valve guide by installing a cap screw or dowel in guide to protect from weld spatter.

2. Protect the cylinder head surface with a non-flammable welder's cloth (A). Apply a thin bead of weld (B) around ID of valve seat insert. Allow insert to cool and use a screwdriver (C) or similar tool and carefully pry insert from bore.

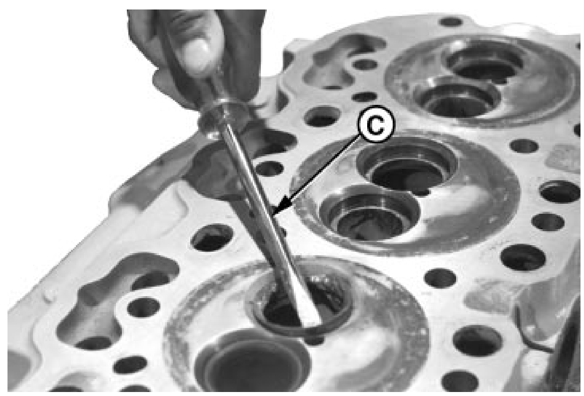
3. After removal of inserts, thoroughly clean area around valve seat bore and inspect for damage or cracks. Replace cylinder head as necessary.



RG7761 –UN–10NOV97



RG7813 –UN–13NOV97

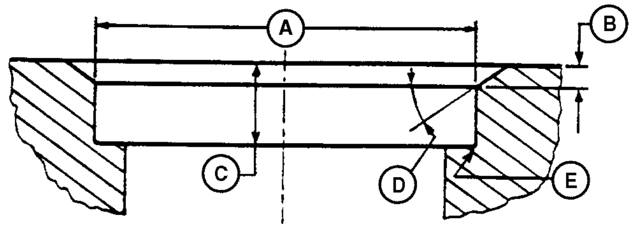


RG7763 –UN–10NOV97

A—Welders Cloth
B—Weld Bead
C—Screwdriver

RG,05,DT7352 –19–11NOV97–4/4

MEASURE VALVE SEAT BORE IN CYLINDER HEAD



If bore dimensions are not within specification, machine head to the following specifications:

Exhaust Valve Seat Insert Bore Specifications:

A	42.987—43.013 mm (1.6924—1.6934 in.)
B	3.82 mm (0.150 in.) Reference
C	9.936—10.064 mm (0.3912—0.3962 in.)
D	38—42°
E	Maximum Radius 0.5 mm (0.019 in.)
Maximum surface finish of bore “A”	0.00158 mm (0.000062 in.)

Intake Valve Seat Insert Bore Specifications:

A	47.104—47.130 mm (1.8545—1.8555 in.)
B	3.45 mm (0.136 in.) Reference
C	9.936—10.064 mm (0.3912—0.3962 in.)
D	38—42°
E	Maximum Radius 0.5 mm (0.019 in.)
Maximum surface finish of bore “A”	0.00158 mm (0.000062 in.)

Replacement Valve Seat Insert OD:

Intake	47.155—47.181 mm (1.8565—1.8575 in.)
Exhaust	43.038—43.064 mm (1.6944—1.6954 in.)

RG,05,DT7351 –19–11NOV97–1/1

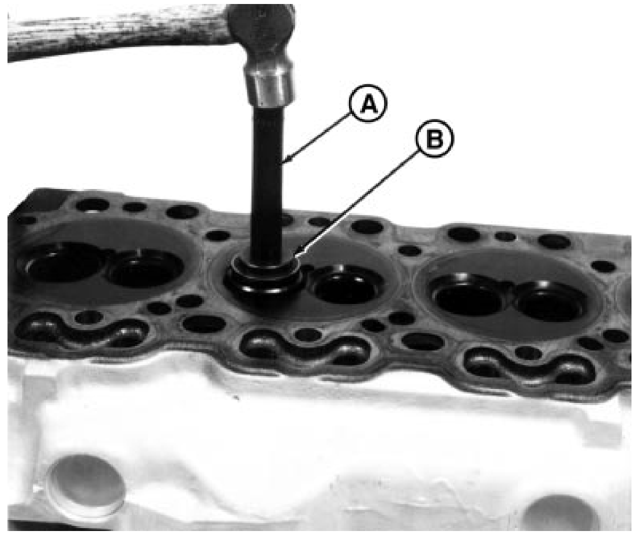
INSTALL VALVE SEAT INSERTS

1. Use JDG676 Pilot Driver (A) and JDG675 Valve Seat Insert Installing Adapter (B) to install valve seat inserts in cylinder head.

   Use one end of JDG675 Adapter to install intake valve seat inserts and the other end to install exhaust valve seat inserts.

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.)



RG5653 –UN–31OCT97

A—Pilot Driver
B—Adapter

RG,05,DT7350 –19–11NOV97–1/1

INSTALL VALVES

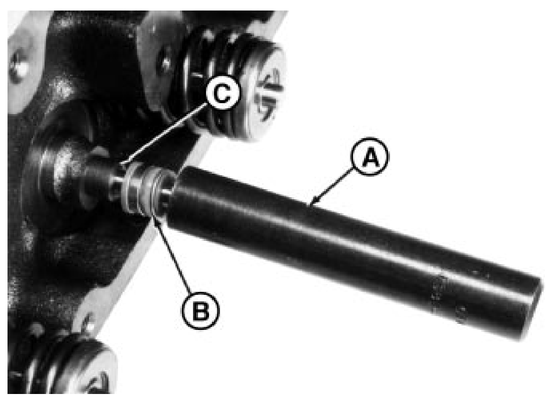
1. Lubricate valve stems and guides with AR44402 Valve Stem Lubricant or clean engine oil.

NOTE: Valves must move freely in guide and seat properly in head to form an effective seal.

2. Insert valves in head (if valves are reused, install in same location from which removed).

NOTE: Some early Dubuque-built engines were not equipped with valve stem seals. It is recommended that valve stem seals be installed if the cylinder head is being rebuilt. Valve towers are already machined to accept stem seals.

3. Use JDG678 Valve Stem Seal Installer (A) to slide valve stem seals (B) over valve stems and onto valve guide tower (C).



RG5654 –UN–31OCT97

A—Seal Installer
B—Valve Stem Seals
C—Valve Guide Tower

Continued on next page

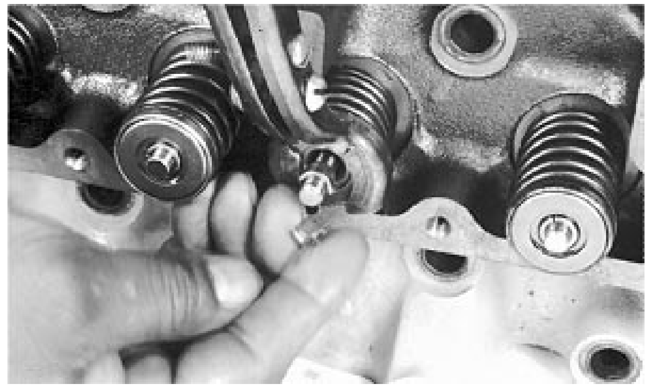
RG,CTM8,G05,49 –19–02OCT92–1/2

4. Install valve springs and rotators.

5. Compress valve springs using JDE138 Valve Spring Compressor and install keepers on valve stems.

6. Strike end of each valve three or four times with a soft mallet (non-metallic) to insure proper positioning of the keepers.

7. Recheck valve recess. (See CHECK VALVE RECESS IN CYLINDER HEAD earlier in this group.)



RG5655 –UN–12APR90

RG,CTM8,G05,49 –19–02OCT92–2/2

CLEAN AND INSPECT CYLINDER HEAD CAP SCREWS

1. Clean entire length of cap screws. Use a wire brush and solvent to remove rust and scale. Dry cap screws with compressed air.

2. Inspect cap screws for corrosion damage and overall condition of threads. CAP SCREWS WITH CORROSION OR OTHER IMPERFECTIONS MUST BE REPLACED.

RG6319 –UN–23NOV97

RG,CTM8,G05,52 –19–16SEP92–1/1

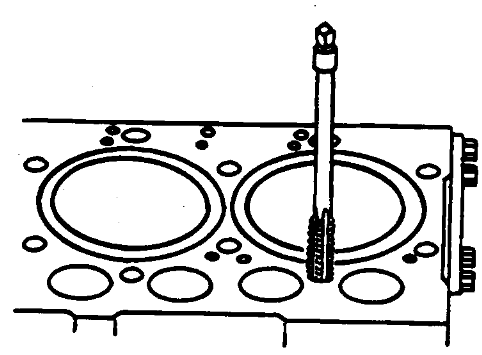
INSPECT AND CLEAN EXHAUST MANIFOLD

1. Thoroughly clean all passages and gasket surfaces in exhaust manifold and exhaust elbow.

2. Inspect entire exhaust manifold for cracks or damage. Replace parts as necessary.

RG,CTM8,G05,54 –19–16SEP92–1/1

CLEAN AND INSPECT TOP DECK OF CYLINDER BLOCK



RG4718 –UN–13DEC88

1. Remove gasket material, rust, carbon, and other foreign material from top deck. Gasket surface must be clean.

2. Clean threaded holes in cylinder block using JDG680 Tap or any 1/2-13 UNC-2A tap about 76 mm (3.0 in.) long. Use compressed air to remove debris and fluids from the cap screw holes. Replace block if there is evidence of damage.

3. Use compressed air to remove all loose foreign material from cylinders and top deck.

T90973 –UN–28OCT88

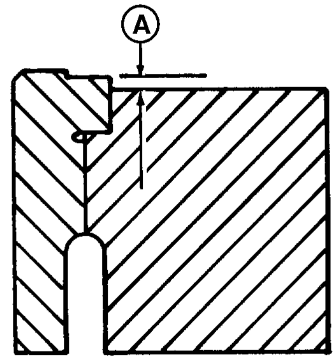
IMPORTANT: All debris must be cleaned from the camshaft followers before assembling the engine.

4. If not previously done, remove camshaft followers from block and wash in solvent. Lubricate with clean engine oil and install in the same bore.

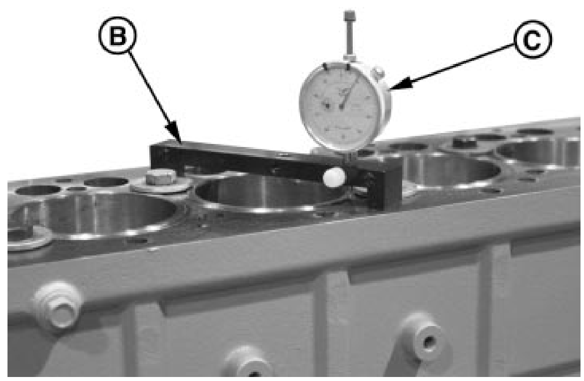
5. Inspect top deck for flatness and serviceability. (See Group 10.)

RG,CTM8,G05,55 –19–16SEP92–1/1

MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK)



RG6439 –UN–03NOV97



RG7445A –UN–03NOV97

A—Liner Height
B—Gauge
C—Dial Indicator

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

Cylinder Liner Height Above Block—Specification

Height .... 0.030—0.100 mm (0.001—0.004 in.)

Cylinder Liner Height Difference At Nearest Point of Two Adjacent Liners, or Within a Single Liner—Specification

Maximum Permissible Height Difference .... 0.05 mm (0.002 in.)

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

3. Remove and shim, or replace, any liner that does not meet height specifications. (See Group 10.)

NOTE: Two sizes of shims are available: 0.05 mm (0.002 in.) and 0.10 mm (0.004 in.).

RG,05,DT7345 –19–11NOV97–1/1

INSTALL CYLINDER HEAD

RG5650 –UN–12APR90

IMPORTANT: ALWAYS thoroughly inspect cylinder head gasket for possible manufacturing imperfections. Return any gasket that does not pass inspection.

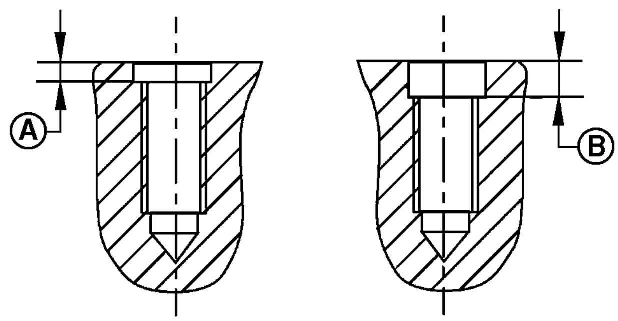
1. Place new head gasket on cylinder block. Do not use sealant; install dry.

NOTE: Head gasket must have a minimum of 120 mm (4.724 in.) combustion ring I.D.

2. Install two guide studs in cylinder block at locating holes (D). (See figure on following page.)

IMPORTANT: The O-ring seals in head gasket can be damaged if head is repositioned while resting on engine block. Use guide studs to position cylinder head on block.

3. Position cylinder head over guide studs and lower onto cylinder block.



RG9449 –UN–02SEP98

A—3 mm Recess
B—9.5 mm Recess

IMPORTANT: On Saran Series 300 Engines (CD) built prior to 1987, DO NOT reuse the 108 mm cylinder head cap screws when replacing the block or installing a short block. New blocks have deeper counterbores and threads. To verify proper use, measure cylinder block counterbore depth. Use108 mm cap screws on cylinder blocks with counterbore depth of 3mm (0.12 in.) (A) and 112mm cap screws on cylinder blocks with counterbore depth of 9.5 mm (0.37 in.) (B).

4. Dip entire cap screw in clean engine oil. Remove excess oil from screw.

5. Remove guide studs. Install flanged head cylinder head cap screws.

Continued on next page

RG,CTM8,G05,58 –19–27DEC94–1/2

6. Tighten all cap screws to specified torque (in sequence, beginning with No. 1) before proceeding to next step:

Step 1-Initial Torque—Specification

Torque .... 100 N•m (75 lb-ft)

Step 2-Second Torque—Specification

Torque .... 150 N•m (110 lb-ft)

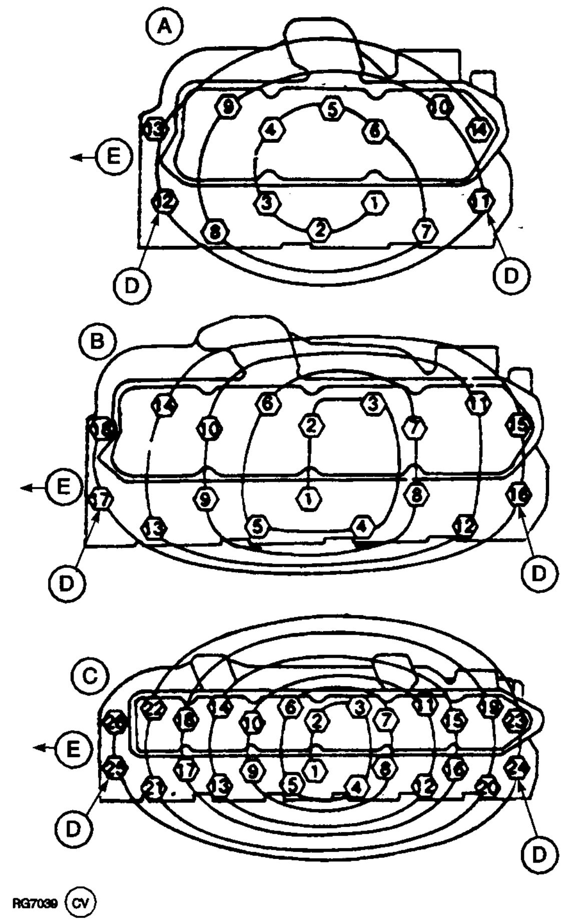
Step 3-Verify Torque (After 5 Minutes)—Specification

Torque .... 150 N•m (110 lb-ft)

Step 4-Torque Turn—Specification

Torque Turn... Tighten each screw an additional 60°± 10° (See TORQUE-TURN METHOD FOR PROPER TORQUE next in this group.)

Retorque of cylinder head cap screws after engine break-in is not required when using the recommended torque procedure along with flanged-head cap screw.



RG7039 –UN–10OCT94

A—3-Cylinder Engine
B—4-Cylinder Engine
C—6-Cylinder Engine
D—Locating Holes (Guide Stud Locations)
E—Arrow Toward Front of Engine

RG,CTM8,G05,58 –19–27DEC94–2/2

TORQUE-TURN METHOD FOR PROPER TORQUE

After tightening cap screws to 150 N•m (110 lb-ft), use JT05993 Torque Angle Gauge or the line scribe method below to tighten each cap screw an additional 60°.

Line scribe method:

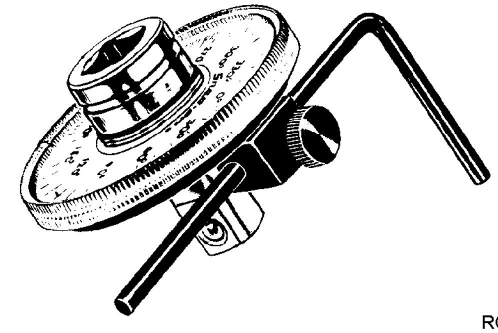
Step A—Make two marks on socket 1/6 turn (60°±10°) apart.

Step B—Make a mark on cylinder head next to each cap screw.

Step C—Place socket on cap screw so first mark aligns with mark on cylinder head.

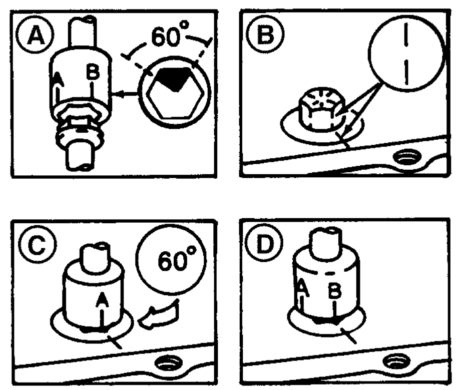
Step D—Tighten (in sequence) all cap screws until second mark on socket aligns with mark on cylinder head.

Retorque of cylinder head cap screws after engine break-in is not required when using the recommended torque procedure along with flanged-head cap screws.



RG5698 RG5698 –UN–05DEC97

JT05993 Torque Angle Gauge



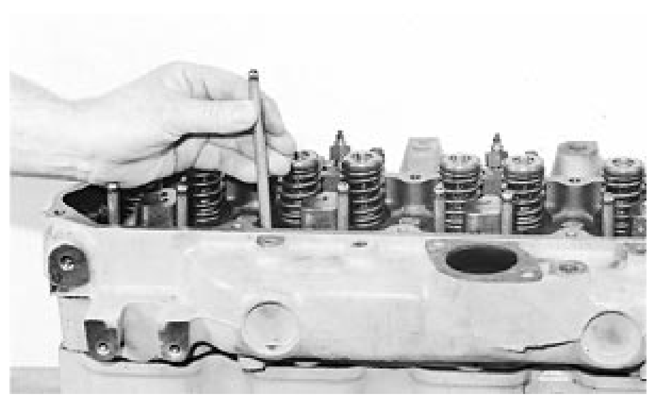
RG5587 –UN–31OCT97

RG,CTM8,G05,60 –19–08FEB95–1/1

INSTALL ROCKER ARM ASSEMBLY

1. Install push rods in same location from which removed.

NOTE: Valve stem tips are specially hardened, wear caps are not required.



RG6321 –UN–03AUG92

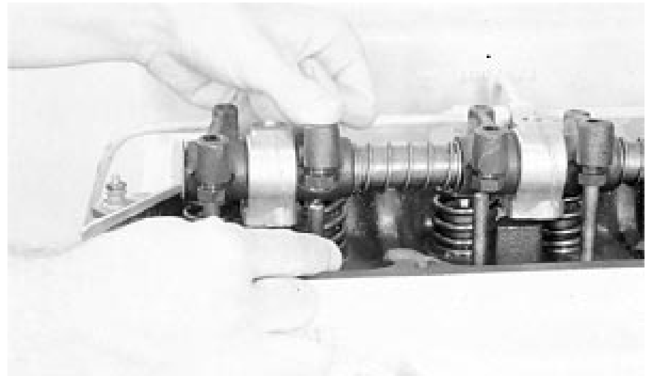
Continued on next page RG,CTM8,G05,61 –19–20AUG92–1/2

IMPORTANT: Relieve tension on rocker arm adjusting screw to avoid damaging rocker arm shaft during installation.

2. Position rocker arm assembly on engine.

IMPORTANT: Oil supply hole in rocker arm shaft must be positioned at the flywheel end of engine and facing downward when rocker shaft is installed.

3. Lubricate all rocker arms with engine oil and make sure they move freely. Tighten rocker arm support cap screws in criss-cross sequence to specifications.


T81240 –UN–01NOV88

Rocker Arm Support Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

4. Adjust valve clearance. (See CHECK AND ADJUST VALVE CLEARANCE earlier in this group.)

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

RG,CTM8,G05,61 –19–20AUG92–2/2

INSPECT AND CLEAN VENTILATOR OUTLET HOSE

1. Check ventilator outlet hose on rocker arm cover for bent or damaged condition. Replace if necessary.

2. Clean ventilator hose and tube if they are restricted.

RG,CTM8,G05,53 –19–16SEP92–1/1

INSTALL ROCKER ARM COVER

Two types of rocker arm covers are used:

Sheet Metal Cover

1. Install rocker arm cover and gasket. Install gasket dry (without sealant).

NOTE: The old gasket can be reused if not damaged.

2. Tighten rocker arm cover cap screws (A) to specifications.

Rocker Arm Cover Cap Screws—Specification

Torque .... 11 N•m (8 lb-ft) (96 lb-in.)

Composite Material Cover

IMPORTANT: Dispose of sealing ring (A) if there is evidence of damage. Otherwise, do NOT remove seal from groove.

1. Install rocker arm cover with built-in seal ring (B). Do not use sealant on seal ring.

2. Install all cap screws finger tight.

3. Tighten all cap screws to specifications, starting at the center and alternate sides until reaching the ends.

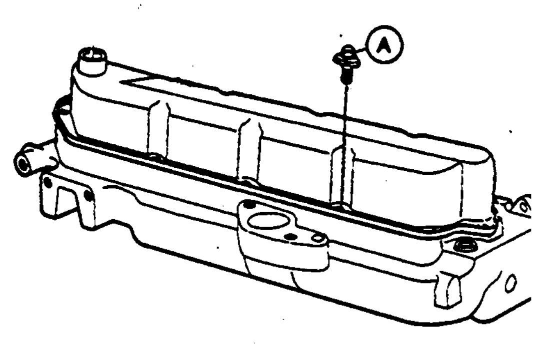
Rocker Arm Cover Cap Screws—Specification

Torque .... 11 N•m (8 lb-ft) (96 lb-in.)

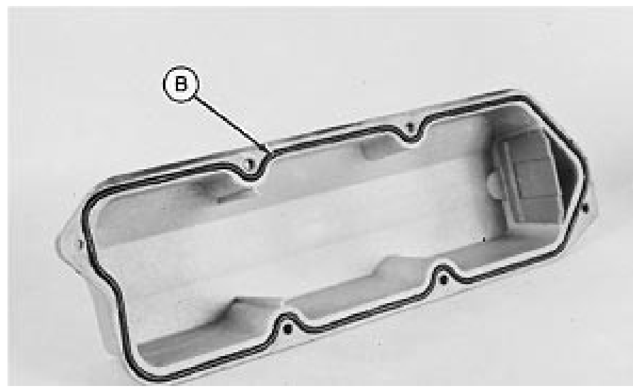
The sealing ring is reusable if not damaged. If the sealing ring leaks, the following procedure should be used to install a new sealing ring:

a. Carefully remove the old sealing ring from rocker arm cover. Do not use any cutting tool that could damage the cover.

b. Clean the groove with acetone. Follow manufacturer's recommendations on label. Dry with compressed air.



CD7350 –UN–09DEC88



RG6322 –UN–03AUG92

A—Cap Screws
B—Seal Ring

Continued on next page

RG,CTM8,G05,63 –19–27DEC94–1/2

c. Lubricate sealing ring with grease to avoid misalignment. Install in groove.

d. Cut sealing ring slightly longer than necessary.

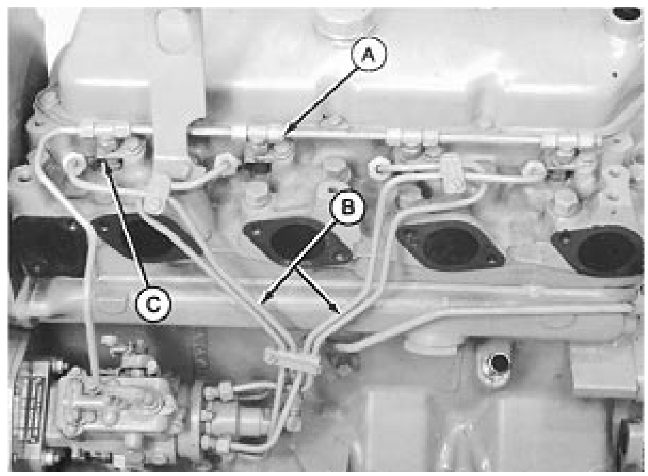
e. Place the two ends of sealing ring end-to-end. Press the sealing ring into the groove all the way around the cover to ensure proper assembly. Tighten cap screws to specification listed above.

RG,CTM8,G05,63 –19–27DEC94–2/2

COMPLETE FINAL ASSEMBLY

1. Install injection nozzles (C). Install injection lines (B) as an assembly. (See Group 35.)

2. Install fuel leak-off line (A). (See Group 35.)



RG5658 –UN–12APR90

Continued on next page

RG,CTM8,G05,64 –19–10JUL92–1/2

3. Install exhaust manifold (D), turbocharger (C) (if equipped), and exhaust elbow (B). (See Group 30.)

4. Install water manifold or thermostat housing (A). (See Group 25.)

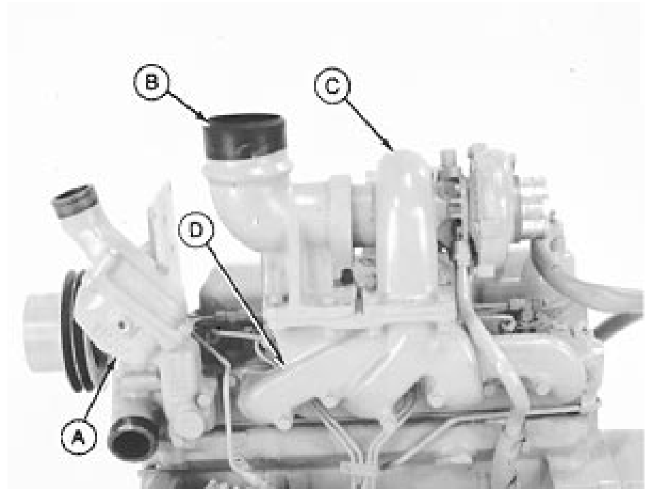
5. Install fuel filter.

6. Install intake manifold and air intake adapter. (See Group 30.)

7. Install air heater if equipped.

8. If engine oil was drained from crankcase, install new oil filter and fill engine with clean oil of correct grade and viscosity. (See Group 02.)

9. Fill cooling system with clean coolant. (See Group 02.)



RG5657 –UN–12APR90

A—Thermostat Housing
B—Exhaust Elbow
C—Turbocharger
D—Exhaust Manifold

RG,CTM8,G05,64 –19–10JUL92–2/2

PERFORM ENGINE BREAK-IN

1. Run engine at slow idle no load for 1 minute. Check for liquid leaks.

2. Increase RPM to fast idle, then load down to 50 rpm above rated speed for 10 minutes. (See DYNAMOMETER TEST SPECIFICATIONS in Group 100.)

NOTE: Dynamometer is the preferred load control, but loading can be improvised by matching engine lugging conditions with gear ratio selection.

3. Recheck valve clearances and adjust as necessary. (See CHECK AND ADJUST VALVE CLEARANCE earlier in this group.)

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

   Retorque of cylinder head cap screws after engine break-in is not required.

IMPORTANT: After engine break-in, follow ALL recommended hourly service intervals outlined in your Operator's Manual.

RG,CTM8,G05,65 –19–21FEB95–1/1

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,OUO1004,342 –19–09SEP98–1/16

RG6246 –UN–05DEC97

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

Use with JDG451, KJD10123 or magnetic base to measure valve recess in cylinder head and piston and liner height.

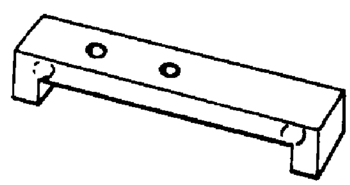
RG6246

DPSG,OUO1004,342 –19–09SEP98–2/16

RG7029 –UN–05DEC97

Height Gauge. . . . . JDG451 or KJD10123

Used with a dial indicator to measure valve recess in cylinder head. Also used to measure piston and liner height.



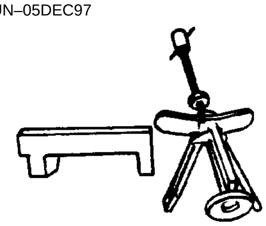
RG7029

DPSG,OUO1004,342 –19–09SEP98–3/16

RG5019 –UN–05DEC97

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

Used to remove and install cylinder liners.



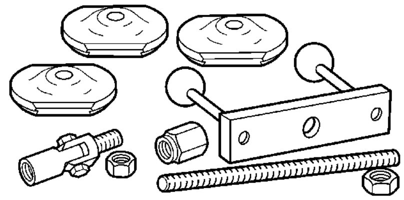
RG5019

Continued on next page

DPSG,OUO1004,342 –19–09SEP98–4/16

Cylinder Liner Puller JDG1145

Used to remove and install cylinder liners.


RG9441 –UN–10JUL98

DPSG,OUO1004,342 –19–09SEP98–5/16

RG9450 –UN–02SEP98

Piston Ring Expander JDE85

Remove and install piston rings.

DPSG,OUO1004,342 –19–09SEP98–6/16

RG9452 –UN–02SEP98

Piston Ring Expander JDE135

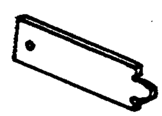
Remove and install piston rings.

DPSG,OUO1004,342 –19–09SEP98–7/16

RG5076 –UN–23AUG88

Piston Ring Groove Wear Gauge JDE62

Check wear of keystone ring groove on pistons.



DPSG,OUO1004,342 –19–09SEP98–8/16

RG5074 –UN–07NOV97

Flexible Cylinder Hone D17004BR

Hone cylinder liners.

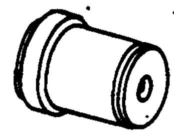
RG5074

Continued on next page

DPSG,OUO1004,342 –19–09SEP98–9/16

RG5107 –UN–23AUG88

Piston Pin Bushing Remover and Installer JD286



Remove and install large 41 mm (1.6 in.) piston pin bushings.

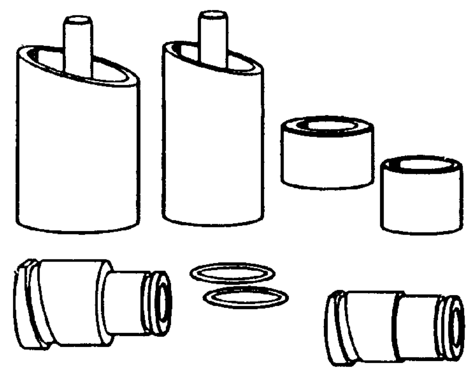
Piston Pin Bushing Remover and Installer JDE88

Remove and install small 35 mm (1.3 in.) piston pin bushings.

DPSG,OUO1004,342 –19–09SEP98–10/16

Connecting Rod Bushing Remover and Installer. JDG738

Replace pin bushings in connecting rods with tapered pin ends.



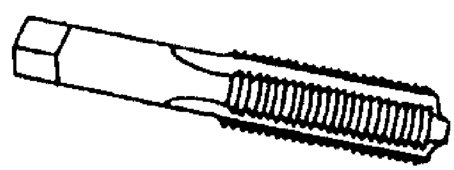
RG9451 –UN–02SEP98

DPSG,OUO1004,342 –19–09SEP98–11/16

RG5100 –UN–05DEC97

Tap JDG680

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

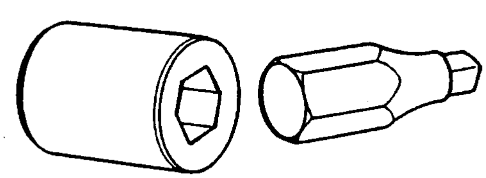


RG5100

DPSG,OUO1004,342 –19–09SEP98–12/16

Oil Gallery Plug Tool JDG782

Used to remove and install oil gallery plugs.



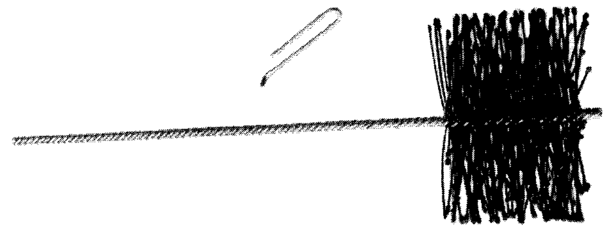
RG6612 –UN–29JAN93

Continued on next page

DPSG,OUO1004,342 –19–09SEP98–13/16

O-Ring Groove Cleaning Brush D17015BR

Clean cylinder liner O-ring groove in block.



RG5075 –UN–07NOV97

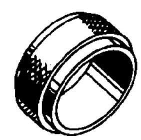
RG5075

DPSG,OUO1004,342 –19–09SEP98–14/16

RG5031 –UN–05DEC97

Piston Ring Compressor JDE84

Compress rings while installing pistons.

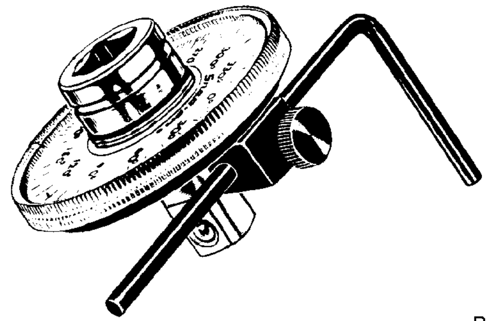


RG5031

DPSG,OUO1004,342 –19–09SEP98–15/16

Torque Angle Gauge JT05993

Used to TORQUE-TURN flanged-head cylinder head and connecting rod cap screws.



RG5698 –UN–05DEC97

RG5698

DPSG,OUO1004,342 –19–09SEP98–16/16

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

Continued on next page

DPSG,OUO1004,343 –19–09SEP98–1/4

Cylinder Bore Ridge Reamer . . . .

Remove carbon from liner bore.

DPSG,OUO1004,343 –19–09SEP98–2/4

Piston Ring Groove Cleaner . . . .

Clean piston ring grooves.

DPSG,OUO1004,343 –19–09SEP98–3/4

Precision “Bevelled Edge” Straightedge D05012ST

Check cylinder head flatness.

DPSG,OUO1004,343 –19–09SEP98–4/4

OTHER MATERIAL

Number	Name	Use
N/A (U.S.)	PLASTIGAGE®	Determine connecting rod bearing-to-journal oil clearance.
AR54749 (U.S.)	Soap Lubricant	Apply to Cylinder Liner O-Rings and Packing

PLASTIGAGE is a registered trademark of DANA Corp.

DPSG,OUO1004,344 –19–09SEP98–1/1

CYLINDER BLOCK, LINERS, PISTONS AND RODS SPECIFICATIONS

Item	Measurement	Specification
Piston Rings		
3029DF120/160 (263024—) 3029DLV01 (262109—) 3029DLV02 (291223—) 3029TF120/160 (287526—) 3029TF001/031 (264813—) 3029TLV01 (261581—)	End Gap (No. 1 Compression)) End Gap (No. 2 Compression) End Gap (No. 3 Oil Control)	0.33—0.58 mm (0.013—0.023 in.) 1.23—1.49 mm (0.048—0.059 in.) 0.30—0.56 mm (0.012—0.022 in.)
All Other Saran-Built Engines	End Gap (No. 1 Compression))	0.35—0.60 mm (0.014—0.024 in.)
	End Gap (No. 2 Compression) (Early Engines)	0.33—0.58 mm (0.013—0.023 in.)
	End Gap (No. 2 Compression) (Later Engines)	0.75—1.00 mm (0.030—0.039 in.)
	End Gap (No. 3 Oil Control)	0.30—0.60 mm (0.012—0.024 in.)
Dubuque-Built Engines	End Gap (No. 1 Compression))	00.35 mm (0.014 in.)
	End Gap (No. 2 Compression)	0.75—1.00 mm (0.029—0.039 in.)
	End Gap (No. 3 Oil Control)	0.30—0.60 mm (0.012—0.024 in.)
Cylinder Liner Height	Height above block	0.030—0.100 mm (0.001—0.004 in.)
	Maximum permissible difference between readings within one cylinder or between adjacent cylinders	0.05 mm (0.002 in.)
Piston Ring-to-Groove Clearance—New Piston Ring (Second and Third Ring Grooves)	Maximum Clearance	0.20 mm (0.008 in.)
Piston Pin Bore (Small Pin)	ID	34.93—34.94 mm (1.375—1.376 in.)
Piston Pin Bore (Large Pin)	ID	41.29—41.30 mm (1.625—1.626 in.)

Continued on next page

Item	Measurement	Specification
Piston Pin Bore (Later 3029D)	ID	32.003—32.013 mm (1.256—1.260 in.)
Piston Skirt (Measurement taken bottom of skirt 19 mm (0.74 in.) from bottom of piston)	Diameter	106.38—106.40 mm (4.188—4.189 in.)
Piston (3029, 4039, 6059 Engines)	Height (Measured From Center of Pin Bore to Top of Piston)	66.27—66.33 mm (2.609—2.611 in.)
Piston (4045 and 6068 Engines)	Height (Measured From Center of Pin Bore to Top of Piston)	71.64—71.70 mm (2.820—2.823 in.)
Piston-to-Liner Clearance: (Measured at Bottom of Piston Skirt) (Naturally Aspirated Engines)	Clearance	0.08—0.14 mm (0.003—0.005 in.)
Piston-to-Liner Clearance: (Measured at Bottom of Piston Skirt) (Turbocharged Engines)	Clearance	0.08—0.15 mm (0.003—0.006 in.)
Cylinder Liner Out-Of-Round (Top or Bottom)	Maximum Out-of-Round	0.05 mm (0.002 in.)
Cylinder Liner Taper	Maximum Taper	0.05 mm (0.002 in.)
Crankshaft Journal (3029/4039/6059)	OD	69.799—69.825 mm (2.7479—2.7490 in.)
Crankshaft Journal (4045/6068)	OD	77.800—77.826 mm (3.0629—3.0640 in.)
Assembled Rod Bearing (3029/4039/6059)	ID	69.850—69.901 mm (2.7499—2.7520 in.)
Assembled Rod Bearing (4045/6068)	ID	77.876—77.927 mm (3.0659—3.0679 in.)
Connecting Rod Bearing-to-Journal (New Parts 3029/4039/6059)	Oil Clearance	0.025—0.102 mm (0.0012—0.0040 in.)
	Wear Limit	0.152 mm (0.0600 in.)

Continued on next page

DPSG,OUO1004,486 –19–07NOV98–2/9

Item	Measurement	Specification
Connecting Rod Bearing-to-Journal (New Parts 4045/6068)	Oil Clearance	0.050—0.127 mm (0.0020—0.0050 in.)
	Wear Limit	0.152 mm (0.0600 in.)
Connecting Rod Cap Screws (3029/4039/6059)	Initial Torque	55 N•m (40 lb-ft)
Connecting Rod Cap Screws (3029/4039/6059)	Torque Turn	1/4 Turn (90—100°) After Initial Torque
Connecting Rod Cap Screws (4045/6068)	Initial Torque	68 N•m (50 lb-ft)
Connecting Rod Cap Screws (4045/6068)	Torque Turn	1/4 Turn (90—100°) After Initial Torque
Connecting Rod Bore (Without Bearing Inserts 3029/4039/6059)	ID	73.660—73.686 mm (2.9000—2.9010 in.)
Connecting Rod Bore (Without Bearing Inserts 4045/6068)	ID	82.677—82.703 mm (3.2550—3.2560 in.)
Connecting Rod Bore	Maximum Permissible Out-of-Round	0.038 mm (0.0015 in.)
Piston Pin (Small)	OD	34.920—34.930 mm (1.3748—1.3752 in.)
	Wear Limit	34.907 mm (1.3743 in.)
Piston Pin (Large)	OD	41.270—41.280 mm (1.6248—1.6252 in.)
	Wear Limit	41.257 mm (1.6243 in.)
Piston Pin (Later 3029D)	OD	31.994—32.000 mm (1.2596—1.2598 in.)
	Wear Limit	31.981 mm (1.2591 in.)
Piston Pin (All Except 3029)	Length	84.05—84.45 mm (3.309—3.325 in.)

Continued on next page

DPSG,OUO1004,486 –19–07NOV98–3/9

Item	Measurement	Specification
Piston Pin 3029DF120/160 (—263023) 3029DLV01 (—262108) 3029DLV02 (—291222) 3029TF120/160 3029TF001/031 (—264812) 3029TLV01	Length	71.61—72.01 mm (2.819—2.835 in.)
Piston Pin 3029DF120/160 (263024—) 3029DLV01 (262109—) 3029DLV02 (291223—) 3029TF001/031 (264813—)	Length	79.80—80.20 mm (3.14—3.16 in.)
Piston Pin Bushing Installed (Small Pin)	ID	34.950—34.976 mm (1.3760—1.3770 in.)
	Wear Limit	35.026 mm (1.3790 in.)
Piston Pin Bushing Installed (Large Pin)	ID	41.300—41.326 mm (1.6260—1.6270 in.)
	Wear Limit	41.376 mm (1.6290 in.)
Piston Pin Bushing Installed (Later 3029D)	ID	32.010—32.036 mm (1.2602—1.2612 in.)
	Wear Limit	32.086 mm (1.2632 in.)
Piston Pin-to-Bushing (Dubuque Engines)	Clearance	0.020—0.056 mm (0.0008—0.0022 in.)
	Wear Limit	0.102 mm (0.0040 in.)
Small Piston Pin-to-Bushing (Saran Engines)	Clearance	0.010—0.042 mm (0.0003—0.0016 in.)
Medium Piston Pin-to-Bushing (Saran Engines)	Clearance	0.020—0.056 mm (0.0007—0.0022 in.)
Large Piston Pin-to-Bushing (Saran Engines)	Clearance	0.007—0.043 mm (0.0002—0.0017 in.)
Connecting Rod Small Pin Bore (Bushing Removed)	ID	38.087—38.113 mm (1.4995—1.5005 in.)

Continued on next page

Item	Measurement	Specification
Connecting Rod Large Pin Bore (Bushing Removed)	ID	46.025—46.051 mm (1.8120—1.8130 in.)
Piston Pin-to-Bushing (Tapered Pin-End)	Oil Clearance	0.020—0.056 mm (0.0007—0.0022 in.)
	Wear Limit	0.102 mm (0.0040 in.)
Piston Pin-to-Bushing (Straight Pin-End)	Oil Clearance	0.020—0.056 mm (0.0008—0.0022 in.)
	Wear Limit	0.102 mm (0.0040 in.)
Rod Bearing Bore-to-Piston Pin Bushing Bore (Center-to-Center 3029/4039/6059)	Measurement	180.95—181.05 mm (7.124—7.128 in.)
Rod Bearing Bore-to-Piston Pin Bushing Bore (Center-to-Center 4045/6068)	Measurement	202.95—203.05 mm (7.990—7.994 in.)
Cylinder Block Main Bearing Bore	ID	84.46—84.48 mm (3.325—3.326 in.)
Cylinder Block Main Thrust Bearing	Width	33.62—33.72 mm (1.324—1.328 in.)
Camshaft Follower Bore	ID	31.70—31.75 mm (1.248—1.250 in.)
Camshaft Follower (New)	OD	31.61—31.64 mm (1.245—1.246 in.)
Camshaft Follower-to-Bore	Clearance	0.06—0.13 mm (0.002—0.005 in.)
Camshaft Bearing Bore (Except 3029 and 4039 No. 1 Camshaft Bore)	ID	55.986—56.012 mm (2.2042—2.2052 in.)
Camshaft Bearing Bore (3029 and 4039 No. 1 Bushing Removed)	ID	59.961—59.987 mm (2.3607—2.3617 in.)
Camshaft Bushing (3029 and 4039 No. 1 Bushing Installed)	ID	55.948—56.000 mm (2.2026—2.2047 in.)

Continued on next page

DPSG,OUO1004,486 –19–07NOV98–5/9

Item	Measurement	Specification
Camshaft Journal-to-Bearing Bore (Except 3029 and 4039 No. 1 Journal)	Clearance	0.08—0.13 mm (0.003—0.005 in.)
	Wear Limit	0.15 mm (0.006 in.)
Camshaft Journal-to-Bushing (3029 and 4039 No. 1 Journal)	Clearance	0.05—0.13 mm (0.002—0.005 in.)
	Wear Limit	0.18 mm (0.007 in.)
Balancer Shaft Bore-Standard Bushings (Bushing Removed)[1]	ID	41.26—41.29 mm (1.625—1.626 in.)
Balancer Shaft Bore-Oversize Bushings (Bushing Removed)[2]	ID	43.237—43.263 mm (1.7015—1.7025 in.)
Balancer Shaft Bore	Chamfer	20°—25° x 1.50 mm (0.060 in.)
Balancer Shaft Bushing	ID	38.176—38.237 mm (1.5030—1.5054 in.)
Balancer Shaft Bushing-to-Bore	Oil Clearance	0.016—0.102 mm (0.0006—0.0040 in.)
Cylinder Block Top Deck		
Maximum Acceptable Out-of-Flat, Entire Length or Width (Used)	Measurement	0.08 mm (0.003 in.)
Maximum Acceptable Out-of-Flat (Any 150 mm (5.90 in.) Length)	Measurement	0.025 mm (0.001 in.)
Top Deck Surface Finish (Surface Grind Only) (AA)	Surface Finish	0.0008—0.0032 mm (31—125 micro-in.)
Top Deck Surface Finish Wave Depth	Maximum Depth	0.012 mm (0.0005 in.)

[1]4039 and 4045 (4-cylinder) Engines only.

[2]4039 Engines with one-piece balancer shafts only.

Continued on next page

DPSG,OUO1004,486 –19–07NOV98–6/9

Item	Measurement	Specification
Main Bearing Bore Centerline-to-Cylinder Block Top Deck (3029/4039/6059)	Minimum Distance	301.98 mm (11.889 in.)
Main Bearing Bore Centerline-to-Cylinder Block Top Deck (4045/6068)	Minimum Distance	337.87 mm (13.302 in.)
Cylinder Liner Flange Counterbore Depth in Block	Depth	5.95—5.99 mm (0.234—0.236 in.)
Cylinder Liner Flange	Thickness	6.022—6.058 mm (0.2371—0.2385 in.)
Piston Cooling Orifices	Torque	10.5 N•m (7.7 lb-ft) (93 lb-in.)
Lower Block Bore for Seating Liner (Dubuque Engines)	ID	115.698—115.773 mm (4.555—4.558 in.)
Lower Block Bore for Seating Liner (Saran Engines)	ID	115.748—115.798 mm (4.557—4.559 in.)
Upper Block Bore for Seating Liner	ID	120.70—120.75 mm (4.752—4.754 in.)
OD of Liner at Upper Bore	OD	120.61—120.69 mm (4.7484—4.7516 in.)
OD of Liner at Lower Bore (Dubuque Engines)	OD	115.697—115.733 mm (4.555—4.556 in.)
OD of Production Liner First Class at Lower Bore (Saran Engines —317306)	OD	115.724—115.748 mm (4.556—4.557 in.)
OD of Production Liner Second Class at Lower Bore (Saran Engines —317306)	OD	115.698—115.723 mm (4.555—4.556 in.)
OD of Service Liner at Lower Bore (Saran Engines —317306)	OD	115.724—115.748 mm (4.556—4.557 in.)

Continued on next page

DPSG,OUO1004,486 –19–07NOV98–7/9

Item	Measurement	Specification
OD of Liner at Lower Bore (Saran Engines 317307—)	OD	115.695—115.735 mm (4.555—4.557 in.)
Liner-to-Cylinder Block Clearance at Lower Bore (Dubuque Engines)	Clearance	0.035—0.100 mm (0.001—0.004 in.)
Production Liner First and Second Class-to-Cylinder Block Clearance at Lower Bore (Saran Engines —317306)	Clearance	0.025—0.075 mm (0.001—0.003 in.)
Service Liner-to-Cylinder Block Clearance at Lower Bore (Saran Engines —317306)	Clearance	0.025—0.075 mm (0.000—0.003 in.)
Liner-to-Cylinder Block Clearance at Lower Bore (Saran Engines 317307—)	Clearance	0.015—0.105 mm (0.001—0.004 in.)
Liner-to-Cylinder Block Clearance at Upper Bore	Clearance	0.10—0.14 mm (0.004—0.005 in.)
Cylinder Liner	ID	106.48—106.52 mm (4.192—4.194 in.)
Cylinder Wear	Maximum Wear	0.10 mm (0.004 in.)
Cylinder Taper	Maximum Taper	0.05 mm (0.002 in.)
Cylinder Out-of-Round	Maximum Out-of-Round	0.05 mm (0.002 in.)
Cylinder Liner Height Above Block	Height	0.030—0.100 mm (0.001—0.004 in.)
Cylinder Liner Height Difference At Nearest Point of Two Adjacent Liners, or Within a Single Liner	Maximum Permissable Height Difference	0.05 mm (0.002 in.)
Liner Shims	Thickness	0.05 mm (0.002 in.) and 0.10 mm (0.004 in.)

Continued on next page
DPSG,OUO1004,486 –19–07NOV98–8/9

Item	Measurement	Specification
Piston Protrusion (Above Block Deck) (Using JDG451 or KJD10123 Gauge)	Dimensions	0.08—0.31 mm (0.003—0.012 in.)
Piston Protrusion (Above Block Deck) (Using Magnetic Base Dial Indicator)	Dimensions	0.15—0.38 mm (0.006—0.015 in.)

DPSG,OUO1004,486 –19–07NOV98–9/9

REMOVE PISTONS AND CONNECTING RODS

If engine is to be removed from the machine, 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 coolant and engine oil.

NOTE: If engine is to be completely disassembled, see ENGINE DISASSEMBLY SEQUENCE in Group 04.

2. Remove cylinder head. (See REMOVE CYLINDER HEAD in Group 05.)

3. Remove camshaft followers and keep in order for reassembly in same position.

4. Clean all foreign material from cylinder block top deck.

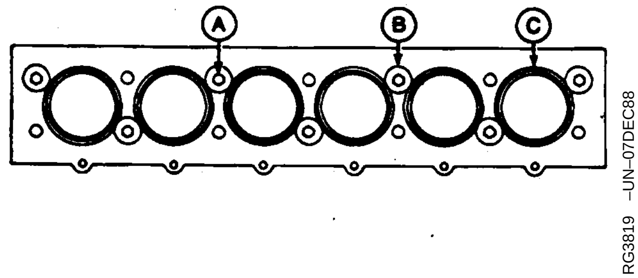
Continued on next page

RG,CTM8,GR10,62 –19–27DEC94–1/5

IMPORTANT: Cap screws and washers must be tightened to the correct specification to achieve an accurate reading when checking liner standout (height above block), as detailed later in this group.

5. Use short cap screws (A) and 3 mm (1/8 in.) thick washers (B) to bolt down cylinder liners (C). Fasten each liner in two locations. Tighten cap screws to 68 N•m (50 lb-ft).

NOTE: Do not rotate crankshaft with cylinder head removed unless liners are fastened down.

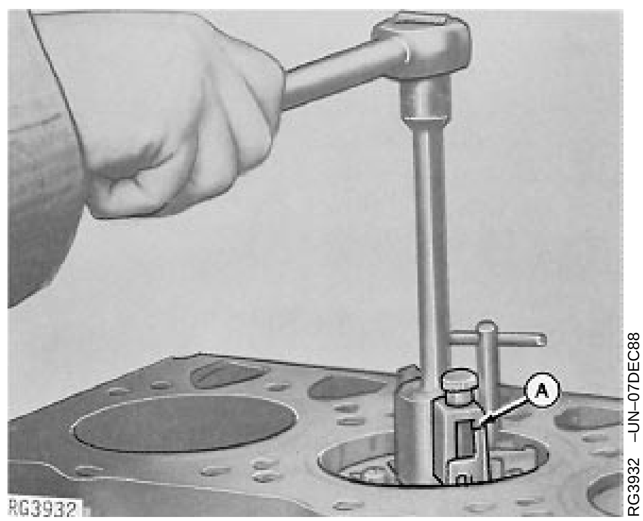


A—Cap Screws
B—Washers
C—Liners

RG,CTM8,GR10,62 –19–27DEC94–2/5

NOTE: Always follow manufacturer's directions provided with ridge reamer.

6. Remove carbon from liner bore with a scraper or reamer (A). Use compressed air to remove loose material from cylinders.



A—Ridge Reamer

Continued on next page RG,CTM8,GR10,62 –19–27DEC94–3/5

7. Remove oil pan, oil pump, and outlet tube. (See Group 20.)

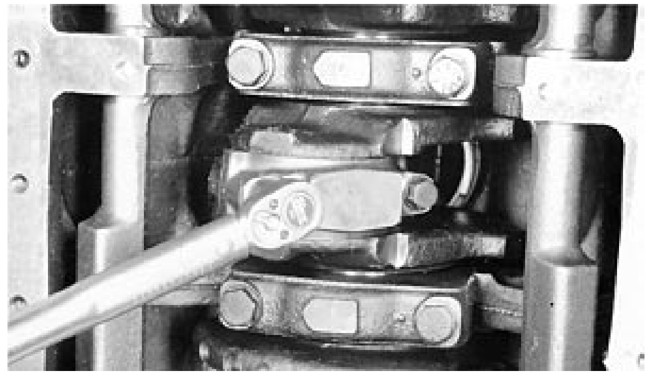
8. Mark rods, pistons, and caps to insure correct assembly in same location.

IMPORTANT: Keep inserts with their respective caps for rod and main bearings.

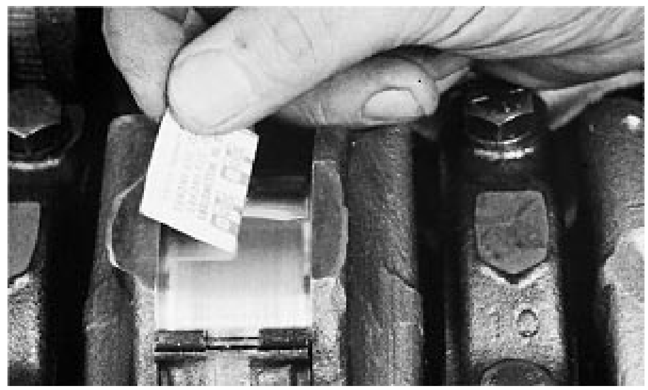
9. Remove all rod caps with bearings.

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.)

NOTE: Use PLASTIGAGE® as directed by the manufacturer. PLASTIGAGE® will determine bearing-to-journal oil clearance, but will not indicate the condition of either surface.



T81615 –UN–07NOV88



RG6405 –UN–21AUG92

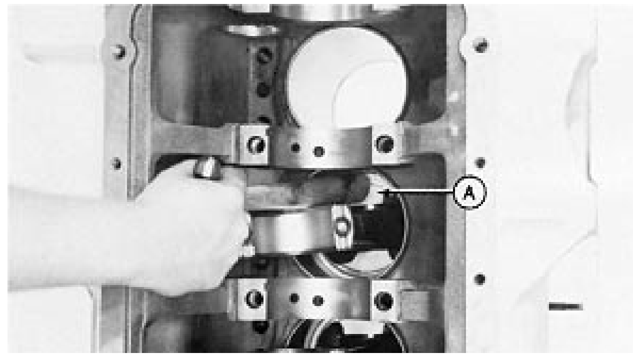
PLASTIGAGE is a registered trademark of the DANA Corp.

Continued on next page

RG,CTM8,GR10,62 –19–27DEC94–4/5

IMPORTANT: Hold on to piston to prevent piston from dropping. Piston will drop once piston rings have cleared cylinder liner.

If liners are to be reused, be extremely careful not to let connecting rod hit liner bore when removing piston and rod assembly.



RG3821 –UN–07DEC88

11. Gently tap piston through top of cylinder block from the bottom.

12. Remove pistons and rods from engine.

13. If piston rings are to be reused, measure piston ring end gap and compare to the following specifications:

**3029DF120/160 (263024—)
3029DLV01 (262109—)
3029DLV02 (291223—)
3029TF120/160 (287526—)
3029TF001/031 (264813—)
3029TLV01 (261581—)—Specification**

End Gap (No. 1 Compression))	0.33—0.58 mm (0.013—0.023 in.)
End Gap (No. 2 Compression)	1.23—1.49 mm (0.048—0.059 in.)
End Gap (No. 3 Oil Control)	0.30—0.56 mm (0.012—0.022 in.)

All Other Saran-Built Engines—Specification

End Gap (No. 1 Compression))	0.35—0.60 mm (0.014—0.024 in.)
End Gap (No. 2 Compression) (Early Engines)	0.33—0.58 mm (0.013—0.023 in.)
End Gap (No. 2 Compression) (Later Engines)	0.75—1.00 mm (0.030—0.039 in.)
End Gap (No. 3 Oil Control)	0.30—0.60 mm (0.012—0.024 in.)

Dubuque-Built Engines—Specification

End Gap (No. 1 Compression))	00.35 mm (0.014 in.)
End Gap (No. 2 Compression)	0.75—1.00 mm (0.029—0.039 in.)
End Gap (No. 3 Oil Control)	0.30—0.60 mm (0.012—0.024 in.)

RG,CTM8,GR10,62 –19–27DEC94–5/5

REMOVE CYLINDER LINERS

IMPORTANT: Cap screws and washers must be tight to achieve an accurate liner height reading.

1. Using D17526CI (or D17527CI) Dial Indicator and JDG451 Gauge (or KJD10123 Gauge), measure height (A) of each liner at 1, 5, 7, and 11 o’clock positions as viewed from rear of engine. Record all measurements.

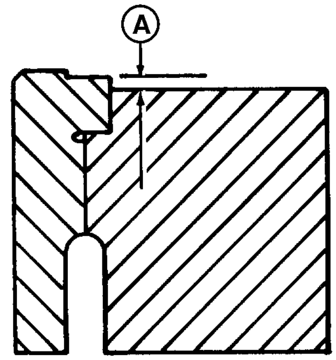
Cylinder Liner Height—Specification

Height above block	0.030—0.100 mm (0.001—0.004 in.)
Maximum permissible difference between readings within one cylinder or between adjacent cylinders	0.05 mm (0.002 in.)

2. Remove cap screws and washers securing liners to cylinder block.

IMPORTANT: DO NOT stamp top of piston. Piston may be damaged.

3. Number cylinder liners and pistons. Stamp front of liner to assure correct assembly. Do not stamp liner flange; stamp on fire dam only.



RG6439 –UN–03NOV97

T81646 –UN–01NOV88

A—Liner Height

Continued on next page

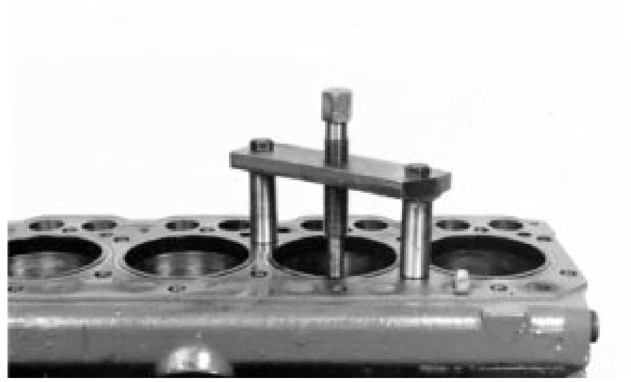
RG,CTM8,GR10,38 –19–18SEP92–1/3

IMPORTANT: Keep matched pistons and liners together. Liners must be reinstalled in same cylinder bore.

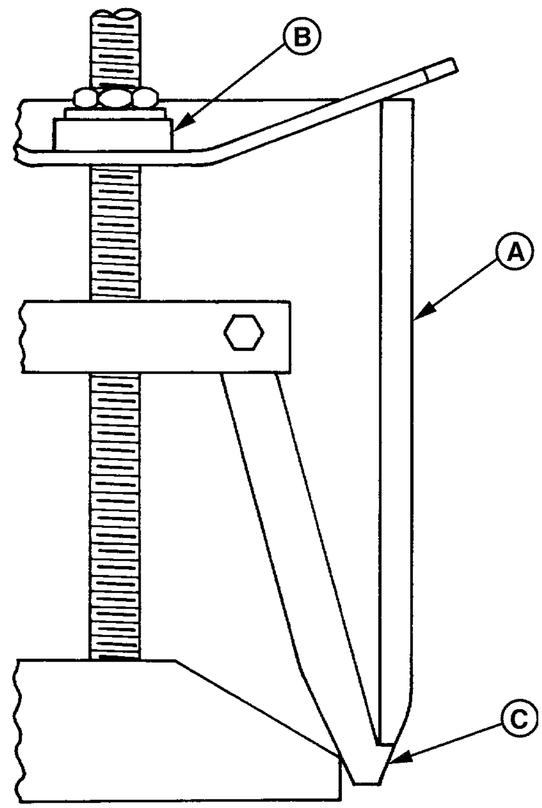
4. Pull liners out of cylinder block with D01062AA, D01073AA, KCD10001 or JDG1145 Puller.

NOTE: If the KCD10001 Puller is used, secure puller with two cylinder head cap screws.

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.



CD6372 –UN–23FEB89



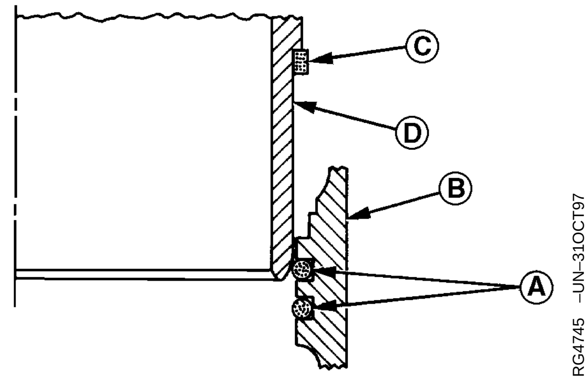
RG1179 –UN–05DEC97

A—Liners
B—Cylinder Liner Puller
C—Jaw

Continued on next page

RG,CTM8,GR10,38 –19–18SEP92–2/3

5. Remove cylinder liner O-rings (A) from grooves in cylinder block (B). Also remove packing (C) from cylinder liner (D).



A—O-Rings
B—Cylinder Block
C—Packing
D—Cylinder Liner

RG,CTM8,GR10,38 –19–18SEP92–3/3

COMPLETE DISASSEMBLY OF CYLINDER BLOCK (IF REQUIRED)

If not previously removed, also remove:

1. Crankshaft pulley (Group 15).
2. Oil pressure regulating plug, valve, and spring in timing gear cover (Group 16).
3. Timing gear cover, timing gears, and camshaft (Group 16).
4. Camshaft bushing (if equipped, Group 16).
5. Balancer shafts and balancer shaft bushings (if equipped, Group 16).
6. Front plate and oil-bypass valve (if equipped, Group 16).
7. Crankshaft and main bearings (Group 15).
8. Piston cooling orifices.
9. Remove water gallery plugs.
10. If necessary to “Hot Tank” the block, also remove screw-in type oil gallery plugs and the engine serial number plate.

CTM8,GR10,6 –19–07JUL92–1/1

PRELIMINARY LINER, PISTON AND ROD CHECKS

Scuffed or Scored Pistons:

- Insufficient lubrication.
- Insufficient cooling.
- Improper piston-to-liner clearance.
- Coolant leakage in 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 break-in.
- Worn piston.
- Contaminated oil.
- Distorted cylinder liner.

Worn or Broken Compression Rings:

- Insufficient lubrication.
- Insufficient cooling.
- Improper ring installation.
- Improper combustion.
- Improper timing.
- Abrasives in combustion chamber.

Clogged Oil Control Ring:

- Improper oil.
- Excessive blow-by.
- Contaminated oil.
- Improper periodic service.
- Low operating temperature.

Dull Satin Finish and Fine Vertical Scratches on Rings:

Dirt and abrasive in air intake system.

Stuck Rings:

- Improper oil classification.
- Improper periodic service.
- Poor operating conditions.
- Coolant leakage in crankcase.
- Excessive cylinder liner taper.

Cylinder Liner Wear and Distortion:

- Incorrectly installed compression rings.
- Insufficient lubrication.
- Uneven cooling around liner.
- Improper piston-to-liner clearance.
- Liner bore damage.

Warped Cylinder Block:

Insufficient cooling.

Broken Connecting Rod:

- Inadequate piston-to-liner clearance.
- Worn connecting rod bearing.
- Distorted cylinder liner.
- Piston pin failure.

Piston Pin and Snap Ring Failure:

- Misaligned connecting rod.
- Excessive crankshaft end play.
- Incorrect snap rings.

Mottled, Grayish or Pitted Compression Rings:

Internal coolant leaks.

CTM8,GR10,37 –19–17AUG94–1/1

DISASSEMBLE PISTON AND ROD ASSEMBLY

IMPORTANT: Do NOT reuse piston rings.

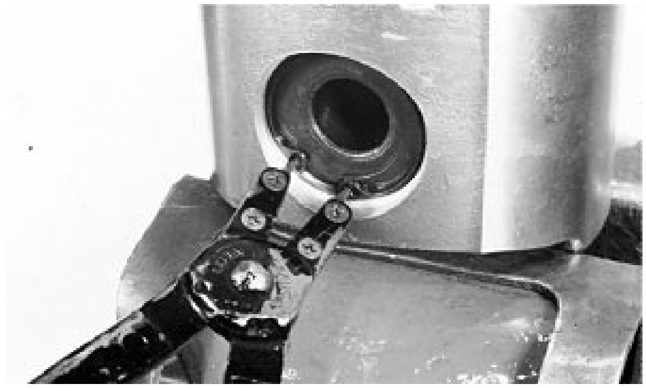
1. Remove piston rings using the JDE85 or JDE135 Piston Ring Expander.

RG5622 –UN–28MAR90

CTM8,GR10,25 –19–29SEP94–1/2

2. Remove and discard piston pin snap rings.

3. Separate piston and rod. Keep these parts in place with their respective cylinder liner.



RG5623 –UN–28MAR90

CTM8,GR10,25 –19–29SEP94–2/2

CLEAN PISTONS

CAUTION: Always follow manufacturer's instructions, and safety steps exactly.

1. 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.

2. 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 to loosen carbon residue. Dry with compressed air.

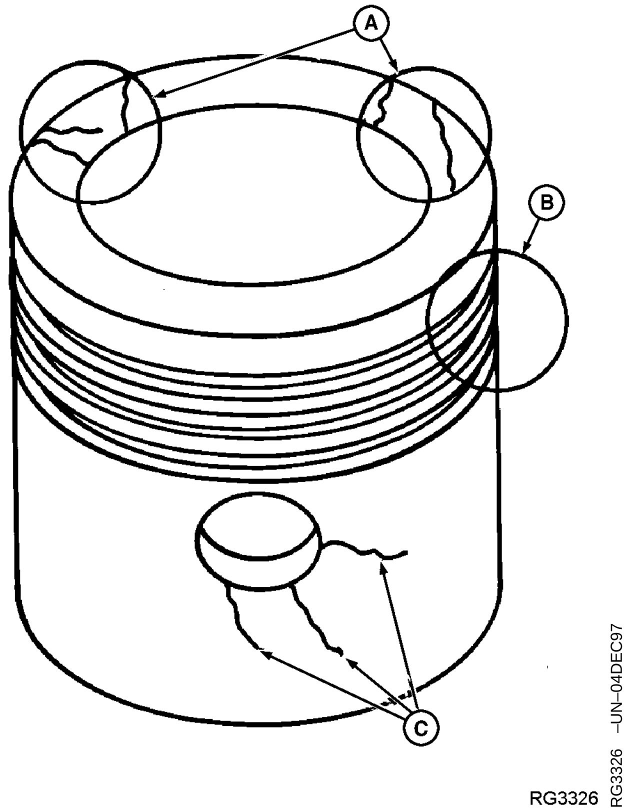
CTM8,GR10,31 –19–27DEC94–1/1

VISUALLY INSPECT PISTONS

1. Carefully inspect pistons under magnification. Check for:

   - signs of fatigue;
   - fine cracks in the piston head (A);
   - bent or broken ring lands (B);
   - cracks in the skirt (C) at inner and outer ends of piston pin bore;
   - excessive piston skirt wear. (Original machining marks must be visible.)

   If any imperfections are found, replace the piston and liner as a set.



(Imperfections Exaggerated)

A—Piston Head
B—Ring Lands
C—Piston Pin Bore

Continued on next page

CTM8,GR10,33 –19–29SEP94–1/2

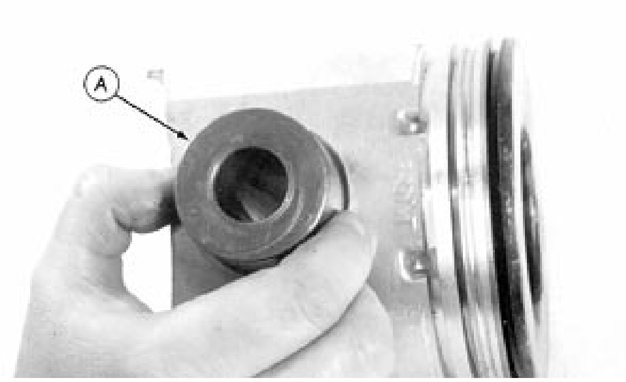
2. Visually inspect piston pin. Pin must be in good condition with no visible wear.

3. Dip piston pin in clean engine oil.

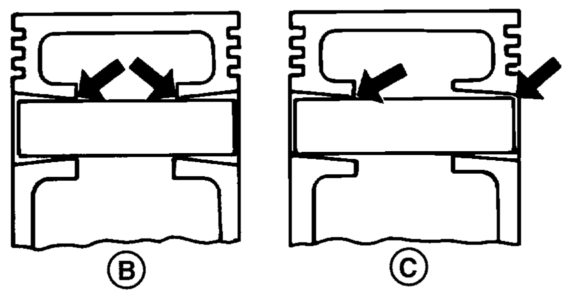
4. Install pin (A) through piston. Pin should pass through piston using only light thumb pressure.

5. Insert pin from both sides. If pin enters freely, but binds in the center, the bore could be tapered (B).

   Insert pin to check for bore alignment (C). Pin should not "click" or need to be forced into bore on opposite side.



RG5626 –UN–28MAR90



RG4747 –UN–31OCT97

A—Piston Pin
B—Tapered Bore
C—Bore Alignment

CTM8,GR10,33 –19–29SEP94–2/2

CLEAN CYLINDER LINERS

1. Use a stiff bristle brush to remove all debris, rust, and scale from O.D. 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 solvents to clean liners. Solvents will not remove all abrasives from liner walls.

2. Thoroughly clean liner I.D. 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 often as necessary with clean SAE 10W oil. Clean liner until a clean, white rag shows no discoloration.

CTM8,GR10,32 –19–16SEP92–1/1

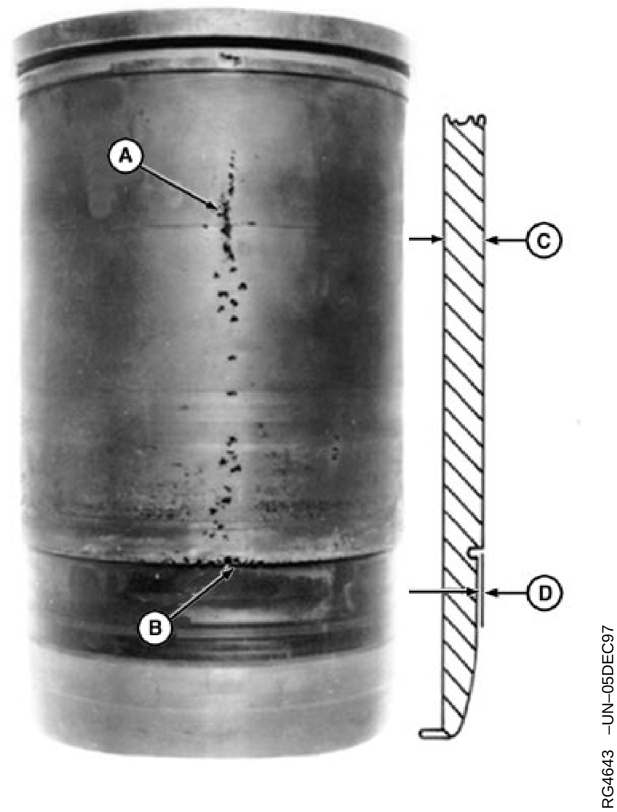
VISUALLY INSPECT CYLINDER LINERS

IMPORTANT: If liner pitting has occurred, check condition of coolant.

NOTE: When installing reusable liners, rotate 90° from original position. The liners should be deglazed and ring sets installed in pistons.

1. Inspect exterior length of liner for pitting (A). Check packing step for erosion (B). If pitting or erosion is observed, measure depth of pits with a fine wire or needle. Replace piston and liner if:

   - Depth of any pit is one-half or more of liner thickness (C).
   - Depth of erosion is one-half or more of the packing step (D).



A—Liner Pitting
B—Liner Erosion
C—Liner Thickness
D—Packing Step

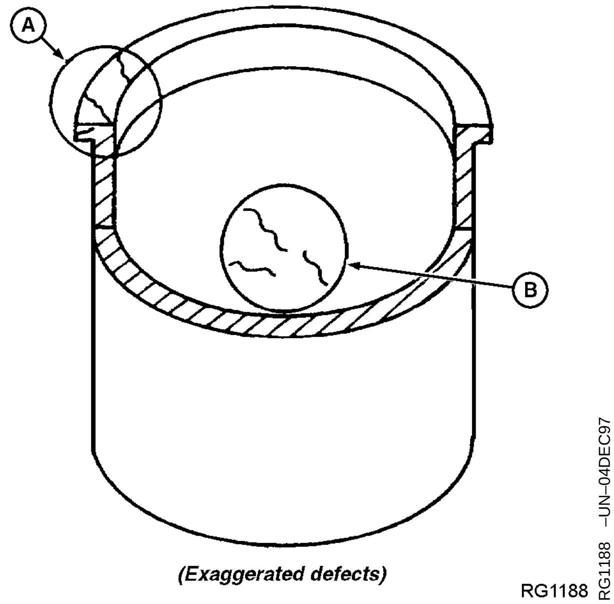
Continued on next page DPSG,OUO1004,278 –19–21JUL98–1/2

2. Visually inspect liner ID. Replace piston and liner if:

   - The crosshatch honing pattern is not visible immediately below the top ring turn-around area for turbocharged engines.
   - The hone pattern is not visible all the way around the liner in over 75 percent of the ring travel area for naturally aspirated engines.
   - 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.)



Cylinder Liner (Exaggerated Defects)

A—Flange Area
B—Ring Travel Area

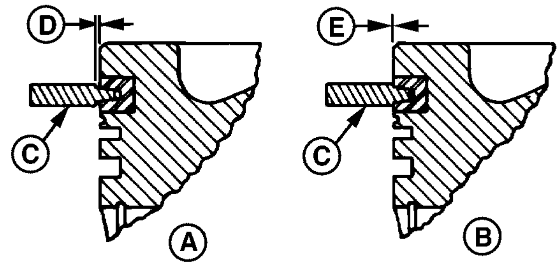
DPSG,OUO1004,278 –19–21JUL98–2/2

CHECK PISTON RING GROOVE WEAR

1. Use the JDE62 Ring Groove Wear Gauge (C) to check wear of keystone ring groove (top groove). Gauge shoulders should not contact ring land. Clearance (D) between shoulders of tool and ring land indicate ring groove is good.

   If ring groove is worn, replace piston and liner as a matched set. If ring groove is good, proceed to next step.

RG5624 –UN–28MAR90



RG9059 –UN–16MAR98

A—Piston With Good Keystone Ring Groove
B—Piston With Worn Keystone Ring Groove
C—JDE62 Gauge
D—Tool Shoulder-to-Ring Land Clearance-Normal
E—No Clearance-Replace

CTM8,GR10,23 –19–29SEP94–1/2

2. Check second and third ring grooves using a new piston ring and a feeler gauge.

   Replace piston if clearance exceeds specification.

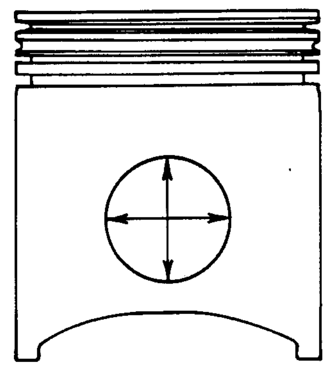
Piston Ring-to-Groove Clearance—New Piston Ring (Second and Third Ring Grooves)—Specification

Maximum Clearance.. 0.20 mm (0.008 in.)

RG5625 –UN–28MAR90

CTM8,GR10,23 –19–29SEP94–2/2

MEASURE PISTON PIN BORE



Measure piston pin bore. If bore is not within specifications, replace piston and liner set.

Piston Pin Bore (Small Pin)—Specification

ID .... 34.93—34.94 mm (1.375—1.376 in.)

Piston Pin Bore (Large Pin)—Specification

ID .... 41.29—41.30 mm (1.625—1.626 in.)

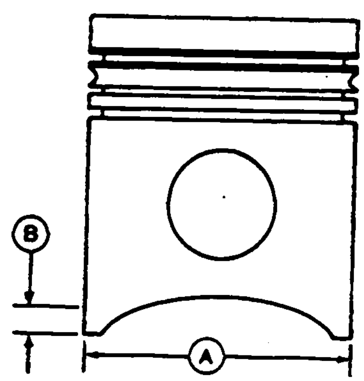
Piston Pin Bore (Later 3029D)—Specification

ID ....32.003—32.013 mm (1.256—1.260 in.)

NOTE: Some piston pin bores are elliptical, the width being 0.038 mm (0.0015 in.) larger than the bore specifications.

RG,CTM8,GR10,41 –19–27DEC94–1/1

MEASURE PISTON SKIRT



A—Piston Skirt
B—Measurement Area

1. Measure piston skirt (A) 90° to piston pin bore and 19 mm (0.74 in.) from bottom of piston (B). Record measurement.

2. Measure cylinder liner as directed later in this group and compare with piston measurement.

Piston Skirt (Measurement taken bottom of skirt 19 mm (0.74 in.) from bottom of piston)—Specification

Diameter..106.38—106.40 mm (4.188—4.189 in.)

RG,CTM8,DX348 –19–08FEB95–1/1

MEASURE PISTON HEIGHT

Measure piston height from center of piston pin bore-to-top of piston.

Piston (3029, 4039, 6059 Engines)—Specification

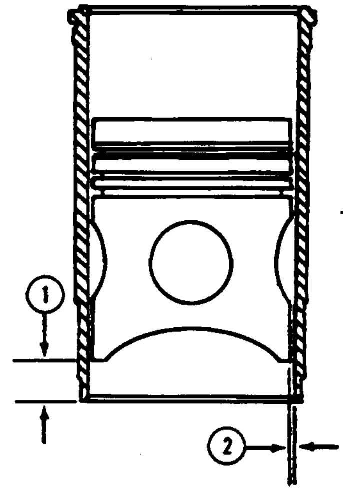
Height (Measured From Center of Pin Bore to Top of Piston) .... 66.27—66.33 mm (2.609—2.611 in.)

Piston (4045 and 6068 Engines)—Specification

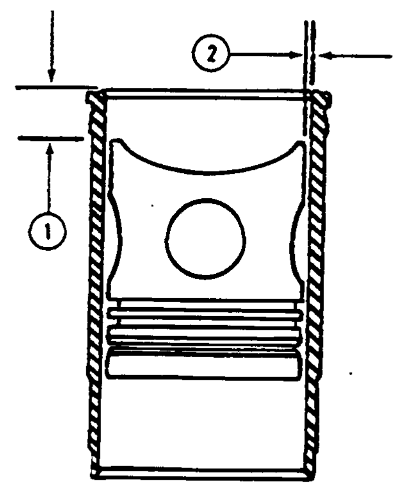
Height (Measured From Center of Pin Bore to Top of Piston) .... 71.64—71.70 mm (2.820—2.823 in.)

DPSG,OUO1004,279 –19–21JUL98–1/1

DETERMINE PISTON-TO-LINER CLEARANCE



T71624 –UN–25OCT88



T71625 –UN–25OCT88

1. Put piston (without rings) in matched liner with piston “front” and liner “front”[1] aligned. Move piston down until bottom edge of piston skirt is 25.4 mm (1.00 in.) (1) from bottom of liner. Use a feeler gauge to measure clearance (2) between piston skirt and liner 90° to pin bore. Record the measured clearance.

2. Turn piston 90° in liner. Measure clearance between piston skirt and liner 90° to pin bore. Record the clearance.

3. Put piston upside down in liner with piston “front” and liner “front” aligned. Move piston so bottom edge of piston skirt is 25.4 mm (1.00 in.) (1) below top of liner. Measure clearance (2) between piston skirt and liner at 90° to pin bore. Record the clearance.

4. Turn piston 90° in liner. Measure clearance between piston skirt and liner 90° to pin bore. Record the clearance.

5. The difference between clearances in Steps 1 and 2 is the amount liner is out-of-round at bottom of the liner.

6. The difference between clearances in Steps 3 and 4 is the amount liner is out-of-round at top of the liner.

7. The difference between clearances in Steps 1 and 3 is the amount liner is tapered.

Piston-to-Liner Clearance: (Measured at Bottom of Piston Skirt) (Naturally Aspirated Engines)—Specification

Clearance .... 0.08—0.14 mm (0.003—0.005 in.)

Piston-to-Liner Clearance: (Measured at Bottom of Piston Skirt) (Turbocharged Engines)—Specification

Clearance .... 0.08—0.15 mm (0.003—0.006 in.)

[1] *As marked during liner removal from engine.*

Continued on next page

RG,CTM8,GR10,42 –19–27DEC94–1/2

Cylinder Liner Out-Of-Round (Top or Bottom)—Specification

Maximum Out-of-Round .... 0.05 mm (0.002 in.)

Cylinder Liner Taper—Specification

Maximum Taper... 0.05 mm (0.002 in.)

8. If cylinder liner geometry is not within specifications, replace piston and liner set.

RG,CTM8,GR10,42 –19–27DEC94–2/2

DEGLAZE CYLINDER LINERS

1. Secure cylinder liner in a holding fixture. (See Dealer Fabricated Tools, Group 199 for assembly of holding fixture.)

2. Use D17004BR Flexible Cylinder Hone to deglaze cylinder liner.

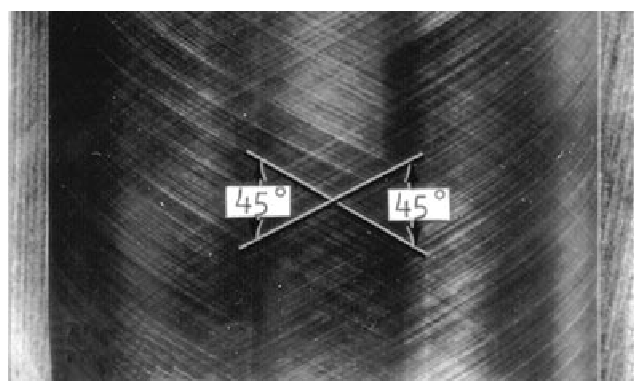
NOTE: Use honing oil along with flex hone when deglazing liners.

RGR26164 –UN–11DEC97

S11,0402,AS –19–08FEB95–1/2

3. Use D17004BR Hone according to instructions supplied with tool to obtain a 45° cross-hatch pattern.

   Thoroughly clean liners after deglazing. See CLEAN CYLINDER LINERS earlier in this group.



RGR26165 –UN–11DEC97

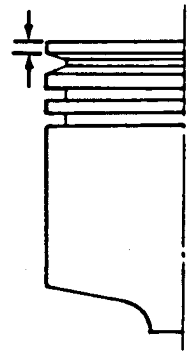
S11,0402,AS –19–08FEB95–2/2

REPLACE PISTON AND LINER SETS

IMPORTANT: ALWAYS install a new (matched set) liner when replacing a piston.

Do not stamp top of 4 mm (0.158 in.) high ring piston. Piston may be damaged.

Mark matched piston and liner for placement in the same cylinder location.



RG5615 –UN–10MAR90

CTM8,GR10,9 –19–16SEP92–1/1

INSPECT AND MEASURE CONNECTING ROD BEARINGS (RODS REMOVED FROM ENGINE)

Inspect rod bearings for damage or wear.

1. Measure crankshaft rod journal OD at several points.

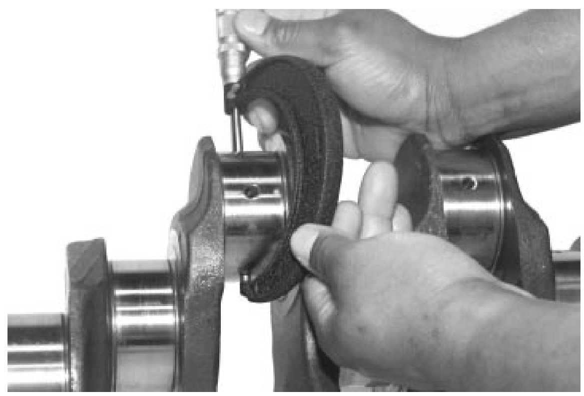
Crankshaft Journal (3029/4039/6059)—Specification

OD .... 69.799—69.825 mm (2.7479—2.7490 in.)

Crankshaft Journal (4045/6068)—Specification

OD .... 77.800—77.826 mm (3.0629—3.0640 in.)

2. Assemble connecting rod, cap, and bearings with OLD cap screws. Tighten cap screws to 56 N•m (41 lb-ft) on 3029 4039 and 6059 engines, and to 68 N•m (50 lb-ft) on 4045 and 6068 engines. Tighten cap screw an additional 90—100°. (See TORQUE-TURN CONNECTING ROD CAP SCREWS later in this group.)



RG7471 –UN–23NOV97

Continued on next page

CTM8,GR10,11 –19–09FEB95–1/2

3. Measure assembled rod bearing ID.

T81598 –UN–07NOV88

Assembled Rod Bearing (3029/4039/6059)—Specification

ID .... 69.850—69.901 mm (2.7499—2.7520 in.)

Assembled Rod Bearing (4045/6068)—Specification

ID .... 77.876—77.927 mm (3.0659—3.0679 in.)

4. Subtract crankshaft journal OD from rod bearing ID to determine oil clearance. Replace bearings if out of specifications.

Connecting Rod Bearing-to-Journal (New Parts 3029/4039/6059)—Specification

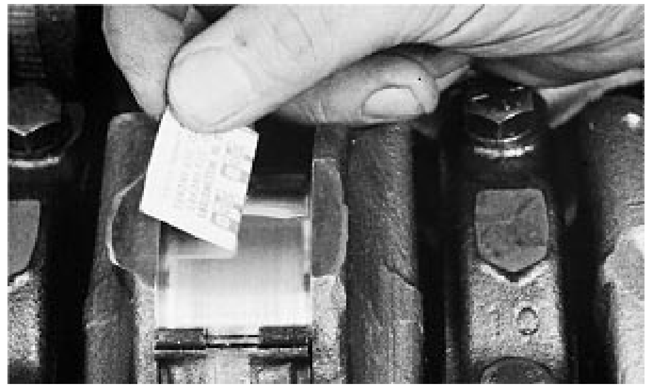
Oil Clearance.. 0.025—0.102 mm (0.0012—0.0040 in.)
Wear Limit .... 0.152 mm (0.0600 in.)

Connecting Rod Bearing-to-Journal (New Parts 4045/6068)—Specification

Oil Clearance.. 0.050—0.127 mm (0.0020—0.0050 in.)
Wear Limit .... 0.152 mm (0.0600 in.)

CTM8,GR10,11 –19–09FEB95–2/2

INSPECT AND MEASURE CONNECTING ROD BEARINGS (ROD AND CRANKSHAFT IN ENGINE)



RG6405 –UN–21AUG92

IMPORTANT: Use hand wrenches. Pneumatic wrenches may cause thread damage.

NOTE: Use PLASTIGAGE® as directed by manufacturer. PLASTIGAGE® will determine oil clearance, but will not indicate condition of either surface.

1. Remove rod cap. Place a piece of PLASTIGAGE® in center of bearing. Install rod cap using OLD cap screws. Tighten cap screws to 55 N•m (40 lb-ft) on 3029, 4039 and 6059 engines and 68 N•m (50 lb-ft) on 4045 and 6068 engines. Tighten cap screw an additional 90—100°. (See TORQUE-TURN CONNECTING ROD CAP SCREWS later in this group.)

2. Remove rod cap. Compare width of PLASTIGAGE® with scale provided on package to determine clearance. Replace bearings if oil clearance is out of specification.

PLASTIGAGE is a registered trademark of the DANA Corp.

DPSG,OUO1004,280 –19–21JUL98–1/1

INSPECT ROD AND CAP

1. Inspect rod and cap for wear or damage, such as chips or cracks in the joint area.

IMPORTANT: Do not nick the joint surfaces of the rod and cap.

2. Inspect in and around cap screw holes in cap. If any imperfections are found, replace rod and cap.

3. Carefully clamp rod in a soft-jawed vise (cap end upward).

IMPORTANT: Never use new connecting rod cap screws when checking rod bore ID. Use new cap screws only for final assembly of connecting rods.

4. Install cap WITHOUT bearing inserts. Use old cap screws.

5. Tighten cap screws to specified torque.

Connecting Rod Cap Screws (3029/4039/6059)—Specification

Initial Torque.. 55 N•m (40 lb-ft)

Connecting Rod Cap Screws (3029/4039/6059)—Specification

Torque Turn..1/4 Turn (90—100°) After Initial Torque

Connecting Rod Cap Screws (4045/6068)—Specification

Initial Torque.. 68 N•m (50 lb-ft)

Connecting Rod Cap Screws (4045/6068)—Specification

Torque Turn..1/4 Turn (90—100°) After Initial Torque

(See TORQUE-TURN CONNECTING ROD CAP SCREWS later in this gruop.)

Continued on next page S11,2010,GV –19–29SEP94–1/2

6. Using an inside micrometer, measure rod bore at center of bore and record measurements as follows:

   - At right angle to rod-to-cap joint.
   - At 45 degrees left of measurement step “A”.
   - At 45 degrees right of measurement step “A”.

7. Compare measurements to specifications.

Connecting Rod Bore (Without Bearing Inserts 3029/4039/6059)—Specification

ID .... 73.660—73.686 mm (2.9000—2.9010 in.)

Connecting Rod Bore (Without Bearing Inserts 4045/6068)—Specification

ID .... 82.677—82.703 mm (3.2550—3.2560 in.)

Connecting Rod Bore—Specification

Maximum Permissible Out-of-Round .... 0.038 mm (0.0015 in.)

8. If difference between the greatest and least measurement exceeds out-of-round specification, replace connecting rod.

S11,2010,GV –19–29SEP94–2/2

INSPECT PISTON PINS AND BUSHINGS

T81604 –UN–07NOV88

1. Inspect piston pin for general overall condition. Replace pin if it shows signs of fretting.

IMPORTANT: Do not attempt to polish or refinish piston pin. Pin has a highly polished surface.

2. Measure pin OD. Replace if not within specifications.

Piston Pin (Small)—Specification

OD .... 34.920—34.930 mm (1.3748—1.3752 in.)
Wear Limit .... 34.907 mm (1.3743 in.)

Piston Pin (Large)—Specification

OD .... 41.270—41.280 mm (1.6248—1.6252 in.)
Wear Limit .... 41.257 mm (1.6243 in.)

Piston Pin (Later 3029D)—Specification

OD .... 31.994—32.000 mm (1.2596—1.2598 in.)
Wear Limit .... 31.981 mm (1.2591 in.)

Piston Pin (All Except 3029)—Specification

Length.......... 84.05—84.45 mm (3.309—3.325 in.)

Piston Pin
3029DF120/160 (—263023)
3029DLV01 (—262108)
3029DLV02 (—291222)
3029TF120/160
3029TF001/031 (—264812)
3029TLV01—Specification

Length.......... 71.61—72.01 mm (2.819—2.835 in.)

Piston Pin
3029DF120/160 (263024—)
3029DLV01 (262109—)
3029DLV02 (291223—)
3029TF001/031 (264813—)
—Specification

Length.......... 79.80—80.20 mm (3.14—3.16 in.)

Continued on next page

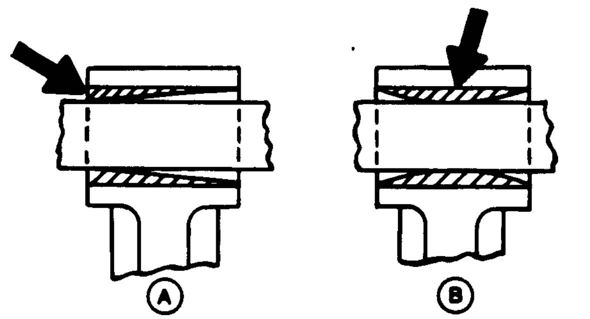
RG,CTM8,GR10,44 –19–11OCT94–1/3

3. Inspect piston pin bushing for damage or excessive wear. Lubrication hole must be open.

4. Measure pin bushing ID and pin OD to determine oil clearance.

5. 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).


T81605 –UN–07NOV88



RG5595 –UN–01NOV89

A—Tapered Bore
B—Bell Mouthed Bore

Piston Pin Bushing Installed (Small Pin)—Specification

ID .... 34.950—34.976 mm (1.3760—1.3770 in.)
Wear Limit .... 35.026 mm (1.3790 in.)

Piston Pin Bushing Installed (Large Pin)—Specification

ID .... 41.300—41.326 mm (1.6260—1.6270 in.)
Wear Limit .... 41.376 mm (1.6290 in.)

Piston Pin Bushing Installed (Later 3029D)—Specification

ID .... 32.010—32.036 mm (1.2602—1.2612 in.)
Wear Limit .... 32.086 mm (1.2632 in.)

Piston Pin-to-Bushing (Dubuque Engines)—Specification

Clearance .... 0.020—0.056 mm (0.0008—0.0022 in.)
Wear Limit .... 0.102 mm (0.0040 in.)

Small Piston Pin-to-Bushing (Saran Engines)—Specification

Clearance .... 0.010—0.042 mm (0.0003—0.0016 in.)

Medium Piston Pin-to-Bushing (Saran Engines)—Specification

Clearance .... 0.020—0.056 mm (0.0007—0.0022 in.)

Large Piston Pin-to-Bushing (Saran Engines)—Specification

Clearance .... 0.007—0.043 mm (0.0002—0.0017 in.)

Continued on next page

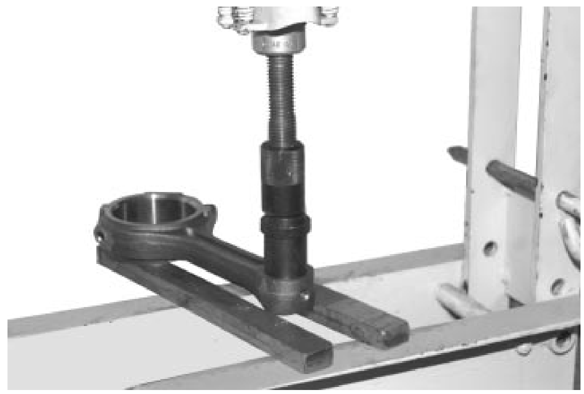
NOTE: Saran-built 3029D engines are equipped with straight pin-end connecting rods while 3029T engines have tapered pin-end rods.

If the diameter or clearances are more than specified, replace connecting rod bushing on 3029T engines and replace connecting rod/piston pin assembly on 3029D engines.

RG,CTM8,GR10,44 –19–11OCT94–3/3

REMOVE PISTON PIN BUSHING

REMOVING PISTON PIN BUSHING ON STRAIGHT PIN-END ROD



RG7476 –UN–23NOV97

Straight Pin-End Rod

1. Use JD286 Driver for 41 mm (1.6 in.) pin, or JDE88 Driver for 35 mm (1.3 in.) pin to remove bushing.

IMPORTANT: If bushing is heavily worn, the driver may contact the I.D. of the rod bore. Be careful not to damage the rod bore.

2. Clean, inspect, and measure I.D. of rod pin bore, as described later in this group.

Continued on next page RG,CTM8,DX172 –19–27DEC94–1/2

10
42

REMOVING PISTON PIN BUSHING ON TAPERED PIN-END ROD

JDG738 contains drivers and cups for removing and installing both large and small tapered rod pin bushings. Tool numbers in parenthesis are for the smaller 1-3/8 in. I.D. bushing. The large bushing is approximately 1-5/8 in. I.D.

1. Select correct Driver JDG738-1 (-4) (A) and Receiver Cup JDG738-3A (-6A) (B) to remove bushing (C). Remove pilot ring from the driver, if installed.

2. Slide driver into one side of rod bushing. Turn driver until taper on driver flange matches up with taper on the bushing.

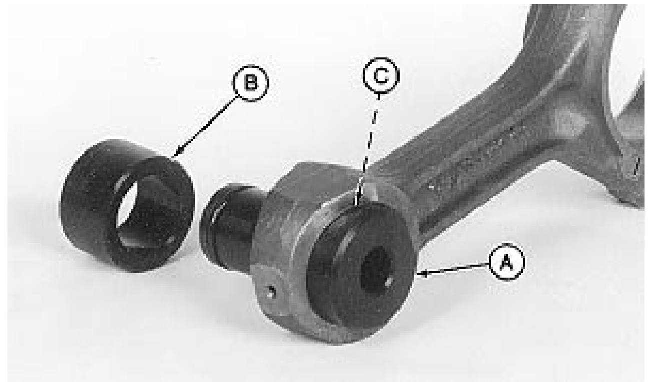
3. Install receiver cup onto opposite side of rod bushing. Taper of cup should match up with taper of rod when oil hole in end of rod is aligned with mark on O.D. of cup.

NOTE: Stud in cup keeps rod properly located on the cup. Use JDG738-2 (-5) Pilot Ring as a hollow spacer when pressing bushing out of rod.

4. Using hydraulic press, press bushing out of the rod until driver and bushing fall into receiver cup.

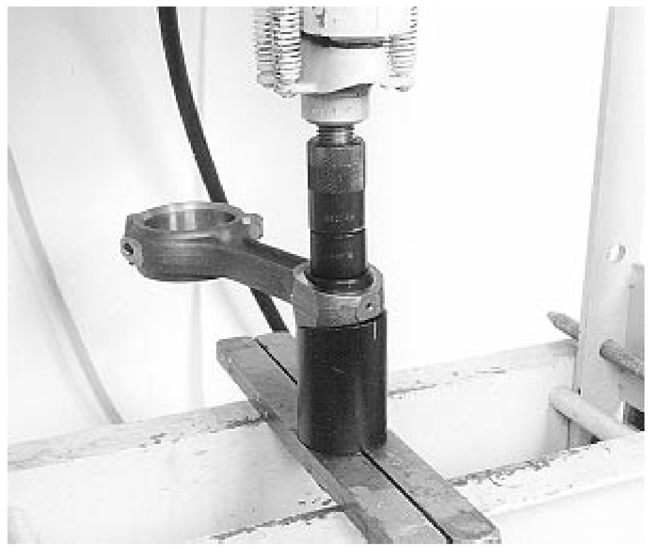
IMPORTANT: If bushing is heavily worn, the driver may contact the I.D. of the rod bore. Be careful not to damage the rod bore.

5. Clean, inspect, and measure I.D. of rod pin bore, as described later in this group.



RG7130 –UN–10OCT94

Tapered Pin-End

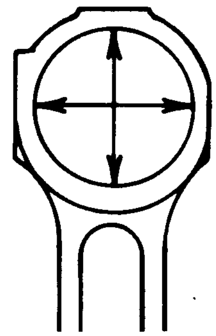


RG7131 –UN–10OCT94

A—JDG738-1 Driver
B—JDG738-3A Receiver Cup
C—Bushing

RG,CTM8,DX172 –19–27DEC94–2/2

CLEAN AND INSPECT CONNECTING ROD PIN BORE



RG6273 –UN–03AUG92

1. Clean bore of rod with medium grit emery cloth.

2. Inspect for cracks or other damage. Make sure that lube oil hole in top of rod is open.

IMPORTANT: If bushing has spun in rod, replace connecting rod.

3. Measure bore diameter in two places, 90° apart. Replace rod if not within specification.

Connecting Rod Small Pin Bore (Bushing Removed)—Specification

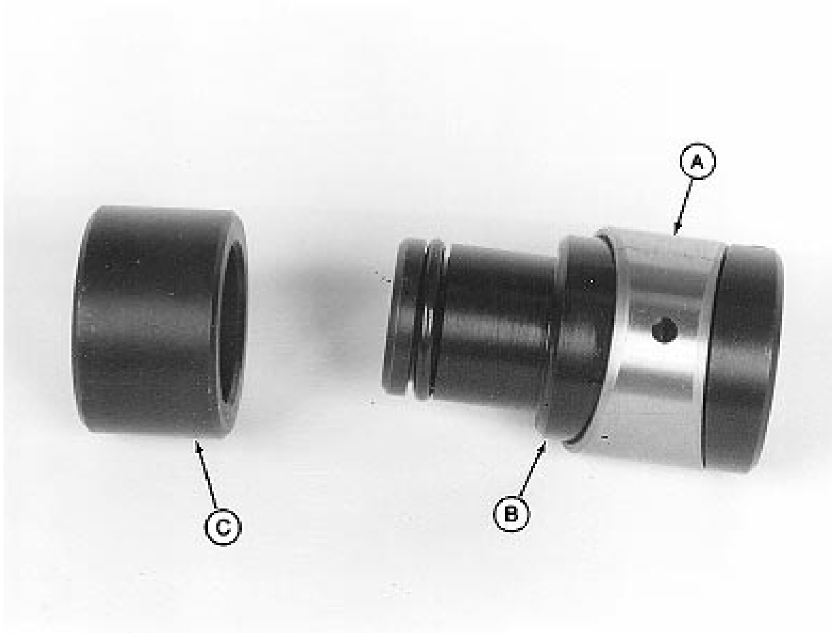
ID .... 38.087—38.113 mm (1.4995—1.5005 in.)

Connecting Rod Large Pin Bore (Bushing Removed)—Specification

ID .... 46.025—46.051 mm (1.8120—1.8130 in.)

RG,CTM8,GR10,60 –19–16SEP92–1/1

INSTALL PISTON PIN BUSHING IN CONNECTING ROD



RG7132 –UN–10OCT94

INSTALLING PISTON PIN BUSHING IN TAPERED PIN-END ROD

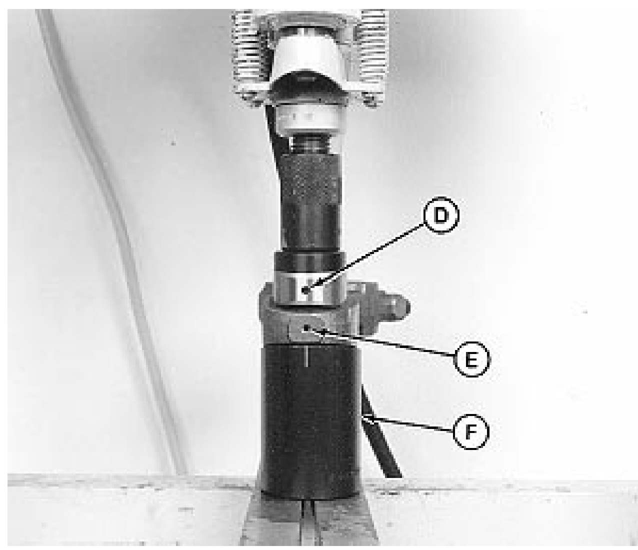
1. Carefully file a slight chamfer on edge of rod pin bore. Remove any burrs or sharp edges from edge of bushing bore.

NOTE: JDG738 contains drivers and cups for removing and installing both large and small tapered rod pin bushings. Tool numbers in parenthesis are for the smaller 1-3/8 in. I.D. bushing. The large bushing is approximately 1-5/8 in. I.D.

2. Slide bushing (A) onto JDG738-1 (-4) Driver (B) and install JDG738-2 (-5) Pilot Ring (C) onto O-ring end of driver. Apply clean engine oil or grease to O.D. of new bushing, O.D. of pilot ring, and I.D. of rod pin bore.

3. Insert driver into rod pin bore so pilot ring pilots in rod bore, and bushing taper aligns with taper on driver flange. Align oil hole in bushing (D) with oil hole in end of rod (E).

4. Install JDG738-3 Receiver Cup (F) onto the opposite side of rod so oil hole in end of rod is aligned with mark of O.D. of cup.



RG7236 –UN–10OCT94

A—Bushing
B—JDG738-1 (-4) Driver
C—JDG738-2 (-5) Pilot Ring
D—Oil Hole (Bushing)
E—Oil Hole (Rod)
F—JDG738-3 Receiver Cup

Continued on next page

RG,CTM8,DX173 –19–27DEC94–1/3

5. Press bushing into rod pin bore until edge of bushing is flush or just slightly below machined surface on face of rod.

IMPORTANT: Oil holes MUST be aligned. If holes are not aligned, remove and discard bushing. Install a new bushing. DO NOT attempt to reuse a bushing.

6. Remove rod from press. Bushing should be centered in the bore, and oil holes must be aligned.

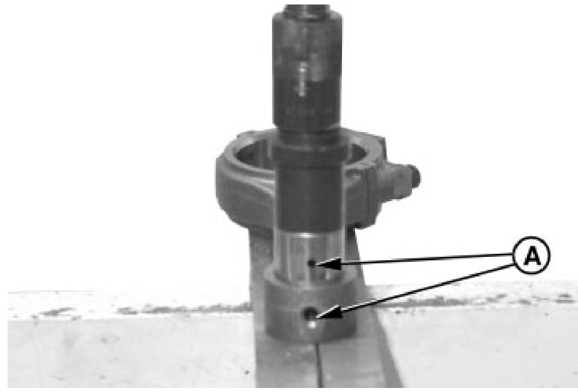
7. I.D. of bushing must be machined by a specialized machine shop to proper size as specified.

Piston Pin-to-Bushing (Tapered Pin-End)—Specification

Oil Clearance	0.020—0.056 mm (0.0007—0.0022 in.)
Wear Limit	0.102 mm (0.0040 in.)

Continued on next page RG,CTM8,DX173 –19–27DEC94–2/3

INSTALLING PISTON PIN BUSHING IN STRAIGHT PIN-END ROD



A—Oil Holes

1. Carefully file a slight chamfer on edge of rod pin bore. Remove any burrs or sharp edges from edge of bushing bore.

2. Use JD286 Driver for 41 mm (1.6 in.) pin or JDE88 Driver for 35 mm (1.3 in.) pin to install bushing.

3. Press bushing into rod bore until edge of bushing is flush or just slightly below machined surface on face of rod.

IMPORTANT: Oil holes (A) MUST be aligned. If holes are not aligned, remove and discard bushing. Install a new bushing. DO NOT attempt to reuse the bushing. Install bushing in rod.

4. Remove rod from press.

5. Check bushing to insure it is centered in bore with oil holes aligned.

6. I.D. of new bushing must be precision bored by specialized machine shop to specifications.

Piston Pin-to-Bushing (Straight Pin-End)—Specification

Oil Clearance	0.020—0.056 mm (0.0008—0.0022 in.)
Wear Limit	0.102 mm (0.0040 in.)

RG,CTM8,DX173 –19–27DEC94–3/3

MEASURE ROD CENTER-TO-CENTER BORES

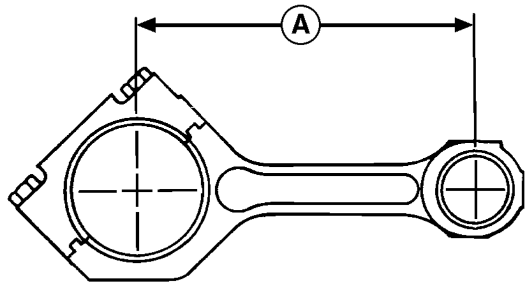
Measure rod center-to-center bores (A) (with bushings removed). Compare to specifications given below. Replace rod if necessary.

Rod Bearing Bore-to-Piston Pin Bushing Bore (Center-to-Center 3029/4039/6059)—Specification

Measurement..180.95—181.05 mm (7.124—7.128 in.)

Rod Bearing Bore-to-Piston Pin Bushing Bore (Center-to-Center 4045/6068)—Specification

Measurement..202.95—203.05 mm (7.990—7.994 in.)



A—Center-to Center Measurement

DPSG,OUO1004,291 –19–23JUL98–1/1

INSPECT AND CLEAN CYLINDER BLOCK

1. Remove all components (including piston cooling orifices, soft plugs and oil gallery plugs) before inspecting and cleaning cylinder block.

IMPORTANT: If block is cleaned in a hot tank, be sure to remove any aluminum parts (such as nameplates). Aluminum parts can be damaged or destroyed by hot tank solutions.

2. Clean block thoroughly using cleaning solvent, pressure steam, or a hot tank.

3. All passages and crevices must be clear of sludge, and grease.

4. All coolant passages must be clear of lime deposits and scale.

Continued on next page

S11,2010,HD –19–07JUL92–1/2

5. Be sure liner support flange (A) is free of any burrs. LIGHTLY file burrs with a small half-moon file. File in a circular motion at approximately a 60° angle. DO NOT let file hit top of cylinder block while filing.

IMPORTANT: DO NOT file liner support flange excessively. Excess filing can damage liner support flange and allow an improper liner fit. Thoroughly clean all filings from cylinder block.

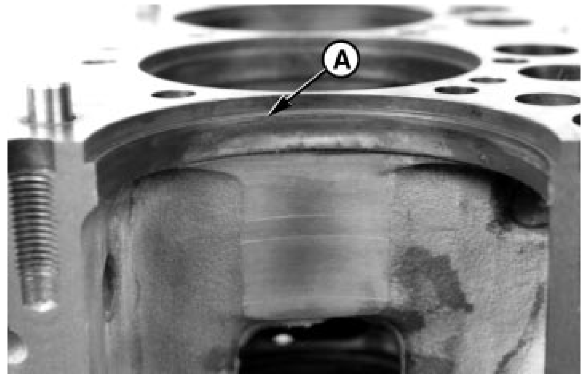
6. Inspect block for cracks or damage. If a cracked block is suspected, pressure-test the block. A procedure for pressure testing is outlined in FOS (Fundamentals of Service) Manual-ENGINES. Check for erosion or cracks in the liner O-ring/packing area (B). Replace cracked or damaged blocks.

7. If cylinder block is serviceable, clean cylinder head cap screw threads in block using JDG680 Tap (C) or equivalent 1/2-13 UNC-2A x 76 mm (3.0 in.) long tap. Remove debris or fluid from tapped holes with compressed air.

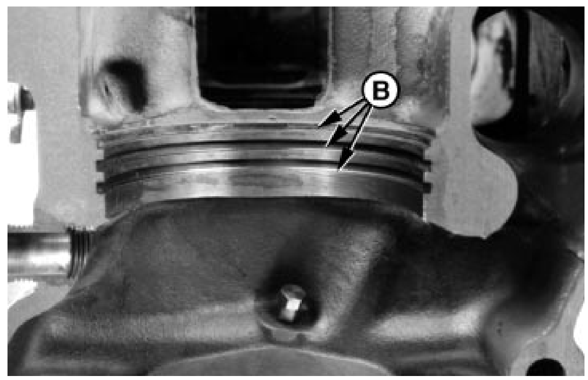
8. Reinstall soft plugs.

9. Install piston cooling orifices. (See INSPECT PISTON COOLING ORIFICES later in this gruop.)

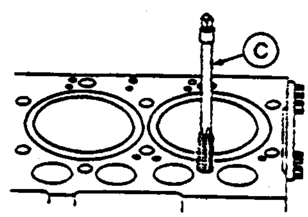
10. Install oil gallery plugs using JDG782 Oil Gallery Plug Tool.



RG6403 –UN–03NOV97



RG6404 –UN–03NOV97



RG4725 –UN–13DEC88

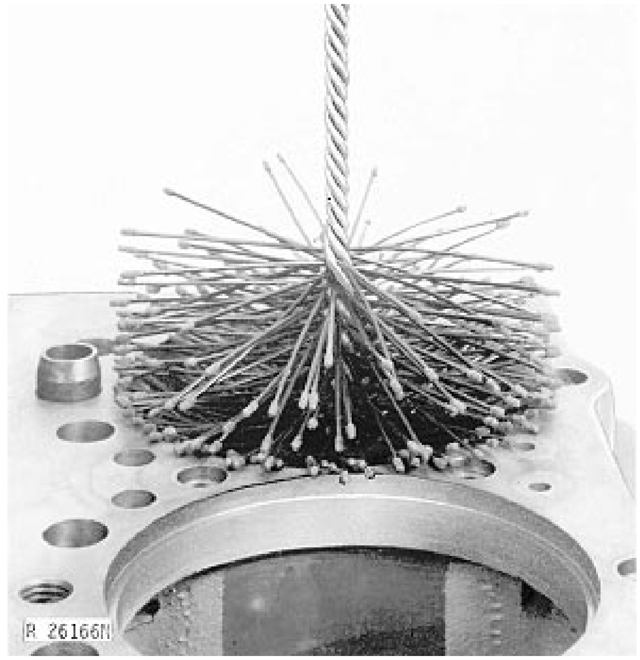
A—Liner Support Flange
B—Packing Area
C—JDG680 Tap

S11,2010,HD –19–07JUL92–2/2

CLEAN CYLINDER LINER O-RING BORE

Use D17015BR O-Ring Bore Cleaning Brush to clean lower liner O-ring bore.

NOTE: Use brush exactly as directed by the manufacturer.



R26166 –UN–13DEC88

RG,CTM8,GR10,63 –19–29SEP94–1/1

MEASURE CYLINDER BLOCK MAIN BEARING BORE

Measure main bearing bore diameter and cylinder block main thrust bearing width.

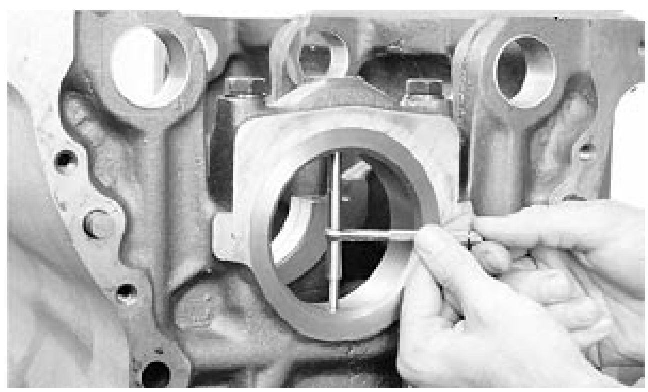
Cylinder Block Main Bearing Bore—Specification

ID .... 84.46—84.48 mm (3.325—3.326 in.)

Cylinder Block Main Thrust Bearing—Specification

Width... 33.62—33.72 mm (1.324—1.328 in.)

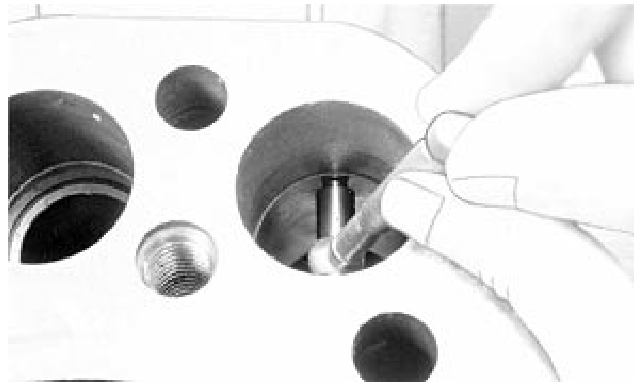
If bearing caps are damaged, or bore is not within specification, replace caps and line bore to specifications. (See MEASURE ASSEMBLED ID OF MAIN BEARING CAPS in Group 15.)



T81655 –UN–01NOV88

RG,CTM8,GR10,50 –19–11OCT94–1/1

MEASURE CAMSHAFT FOLLOWER BORE



T81656 –UN–01NOV88

Measure camshaft follower bore diameter.

Camshaft Follower Bore—Specification

ID .... 31.70—31.75 mm
(1.248—1.250 in.)

Camshaft Follower (New)—Specification

OD .... 31.61—31.64 mm
(1.245—1.246 in.)

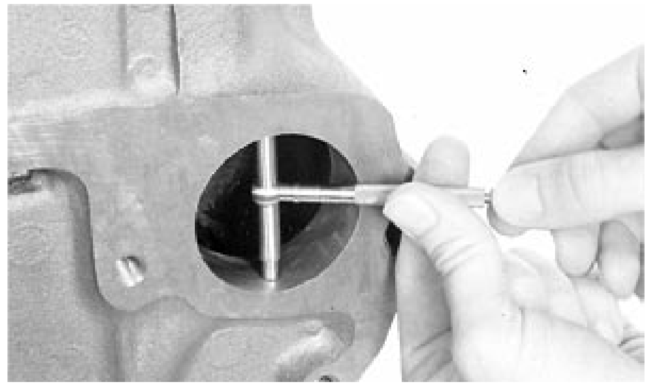
Camshaft Follower-to-Bore—Specification

Clearance .... 0.06—0.13 mm
(0.002—0.005 in.)

If any one camshaft follower bore ID and follower-to-bore clearance exceed specified maximum, install a new cylinder block.

RG,CTM8,GR10,51 –19–19OCT92–1/1

MEASURE CAMSHAFT BEARING BORE


T81657 –UN–01NOV88

NOTE: 3029 and 4039 engines have a bushing installed in No. 1 camshaft bore.

Measure camshaft bearing bore diameter.

Camshaft Bearing Bore (Except 3029 and 4039 No. 1 Camshaft Bore)—Specification

ID .... 55.986—56.012 mm (2.2042—2.2052 in.)

Camshaft Bearing Bore (3029 and 4039 No. 1 Bushing Removed)—Specification

ID .... 59.961—59.987 mm (2.3607—2.3617 in.)

Camshaft Bushing (3029 and 4039 No. 1 Bushing Installed)—Specification

ID .... 55.948—56.000 mm (2.2026—2.2047 in.)

Camshaft Journal-to-Bearing Bore (Except 3029 and 4039 No. 1 Journal)—Specification

Clearance .... 0.08—0.13 mm (0.003—0.005 in.)
Wear Limit .... 0.15 mm (0.006 in.)

Camshaft Journal-to-Bushing (3029 and 4039 No. 1 Journal)—Specification

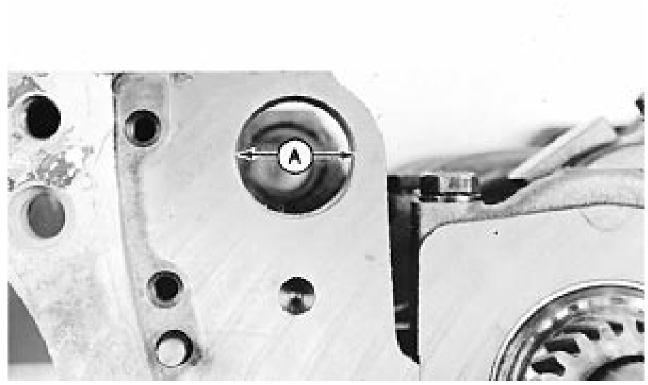
Clearance .... 0.05—0.13 mm (0.002—0.005 in.)
Wear Limit .... 0.18 mm (0.007 in.)

If bearing bore diameter in cylinder block is larger than specified, install a new cylinder block. If bushing in 3029 No. 1 bore is worn or damaged, install a new bushing. (See REMOVE AND INSTALL CAMSHAFT BUSHING in Group 16.)

RG,CTM8,GR10,52 –19–29SEP94–1/1

MEASURE BALANCER SHAFT BORE—4-CYLINDER ENGINES

Measure balancer shaft bore diameters (A) in cylinder block.



RG6336 –UN–03AUG92

Balancer Shaft Bore-Standard Bushings (Bushing Removed)[1]—Specification

ID .... 41.26—41.29 mm
(1.625—1.626 in.)

Balancer Shaft Bore-Oversize Bushings (Bushing Removed)[2]—Specification

ID .... 43.237—43.263 mm
(1.7015—1.7025 in.)

Balancer Shaft Bore—Specification

Chamfer .... 20°—25° x 1.50 mm (0.060 in.)

Balancer Shaft Bushing—Specification

ID .... 38.176—38.237 mm
(1.5030—1.5054 in.)

Balancer Shaft Bushing-to-Bore—Specification

Oil Clearance.. 0.016—0.102 mm
(0.0006—0.0040 in.)

If diameter is larger than specified on 4045 engines, install a new cylinder block. Oversize balancer shaft bushings are available for 4039 engines. (See INSTALL OVERSIZE BALANCER SHAFT BUSHINGS in Group 16.)

IMPORTANT: Oversize balancer shaft bushings must not be used on 4045 engines with bolt-on balancer shaft weights. Machining for oversize bushings reduces strength of balancer shaft bore.

[1]4039 and 4045 (4-cylinder) Engines only.

[2]4039 Engines with one-piece balancer shafts only.

CTM8,GR10,15 –19–29SEP94–1/1

MEASURE CYLINDER BLOCK TOP DECK FLATNESS


T81658 –UN–07NOV88

Measure cylinder block top deck flatness using D05012ST Precision Straightedge. If flatness is not as specified, resurface cylinder block.

Maximum Acceptable Out-of-Flat, Entire Length or Width (Used)—Specification

Measurement... 0.08 mm (0.003 in.)

Maximum Acceptable Out-of-Flat (Any 150 mm (5.90 in.) Length)—Specification

Measurement... 0.025 mm (0.001 in.)

Top Deck Surface Finish (Surface Grind Only) (AA)—Specification

Surface Finish...0.0008—0.0032 mm
(31—125 micro-in.)

Top Deck Surface Finish Wave Depth—Specification

Maximum Depth .... 0.012 mm (0.0005 in.)

Main Bearing Bore Centerline-to-Cylinder Block Top Deck (3029/4039/6059)—Specification

Minimum Distance... 301.98 mm (11.889 in.)

Main Bearing Bore Centerline-to-Cylinder Block Top Deck (4045/6068)—Specification

Minimum Distance... 337.87 mm (13.302 in.)

IMPORTANT: When cylinder block top deck or main bearing bores are machined, the dimension from crankshaft centerline to top deck will be changed. Make sure this dimension is within specifications, otherwise, piston may contact cylinder head.

CTM8,GR10,16 –19–16SEP92–1/1

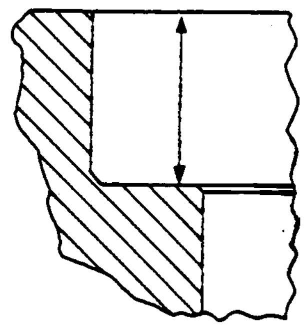
MEASURE LINER FLANGE COUNTERBORE DEPTH IN BLOCK

Measure liner flange counterbore depth in block and compare to specification given below. If depth is not within specification, liner shims are available.

Cylinder Liner Flange Counterbore Depth in Block—Specification

Depth .... 5.95—5.99 mm (0.234—0.236 in.)

RG7490 –UN–23NOV97



RG4726 –UN–13DEC88

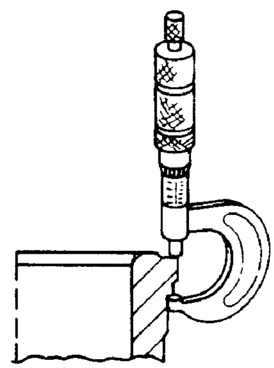
DPSG,OUO1004,281 –19–22JUL98–1/1

MEASURE LINER FLANGE THICKNESS

Measure cylinder liner flange thickness at several locations. If liner flange is not within specifications, replace piston and liner set.

Cylinder Liner Flange—Specification

Thickness .... 6.022—6.058 mm (0.2371—0.2385 in.)

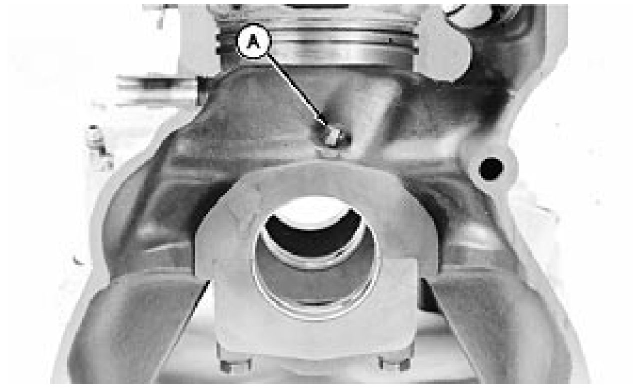


RG4727

RG4727 –UN–05DEC97

RG,CTM8,GR10,61 –19–16SEP92–1/1

REMOVE, INSPECT AND INSTALL PISTON COOLING ORIFICES



RG6426 –UN–17SEP92

Cut-Away View

A—Piston Cooling Orifice

1. Remove and clean each piston cooling orifice (A) to make sure it is not plugged or damaged. Replace if questionable.

IMPORTANT: A piston cooling orifice failure could cause damage to piston, piston pin, pin bushing, and liner. If a piston cooling orifice is left out, low or no oil pressure will result.

2. Install and tighten orifices to specifications.

Piston Cooling Orifices—Specification

Torque .... 10.5 N•m
(7.7 lb-ft) (93 lb-in.)

RG,CTM8,GR10,64 –19–04OCT94–1/1

MEASURE CYLINDER LINERS AND BLOCK BORES

Measure cylinder liners and block bores. Replace liners not within specifications.

Lower Block Bore for Seating Liner (Dubuque Engines)—Specification

ID .... 115.698—115.773 mm
(4.555—4.558 in.)

Lower Block Bore for Seating Liner (Saran Engines)—Specification

ID .... 115.748—115.798 mm
(4.557—4.559 in.)

Upper Block Bore for Seating Liner—Specification

ID .... 120.70—120.75 mm
(4.752—4.754 in.)

OD of Liner at Upper Bore—Specification

OD .... 120.61—120.69 mm
(4.7484—4.7516 in.)

OD of Liner at Lower Bore (Dubuque Engines)—Specification

OD .... 115.697—115.733 mm
(4.555—4.556 in.)

OD of Production Liner First Class at Lower Bore (Saran Engines —317306)—Specification

OD .... 115.724—115.748 mm
(4.556—4.557 in.)

OD of Production Liner Second Class at Lower Bore (Saran Engines —317306)—Specification

OD .... 115.698—115.723 mm
(4.555—4.556 in.)

OD of Service Liner at Lower Bore (Saran Engines —317306)—Specification

OD .... 115.724—115.748 mm
(4.556—4.557 in.)

Continued on next page

DPSG,OUO1004,283 –19–22JUL98–1/2

**OD of Liner at Lower Bore
(Saran Engines 317307—)—Specification**

OD .... 115.695—115.735 mm
(4.555—4.557 in.)

**Liner-to-Cylinder Block Clearance at Lower Bore
(Dubuque Engines)—Specification**

Clearance .... 0.035—0.100 mm
(0.001—0.004 in.)

**Production Liner First and Second Class-to-Cylinder Block
Clearance at Lower Bore
(Saran Engines —317306)—Specification**

Clearance .... 0.025—0.075 mm
(0.001—0.003 in.)

**Service Liner-to-Cylinder Block Clearance at Lower Bore
(Saran Engines —317306)—Specification**

Clearance .... 0.025—0.075 mm
(0.000—0.003 in.)

**Liner-to-Cylinder Block Clearance at Lower Bore
(Saran Engines 317307—)—Specification**

Clearance .... 0.015—0.105 mm
(0.001—0.004 in.)

Liner-to-Cylinder Block Clearance at Upper Bore—Specification

Clearance .... 0.10—0.14 mm
(0.004—0.005 in.)

Cylinder Liner—Specification

ID .... 106.48—106.52 mm
(4.192—4.194 in.)

Cylinder Wear—Specification

Maximum Wear .... 0.10 mm (0.004 in.)

Cylinder Taper—Specification

Maximum Taper.. 0.05 mm (0.002 in.)

Cylinder Out-of-Round—Specification

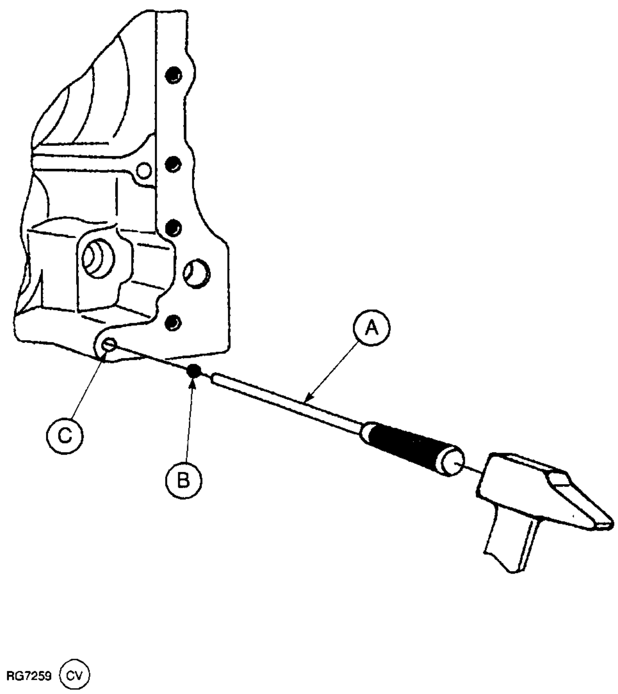
Maximum Out-of-Round .... 0.05 mm (0.002 in.)

INSTALL STEEL BALL IN OIL PASSAGE OF CYLINDER BLOCK

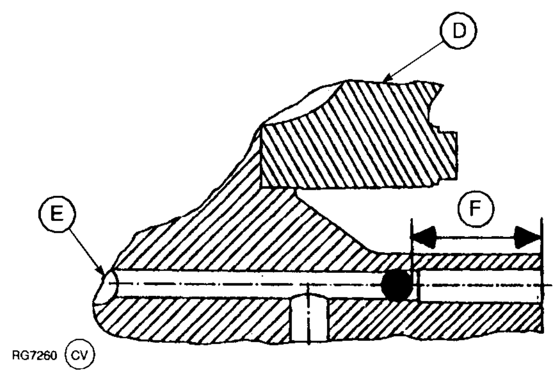
NOTE: On Dubuque-built engines, the steel ball is already installed in block. On Saran-built 3 and 6-cylinder engine service cylinder blocks, the steel ball is provided but may not be installed.

1. Install steel ball (B) in passage (C).

2. Using a driver (A), push steel ball into the main oil gallery (E) until it bottoms. The distance between oil pan rail and top of ball is approximately 54 mm (2.16 in.) (F).



RG7259 –UN–20JUL95

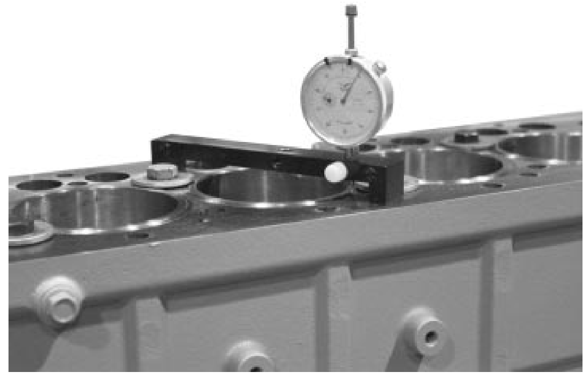


RG7260 –UN–20JUL95

A—Driver
B—Steel Ball
C—Passage
D—Main Bearing Cap
E—Oil Gallery
F—54mm (2.16 in.)

DPSG,OUO1004,308 –19–17AUG98–1/1

MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK)



NOTE: If a new liner assembly is being installed in a new or used cylinder block, liner height must be checked.

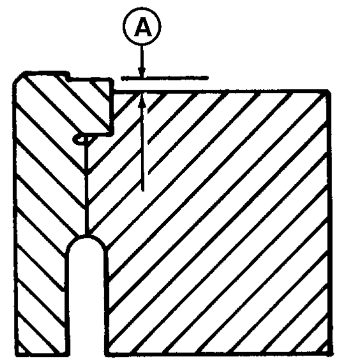
1. Be sure liner bore in cylinder block and top deck of block are clean.

IMPORTANT: Liner should rotate smoothly by hand when installed without O-rings or packing. If not, remove liner and clean block.

2. Install liner without O-rings and packing. If liner does not rotate smoothly by hand, remove liner and polish lower pilot bore in block with emery cloth or D17015BR Brush. Use a shop towel or other suitable means to collect debris when polishing bore.

   Locate liner mark toward the front of the engine. Secure with cap screws and washers (approximately 3 mm [1/8 in.] thick). Tighten screws to 68 N•m (50 lb-ft).

3. Using JDG451 or KJD10123 Gauge and D17526CI or D17527CI Dial Indicator, measure height (A) of liner at 1, 5, 7, and 11 o'clock positions as viewed from flywheel end of engine.



A—Liner Height

Cylinder Liner Height Above Block—Specification

Height .... 0.030—0.100 mm (0.001—0.004 in.)

Cylinder Liner Height Difference At Nearest Point of Two Adjacent Liners, or Within a Single Liner—Specification

Maximum Permissable Height Difference .... 0.05 mm (0.002 in.)

Continued on next page

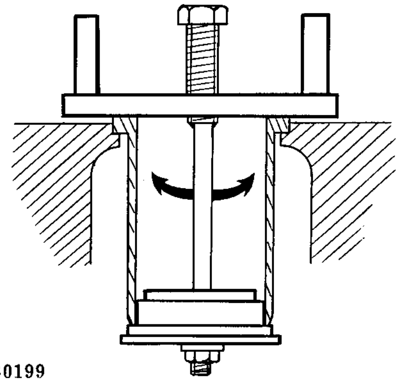
DPSG,OUO1004,282 –19–22JUL98–1/2

4. If liner height is above specification, check cylinder block for burrs on liner support flange or incorrect counterbore depth. If burrs are present, apply lapping compound to liner flange shoulder in the block, then install liner and turn to left and right using KCD10001or JDG1145 Cylinder Liner Puller to rub off enough material to seat liner as necessary.

IMPORTANT: ONE LINER SHIM ONLY may be installed under each liner flange. If liner requires more than one shim, install a new liner or cylinder block.

5. If liner height is no more than 0.08 mm (0.003 in.) below top deck of block, install one liner shim under liner flange.

   Two shim sizes are available; 0.05 mm (0.002 in.) and 0.10 mm (0.004 in.).



CD30199 –UN–07MAR95

KCD10001 Shown

Liner Shims—Specification

Thickness	0.05 mm (0.002 in.) and 0.10 mm (0.004 in.)

DPSG,OUO1004,282 –19–22JUL98–2/2

INSTALL CYLINDER LINER O-RINGS AND PACKINGS

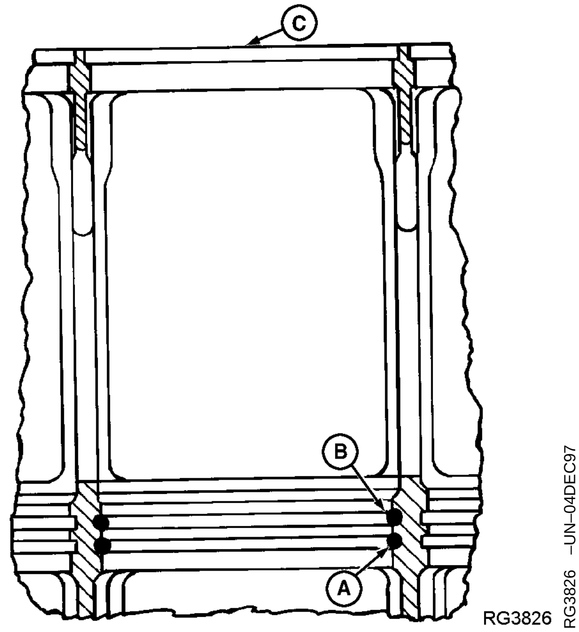
IMPORTANT: DO NOT use oil or hand cleaner soap on cylinder liner packing or O-rings. Petroleum products will cause the red (or white) O-ring to swell, which may result in O-ring damage during liner installation.

1. Pour AR54749 Soap Lubricant into a suitable container.

2. Dip O-rings in AR54749 Soap Lubricant.

3. Install the black O-ring (A) in the lower O-ring groove in the cylinder block (C).

4. Install the red (or white) O-ring (B) in the upper O-ring groove in the cylinder block.



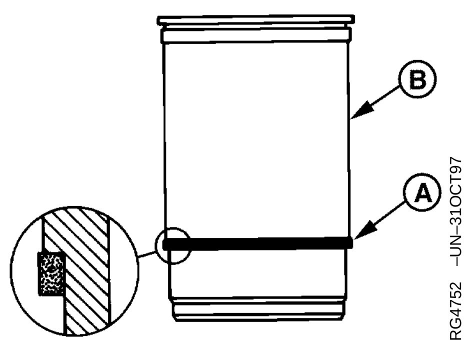
A—Black O-Ring
B—Red or White O-Ring
C—Cylinder Block

S11,2010,HK –19–16SEP92–1/2

5. Turn cylinder liner (B) upside-down. Dip square packing (A) in soap and install over outside of liner.

6. Slide packing down firmly against shoulder on liner. Make sure packing is not twisted.

7. Coat the liner packing sealing area of the cylinder liner and block O-rings with liquid soap.



A—Square Packing
B—Cylinder Liner

S11,2010,HK –19–16SEP92–2/2

INSTALL CYLINDER LINER

IMPORTANT: Install cylinder liners into same cylinder block bore as removed. DO NOT scuff the liner packing across the upper counterbore.

Pitted or eroded liners that meet reuse guidelines should be rotated 90° from their removed position. (See VISUALLY INSPECT CYLINDER LINERS earlier in this group for reuse guidelines.)

1. Install liner in block bore with mark (made during disassembly) toward front of engine, unless liner OD is pitted or eroded.

   If liner OD is pitted or eroded, but still within acceptable service limits, rotate liner 90° from its removed position. Pitted sections of the liner should be facing the front or rear of engine.

Continued on next page RG,CTM8,GR10,53 –19–06OCT94–1/2

2. A resistance will be felt when cylinder liner is aligned in pilot bore. Finish seating liners using clean, hardwood block and mallet. Gently tap hardwood block over top of cylinder liner with mallet. KCD10001 (A) or JDG1145 Puller may also be used to seat liners.

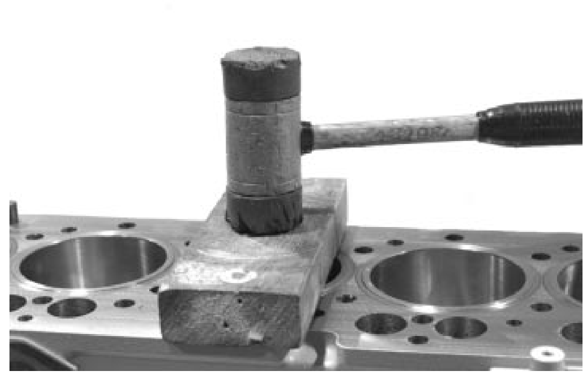
NOTE: Cylinder liner will protrude over top of cylinder block more than normal due to uncompressed packings and O-rings.

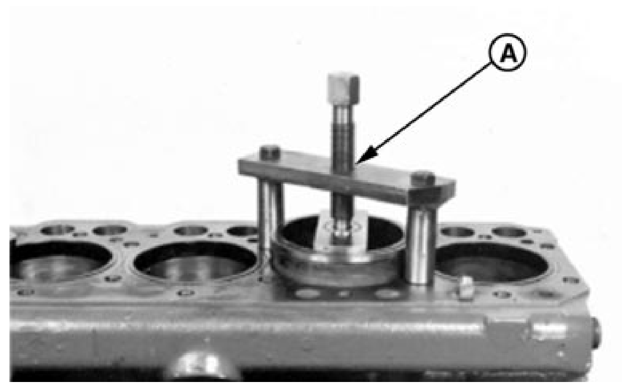
IMPORTANT: If you suspect a packing may have sheared or displaced during liner installation, remove and examine the liner and packing assembly. If no damage is found, check packings for proper position. Resoap packings, and reinstall liner assembly.

3. Hold liners in place with large flat washers and cap screws. Turn cap screws snug but do not tighten.

4. Clean cylinder liner bores with waterless hand cleaner after installation. Wipe dry with clean towels.

5. Apply clean engine oil to liner bores immediately to prevent corrosion.





A—KCD10001 Liner Puller

RG,CTM8,GR10,53 –19–06OCT94–2/2

ASSEMBLE PISTON AND CONNECTING ROD

IMPORTANT: 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. Lubricate piston pin and bushing with clean engine oil.

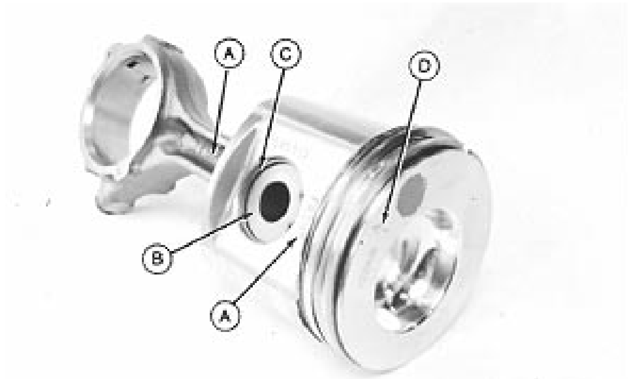
IMPORTANT: Pistons must be installed on connecting rods from which they were removed.

Piston and connecting rod must be assembled so combustion bowl in piston is offset toward fuel injection pump side of engine when long side of connecting rod is toward the camshaft side of engine.

2. Assemble pistons and connecting rods, making sure the word "FRONT" (A) on side or top of piston and side of connecting rod are matched up.

NOTE: Some pistons may have an arrow (D) on the crown, or a flat on a pin boss, to indicate the front side.

3. Insert piston pin (B) into piston pin bore. Install NEW piston pin retaining rings (C) with sharp edge of ring facing away from piston pin. If both edges of rings are sharp, they are reversible. Make sure retaining rings are seated in grooves of piston pin bore.



A—Word "FRONT" on Rod
B—Piston Pin
C—Piston Pin Retaining Rings
D—Arrow Indicating "FRONT" on Piston

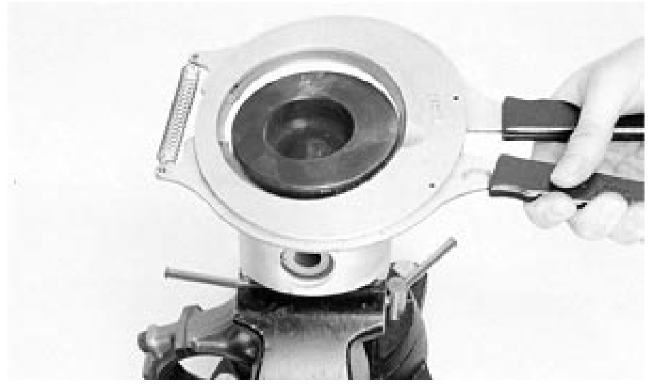
RG,CTM8,GR10,54 –19–16SEP92–1/1

INSTALL PISTON RINGS

IMPORTANT: Piston rings can be damaged if expanded too far. Expand piston rings only as far as necessary to install rings on piston.

1. When installing new piston rings, use JDE85 or JDE135 Piston Ring Expander. Install oil ring expander in bottom ring groove. Position end gap toward either end of piston pin.

2. Install oil control ring (A) in bottom ring groove over ring expander. Install with end gap on opposite side of piston from ring expander gap.



T81600 –UN–07NOV88

RG5628 –UN–28MAR90

A—Oil Control Ring

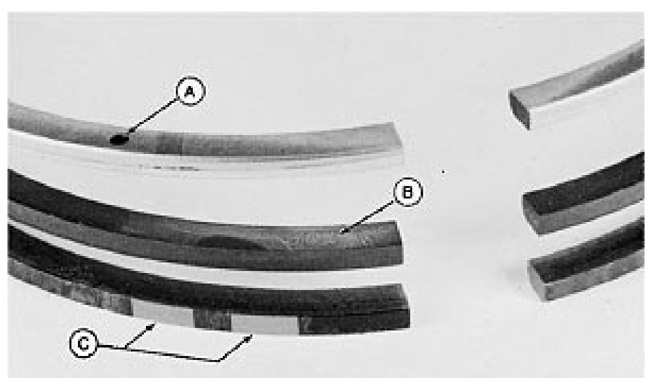
CTM8,GR10,28 –19–29SEP94–1/4

3. Identify top side of compression rings. Top side of rectangular and keystone compression rings will be identified by one of the following:

   - Depression marks (A) on the top side of the ring.
   - "TOP" (B) marked on the top side of the ring.
   - Yellow or blue dye marks (C) on the (face) of the ring. Dye marks must be on the left side of ring gap as shown.

4. Install rectangular compression ring in center ring groove with top of ring toward top of piston.

5. Position gap in rectangular compression ring on opposite side of piston from oil control ring gap.



RG6400 –UN–21AUG92

A—Depression Marks
B—“TOP” Mark
C—Yellow Dye Mark

Continued on next page

CTM8,GR10,28 –19–29SEP94–2/4

6. Install keystone compression ring (A) in top ring groove with top of ring toward top of piston.

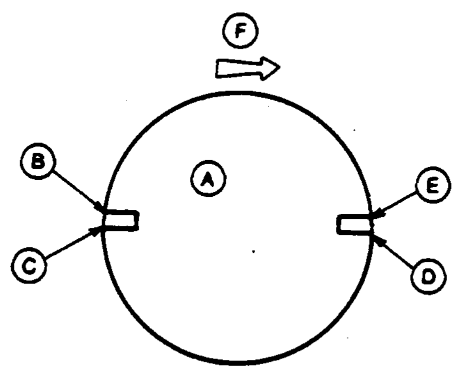
7. Position gap in Keystone compression ring on opposite side of piston from rectangular compression ring gap.

A—Keystone Compression Ring

CTM8,GR10,28 –19–29SEP94–3/4

8. Stagger ring gaps on pistons as shown.

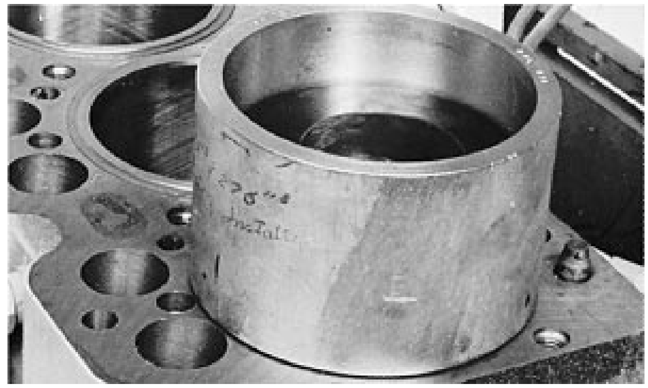
9. Coat pistons, liners and inside of JDE84 Ring Compressor with clean engine oil.



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

CTM8,GR10,28 –19–29SEP94–4/4

INSTALL PISTON AND CONNECTING ROD ASSEMBLY



IMPORTANT: Be careful so crankshaft journals and cylinder liner walls are not damaged by connecting rod when installing piston and rod in liner.

1. Carefully place JDE84 Ring Compressor with piston and rod over liner so the word "FRONT" on side of rod and on the side or top of piston faces toward the front of the engine.

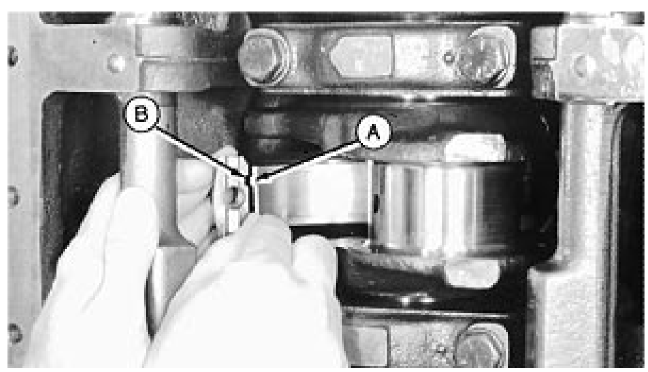
NOTE: If arrow indicating "FRONT" is not visible on side or top of pistons, install piston and rod so combustion bowl in piston is offset toward fuel injection pump side of engine, and the long side of the connecting rod is toward camshaft side of engine.

2. With piston centered in ring compressor and rings staggered correctly, push piston into liner.

CTM8,GR10,30 –19–27DEC94–1/5

3. Install bearing insert in connecting rod with tang (A) in groove (B).

4. Apply clean engine oil on insert and crankshaft journal. Carefully pull connecting rod and insert against crankshaft journal.

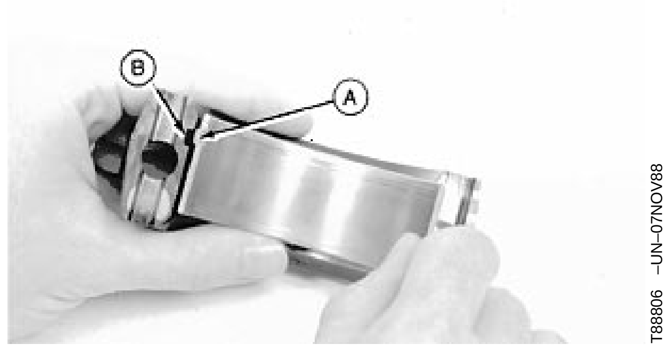


A—Tang
B—Groove

Continued on next page

CTM8,GR10,30 –19–27DEC94–2/5

5. Install bearing insert in connecting rod cap with tang (A) in groove (B).



A—Tang
B—Groove

CTM8,GR10,30 –19–27DEC94–3/5

6. Apply clean engine oil to bearing insert. Install cap on connecting rod with tangs (A) to same side.

A—Tangs

Continued on next page

CTM8,GR10,30 –19–27DEC94–4/5

IMPORTANT: NEVER use connecting rod cap screws more than once for final engine assembly. Once rod cap screws have been tightened, they cannot be reused for another final assembly.

7. Dip NEW connecting rod cap screws in clean oil and install. Tighten cap screws alternately to the following torques:

   - All 3029, 4039, and 6059 Engines: Initially tighten all cap screws to the following specification.

Connecting Rod Cap Screws (All 3029/4039/6059)—Specification

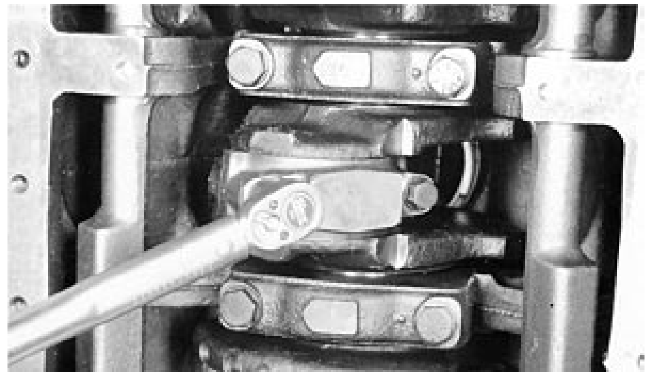
Initial Torque.. 55 N•m (40 lb-ft)

   - All 4045 and 6068 Engines: Initially tighten cap screws to to the following specification.

Connecting Rod Cap Screws (All 4045/6068)—Specification

Initial Torque.. 68 N•m (50 lb-ft)

8. Secondly, TORQUE-TURN all cap screws to 90—100 degrees. (See TORQUE-TURN CONNECTING ROD CAP SCREWS next in this group.)



T81615 –UN–07NOV88

CTM8,GR10,30 –19–27DEC94–5/5

TORQUE-TURN CONNECTING ROD CAP SCREWS

USING ENGINE AXIS METHOD TO TORQUE-TURN CONNECTING ROD CAP SCREWS

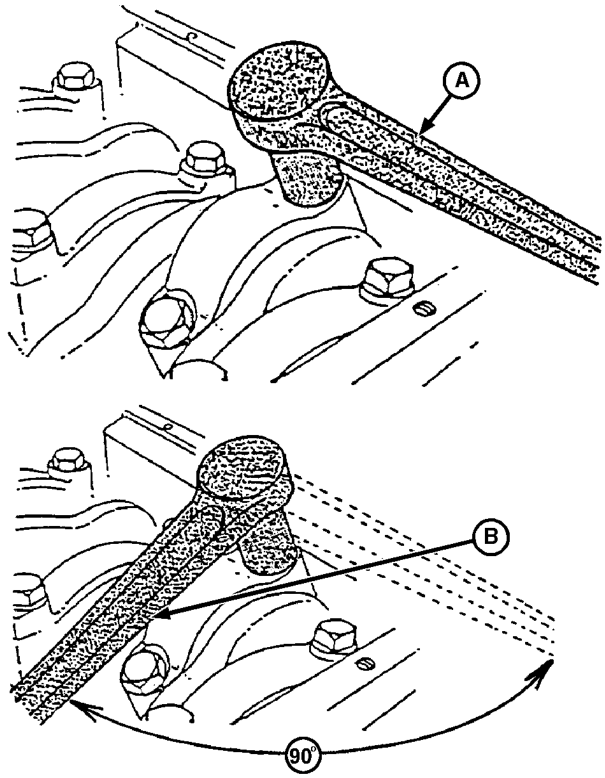
1. After tightening cap screws to initial torque values, mark connecting rod cap and socket.

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.

Connecting Rod Cap Screws—Specification

Torque Turn...1/4 Turn (90—100°)
After Initial Torque



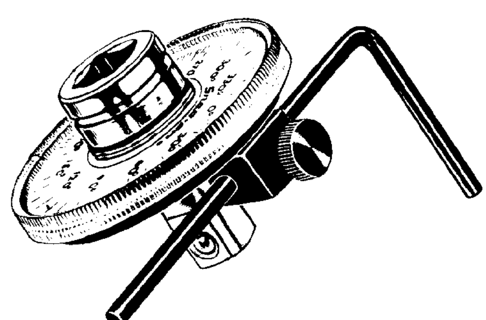
RG9102 –UN–27MAR98

A—Parallel to Centerline Crankshaft
B—Perpendicular to Centerline Crankshaft

CTM8,GR10,19 –19–08FEB95–1/2

USING JT05993 TORQUE ANGLE GAUGE TO TORQUE-TURN CONNECTING ROD CAP SCREWS

After tightening cap screws to initial torque values provided earlier, follow directions provided with JT05993 Gauge and TORQUE-TURN each cap screw 90°—100°.



RG5698

RG5698 –UN–05DEC97

CTM8,GR10,19 –19–08FEB95–2/2

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.

S11,0402,BK –19–08MAR94–1/1

MEASURE PISTON PROTRUSION

1. Press down on top of piston to remove oil clearances before measuring piston protrusion.

2. Use JDG451 or KJD10123 Gauge (or use a magnetic base dial indicator) to measure piston protrusion. Place gauge on top of cylinder block so dial indicator can be set to "zero" with top of block.

3. Position gauge across piston. While pressing gauge downward, rotate crankshaft until piston is at TDC. Measure piston height at several positions around the piston. If using JDG451 Gauge, piston height must be checked at outer most diameter of piston.

4. Piston protrusion for pistons measured with JDG451 or KJDG10123 Gauge must meet the following specifications:

Piston Protrusion (Above Block Deck) (Using JDG451 or KJD10123 Gauge)—Specification

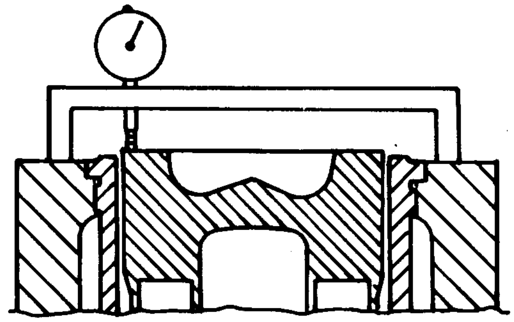
Dimensions	0.08—0.31 mm (0.003—0.012 in.)

5. Piston protrusion for pistons measured using dial indicator with magnetic base must meet the following specifications:

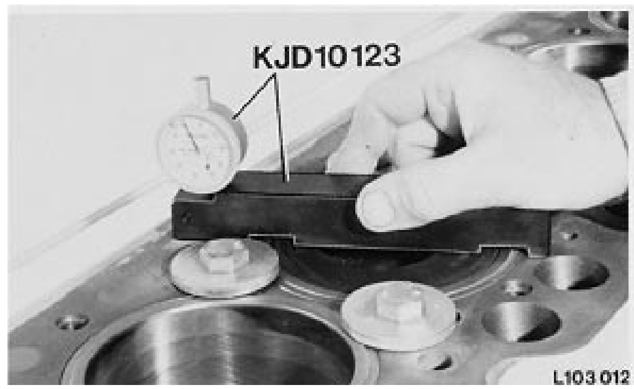
Piston Protrusion (Above Block Deck) (Using Magnetic Base Dial Indicator)—Specification

Dimensions	0.15—0.38 mm (0.006—0.015 in.)

If protrusion does not meet specifications, check dimensions of piston, connecting rod, cylinder block, crankshaft, and bearings to determine the cause.



RG6440 –UN–22SEP92



L103012 –UN–15NOV88

CTM8,GR10,10 –19–16SEP92–1/1

CYLINDER BLOCK ORIFICES (SARAN ENGINES)

The cylinder block has lubrication and cooling system orifices. When reassembling an engine, make sure that coolant lines are connected to corresponding coolant ports and oil lines to oil ports.

NOTE: On engines (121942—), the plugs for oil holes (E) are coated with sealant and can be reused several times without additional sealing compound.

Key	Orifice	Plug with:	Torque Value
A	Coolant drain	R55233	17N•m (13 lb-ft)
B	Turbocharger oil return	15H584	45 N•m (33 lb-ft)
C	1/2" conical for oil dipstick tube (left-hand side option) or for turbocharger oil return (low profile option)	15H584	45 N•m (33 lb-ft)
D	1/2" cylindrical for dipstick tube (right or left)	19H2351	67 N•m (50 lb-ft)
E	Under pressure oil	R119392	17 N•m (13 lb-ft)
F	Coolant heater	R39741	40 N•m (30 lb-ft)
G	Coolant gallery	15H562	45 N•m (33 lb-ft)
H	Oil gallery	15H695	45 N•m (33 lb-ft)
J	Oil gallery	15H584	45 N•m (33 lb-ft)

Depending on turbocharger option (top or side), install 15H584 conical plug (K) in either hole (B) or (C) (4 and 6-cyl. engines only).

Depending on oil dipstick tube option (right or left), use 19H2351 cap screw with sealing compound in either hole (D) or (C) (4 and 6-cyl. engines only).

NOTE: On certain cylinder blocks, the oil dipstick guide is installed in hole (C) (except 3-cyl. engines) which was initially designed for the turbocharger oil return line. In this case, order R121194 adapter (M).

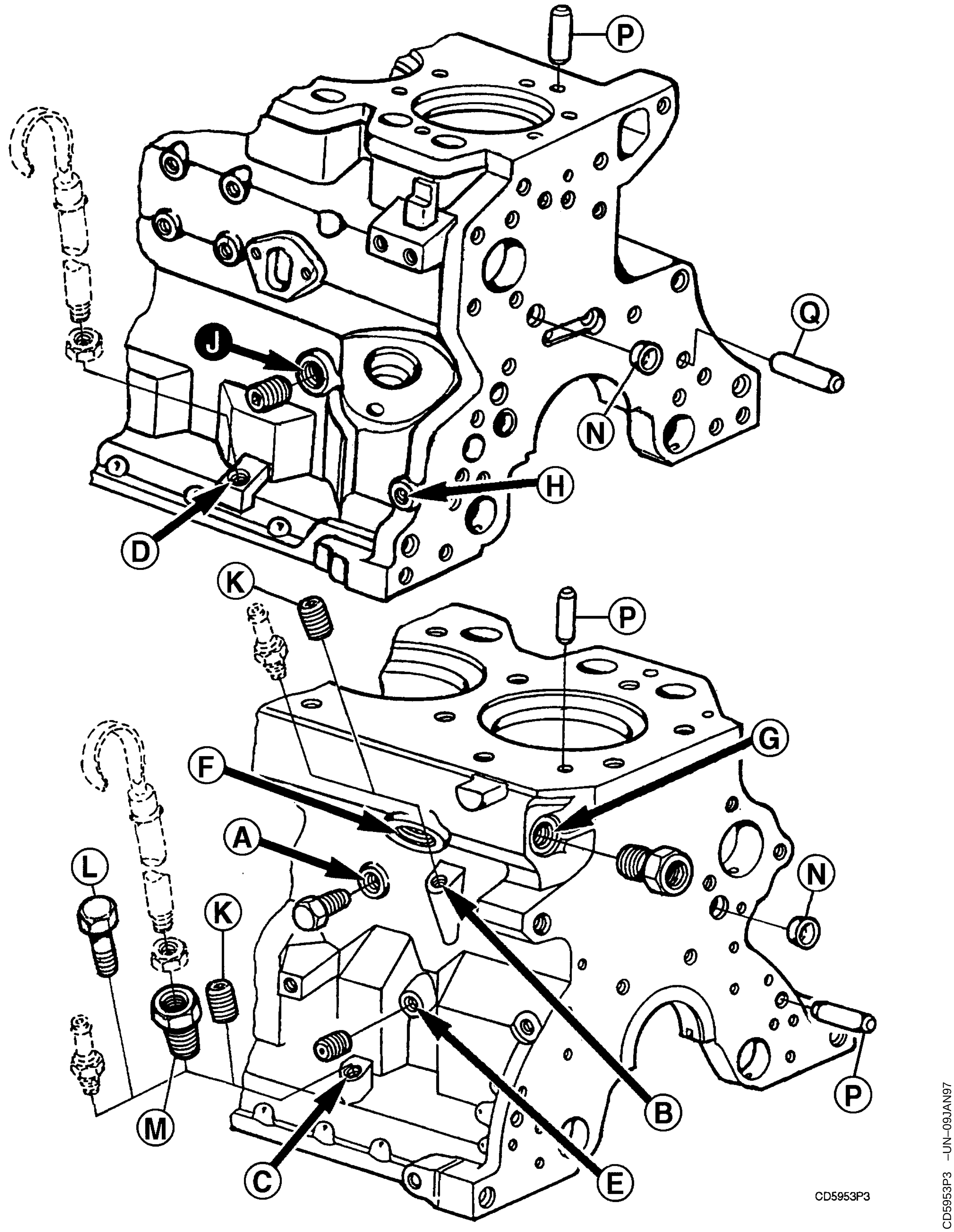
If needed, use steel caps (N) in oil gallery at both ends.

Install dowel pins on cylinder block as follows:

- (2) A120R dowel pins on engine top (P)
- (2) A120R dowel pins on engine rear (P)
- (2) B153R dowel pins on engine front (Q)

DPSG,OUO1004,484 –19–07NOV98–1/1

CYLINDER BLOCK ORIFICES



DPSG,OUO1004,485 –19–07NOV98–1/1

COMPLETE FINAL ASSEMBLY

1. Install oil pump outlet tube O-ring in cylinder block. Install oil pump and outlet tube. (See Group 20.)
2. Install balancer shaft bushings (4-cylinder engines) and camshaft bushing (3029 engines) (Group 16).
3. Install oil bypass valve (in front of block) and front plate (Group 16).
4. Install balancer shafts (if equipped) (Group 16).
5. Install camshaft, timing gears, and timing gear cover. (Group 16).
6. Install oil pressure regulator valve, spring, and plug in timing gear cover (Group 16).
7. Install oil pan. (See Group 20.)
8. Install crankshaft pulley. (Group 15).
9. Install camshaft followers. (See Group 16.)
10. Install cylinder head with new gasket. (See Group 05.)
11. Fill engine with clean oil and proper coolant.
12. Perform engine break-in. (See Group 05.)

CTM8,GR10,36 –19–07JUL92–1/1

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,OUO1004,347 –19–12SEP98–1/14

RG6246 –UN–05DEC97

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

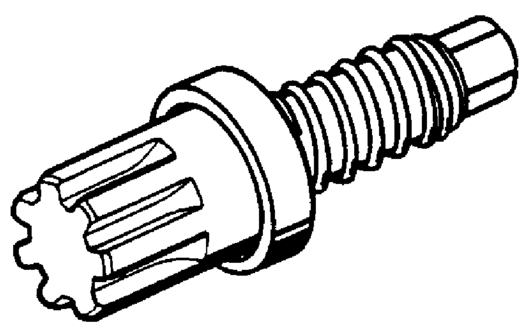
Used with magnetic base to measure radial runout and wobble on vibration damper.

RG6246

DPSG,OUO1004,347 –19–12SEP98–2/14

Flywheel Turning Tool JDG820

Used to rotate flywheel on engines with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) flywheel housing guide bore diameter. JDE81-1 may be used if JDG820 is not available.



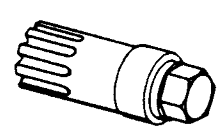
RG7056

RG7056 –UN–05DEC97

DPSG,OUO1004,347 –19–12SEP98–3/14

Flywheel Turning Tool JDE83

Used to rotate flywheel on engines with 142-tooth flywheel ring gear and a 26.5 mm (1.04 in.) flywheel housing guide bore diameter.



RG6251 –UN–22JUL92

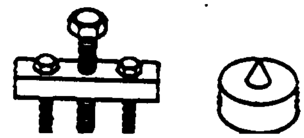
Continued on next page

DPSG,OUO1004,347 –19–12SEP98–4/14

RG5112 –UN–06APR89

Vibration Damper Puller Set JDG410

Remove vibration damper and pulley.

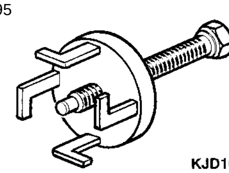


DPSG,OUO1004,347 –19–12SEP98–5/14

KJD10206 –UN–19JUN95

Crankshaft Pulley Puller KJD10206

Remove crankshaft pulley without threaded holes on 6000 Series Tractors.

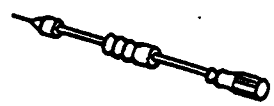


DPSG,OUO1004,347 –19–12SEP98–6/14

RG5109 –UN–23AUG88

Seal Remover JDG22

Remove crankshaft front oil seal with timing gear cover installed. Also used to remove crankshaft rear oil seal without removing flywheel housing.

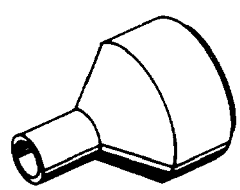


DPSG,OUO1004,347 –19–12SEP98–7/14

RG6214 –UN–05DEC97

Seal Puller Adapter JDG719

Used with standard metal screw, JDE38-2 shank, and JDE38-3 Slide Handle to remove front crankshaft oil seal with timing gear cover installed. Also used to remove rear crankshaft oil seal with seal housing installed.

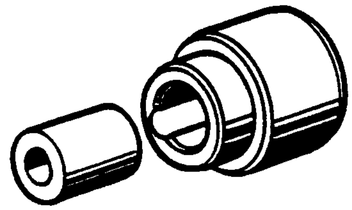


Continued on next page

DPSG,OUO1004,347 –19–12SEP98–8/14

Front Crankshaft Oil Seal Installer KJD10164

Install front crankshaft oil seal with timing gear cover installed on the engine. MUST BE used on composite material timing gear covers.

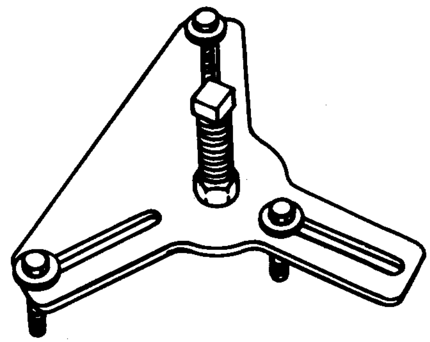


RG6304 –UN–03AUG92

DPSG,OUO1004,347 –19–12SEP98–9/14

Seal and Wear Sleeve Remover. JDG698

Remove unitized crankshaft rear oil seal and wear sleeve. This tool will also remove the non-unitized (two-piece) oil seal. However, JDG645 Rear Crankshaft Wear Sleeve Puller must be used to remove the wear sleeve.

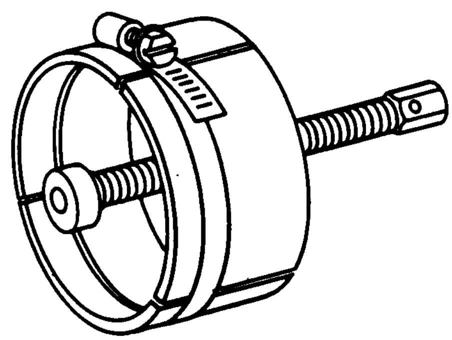


RG5631 –UN–12APR90

DPSG,OUO1004,347 –19–12SEP98–10/14

Rear Wear Sleeve Puller JDG645

Remove wear sleeve from rear crankshaft flange.



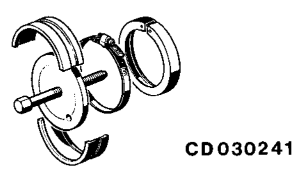
RG5561 –UN–01NOV89

DPSG,OUO1004,347 –19–12SEP98–11/14

Rear Crankshaft Oil Seal/Wear Sleeve Puller . . JDG645E

Remove rear oil seal/wear sleeve from crankshaft flange.

CD30241 –UN–08MAR95

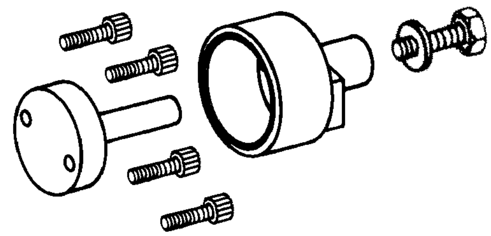


Continued on next page

DPSG,OUO1004,347 –19–12SEP98–12/14

Rear Oil Seal/Wear Sleeve Installer Set. . . . . JT30040 or KCD10002

Install crankshaft rear oil seal/wear sleeve assembly.

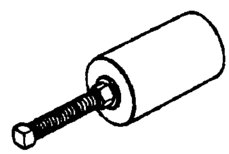


RG9122 –UN–22APR98

DPSG,OUO1004,347 –19–12SEP98–13/14

Crankshaft Gear Installer JDG794

Used to install crankshaft gear or front PTO drive gear either prior to, or after, installing crankshaft into engine.



RG7030 –UN–30SEP94

DPSG,OUO1004,347 –19–12SEP98–14/14

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,OUO1004,348 –19–12SEP98–1/4

Bushing, Bearing and Seal Driver Set D01045AA

Install pilot bearing in flywheel.

Continued on next page

DPSG,OUO1004,348 –19–12SEP98–2/4

Pulling Attachment. D01218AA

Use with D01200AA Push Puller to remove crankshaft gear from crankshaft.

DPSG,OUO1004,348 –19–12SEP98–3/4

Push Puller D01200AA

Use with D01218AA to remove crankshaft gear from crankshaft.

DPSG,OUO1004,348 –19–12SEP98–4/4

OTHER MATERIAL

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to 45 mm damper single mount cap screw.
(U.S.)	Brake Kleen or Ignition Cleaner and Drier	Remove sealant from crankshaft flange.
TY15969 (U.S.) TY9479 (Canadian) 680 (LOCTITE®)	Retaining Compound (Maximum Strength)	Apply to crankshaft flange.
(U.S.)	PLASTIGAGE®	Check main bearing-to-crankshaft journal oil clearance.
TY6304 (U.S.) TY9484 (Canadian) 515 (LOCTITE®)	Flexible Sealant	Apply to rear face of cylinder block prior to installing flywheel housing.
T43514 (U.S.) TY9475 (Canadian) 277 (LOCTITE®)	Plastic Gasket	Apply to torque converter access hole plug.

DPSG,OUO1004,349 –19–12SEP98–1/1

CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL SPECIFICATIONS

Item	Measurement	Specification
Damper (w/o Front PTO)	Maximum Radial Runout	1.50 mm (0.060 in.)
Damper Pulley Outer Ring (w/o Front PTO)	Wobble (Maximum)	1.50 mm (0.060 in.)
Damper or Pulley (w/o Front PTO)	Wobble (Maximum)	0.5 mm (0.020 in.)
Crankshaft Damper Pulley w/o Front PTO or Auxiliary Drive (45 mm or 1/2 x 1-3/4 in. Cap Screw Mounted) (Dubuque Engines)	Torque	183 N•m (135 lb-ft)
Crankshaft Damper Pulley w/o Auxiliary Drive (45 mm Cap Screw Mounted) (Saran Engines)	Torque	150 N•m (110 lb-ft)
Crankshaft Damper Pulley w/o Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)	Initial Torque	150 N•m (110 lb-ft)
Crankshaft Damper Pulley w/o Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)	Torque Turn (Final Torque)	50—70°
Vibration Damper Only (w/Front PTO)	Maximum radial run-out (A) Maximum wobble (B)	1.50 mm (0.060 in.) 1.50 mm (0.060 in.)
Vibration Damper Pulley (w/Front PTO)	Maximum wobble (C)	0.5 mm (0.02 in.)
Crankshaft Damper Pulley w/Front PTO or Auxiliary Drive (1/2 x 2-1/2 in.Cap Screw Mounted)	Torque	183 N•m (135 lb-ft)
Crankshaft Damper Pulley w/Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)	Initial Torque	150 N•m (110 lb-ft)

Continued on next page

DPSG,OUO1004,489 –19–07NOV98–1/5

Item	Measurement	Specification
Crankshaft Damper Pulley w/Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)	Torque Turn (Final Torque)	50—70°
Front PTO Collet Cap Screws	Torque	35 N•m (25 lb-ft)
Crankshaft Damper Pulley w/Crankshaft Gear Driven PTO (45 mm Cap Screw Mounted)	Torque	183 N•m (135 lb-ft)
Crankshaft Damper Pulley w/Crankshaft Gear Driven PTO (112 mm Cap Screw Mounted)	Initial Torque	150 N•m (110 lb-ft)
Crankshaft Damper Pulley w/Crankshaft Gear Driven PTO (112 mm Cap Screw Mounted)	Torque Turn (Final Torque)	50—70°
Crankshaft, New Parts: Two-Piece Thrust Bearing	End Play Wear Limit	0.05—0.25 mm (0.002—0.010 in.) 0.50 mm (0.020 in.)
Crankshaft, New Parts: Six-Piece Thrust Bearing	End Play Wear Limit	0.025—0.35 mm (0.001—0.014 in.) 0.50 mm (0.020 in.)
Flywheel Housing	Maximum Face Runout (12 O'Clock) Maximum Face Runout (3 and 9 O'Clock)	0.30 mm (0.012 in.) 0.25 mm (0.010 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 Bearing Bore Concentricity	Maximum Variation	0.127 mm (0.005 in.)
Flywheel Pilot Bearing Bore (3-Cylinder Engines)	ID	39.967—39.993 mm (1.5735—1.5745 in.)
Flywheel Pilot Bearing Bore (4-Cylinder Engines)	ID	71.970—72.000 mm (2.8335—2.8346 in.)

Continued on next page

Item	Measurement	Specification
Flywheel-to-Crankshaft Flanged-Head, High Strength Cap Screws	Initial Torque Final Torque-Turn	55 N•m (40 lb-ft) 1/6 turn (60 degrees)
Flywheel-to-Crankshaft Hexagon Head Cap Screws (Plated w/Washers)	Torque	163 N•m (120 lb-ft)
Flywheel-to-Crankshaft Hexagon Head Cap Screws (Plated w/o Washers)	Torque	150 N•m (111 lb-ft)
Flywheel-to-Crankshaft Allen Head Cap Screws	Torque	160 N•m (118 lb-ft)
Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number —419999)	Torque	115 N•m (85 lb-ft)
Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number 420000—)	Torque	135 N•m (100 lb-ft)
Saran-Built Engines: Main Bearing Cap Screw (Serial No. —135640)	Torque	115 N•m (85 lb-ft)
Saran-Built Engines: Main Bearing Cap Screw (Serial No. 135641—)	Torque	135 N•m (100 lb-ft)
Crankshaft Main Bearing-to-Journal	Clearance	0.025—0.102 mm (0.0009—0.0040 in.)
Crankshaft Main Bearing (Standard)	ID	79.375—79.426 mm (3.1249—3.1270 in.)
Crankshaft Main Journal (Standard)	OD	79.324—79.350 mm (3.1229—3.1240 in.)

Continued on next page

DPSG,OUO1004,489 –19–07NOV98–3/5

Item	Measurement	Specification
Crankshaft Rod Journal (Standard 3029, 4039, and 6059 Engines)	OD	69.80—69.83 mm (2.748—2.749 in.)
Crankshaft Rod Journal (Standard 4045 and 6068 Engines)	OD	77.80—77.83 mm (3.063—3.064 in.)
Crankshaft Main Bearing-to-Journal	Oil Clearance	0.025—0.102 mm (0.0009—0.0040 in.)
Crankshaft Main or Rod Journal	Maximum Taper Maximum Out-of-Round	0.010 mm (0.0004 in.) 0.005 mm (0.0002 in.)
Crankshaft Main Thrust Bearing Journal (New)	Width	38.952—39.028 mm (1.5335—1.5365 in.)
Crankshaft Main Thrust Bearing (Standard)	Width	38.811—38.862 mm (1.5279—1.5299 in.)
Crankshaft Main Thrust Bearing-to-Journal (Side)	Oil Clearance	0.090—0.217 mm (0.0035—0.0085 in.)
Crankshaft Main Bearing Bore (Without Bearings)	ID	84.455—84.480 mm (3.3249—3.3259 in.)
Crankshaft Main Bearing Bore Centerline-to-Top Deck (3029/4039/6059)	Distance (Minimum)	301.981 mm (11.8889 in.)
Crankshaft Main Bearing Bore Centerline-to-Top Deck (4045/6068)	Distance (Minimum)	337.871 mm (13.3019 in.)
Piston Cooling Orifice	Torque	10.5 N•m (7.7 lb-ft) (93 lb-in.)
Flywheel Housing Allen Head Cap Screws (6000 Series Tractors)	Torque	183 N.m (135 lb-ft)
SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws	Initial Torque	30 N•m (22 lb-ft)
SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws	Final Torque	47 N•m (35 lb-ft)

Continued on next page

DPSG,OUO1004,489 –19–07NOV98–4/5

Item	Measurement	Specification
SAE 2, 3, and 4 Flywheel Housing 5/8 in. Cap Screws	Torque	230 N•m (170 lb-ft)
Standard Flat Flywheel Housing 3/8 in. Cap Screws	Initial Torque	30 N•m (22 lb-ft)
SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws	Final Torque	47 N•m (35 lb-ft)
Special Flat Flywheel Housing 3/8 in. Cap Screws	Initial Torque	30 N•m (22 lb-ft)
SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws	Final Torque	47 N•m (35 lb-ft)
Special Flat Flywheel Housing 3/4 x 2-1/2 in. Cap Screws	Torque	450 N•m (330 lb-ft)
Special Flat Flywheel Housing 3/4 x 3-1/2 in. Cap Screws	Torque	570 N•m (420 lb-ft)
Special Flat Flywheel Housing 5/8 x 2-1/4 in. Cap Screws	Torque	325 N•m (240 lb-ft)
Flywheel Housing Seal Bore	Maximum Permissible Run-Out	0.152 mm (0.006 in.)

DPSG,OUO1004,489 –19–07NOV98–5/5

CRANKSHAFT AND MAIN BEARING FAILURE ANALYSIS

Scored Main Bearing:
(Diagnosis also applies to connecting rod bearing.)

- Oil starvation.
- Contaminated oil.
- Engine parts failure.
- Excessive heat.
- Poor periodic service.

Galled or "Wiped" Bearings:

- Fuel in lubricating oil (incomplete combustion).
- Coolant in lubrication system (cracked block, liner seal failure, or leaking water pump seal with plugged hole).
- Insufficient bearing oil clearance.
- Parts not lubricated prior to engine operation.
- Wrong bearing size.

Inconsistent Wear Pattern:

- Misaligned or bent connecting rod.
- Warped or bowed crankshaft.
- Distorted cylinder block.

Broken Main Bearing Caps:

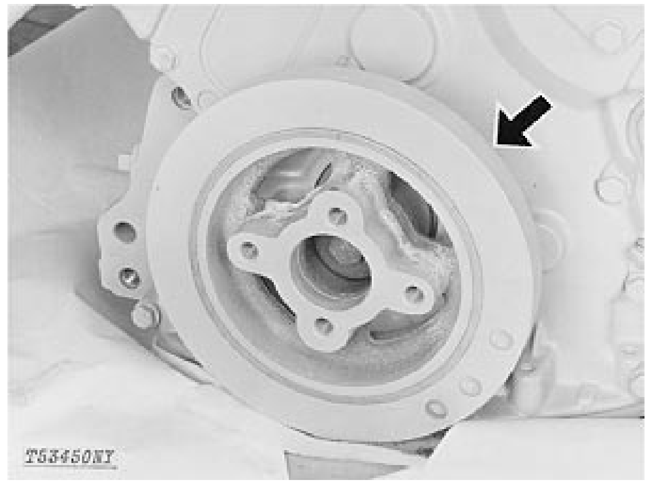
- Improper installation.
- Dirt between bearing and crankshaft journal.
- Low oil pressure.
- Oil pump failure.

Cracked, Chipped or Broken Bearings:

- Overspeeding.
- Excessive idling.
- Lugging.
- Excessive oil clearance.
- Improper installation.

S11,2015,C –19–29SEP94–1/1

INSPECT VIBRATION DAMPER (6-CYLINDER ENGINE)



T53450NY –UN–23FEB89

IMPORTANT: If the damper came loose during engine operation, replace damper and check crankshaft for fretting. If the crankshaft shows evidence of fretting, replace crankshaft.

Do not immerse the vibration damper in cleaning solvent or any petroleum product. Rubber portion of damper may be damaged.

Never apply thrust on outer ring. Damper is sensitive to impact damage, such as being dropped or struck with a hammer.

The damper assembly is not repairable. Replace damper every 5 years or 4500 hours, whichever occurs first. Also, replace damper whenever crankshaft is replaced or after major engine overhaul.

1. Grasp outer ring of damper and attempt to turn it in both directions. If rotation is felt, damper is defective and should be replaced. Also, if rubber is separated, partially missing, or displaced, replace damper.

Continued on next page

S11,2015,EF –19–29SEP94–1/3

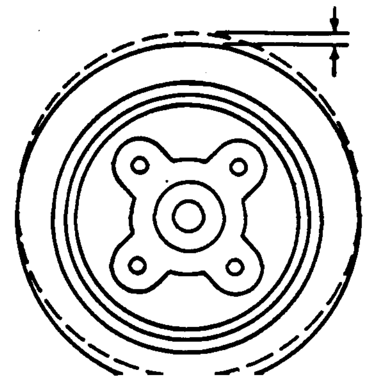
2. Check vibration damper radial runout by positioning a dial indicator so probe contacts damper OD.

3. With engine at operating temperature, rotate crankshaft using JDG820 or JDE83 Flywheel Rotation Tool.

4. Note dial indicator reading. If runout exceeds specifications given below, replace vibration damper.

Damper (w/o Front PTO)—Specification

Maximum Radial Runout.. 1.50 mm (0.060 in.)



RG4779 –UN–14DEC88

S11,2015,EF –19–29SEP94–2/3

5. Check vibration damper wobble using a dial indicator.

   Measure wobble at the outer edges of damper face (A).

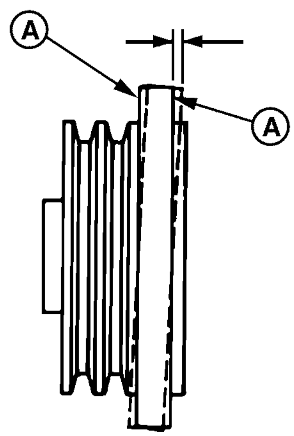
6. Rotate crankshaft one complete revolution using engine rotation tool, and note total dial indicator movement. Compare readings with specifications below.

Damper Pulley Outer Ring (w/o Front PTO)—Specification

Wobble (Maximum) .... 1.50 mm (0.060 in.)

Damper or Pulley (w/o Front PTO)—Specification

Wobble (Maximum) .... 0.5 mm (0.020 in.)



RG5679 –UN–31OCT97

Damper Wobble

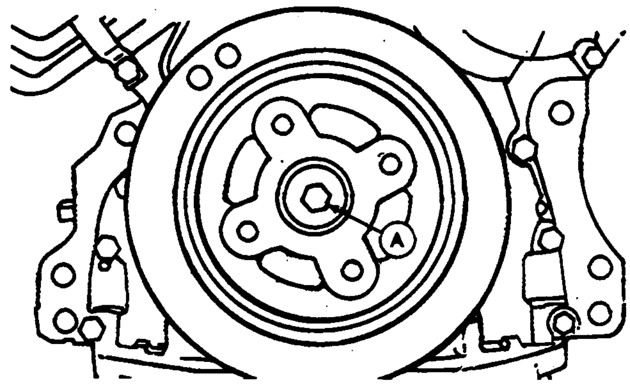
S11,2015,EF –19–29SEP94–3/3

REMOVE PULLEY OR VIBRATION DAMPER PULLEY (ENGINE W/O FRONT PTO)

NOTE: The V-belt pulley used on engines without a vibration damper attaches to engine same as damper pulley shown.

IMPORTANT: Never apply thrust on outer ring of damper. Do not drop or hammer on damper.

1. Remove pulley or damper pulley cap screw (A).



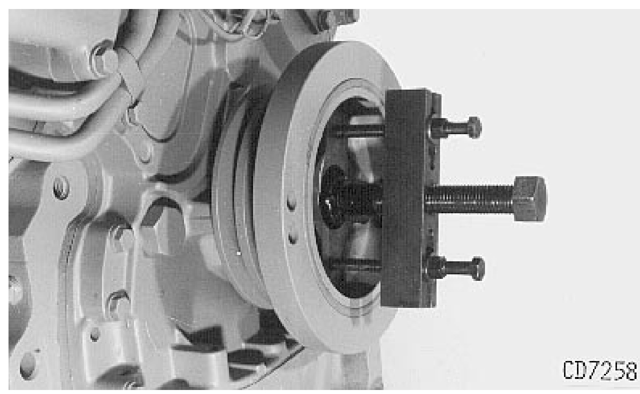
RG5113 –UN–14DEC88

S11,2015,EI –19–16SEP92–1/2

NOTE: Lubricate threads of JDG410 Puller before installing.

2. Using JDG410 Puller or other suitable puller, remove damper pulley from crankshaft.

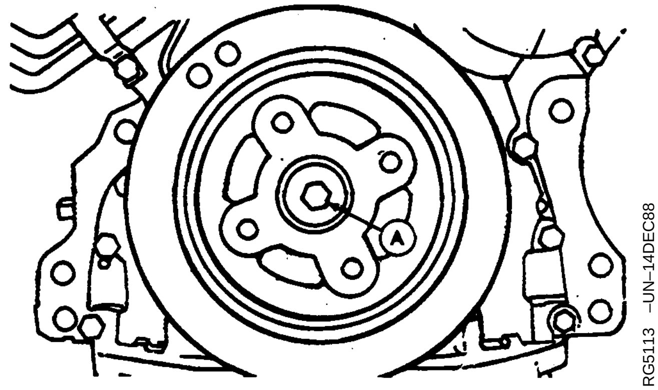
NOTE: On 6000 Series Tractors, use KJD10206 Crankshaft Pulley Puller.



CD7258 –UN–23MAY95

S11,2015,EI –19–16SEP92–2/2

INSTALL PULLEY OR VIBRATION DAMPER PULLEY (ENGINE W/O FRONT PTO)



A—Cap Screw

45 MM OR 1/2 X 1-3/4 IN. CAP SCREW MOUNTED DAMPERS

1. Position damper pulley on crankshaft. Handle damper with care to avoid impact damage.

IMPORTANT: Damper pulley-to-crankshaft cap screw must be SAE Grade 8 or higher. If a lower grade cap screw was previously used on engine, replace it with an appropriate SAE Grade 8 or higher cap screw.

2. Apply LOCTITE® 242 Thread Lock and Sealer to cap screw (A) threads. Install cap screw and 12 mm (0.47 in.) thick washer (with flat side toward crankshaft).

NOTE: Some engines are equipped with a 10 mm (0.39 in.) thick washer, but cap screw torque remains the same.

3. Tighten cap screw (A) to specifications.

Crankshaft Damper Pulley w/o Front PTO or Auxiliary Drive (45 mm or 1/2 x 1-3/4 in. Cap Screw Mounted) (Dubuque Engines)—Specification

Torque .... 183 N•m (135 lb-ft)

Crankshaft Damper Pulley w/o Auxiliary Drive (45 mm Cap Screw Mounted) (Saran Engines)—Specification

Torque .... 150 N•m (110 lb-ft)

112 MM CAP SCREW MOUNTED DAMPERS

1. Clean the bore of the vibration damper and the nose of the crankshaft then lightly lubricate hub and crank nose with clean engine oil.

2. Position damper pulley on crankshaft. Handle damper with care to avoid impact damage.

LOCTITE is a registered trademark of Loctite Corp.

Continued on next page

S11,2015,EJ –19–27DEC94–1/2

3. Apply clean engine oil to threads and under head of cap screw (A). Install washer with the flat side toward crankshaft.

4. Tighten cap screw to specifications.

Crankshaft Damper Pulley w/o Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)—Specification

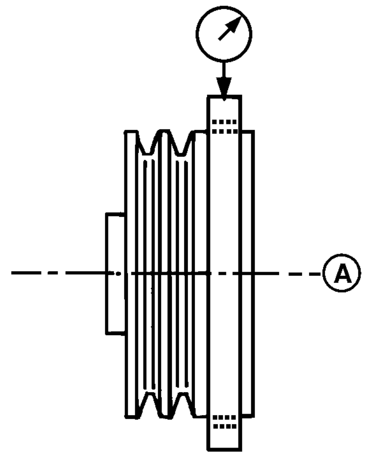
Initial Torque.. 150 N•m (110 lb-ft)

Crankshaft Damper Pulley w/o Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)—Specification

Torque Turn (Final Torque)... 50—70°

S11,2015,EJ –19–27DEC94–2/2

CHECKING VIBRATION DAMPER OR PULLEY (ENGINE WITH FRONT PTO)



RG7123 –UN–03NOV97

IMPORTANT: If the damper came loose during engine operation, replace damper and check crankshaft for fretting. If the crankshaft shows evidence of fretting, replace crankshaft.

NOTE: When cleaning damper, never soak in a cleaning solvent. Use a steam cleaner, soap solution or water only.

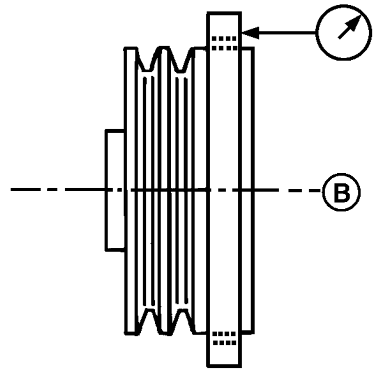
1. Prior to disassembly, check the following specifications:

Vibration Damper Only (w/Front PTO)—Specification

Maximum radial run-out (A).. 1.50 mm (0.060 in.)
Maximum wobble (B)... 1.50 mm (0.060 in.)

Vibration Damper Pulley (w/Front PTO)—Specification

Maximum wobble (C) .... 0.5 mm (0.02 in.)

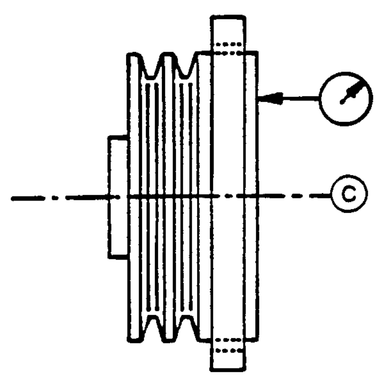


RG7124 –UN–03NOV97

2. Replace damper if total run-out (A) or wobble (B) exceeds specifications, or if outer ring has slipped relative to rubber member or drive hub.

3. Grasp damper and attempt to turn in both directions (clockwise and counterclockwise). If rotation is felt, replace damper.

4. If wobble (C) exceeds specifications, it indicates improper mating of tapered surfaces due to uneven tightening of collet cap screws or damage to one or both the tapered surfaces.



RG7125 –UN–06OCT94

IMPORTANT: Replace damper after 4500 hours or every five years, whichever occurs first.

RG,CTM8,DX160 –19–27DEC94–1/1

REMOVING VIBRATION DAMPER OR PULLEY (ENGINE WITH FRONT PTO)

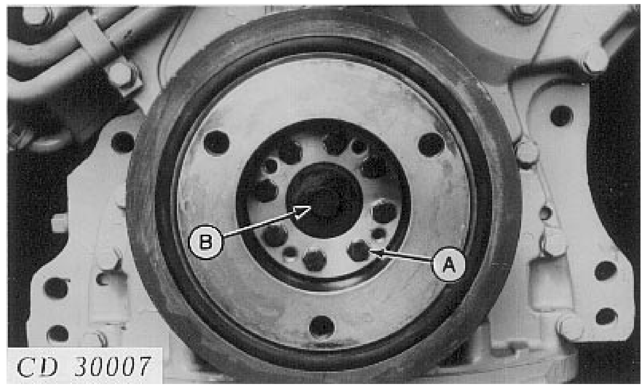
1. Remove cap screws (A) attaching damper or pulley to collet.

IMPORTANT: Never tap or apply thrust to outer ring of damper.

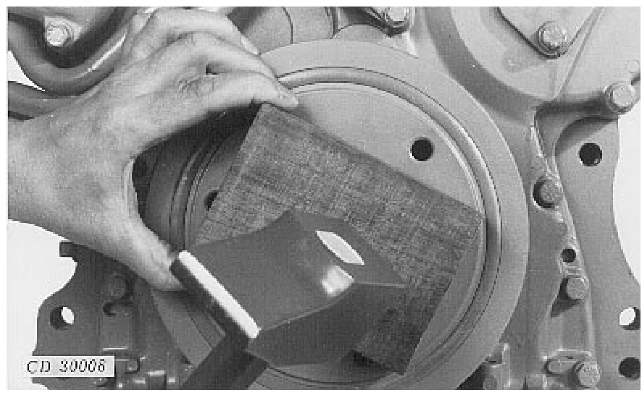
2. Using a wooden block and a hammer, tap on inner damper ring or pulley until it loosens from conical seat of collet.

3. Remove collet attaching cap screw (B).

4. Remove collet and damper or pulley.



CD30007 –UN–05OCT94

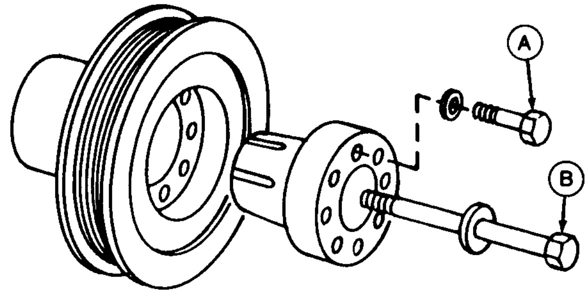


CD30008 –UN–05OCT94

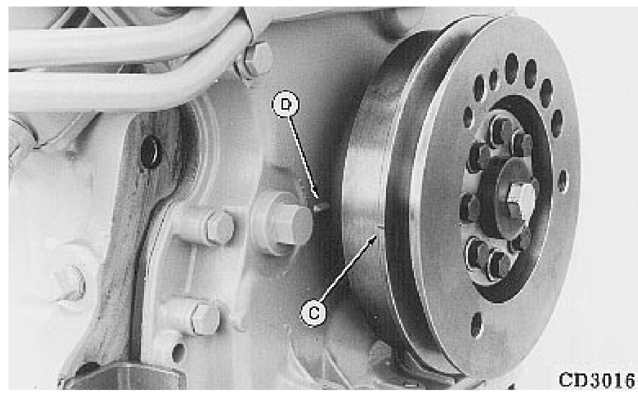
A—Damper Cap Screws
B—Collet Cap Screw

RG,CTM8,DX344 –19–08FEB95–1/1

INSTALLING VIBRATION DAMPER OR PULLEY (ENGINE WITH FRONT PTO)



RG7128 –UN–06OCT94



CD30160 –UN–05OCT94

A—Cap Screw
B—Collet Retaining Cap Screw
C—External Groove Mark on Pulley
D—TDC Reference Mark on Timing Gear Cover

1. Clean then lubricate crankshaft nose and bore of collet.
2. Position collet in damper or pulley. Install both cap screws (A) 180° apart to keep collet with the damper or pulley.
3. Install collet/damper or collet/pulley assembly on the crankshaft with washer and cap screw (B).
4. **For 3-cylinder engines only** , put cylinder No. 1 at TDC then turn pulley/collet assembly so that external groove mark (C) on pulley is aligned with TDC reference mark on timing gear cover (D).
5. Tighten collet retaining cap screw (B) to specifications.

Crankshaft Damper Pulley w/Front PTO or Auxiliary Drive (1/2 x 2-1/2 in.Cap Screw Mounted)—Specification

Torque .... 183 N•m (135 lb-ft)

Crankshaft Damper Pulley w/Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)—Specification

Initial Torque.. 150 N•m (110 lb-ft)

Crankshaft Damper Pulley w/Front PTO or Auxiliary Drive (112 mm Cap Screw Mounted)—Specification

Torque Turn (Final Torque)... 50—70°

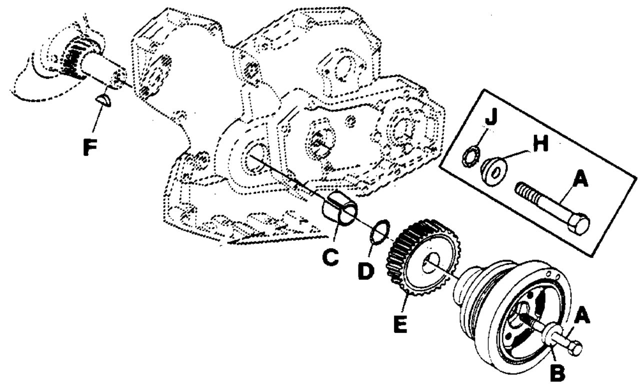
6. Tighten the two collet cap screws (previously installed) alternately and evenly to torque specification below.
7. Install remaining six collet cap screws. Again, alternately and evenly tighten the next two cap screws 90° from the first two cap screws. Tighten the remaining cap screws in opposing pairs to specifications.

Front PTO Collet Cap Screws—Specification

Torque .... 35 N•m (25 lb-ft)

8. Check damper/pulley wobble to ensure that tapered surfaces are mated correctly.

INSTALLING VIBRATION DAMPER OR PULLEY (ENGINE WITH CRANKSHAFT GEAR-DRIVEN PTO)



CD630P3 –UN–13MAY98

A—Damper Cap Screw
B—Hardened Washer
C—Collet
D—O-Ring
E—Auxiliary Drive Gear
F—Woodruff Key
G—Not Used
H—Special Washer
I—Not Used
J—O-Ring

1. Clean then lubricate crankshaft nose and bore of collet.

2. Slide collet onto nose of crankshaft with large diameter toward crankshaft gear.

NOTE: On engines equipped with special washer (H) and O-ring (J), O-ring (D) is not needed.

3. If equipped, install O-ring (D) on crankshaft and position against front edge of collet.

4. Clean and lubricate ID of auxiliary drive gear (E) with clean engine oil and place on collet.

5. Using JDG794 Gear Installer, push drive gear onto collet by tightening nut to 150 N•m (110 lb-ft). Remove tool.

6. Install woodruff key (F) in key slot of crankshaft.

7. Install damper on crankshaft. Apply clean engine oil to threads and under side of bolt head (A). Place hardened washer (B) with flat side toward threads on cap screw and install in crankshaft. Tighten cap screw to specifications.

Crankshaft Damper Pulley w/Crankshaft Gear Driven PTO (45 mm Cap Screw Mounted)—Specification

Torque .... 183 N•m (135 lb-ft)

Crankshaft Damper Pulley w/Crankshaft Gear Driven PTO (112 mm Cap Screw Mounted)—Specification

Initial Torque.. 150 N•m (110 lb-ft)

Crankshaft Damper Pulley w/Crankshaft Gear Driven PTO (112 mm Cap Screw Mounted)—Specification

Torque Turn (Final Torque)... 50—70°

8. Check damper/pulley wobble to ensure that tapered surfaces are mated correctly.

DPSG,OUO1004,373 –19–08OCT98–1/1

REPLACE FRONT CRANKSHAFT OIL SEAL (WITHOUT REMOVING TIMING GEAR COVER)

NOTE: If timing gear cover is to be removed, remove seal after cover is removed.

TO REMOVE FRONT OIL SEAL

1. Remove V-belts.

NOTE: DO NOT use a jaw-type puller to remove vibration damper. Damage could result to the damper.

2. Remove cap screw (A) and washer. Remove vibration damper/pulley or pulley from crankshaft using JDG410 Puller or equivalent puller, as previously instructed in this group.

3. Remove Woodruff key from key slot of crankshaft.

4. Center punch seal casing at 12 O'clock position and drill 1/8 in. hole in casing.

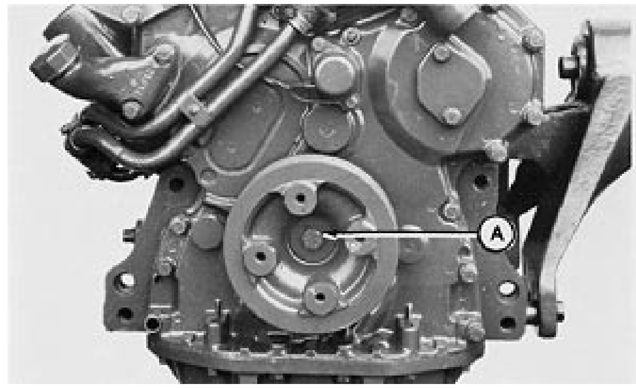
5. Remove seal from timing gear cover using JDG22 Seal Remover or JDG719 Seal Puller along with JDE38-2 Shank and JDE38-3 Hammer. Be careful not to damage seal bore in timing gear cover.

IMPORTANT: If wear ring can not be removed with timing gear cover installed, remove timing gear cover and remove wear ring. Wear ring MUST BE replaced whenever oil seal is replaced.

NOTE: The shoulder on pulley serves as a wear ring on crankshaft gear-driven auxiliary drive engines.

6. On non-auxiliary drive (crankshaft gear-driven) engines, remove wear ring from crankshaft flange. Remove O-ring from crankshaft after wear ring is removed.

7. Thoroughly clean crankshaft flange and seal housing bore to assure oil seal will seal properly after installation.



CD7373 –UN–23FEB89

A—Cap Screw

Continued on next page

S11,2015,EM –19–16FEB95–1/4

TO INSTALL FRONT OIL SEAL

IMPORTANT: Wear ring must be installed after the oil seal to avoid rolling seal lips.

1. Inspect and clean seal bore in cover. Check for nicks or burrs. Use a medium-grit emery cloth to smooth rough areas.

IMPORTANT: To assure proper sealing, the OD of the crankshaft and ID of the wear ring MUST BE cleaned with prior to installing seal. Use Brake Kleen, Ignition Cleaner and Drier or any suitable cleaner that will remove sealant.

NOTE: Timing gear cover shown removed in upper photo for illustration purposes only.

2. If an O-ring is used, lightly lubricate a new O-ring with engine oil and install O-ring inboard, positioned next to oil deflector.

3. Apply a light coating of clean engine oil to lips of seal and position seal on crankshaft. (The spring-loaded side of seal goes into timing gear cover first.)

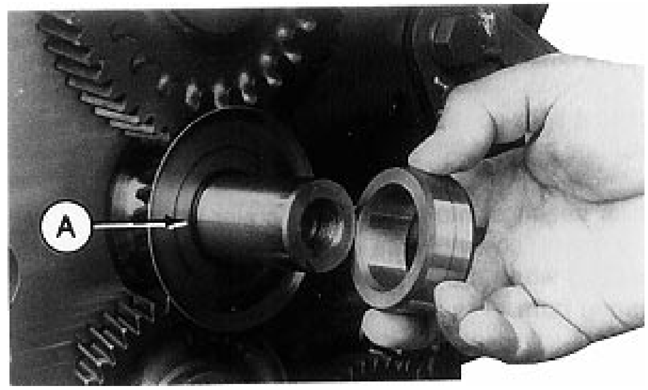
NOTE: KJD10164 Seal Driver Set contains a spacer (D) for use on engine equipped with short nose crankshafts. Use damper retaining cap screw with KJD10164.

4. Slide driver (B) on nose of crankshaft against seal. Install forcing screw (C) with washer.

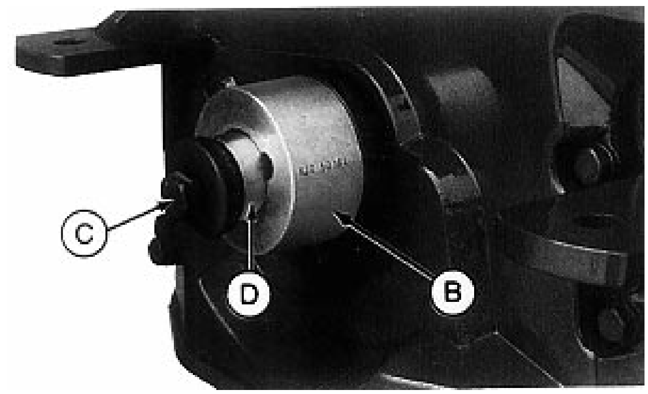
5. Tighten screw until driver bottoms in seal bore of timing gear cover.

NOTE: The shoulder on pulley serves as a wear ring on crankshaft gear-driven auxiliary drive engines.

6. On non-crankshaft gear-driven auxiliary drive engines, lightly lubricate new wear ring with clean engine oil and install on crankshaft against O-ring. Be sure seal lips are properly positioned on wear ring.



RG7302 –UN–20FEB95



RG7303 –UN–20FEB95

A—O-Ring
B—Driver[1]
C—Forcing Screw with Washer[1]
D—Spacer[1]

[1]*Part of KJD10164 Front Crankshaft Seal Driver*

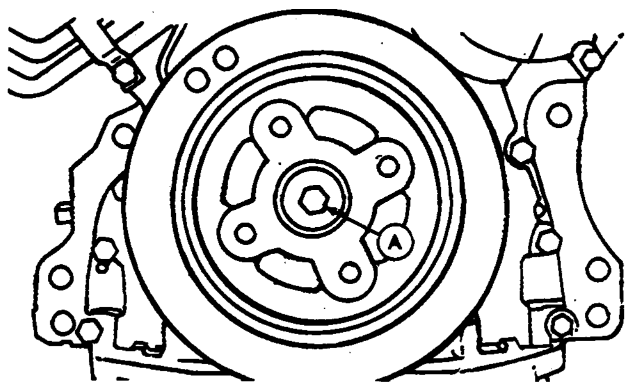
Continued on next page

7. Install Woodruff key in key slot of crankshaft. Seat key all the way in slot.

8. Lightly coat pulley hub with clean engine oil.

S11,2015,EM –19–16FEB95–3/4

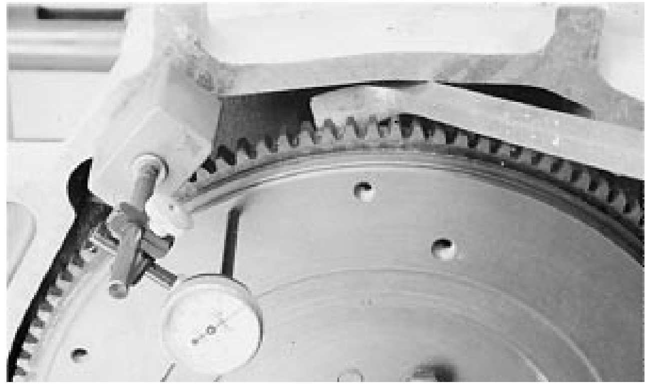
9. Install pulley or damper/pulley on crankshaft. (See procedure earlier in this group.)



RG5113 –UN–14DEC88

S11,2015,EM –19–16FEB95–4/4

CHECK CRANKSHAFT END PLAY



T88331 –UN–14OCT88

Measure end play prior to removing crankshaft to determine condition of thrust bearings.

1. Position dial indicator on contact face of flywheel, on front crankshaft nose, on damper, or front pulley assembly if installed.

IMPORTANT: Do not apply too much pressure with bar, as this could damage bearings.

2. Using a prybar, gently push crankshaft as far to rear of engine as possible.

3. Zero the dial indicator.

4. Gently pry the crankshaft as far forward as possible. Note indicator reading. If end play is not within specifications, install new thrust bearing.

Crankshaft, New Parts: Two-Piece Thrust Bearing—Specification

End Play .... 0.05—0.25 mm (0.002—0.010 in.)
Wear Limit .... 0.50 mm (0.020 in.)

Crankshaft, New Parts: Six-Piece Thrust Bearing—Specification

End Play .... 0.025—0.35 mm (0.001—0.014 in.)
Wear Limit .... 0.50 mm (0.020 in.)

If new thrust bearing does not restore proper end play, install a six-piece thrust bearing with oversize thrust washers[1].

[1] *Six-piece thrust bearings will not fit early production engines with 110 mm (4.33 in.) diameter undercut on main bearing web. Web undercut in block and on cap must be 113.8 mm (4.48 in.) diameter in order to accept five-piece thrust bearings.*

Continued on next page

CTM8,GR15,5 –19–28DEC94–1/2

IMPORTANT: Service thrust bearing kits are now supplied with a six-piece thrust bearing assembly. It is acceptable to use a six-piece bearing where five-piece bearing was previously used. Follow installation instructions provided with kit.

CTM8,GR15,5 –19–28DEC94–2/2

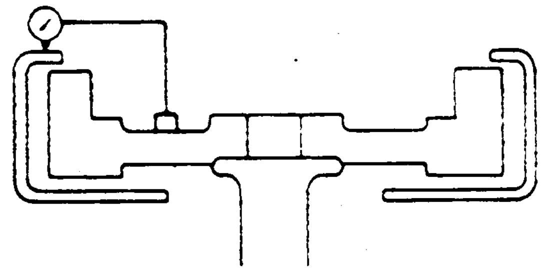
INSPECT FLYWHEEL

1. Inspect the clutch contact face for scoring, overheating, or cracks. Replace flywheel if defective.

2. Examine flywheel ring gear for worn or broken teeth. Replace ring gear if defective, as described later in this group.

RG,CTM8,GR15,43 –19–22JUL92–1/1

CHECK FLYWHEEL HOUSING FACE RUNOUT



R22212 –UN–14DEC88

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.

2. Preload indicator tip. Set dial indicator to 0.0 mm (in.).

IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel housing face runout.

3. Rotate flywheel by turning crankshaft. Read total indicator movement. It should not exceed specifications.

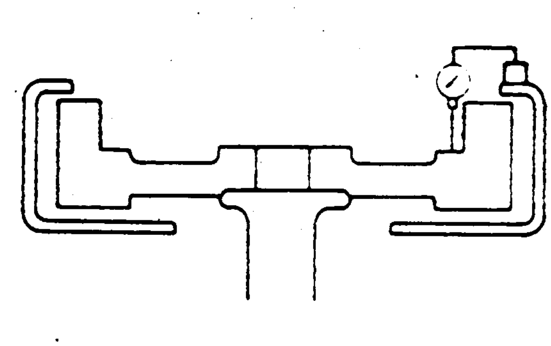
Flywheel Housing—Specification

Maximum Face Runout .... 0.30 mm (0.012 in.)
(12 O'Clock)
Maximum Face Runout .... 0.25 mm (0.010 in.)
(3 and 9 O'Clock)

If runout exceeds specifications, resurface flywheel housing face or replace housing as necessary.

RG,CTM8,GR15,44 –19–28DEC94–1/1

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.

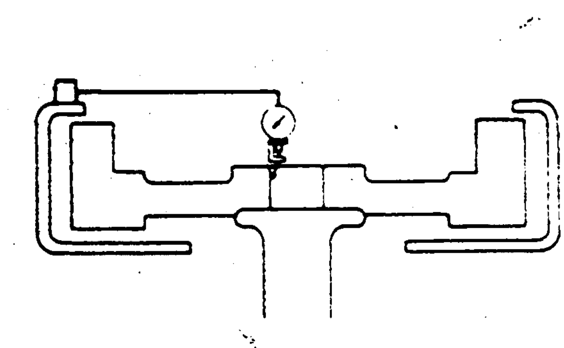
2. Rotate flywheel by turning crankshaft. Read total indicator movement. Resurface flywheel face or replace as required.

Flywheel Face Flatness—Specification

Maximum Variation.. 0.23 mm (0.009 in.)
Maximum Variation per 25 mm............................. 0.013 mm (0.0005 in.)
(1.0 in.) of Travel

RG,CTM8,GR15,45 –19–22JUL92–1/1

CHECK PILOT BEARING BORE CONCENTRICITY



1. Mount dial indicator on flywheel housing face and position pointer to contact I.D. of pilot bearing bore in flywheel.

2. Rotate flywheel by turning crankshaft. Read total dial indicator movement.

Flywheel Bearing Bore Concentricity—Specification

Maximum Variation.. 0.127 mm (0.005 in.)

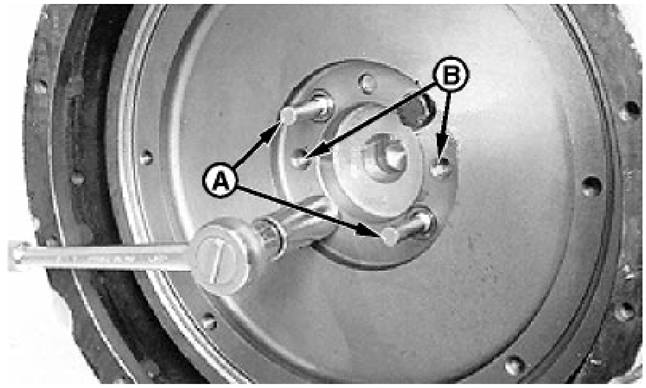
DPSG,OUO1004,69 –19–21APR98–1/1

REMOVE FLYWHEEL

CAUTION: Flywheel is heavy. Plan a proper lifting procedure to avoid personal injury.

1. Remove two cap screws and install guide studs (A) in their place. Remove the remaining cap screws.

2. Install two cap screws in threaded jack screw holes (B). Tighten cap screws evenly to remove flywheel.



RG9075 –UN–16MAR98

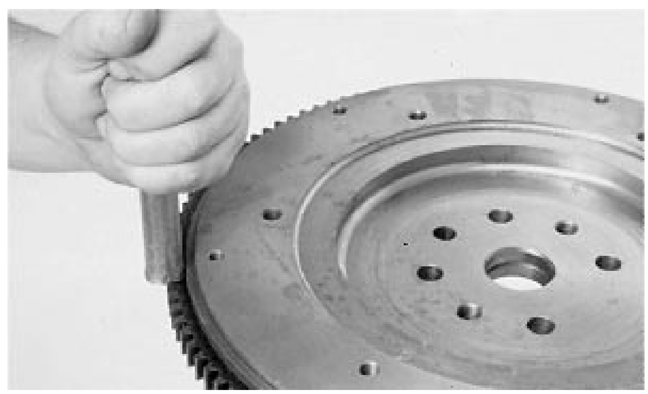
Four Cap Screw Flywheel

A—Guide Studs
B—Jack Screw Holes

CTM8,GR15,10 –19–22JUL92–1/1

REPLACE FLYWHEEL RING GEAR

CAUTION: Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer and do not exceed 182°C (360°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.



T90596 –UN–14OCT88

1. If ring gear is damaged, place the flywheel on a solid flat surface.

2. Remove ring gear with a brass drift and hammer.

IMPORTANT: If flame heat is used, be sure gear is heated uniformly around circumference. DO NOT OVERHEAT. Overheating may destroy original heat treatment of gear. SEE CAUTION.

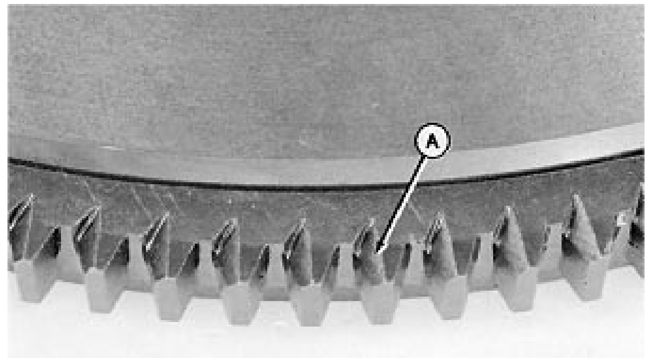
3. Heat new ring gear to 148°C (300°F) using either heated oil, oven heat, or flame heat.

Continued on next page

S11,2015,FX –19–16SEP92–1/2

15
30

4. Install ring gear against shoulder of flywheel so chamfered side (A) is on engine side of flywheel.



A—Flywheel Chamfer

S11,2015,FX –19–16SEP92–2/2

REPLACE PILOT BEARING IN FLYWHEEL—3029, 4039, 4045 ENGINES (IF EQUIPPED)

NOTE: Some 3029, 4039, and 4045 engines are equipped with a ball bearing (D) in flywheel (E). Flywheel must be removed from the engine to replace this bearing.

1. With flywheel removed from engine, drive bearing out of flywheel using appropriate disks and handle (A) from D01045AA Bushing, Bearing and Seal Driver Set. Discard bearing.

2. Measure flywheel bore diameter. If bore is larger than specifications, replace flywheel.

Flywheel Pilot Bearing Bore (3-Cylinder Engines)—Specification

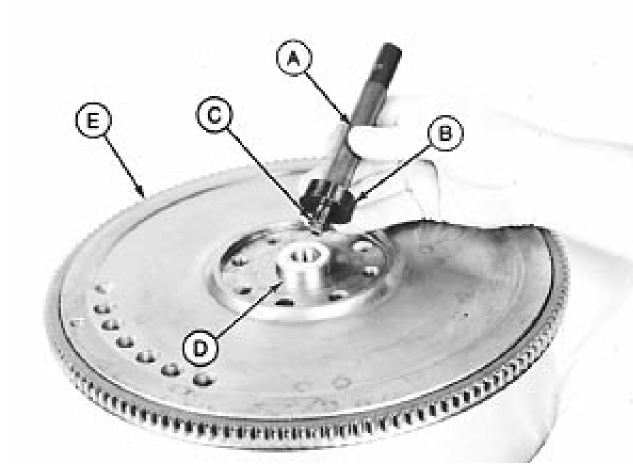
ID	39.967—39.993 mm (1.5735—1.5745 in.)

Flywheel Pilot Bearing Bore (4-Cylinder Engines)—Specification

ID	71.970—72.000 mm (2.8335—2.8346 in.)

IMPORTANT: Push on outer bearing race when installing in flywheel. Bearing may be damaged if force is applied to inner bearing race.

3. Drive new ball bearing into engine side of flywheel using 27487 Driver (A), 27508 Disk (B), and 27493 Disk (C), from D01045AA Bushing, Bearing and Seal Driver Set, until bearing bottoms in bore. Check bearing for smooth operation.



RG6345 –UN–03AUG92

A—27487 Driver
B—27508 Disk
C—27493 Disk
D—Ball Bearing
E—Flywheel

RG,CTM8,GR15,27 –19–28DEC94–1/1

INSTALL FLYWHEEL

RG5633 –UN–02APR90

CAUTION: Flywheel is heavy. Plan a proper handling procedure to avoid injuries.

IMPORTANT: Flywheel MUST BE clean and free of any oil, grease or debris.

1. Install two guide studs in crankshaft cap screw threaded holes. Place flywheel on studs and slide into position against crankshaft.

IMPORTANT: ALWAYS install new flywheel cap screws when flywheel has been removed.

2. Apply LOCTITE® 242 (TY9370) to threads of all flywheel mounting cap screws. Start cap screws in crankshaft. Do not tighten until guide studs are removed and all cap screws are started.

3. Tighten cap screws to specifications below.

Flywheel-to-Crankshaft Flanged-Head, High Strength Cap Screws—Specification

Initial Torque .... 55 N•m (40 lb-ft)
Final Torque-Turn.. 1/6 turn (60 degrees)

Flywheel-to-Crankshaft Hexagon Head Cap Screws (Plated w/Washers)—Specification

Torque .... 163 N•m (120 lb-ft)

Flywheel-to-Crankshaft Hexagon Head Cap Screws (Plated w/o Washers)—Specification

Torque .... 150 N•m (111 lb-ft)

Flywheel-to-Crankshaft Allen Head Cap Screws—Specification

Torque .... 160 N•m (118 lb-ft)

NOTE: Flywheels and front crankshaft pulleys from 3029 engines are not interchangeable with other engine models. 3-cylinder engines are externally balanced.

LOCTITE is a registered trademark of Loctite Corp.

RG,CTM8,GR15,28 –19–28DEC94–1/1

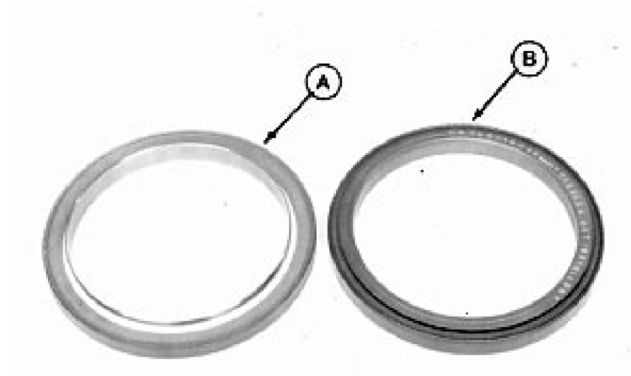
CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE GENERAL INFORMATION

Two types of oil seal and wear sleeve assemblies are used:

- A two-piece oil seal and wear sleeve assembly (A) that can easily be separated by hand.
- A unitized (non-separable) oil seal and wear sleeve assembly (B).

Removal of the two oil seal and wear sleeve types are different; refer to the appropriate procedure when servicing rear crankshaft oil seal and wear sleeve assembly.

The unitized (non-separable) oil seal assembly is the only type that is currently available through service parts.



RG5634 –UN–02APR90

A—Two Piece Seal and Sleeve
B—Unitized Seal and Sleeve

CTM8,GR15,18 –19–16FEB95–1/1

CRANKSHAFT UNITIZED REAR OIL SEAL AND WEAR SLEEVE HANDLING PRECAUTIONS

Use the following precautions for handling seal and wear sleeve assembly (A):

- Seal and wear sleeve are assembled. DO NOT SEPARATE. If parts become separated, discard and replace with a new assembly. Attempts to reassemble will cause the wear sleeve to damage the seal allowing engine oil to leak past seal.
- Always install seal and wear sleeve assembly immediately after removal from plastic bag to avoid possible dirt contamination.
- No lubrication of any kind is to contact seal when installing. Use of a lubricant may result in premature seal failure.
- Install oil seal/wear sleeve assembly with the open side of seal and wear sleeve ID chamfer toward the engine. If seal is reversed, engine oil may be lost because grooves in oil seal lip would be incorrect with respect to direction of crankshaft rotation.

RG5640A –UN–31OCT97

A—Wear Sleeve

DPSG,OUO1004,296 –19–01AUG98–1/1

REMOVE TWO-PIECE CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE (WITHOUT REMOVING FLYWHEEL HOUSING)

These instructions are for use when flywheel housing would not otherwise be removed from cylinder block. If flywheel housing is to be removed, remove seal and wear ring after housing is removed.

Remove flywheel as outlined earlier in this group.

Continued on next page

CTM8,GR15,19 –19–29SEP94–1/4

JDG698 SEAL AND WEAR SLEEVE REMOVER

1. Remove flywheel as outlined earlier in this group.

2. Adjust forcing screw on JDG698 Seal and Wear Sleeve Remover and position screw so it centers tool on crankshaft flange.

3. Using the slots in JDG698 tool as a template, mark three locations on oil seal casing where sheet metal screws will be installed.

4. Drill a hole through oil seal casing at the three locations marked.

5. Install three sheet metal screws into slots of removal tool and thread screws into drilled holes. Evenly tighten screws until plate is flush with rear face of crankshaft.

6. Tighten forcing screw in center of tool until the plate pulls evenly against the three sheet metal screws. Tighten forcing screw until oil seal is free from housing bore. Discard seal.

RG5636 –UN–02APR90

RG5635 –UN–02APR90

CTM8,GR15,19 –19–29SEP94–2/4

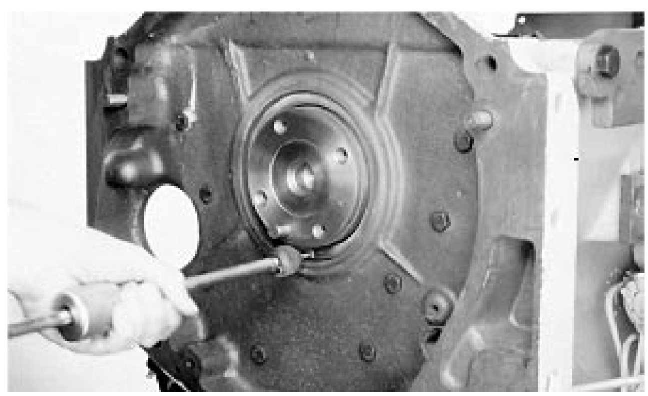
JDG22 SEAL REMOVER

Using JDG698 Seal and Wear Sleeve Remover is the preferred method for removing the rear crankshaft oil seal. If JDG698 tool is not available, JDG22 Seal Remover can be used to remove the seal.

1. Remove flywheel as outlined earlier in this group.

2. Drill a small hole through seal casing at three locations (equally spaced).

3. Use JDG22 Seal Remover and a sheet metal screw to pull seal from housing bore. Discard seal.

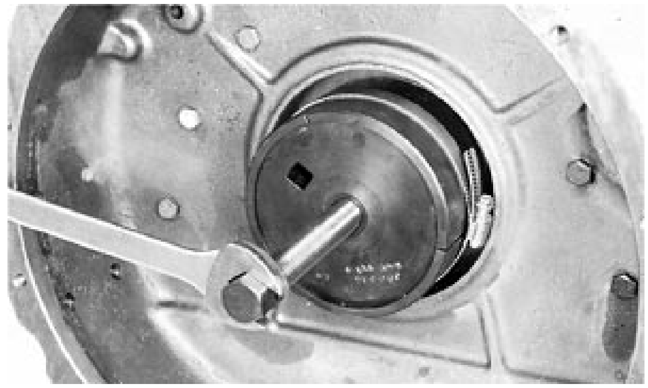


T81200 –UN–07NOV88

Continued on next page

CTM8,GR15,19 –19–29SEP94–3/4

JDG645 REAR WEAR SLEEVE PULLER


RG5637 –UN–02APR90

IMPORTANT: Do not gouge crankshaft flange. Nicks or burrs should be removed with a medium-grit stone. Polishing cloth (180-grit or finer) may also be used when a stone is not available.

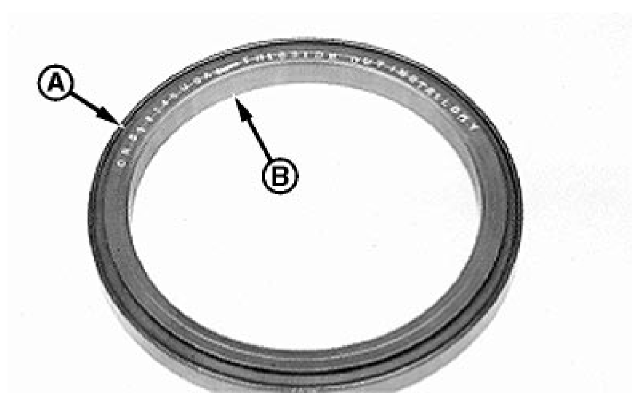
1. Adjust forcing screw on JDG645 Rear Wear Sleeve Puller and position screw with disc so it centers tool on crankshaft flange.
2. Assemble tool so puller pulls against inner edge of wear sleeve. Tighten band clamp until wear sleeve is secured within tool ID.
3. Tighten forcing screw until wear sleeve is removed from crankshaft.

CTM8,GR15,19 –19–29SEP94–4/4

REMOVE UNITIZED (NON-SEPARABLE) CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE

The unitized (non-separable) oil seal and wear sleeve MUST BE removed before removing flywheel housing.

The crankshaft rear oil seal (A) and wear sleeve (B) are fabricated as a non-separable part. To remove the oil seal/wear sleeve assembly, the two following procedures can be used depending on special tool availability.

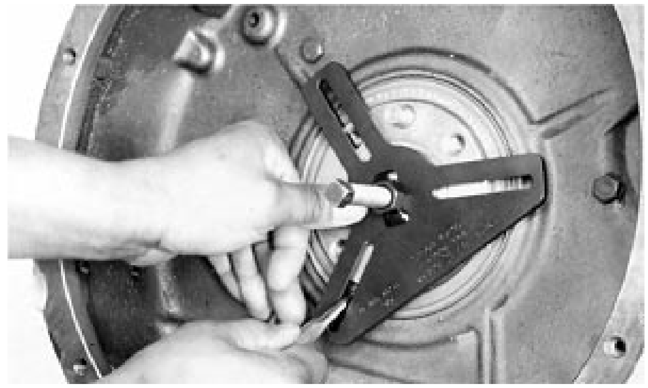


RG9083 –UN–16MAR98

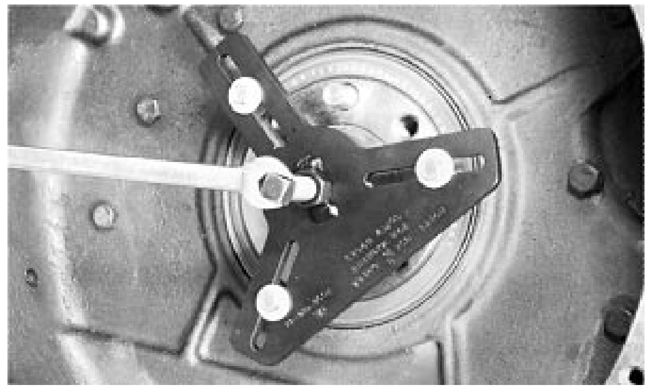
A—Oil Seal
B—Wear Sleeve

Continued on next page CTM8,GR15,23 –19–11OCT94–1/7

REMOVE OIL SEAL/WEAR SLEEVE USING JDG698



RG5638 –UN–02APR90



RG5639 –UN–02APR90

1. Remove flywheel.

2. Adjust forcing screw on JDG698 Seal and Wear Sleeve Remover and position screw so it centers tool on crankshaft flange.

3. Use the slots in JDG698 Remover as a template, mark three locations on seal casing where screws should be installed for removal purposes. Remove tool from crankshaft flange.

IMPORTANT: Holes must be drilled at outer edge of seal case. Screws will pull seal against wear ring, thereby removing both pieces.

4. Drill a 3/16 in. hole through wear sleeve lip and seal casing at the three marked locations.

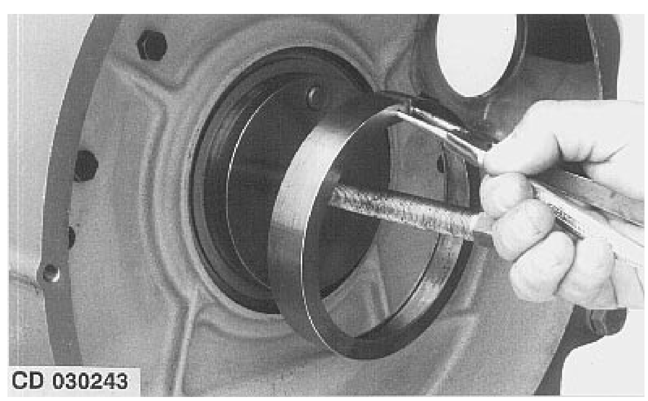
5. Position JDG698 Remover on end of crankshaft.

6. Install three 2-1/2 in. (approximate) sheet metal screws with washers into slots of removal tool and thread screws into holes in seal casing. Evenly tighten screws until plate is flush with rear face of crankshaft.

7. Tighten forcing screw (plate should pull evenly against the three screws) until seal and wear sleeve assembly is removed from engine.

CTM8,GR15,23 –19–11OCT94–2/7

REMOVE OIL SEAL/WEAR SLEEVE USING JDG645E

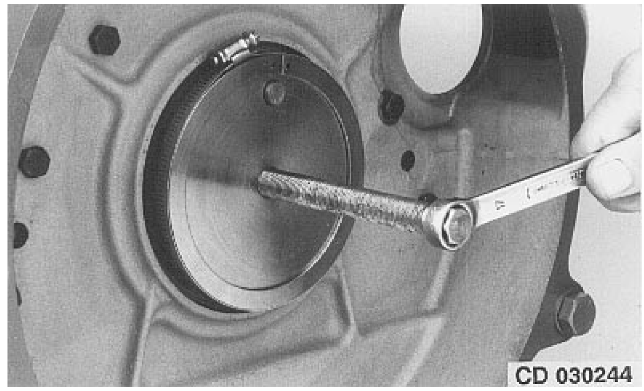


CD30243 –UN–06MAR95

1. Place and center JDG645E cap screws and driver plate asembly onto crankshaft rear face. Then, using snap ring pliers, set the thinner shoulder of ring tool between sleeve flange and seal case.

Continued on next page CTM8,GR15,23 –19–11OCT94–3/7

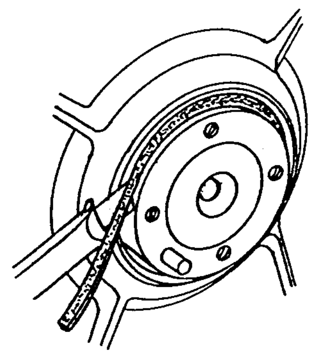
2. Secure the assembly with a clamp then gradually tighten the screw until wear sleeve is extracted.



CD30244 –UN–06MAR95

CTM8,GR15,23 –19–11OCT94–4/7

3. Cut the rubber lip (now accessible) and remove it.

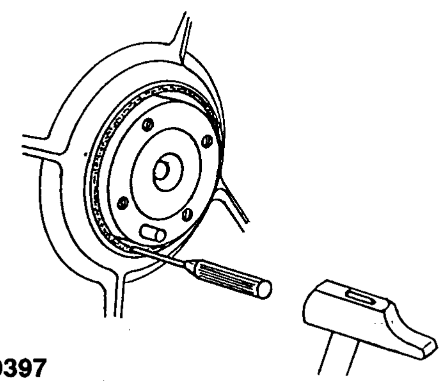


CD30396

CD30396 –UN–10MAY95

CTM8,GR15,23 –19–11OCT94–5/7

4. Using a punch and hammer, tap the seal case toward engine at any location until seal case pivots.

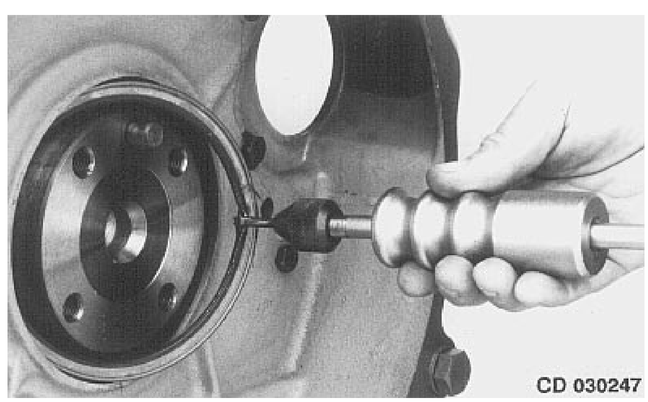


CD30397

CD30397 –UN–10MAY95

CTM8,GR15,23 –19–11OCT94–6/7

5. Using JDG22 Slide Hammer Puller, extract seal case.



CD30247 –UN–06MAR95

CTM8,GR15,23 –19–11OCT94–7/7

CLEAN AND INSPECT CRANKSHAFT FLANGE

T81202 –UN–01NOV88

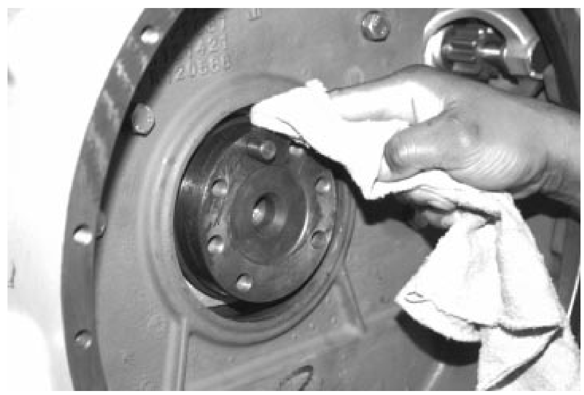
1. Clean OD of crankshaft flange and ID of flywheel housing with Brake Kleen, Ingnition Cleaner and Drier or any other suitable cleaner that will remove sealant.

2. Look for nicks or burrs on wear ring surface and bore in flywheel housing. If necessary, use polishing cloth to remove nicks or burrs.

   Finish cleaning by wiping flange with a clean rag.

DPSG,OUO1004,302 –19–09AUG98–1/1

INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE



RG7522 –UN–23NOV97

IMPORTANT: No lubrication of any kind is to contact seal when installing. Use of a lubricant may result in premature seal failure. Install seal and wear sleeve assembly immediately after removal from plastic bag to avoid possible dirt contamination.

1. Clean OD of crankshaft flange and ID of wear sleeve with Brake Kleen, Ingnition Cleaner and Drier or any other suitable cleaner that will remove sealant. Make sure that OD of crankshaft flange and ID of seal housing bore are free from nicks or burrs.

2. The oil seal/wear sleeve assembly can be installed using JT30040 or KCD10002 Installer Set.

Continued on next page

CTM8,GR15,14 –19–28DEC94–1/4

INSTALL REAR OIL SEAL/WEAR SLEEVE USING JT30040

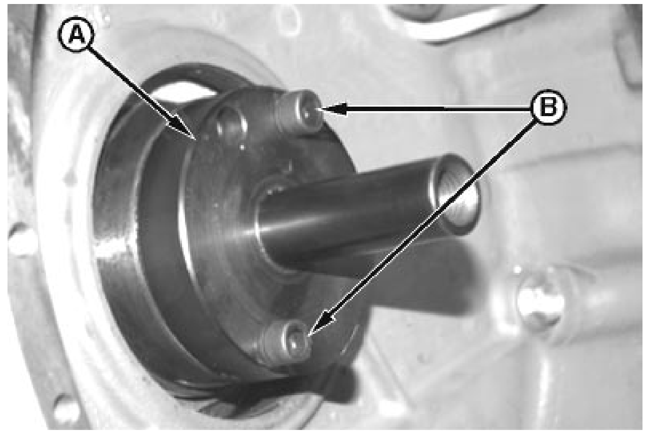
1. Apply a light coating of LOCTITE® 609 (TY15969) completely around leading edge of crankshaft flange.

2. Install JT30041A Pilot (A) from the JT30040B Seal and Wear Sleeve Installer Set on end of crankshaft using two socket-head cap screws. Tighten both cap screws until they touch base of pilot then back them off approximately 1/2 turn.

3. Install JT30042 Driver over JT30041A Pilot until driver cross-plate bottoms on pilot. This will properly center pilot with crankshaft flange.

NOTE: It may be necessary to lift up on pilot to install driver to full depth over pilot and crankshaft flange.

4. Tighten two pilot socket head cap screws (B) securely. Remove driver from pilot.



A—Pilot
B—Cap Screws

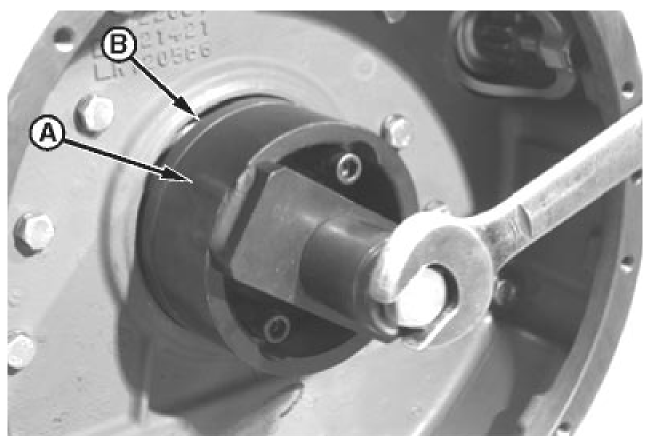
CTM8,GR15,14 –19–28DEC94–2/4

IMPORTANT: Handle the rear oil seal and sleeve assembly carefully. If wear sleeve surface is scratched, gouged or any sealant (liquid) is present, order a new seal assembly.

5. Carefully start oil seal (B) and wear sleeve over pilot and crankshaft flange with open side of seal toward engine.

6. Attach JT30042 Driver (A) and thrust washer to the guide plate with cap screw. Tighten the cap screw until driver bottoms on pilot.

7. Remove seal driver and pilot plate. Check that seal and wear sleeve assembly is properly positioned on crankshaft flange and installed square in flywheel housing bore.



A—Driver
B—Seal

Continued on next page

CTM8,GR15,14 –19–28DEC94–3/4

INSTALL REAR OIL SEAL/WEAR SLEEVE USING KCD10002A

1. Apply a light coating of LOCTITE® 609 (TY15969) completely around leading edge of crankshaft flange.

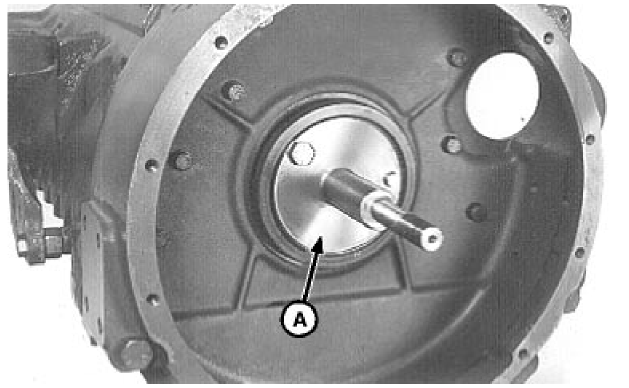
NOTE: Due to a diameter change of the crankshaft bore, it may be necessary to suppress the pilot pin from KCD10002.With this modification, KCD10002 becomes KCD10002A

2. Position guide (A) from KCD10002A Installer Set on crankshaft end with two cap screws finger tight.

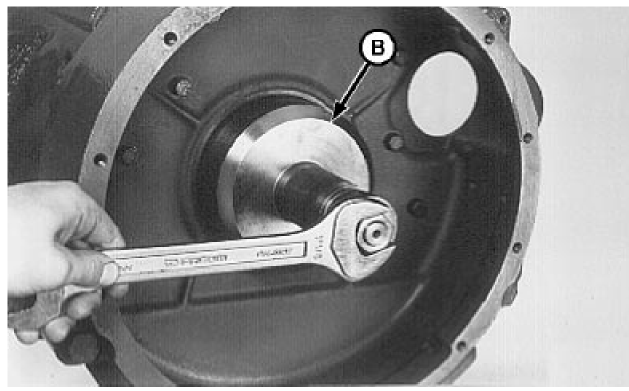
3. Install new oil seal/wear sleeve assembly on guide with open side of seal toward engine, center the guide and tighten cap screws..

4. Slide driver (B) onto guide (A) and gradually tighten hex nut until driver bottoms on guide.

5. Remove seal driver and guide. Check that seal and wear sleeve assembly is properly positioned on crankshaft flange and installed square in flywheel housing bore.



RG9136 –UN–18MAY98



RG9137 –UN–18MAY98

A—Guide
B—Driver

CTM8,GR15,14 –19–28DEC94–4/4

REMOVE FLYWHEEL HOUSING

1. Remove flywheel. (See REMOVE FLYWHEEL earlier in this group.)

2. Remove starting motor.

NOTE: On 3029 engines, oil dipstick tube must be removed before starting motor can be removed. (See REPLACE DIPSTICK NIPPLE in Group 20.)

3. If a unitized rear oil seal is used, it MUST BE removed before removing flywheel housing. (See REMOVE UNITIZED (NON-SEPARABLE) CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE earlier in this group.)

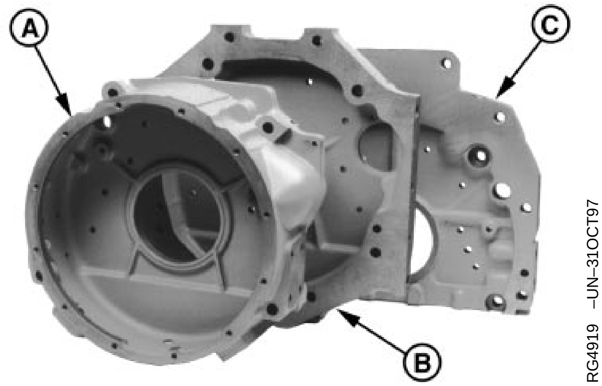
CAUTION: The flywheel housing is heavy. Plan a proper handling procedure to avoid injuries.

4. Remove flywheel housing-to-cylinder block cap screws and flywheel housing-to-oil pan cap screws. Remove flywheel housing from block.

NOTE: Some flywheel housings are assembled to cylinder block by using four 5/8 in. and eight 3/8 in. cap screws; some use eight 3/8 in. cap screws only; and the rest use two 5/8 in., two 3/4 in. and eight 3/8 in. cap screws.The only exceptions are the 6000 Series Tractors which use 1/2-inch allen head cap screws.

Illustration shows three different types of flywheel housings used:

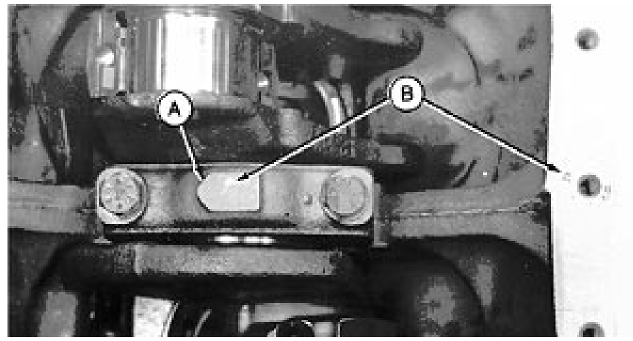
- *SAE 2, 3, and 4 housings (A).*
- *Standard flat housings (B) used primarily on utility tractors.*
- *Special flat housings (C) used primarily on Row-Crop tractors.*



A—SAE 2, 3, 4 Housing
B—Standard Flat Housing
C—Special Flat Housing

CTM8,GR15,12 –19–11OCT94–1/1

REMOVE CRANKSHAFT MAIN BEARINGS



A—Arrows
B—Numbers

1. Drain oil from engine crankcase and remove oil pan. (See Group 20.)

2. Remove timing gear cover and front plate. (See Group 16.)

3. Remove flywheel housing. (See Group 15.)

4. Remove connecting rods from crankshaft. (See Group 10.)

IMPORTANT: Before removing main bearing caps, check for proper torque on all main bearings.

NOTE: When crankshaft is to be removed, leave front and rear main bearing caps installed until all connecting rod caps have been removed.

5. Check main bearing caps for arrows (A) cast in main bearing cap and numbers (B) stamped on cap and oil pan rail. Arrow points toward camshaft side of engine and away from number stamped on pan rail.

   If there are no numbers, stamp corresponding numbers on cap and oil pan rail to assure correct placement of bearing caps during reassembly.

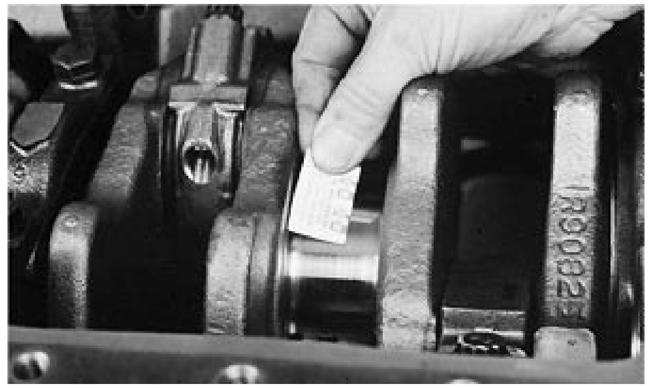
6. Remove main bearing caps.

IMPORTANT: Keep matched bearings with their respective main bearing cap for comparison with crankshaft journal (surface wear) from which removed.

7. Visually inspect condition of bearing inserts as bearing caps are removed.

RG,CTM8,GR15,46 –19–29SEP94–1/1

CHECK MAIN BEARING OIL CLEARANCE



RG6346 –UN–21AUG92

1. Place a strip of PLASTIGAGE® in the center of the main bearing cap (with insert) about three-fourths of the width of the bearing or on crankshaft journal to measure oil clearance.

2. Use clean (SAE30) oil on PLASTIGAGE® to prevent smearing.

3. Install cap and tighten cap screws to specified torque.

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number —419999)—Specification

Torque .... 115 N•m (85 lb-ft)

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number 420000—)—Specification

Torque .... 135 N•m (100 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. —135640)—Specification

Torque .... 115 N•m (85 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. 135641—)—Specification

Torque .... 135 N•m (100 lb-ft)

4. Remove cap and compare width of PLASTIGAGE® with scale provided to determine 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.

Crankshaft Main Bearing-to-Journal—Specification

Clearance .... 0.025—0.102 mm (0.0009—0.0040 in.)

PLASTIGAGE is a registered trademark of the DANA Corp.

RG,CTM8,GR15,31 –19–28DEC94–1/1

REMOVE AND INSTALL CRANKSHAFT GEAR (CRANKSHAFT INSTALLED IN ENGINE)

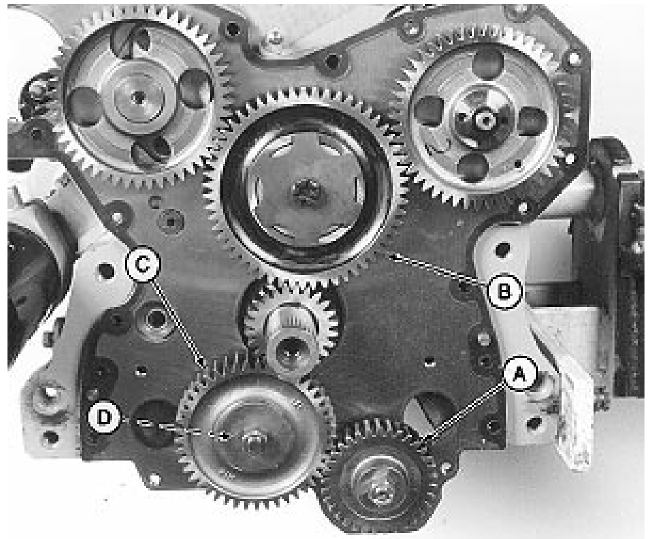
TO REMOVE CRANKSHAFT GEAR

NOTE: Remove crankshaft gear for replacement only; it is not necessary to remove gear for crankshaft removal.

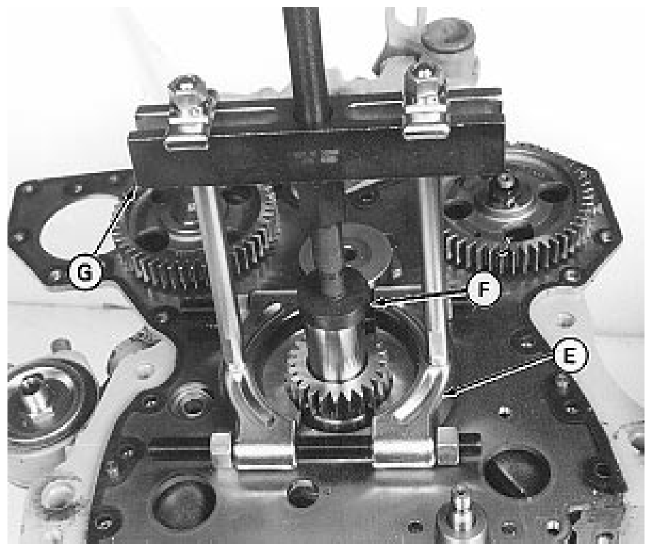
1. Lock engine at No. 1 "TDC" compression.
2. Remove timing gear cover (shown removed).
3. Remove oil pump gear (A).
4. Remove upper idler gear (B) and lower idler gear (C).
5. Remove lower idler gear shaft (D).

NOTE: On 4-cylinder engines it is not necessary to remove balancer shafts, if equipped.

6. Install No. 1123 (D01218AA) Pulling Attachment (E) onto crankshaft gear.
7. Using a disc (F) to protect threads in nose of crankshaft, install D01200AA Push Puller (G) and No. 1123 (D01218AA) Pulling Attachment. Remove crankshaft gear.



RG7237 –UN–10OCT94



RG7238 –UN–10OCT94

A—Oil Pump Gear
B—Upper Idler Gear
C—Lower Idler Gear
D—Lower Idler Shaft
E—No. 1123 Pulling Attachment
F—Disc
G—D01200AA Push Puller

Continued on next page RG,CTM8,DX174 –19–28DEC94–1/2

TO INSTALL CRANKSHAFT GEAR

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.

CAUTION: Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer and do not exceed 182°C (360°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.

NOTE: Chamfered side of gear should be installed toward engine.

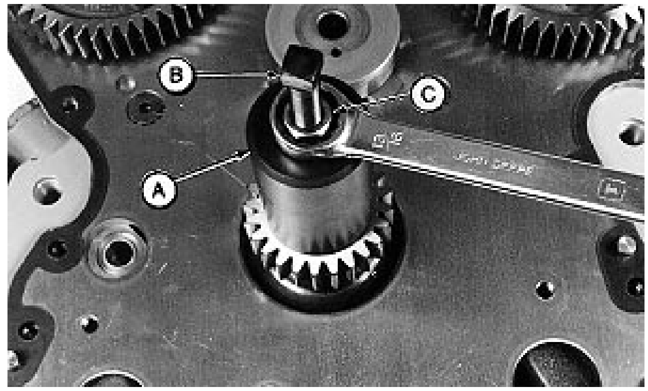
1. Heat crankshaft gear to 148°C (300°F) using either heated oil or oven heat.

IMPORTANT: When installing gear, do not gouge or nick crankshaft flange.

2. Place gear on crankshaft flange. Be sure Woodruff key on crankshaft is properly aligned with keyway in gear.

NOTE: Use the damper retaining cap screw with JDG794 Installer on crankshafts with deeper tapped threads in the nose of the crankshaft.

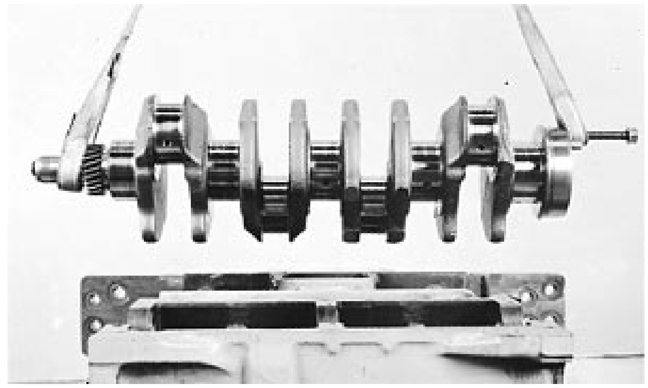
3. Use JDG794 Crankshaft Gear Installer (A) to install gear. Tighten cap screw (B) in crankshaft nose until cap screw bottoms.
4. Turn nut (C) clockwise until gear firmly seats against crankshaft flange. Allow gear to cool before removing JDG794 Installer.
5. Refer to appropriate group to complete final assembly of parts removed to access crankshaft gear.



RG7245 –UN–09FEB95

A—Gear Installer
B—Cap Screw
C—Nut

REMOVE CRANKSHAFT



RG6347 –UN–21AUG92

1. Remove engine front plate. (See Group 16.)
2. Remove flywheel housing and flywheel. (See REMOVE FLYWHEEL HOUSING earlier in this group.)
3. Remove main bearing caps and connecting rod caps, as described earlier in this group.

CAUTION: Crankshaft is very heavy. Plan a proper handling procedure to avoid injury.

4. Attach a lifting sling to crankshaft. Using proper lifting equipment, carefully raise crankshaft out of cylinder block.
5. Clean crankshaft, especially oil passages, using solvent and compressed air.
6. Place crankshaft on a clean flat surface and support journals with V-blocks.
7. If main bearings are to be replaced, remove inserts from cylinder block. Otherwise, leave bearing inserts in block until assembled ID has been measured.

CTM8,GR15,6 –19–29SEP94–1/1

REMOVE CRANKSHAFT REAR WEAR SLEEVE (CRANKSHAFT REMOVED FROM ENGINE)


T81193 –UN–01NOV88

This procedure applies only to the two-piece (separable) oil seal and wear sleeve assemblies. Unitized (non-separable) oil seal/wear sleeve must be removed before flywheel housing can be removed.

IMPORTANT: The preferred method of removing the wear sleeve on two-piece assemblies is with JDG645 Puller. When removing the wear sleeve with a chisel, DO NOT gouge crankshaft flange. Nicks or burrs should be removed with a medium-grit stone. Polishing cloth (180-grit or finer) may also be used when a stone is not available.

Remove crankshaft rear wear sleeve by using one of the following procedures:

- Use JDG645 Puller and pull wear ring from crankshaft flange, as described earlier in this group.
- Use the ball side of a ball peen hammer and tap wear sleeve across its width in a straight line (to deform and stretch sleeve).
- Score (but do not cut) the wear ring in several places around OD with a blunt chisel, as shown in photo.

Remove wear ring from crankshaft flange when loose.

CTM8,GR15,17 –19–28DEC94–1/1

INSPECT CRANKSHAFT

NOTE: If vibration damper damage was discovered during teardown, it is recommended that the crankshaft be magna-fluxed. This will verify whether of 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.

IMPORTANT: Small cracks may not be visible to the eye. Use a method such as the Fluorescent Magnetic Particle Method. This method magnetizes the crank, employs magnetic particles which are fluorescent and glow under "black light". The crankshaft must be de-magnetized after inspection.

2. Inspect crankshaft for signs of load stress, cracks, scoring, or journal scratches. Replace crankshaft if cracks are found.

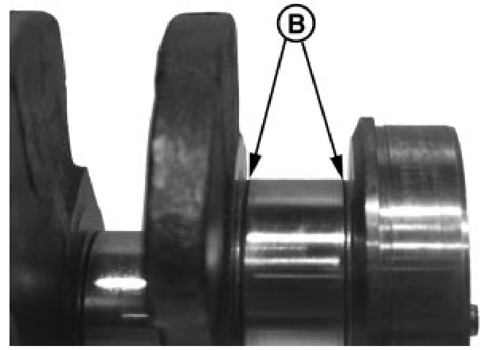
3. Check each journal for evidence of excessive overheating or discoloration. If either condition exists, replace crankshaft since heat treatment has probably been destroyed.

4. Inspect front crankshaft gear for cracks, chipped teeth, or excess wear. Replace gear as required.

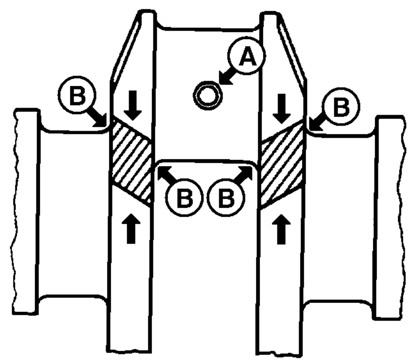
5. Inspect the keyway for evidence of cracks or wear. Replace crankshaft as necessary.

6. Carefully inspect the rear hub of the crankshaft in the area of the 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 or crocus cloth.

7. Carefully check the crankshaft for cracks in the area of rod journal holes (A) and at journal fillets (B). Replace crankshaft if any cracks are found.



RG7536B –UN–05NOV97

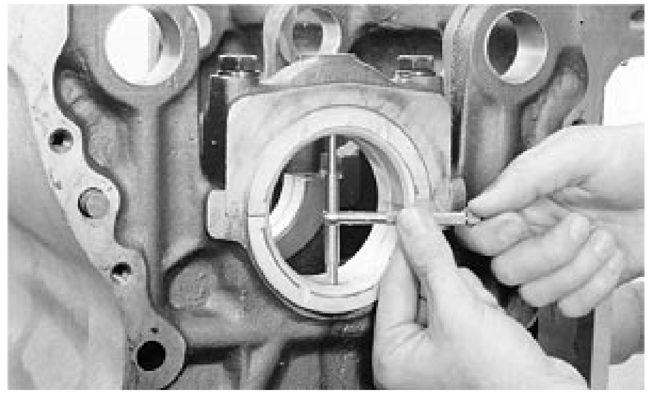


RGCD7147 –UN–30OCT97

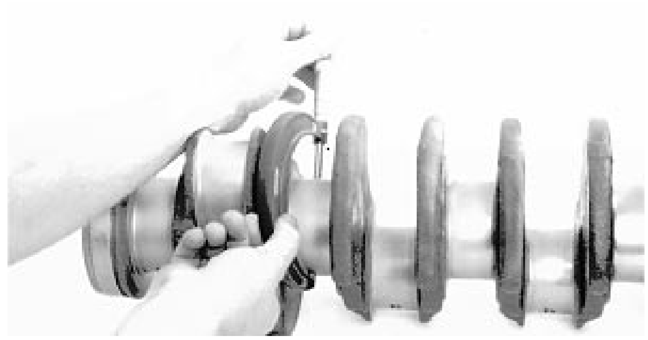
A—Rod Journal Holes
B—Journal Fillets

DPSG,OUO1004,303 –19–09AUG98–1/1

MEASURE MAIN BEARING ID AND CRANKSHAFT JOURNAL OD



T81186 –UN–09NOV88



T88550 –UN–14OCT88

1. With crankshaft removed from engine, assemble main bearing caps with bearing inserts.

2. Tighten main bearing cap screws to specified torque.

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number —419999)—Specification

Torque .... 115 N•m (85 lb-ft)

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number 420000—)—Specification

Torque .... 135 N•m (100 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. —135640)—Specification

Torque .... 115 N•m (85 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. 135641—)—Specification

Torque .... 135 N•m (100 lb-ft)

3. Measure and record main bearing assembled ID at several points.

4. Measure and record crankshaft main journal OD at several points around each journal.

5. Compare measurements with specifications given below.

Crankshaft Main Bearing (Standard)—Specification

ID .... 79.375—79.426 mm
(3.1249—3.1270 in.)

Crankshaft Main Journal (Standard)—Specification

OD .... 79.324—79.350 mm
(3.1229—3.1240 in.)

Crankshaft Rod Journal (Standard 3029, 4039, and 6059 Engines)—Specification

OD .... 69.80—69.83 mm
(2.748—2.749 in.)

Continued on next page

RG,CTM8,GR15,33 –19–08FEB95–1/2

Crankshaft Rod Journal (Standard 4045 and 6068 Engines)—Specification

OD .... 77.80—77.83 mm (3.063—3.064 in.)

Crankshaft Main Bearing-to-Journal—Specification

Oil Clearance.. 0.025—0.102 mm (0.0009—0.0040 in.)

Crankshaft Main or Rod Journal—Specification

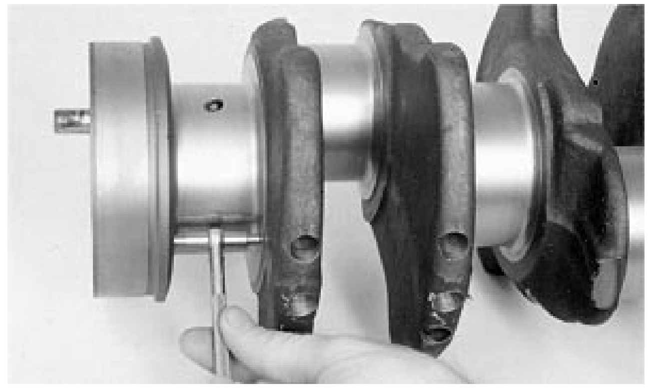
Maximum Taper.. 0.010 mm (0.0004 in.)
Maximum Out-of-Round .... 0.005 mm (0.0002 in.)

Replace or recondition crankshaft if it does not fall within above specifications.

NOTE: If an undersized crankshaft has been installed, measured dimensions will not meet above specifications. However, bearing-to-journal oil clearance must be within specification. See CRANKSHAFT GRINDING GUIDELINES later in this group.

RG,CTM8,GR15,33 –19–08FEB95–2/2

MEASURE MAIN THRUST JOURNAL WIDTH AND THRUST BEARING WIDTH

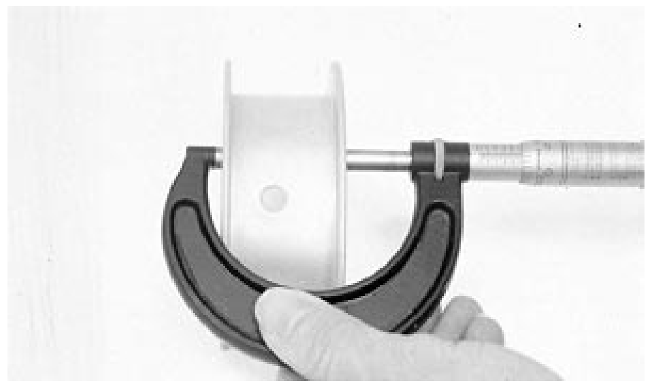

T81187 –UN–09NOV88

1. Measure and record crankshaft main thrust journal width.

   If crankshaft thrust journal width is not within specifications, recondition crankshaft and use an oversize thrust washer set or install a new crankshaft.

NOTE: If crankshaft has been previously reconditioned, thrust journal width may not be within specifications. However, oil (side) clearance must be within specification.

NOTE: Assemble thrust washers onto bearing half prior to measuring five/six-piece thrust bearings.


T81188 –UN–09NOV88

2. Measure and record width of main thrust bearing. Oil (side) clearance between thrust bearing and thrust journal must be within specifications.

Crankshaft Main Thrust Bearing Journal (New)—Specification

Width.. 38.952—39.028 mm (1.5335—1.5365 in.)

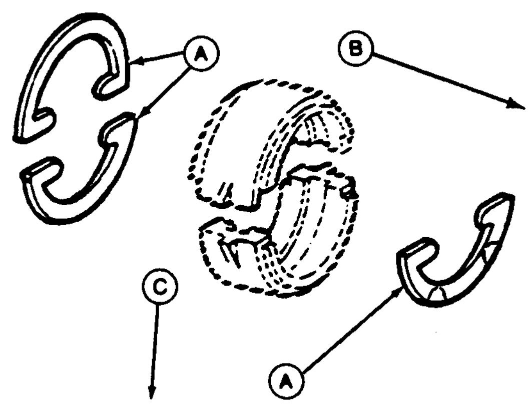
Crankshaft Main Thrust Bearing (Standard)—Specification

Width.. 38.811—38.862 mm (1.5279—1.5299 in.)

Crankshaft Main Thrust Bearing-to-Journal (Side)—Specification

Oil Clearance.. 0.090—0.217 mm (0.0035—0.0085 in.)

NOTE: Oversize thrust washer sets have thrust washers (A) that are 0.18 mm (0.007 in.) wider.



RG5584 –UN–03AUG92

A—Thrust Washers
B—Arrow Toward Front of Engine
C—Arrow Toward Oil Pan

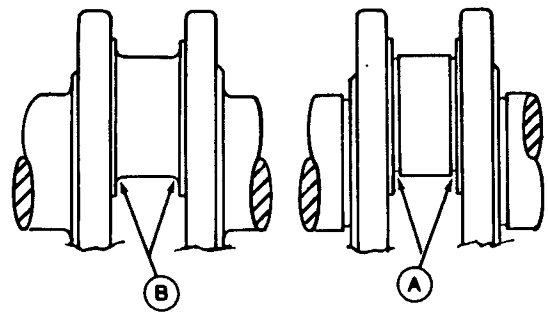
RG,CTM8,GR15,34 –19–16FEB95–1/1

CRANKSHAFT GRINDING GUIDELINES

More recent Saran-built 3029 and 4039 Engines and Dubuque-built 4039 Engines use nodular iron crankshafts. All other engines use steel crankshafts.

Undercut and rolled fillets (A) have taken the place of ground (tangential) fillets (B). These crankshafts also have micro-finished journal surfaces.

Both types of crankshaft journals can be re-ground. However, the undercut and rolled fillet type (A) can be ground ONLY 0.25 mm (0.010 in.).



A—Undercut and Rolled Fillet (Later Engines)
B—Ground (Tangential) Fillet (Earlier Engines)

CRANKSHAFTS WITH UNDERCUT AND ROLLED FILLETS		
ENGINE MODEL	**STEEL CRANKSHAFT**	**NODULAR IRON CRANKSHAFT**
CD3029D,T		(100000—)
CD4039D	(101583—103695)	(103696—)
CD4039T	Long Nose (101625—105305) Short Nose (101625—106050)	Long Nose (105306—) Short Nose (106051—
CD6059D,T	(101700—)	

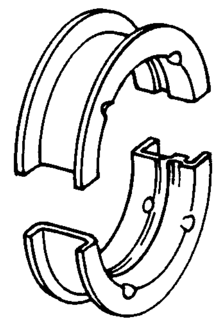
IMPORTANT: Crankshaft grinding should be done ONLY by experienced personnel on equipment capable of maintaining crankshaft size and finish specifications.

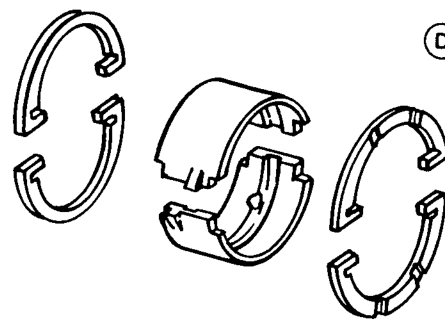
IMPORTANT: If undersize bearings are installed, recheck bearing-to-journal clearance. If oil clearance is not within specifications, premature wear of bearings and journals will result.

In addition to the standard size main and connecting rod bearings, 0.25 and 0.51 mm (0.010 and 0.020 in.) undersize bearings are available for tangential fillets. On undercut and rolled fillets, only 0.25 mm (0.010 in.) undersize bearings can be used.

Continued on next page

IMPORTANT: Service thrust bearing kits are now supplied with a six-piece thrust bearing assembly (D). It is acceptable to use a six-piece bearing where five-piece was previously used. Follow installation instructions provided with kit.





C—Two-Piece Rear Thrust Bearing Insert
D—Six-Piece Rear Thrust Bearing Assembly

To maintain the correct end play, the six-piece main thrust bearing (with individual thrust washers)[1] can be used to replace the two-piece (flanged) main thrust bearing (C) if desired. (See INSTALL MAIN BEARING INSERTS IN BLOCK later in this group for correct installation of five-piece thrust bearings.)

GRINDING CRANKSHAFT JOURNALS

If the crankshaft is to be ground, use the following recommended guidelines:

1. Determine the size to which the journals are to be reground according to the measures taken during inspections. See specification charts which follow.

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. Grind clockwise (as viewed from nose of crankshaft).

[1]Six-piece thrust bearings will not fit early production engines with 110 mm (4.33 in.) diameter undercut on main bearing web in block and on thrust bearing cap. Web undercut must be 113.8 mm (4.48 in.) diameter in order to accept five/six-piece thrust bearings.

Continued on next page RG,CTM8,GR15,35 –19–22FEB95–2/4

IMPORTANT: On tangential fillet crankshafts, 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. The radius may be checked with a fillet gauge.

On undercut and rolled crankshafts (later engines), DO NOT grind within this undercut area when undersize bearings are used.

Care must be taken to avoid localized heating which often produces grinding cracks. Use coolant generously to cool the crankshaft while grinding. DO NOT crowd the grinding wheel into the work. Grind crankshaft with journals turning counterclockwise, as viewed from the front end of the crankshaft. Lap or polish journals in opposite direction of grinding.

3. Polish or lap (clockwise) the ground surfaces to the specified finish except for cast iron crankshafts. The reground journals will be subject to excessive wear unless polished smooth.

NOTE: When thrust surfaces are reground and an oversize washer is used, crankshaft end play specification must be maintained.

4. If the thrust surfaces of the crankshaft are worn or grooved excessively, they must be reground and polished. Care must be taken to maintain the specified radius between each thrust surface and the bearing journal. An oversize thrust washer set is available.

5. Stone the edge of all oil holes in the journal surfaces smooth to provide a radius of approximately 1.50 mm (0.060 in.).

6. After grinding has been completed, inspect the crankshaft by the fluorescent magnetic particle method, or other similar method to determine if cracks have originated due to the grinding operation.

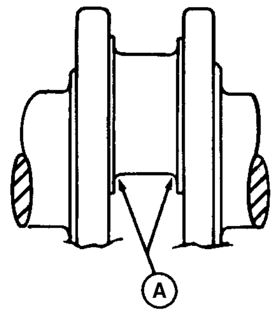
Continued on next page

7. De-magnetize the crankshaft after inspection.

8. Thoroughly clean the crankshaft and oil passages with solvent. Dry with compressed air.

RG,CTM8,GR15,35 –19–22FEB95–4/4

CRANKSHAFT GRINDING SPECIFICATIONS [Earlier Engines With Ground (Tangential) Fillets (A)]



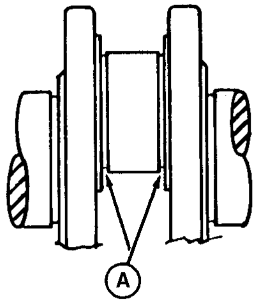
RG9483 –UN–20NOV98

Bearing Size	Crankshaft Main Journal OD	Crankshaft Rod Journal OD (4039, 6059 Engines)	Crankshaft Rod Journal OD (4045, 6068 Engines)
Standard	79.34—79.36 mm (3.123—3.124 in.)	69.81—69.84 mm (2.748—2.749 in.)	77.81—77.84 mm (3.063—3.064 in.)
0.25 mm (0.010 in.) Undersize	79.07—79.09 mm (3.113—3.114 in.)	69.54—69.57 mm (2.738—2.739 in.)	77.55—77.57 mm (3.053—3.054 in.)
0.51 mm (0.020 in.) Undersize	78.82—78.84 mm (3.103—3.104 in.)	69.29—69.32 mm (2.728—2.729 in.)	77.29—77.32 mm (3.043—3.044 in.)

Main and Connecting Rod Journal Surface Finish (AA)	Lap 0.0002 mm (8 micro-in.)
Thrust Surface Finish (AA)	Lap 0.0004 mm (16 micro-in.)
Thrust Bearing Journal Width	38.90—39.00 mm (1.531—1.535 in.)
Connecting Rod Journal Fillet Radius:	
4039 and 6059 Engines	4.2—4.4 mm (0.165—0.175 in.)
4045 and 6068 Engines	3.7—4.0 mm (0.146—0.156 in.)
Main Journal Fillet Radius	3.7—4.0 mm (0.146—0.156 in.)
Thrust Journal Fillet Radius	3.7—4.0 mm (0.146—0.156 in.)
Direction of Crankshaft Rotation (viewed from flywheel end):	
Grinding	clockwise
Lapping	counterclockwise
Engine Stroke:	
4039 and 6059 Engines	110 mm (4.33 in.)
4045 and 6068 Engines	127 mm (5.00 in.)

DPSG,OUO1004,488 –19–07NOV98–1/1

CRANKSHAFT GRINDING SPECIFICATIONS [Later Engines With Undercut and Rolled Fillets (A)]



RG9484 –UN–20NOV98

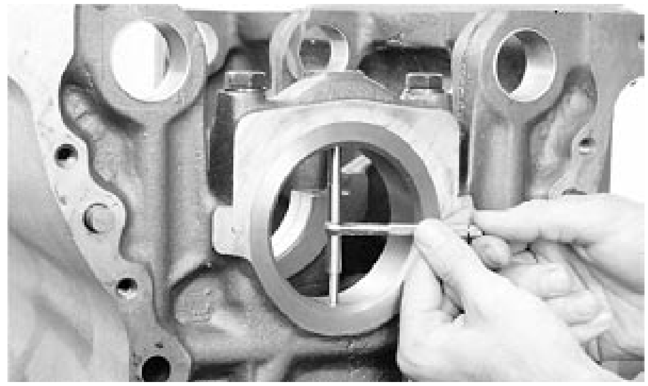
All current engines are now built with crankshafts that use undercut and rolled fillets. 3029 engines have always been built with undercut and rolled fillets.

Bearing Size	**Crankshaft Main Journal OD**	**Crankshaft Rod Journal OD (3029, 4039, 6059 Engines)**	**Crankshaft Rod Journal OD (4045, 6068 Engines)**
Standard	79.34—79.36 mm (3.123—3.124 in.)	69.81—69.84 mm (2.748—2.749 in.)	77.81—77.84 mm (3.063—3.064 in.)
0.25 mm (0.010 in.) Undersize	79.07—79.09 mm (3.113—3.114 in.)	69.54—69.57 mm (2.738—2.739 in.)	77.55—77.57 mm (3.053—3.054 in.)

Main and Connecting Rod Journal Surface Finish (AA)	Lap 0.0002 mm (8 micro-in.)
Thrust Surface Finish (AA)	Lap 0.0004 mm (16 micro-in.)
Thrust Bearing Journal Width	38.90—39.00 mm (1.531—1.535 in.)
Direction of Crankshaft Rotation (viewed from flywheel end):	
Grinding	clockwise
Lapping	counterclockwise
Engine Stroke:	
3029, 4039 and 6059 Engines	110 mm (4.33 in.)
4045 and 6068 Engines	127 mm (5.00 in.)

DPSG,OUO1004,487 –19–07NOV98–1/1

MEASURE ASSEMBLED ID OF MAIN BEARING CAPS



T81655 –UN–01NOV88

1. Remove bearing inserts from caps and cylinder block. Keep inserts in correct order if they are to be reused.

2. Clean and inspect caps for damage. Small burrs or nicks on flat surfaces may be removed with a file. Use a medium-grit polishing cloth to dress curved bearing surfaces.

3. Install bearing caps (without bearings) in cylinder block. Tighten cap screws to specified torque.

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number —419999)—Specification

Torque .... 115 N•m (85 lb-ft)

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number 420000—)—Specification

Torque .... 135 N•m (100 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. —135640)—Specification

Torque .... 115 N•m (85 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. 135641—)—Specification

Torque .... 135 N•m (100 lb-ft)

4. Measure ID of bearing cap bores.

Crankshaft Main Bearing Bore (Without Bearings)—Specification

ID.. 84.455—84.480 mm (3.3249—3.3259 in.)

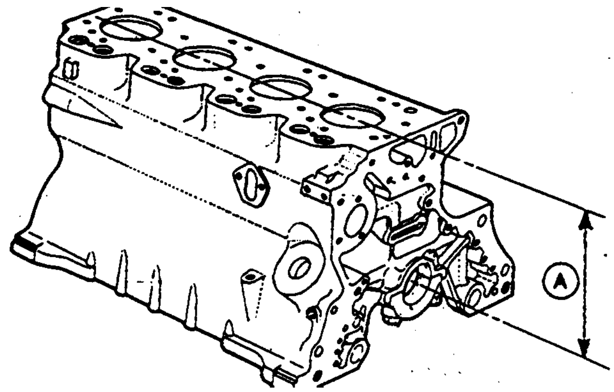
5. If bearing caps are damaged or bore is not within specification, install a new cap and line bore to specified size. (See MEASURE MAIN BEARING ID AND CRANKSHAFT JOURNAL OD earlier in this group.)

NOTE: Replacement bearing caps are supplied with unfinished bearing bore.

CTM8,GR15,8 –19–16FEB95–1/1

MEASURE CRANKSHAFT MAIN BEARING BORE CENTERLINE-TO-TOP DECK

IMPORTANT: When cylinder block is line bored, dimension (A) from centerline of main bearing bore to cylinder block top deck will be changed. Piston may contact cylinder head if this dimension is less than specified above. Main bearing line boring should be done ONLY by experienced personnel on equipment capable of maintaining bore specifications.



A—Dimension

Measure crankshaft main bearing bore centerline-to-top deck (A).

Crankshaft Main Bearing Bore Centerline-to-Top Deck (3029/4039/6059)—Specification

Distance (Minimum).. 301.981 mm (11.8889 in.)

Crankshaft Main Bearing Bore Centerline-to-Top Deck (4045/6068)—Specification

Distance (Minimum).. 337.871 mm (13.3019 in.)

DPSG,OUO1004,346 –19–09SEP98–1/1

INSPECT PISTON COOLING ORIFICES

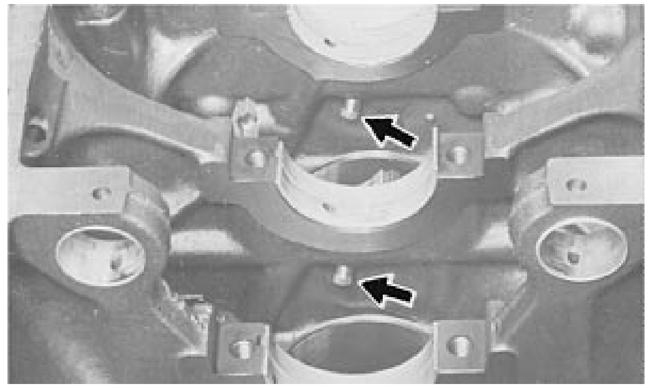
1. Inspect and clean each cooling orifice to make sure it is not plugged or damaged.

   Install orifices in block and tighten to specifications.

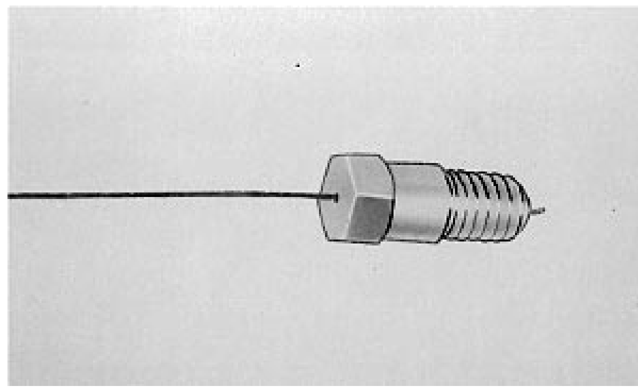
Piston Cooling Orifice—Specification

Torque .... 10.5 N•m (7.7 lb-ft) (93 lb-in.)

2. Use a soft wire and compressed air to clean orifice. Replace if condition is questionable.



RG4943 –UN–14DEC88



T88830 –UN–22OCT88

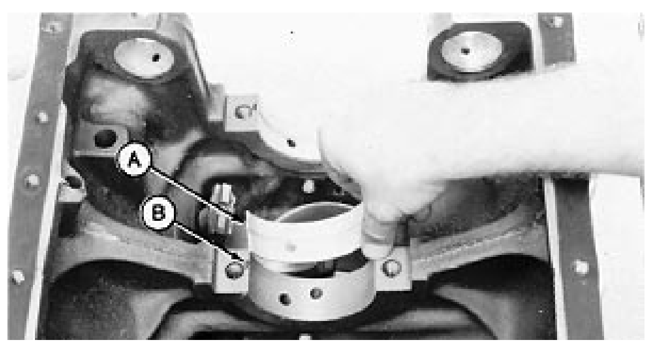
A—Centerline-to-Top Deck

RG,CTM8,DX137 –19–29SEP94–1/1

INSTALL MAIN AND THRUST BEARING INSERTS IN BLOCK

IMPORTANT: Service thrust bearing kits are now supplied with a six-piece thrust bearing assembly. It is acceptable to use a six-piece bearing where five-piece was previously used. Follow installation instructions provided with the kit.

1. Install main bearing inserts. Make sure that tang (A) is engaged with slot (B) in the cylinder block and main bearing caps. Also make sure oil holes line up with oil passages in block.



T88555 –UN–14OCT88

A—Tang
B—Slot

Continued on next page RG,CTM8,GR15,36 –19–28DEC94–1/3

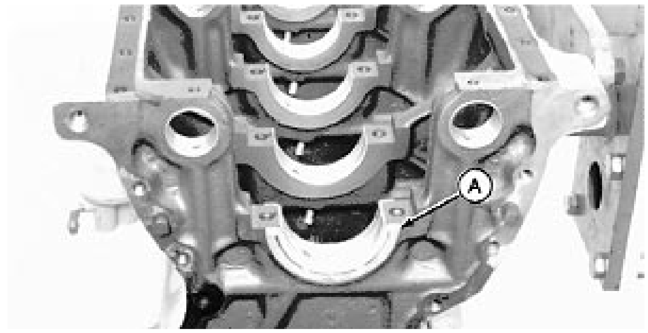
IMPORTANT: If new thrust bearing inserts or thrust washers are installed, they must be installed as a set.

2. Install main thrust bearing (A) in thrust web of cylinder block.

IMPORTANT: If a six-piece main thrust is being used, oil grooves on thrust washer must face crankshaft thrust surface (away from the block web).

NOTE: Some engines may have been built with two thrust washers in the block and one on cap. However, for service ALWAYS reassemble engine with two thrust washers in the block and two on the cap.

3. Apply a liberal coating of clean engine oil to bearing surfaces and crankshaft journals.

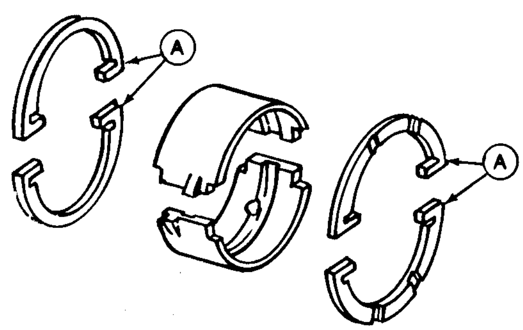


T88556 –UN–14OCT88

A—Main Thrust Bearing

RG,CTM8,GR15,36 –19–28DEC94–2/3

4. Install two thrust washers in the block and two on bearing cap. The oil grooves (A) must face toward crankshaft thrust surfaces.



RG7126 –UN–17FEB95

A—Oil Grooves

RG,CTM8,GR15,36 –19–28DEC94–3/3

INSTALL CRANKSHAFT

1. Using proper lifting equipment, lower crankshaft onto main bearings.

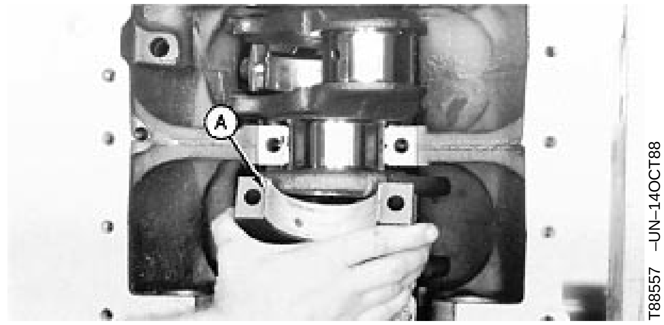
2. Apply a liberal amount of clean oil to bearing insert. Dip main bearing cap screws entirely in clean engine oil and position them in main bearing caps.

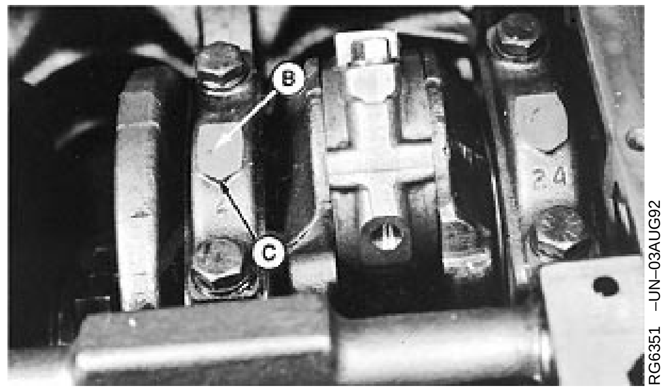
NOTE: Saran produced engines will have the arrow cast into the cap next to machined surface where cap number is stamped.

IMPORTANT: Make sure main bearing caps are installed in locations from which they were removed. Numbers (B) stamped on the caps should match number stamped on pan rail of block. Arrow (C) on cap must point toward camshaft side of block.

If a six-piece main thrust bearing is being used, install a thrust washer on BOTH SIDES of the main thrust bearing cap. Oil grooves on thrust washers must face crankshaft thrust surface (away from the bearing cap).

4. Install main bearing caps so bearing tang (A) in cap and cylinder block are together on same side of cylinder block.

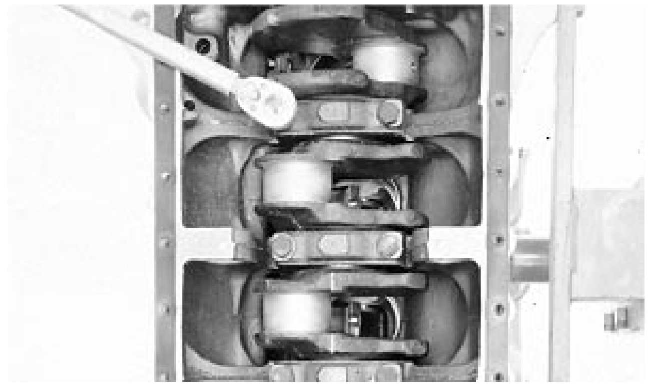




A—Bearing Tang
B—Stamped Numbers
C—Arrow

Continued on next page RG,CTM8,DX129 –19–28DEC94–1/3

IMPORTANT: Do not use pneumatic wrench to install main bearing cap screws, as damage may occur to the threads.



T81198 –UN–09NOV88

5. Tighten all main bearing cap screws to specified torque except rear main (thrust) bearing cap screws. Tighten rear main (thrust) bearing cap screw fingertight.

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number —419999)—Specification

Torque .... 115 N•m (85 lb-ft)

Dubuque-Built Engines: Main Bearing Cap Screw (Serial Number 420000—)—Specification

Torque .... 135 N•m (100 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. —135640)—Specification

Torque .... 115 N•m (85 lb-ft)

Saran-Built Engines: Main Bearing Cap Screw (Serial No. 135641—)—Specification

Torque .... 135 N•m (100 lb-ft)

IMPORTANT: DO NOT pry on thrust washer when forcing crankshaft back and forth to align thrust bearings.

6. Before tightening rear main (thrust) bearing cap screws, align upper and lower thrust bearings. Carefully force crankshaft and main thrust bearing cap to rear using a prybar between crank throw and block web. Then, force crankshaft to front to line up thrust bearing surfaces.

7. Tighten rear main (thrust) bearing cap screws to torque specified above. Turn crankshaft by hand.

   If crankshaft does not turn easily, disassemble main bearing caps and determine the cause.

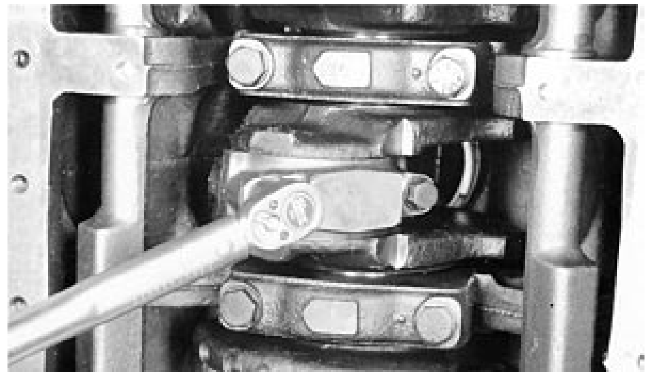
Continued on next page

RG,CTM8,DX129 –19–28DEC94–2/3

8. Install connecting rod caps and bearings. Install new cap screws and tighten to specification. (See Group 10.)

IMPORTANT: Using pneumatic wrenches to install cap screws may cause damage to the threads. Never reuse connecting rod cap screws.

9. Check crankshaft for specified end play. (See CHECK CRANKSHAFT END PLAY earlier in this group.)



T81615 –UN–07NOV88

RG,CTM8,DX129 –19–28DEC94–3/3

INSTALL FLYWHEEL HOUSING

1. Drive old crankshaft rear oil seal out of flywheel housing (if not previously removed).

2. Make sure that wear ring was removed from crankshaft flange. (See REMOVE CRANKSHAFT REAR WEAR SLEEVE earlier in this group.)

T81199 –UN–07NOV88

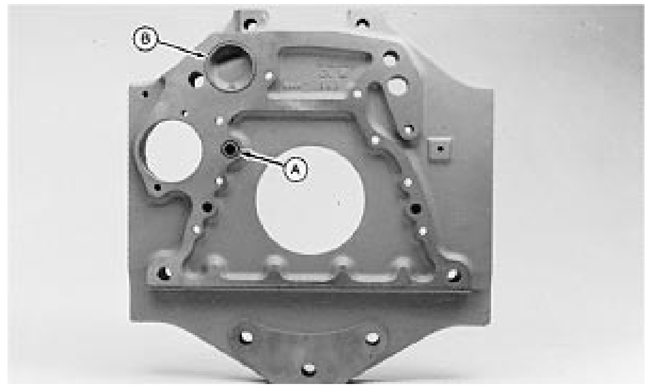
Continued on next page RG,CTM8,GR15,40 –19–29SEP94–1/5

3. Inspect and clean cylinder block and flywheel housing gasket surfaces.

4. Replace flywheel housing O-rings (A and B), if equipped.

NOTE: Some engine overhaul gasket sets may contain two gaskets: one with a silicone bead, and one without silicone bead. Use gasket without silicone bead on applications having O-rings in flywheel housing. Use gasket with silicone bead on all others.

5. Install a new flywheel housing gasket without sealant. Trim gasket flush with bottom of cylinder block and coat trimmed edge with LOCTITE® 515 General Purpose Flexible Sealant.



RG4785 –UN–14DEC88

A—O-Ring
B—O-Ring

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

RG,CTM8,GR15,40 –19–29SEP94–2/5

6. Install flywheel housing on cylinder block.

IMPORTANT: Cap screw torques vary with size of cap screw and type of flywheel housing. Dip threads of cap screw in clean engine oil before installing.

Flywheel housings on 6000 Series Tractors use allen head cap screws. Torque cap screws to the following specifications.

Flywheel Housing Allen Head Cap Screws (6000 Series Tractors)—Specification

Torque .... 183 N.m (135 lb-ft)

For all other flywheel housings, refer to the following specifications.

SAE 2, 3, and 4 Housings (illustrated):

Install eight 3/8 in. cap screws (A) and tighten to initial torque specified below; followed by final torque specification.

SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws—Specification

Initial Torque .... 30 N•m (22 lb-ft)

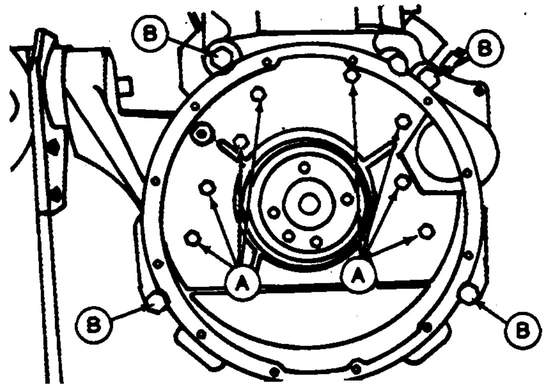
SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws—Specification

Final Torque .... 47 N•m (35 lb-ft)

Install four 5/8 in. cap screws (B) and tighten to specifications.

SAE 2, 3, and 4 Flywheel Housing 5/8 in. Cap Screws—Specification

Torque .... 230 N•m (170 lb-ft)



RG5117 –UN–14DEC88

A—3/8 in. Cap Screws
B—5/8 in. Cap Screws

Continued on next page

RG,CTM8,GR15,40 –19–29SEP94–3/5

Standard Flat Flywheel Housing (not illustrated):

Install eight 3/8 in. cap screws (A) and tighten to initial torque specified below; followed by final torque specification.

Standard Flat Flywheel Housing 3/8 in. Cap Screws—Specification

Initial Torque .... 30 N•m (22 lb-ft)

SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws—Specification

Final Torque .... 47 N•m (35 lb-ft)

Special Flat Flywheel Housing (illustrated):

Install eight 3/8 in. cap screws (A) and tighten to initial torque specified below; followed by final torque specification.

Special Flat Flywheel Housing 3/8 in. Cap Screws—Specification

Initial Torque .... 30 N•m (22 lb-ft)

SAE 2, 3, and 4 Flywheel Housing 3/8 in. Cap Screws—Specification

Final Torque .... 47 N•m (35 lb-ft)

Install 3/4 x 2-1/2 in. cap screw (B) and tighten to specifications.

Special Flat Flywheel Housing 3/4 x 2-1/2 in. Cap Screws—Specification

Torque .... 450 N•m (330 lb-ft)

Install 3/4 x 3-1/2 in. cap screw (C) and tighten to specifications.

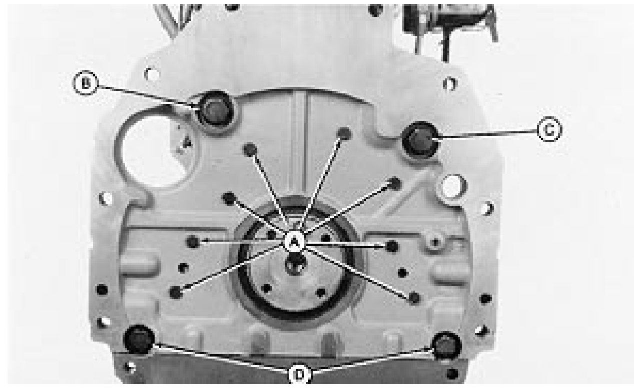
Special Flat Flywheel Housing 3/4 x 3-1/2 in. Cap Screws—Specification

Torque .... 570 N•m (420 lb-ft)

Install two 5/8 x 2-1/4 in. cap screws (D) and tighten to specifications.

Special Flat Flywheel Housing 5/8 x 2-1/4 in. Cap Screws—Specification

Torque .... 325 N•m (240 lb-ft)



RG4920 –UN–14DEC88

A—3/8 in. Cap Screws
B—3/4 x 2-1/2 in. Cap Screws
C—3/4 x 3-1/2 in. Cap Screws
D—5/8 x 2-1/4 in. Cap Screws

Continued on next page

7. Check flywheel housing seal bore run-out. If run-out exceeds specification replace housing.

Flywheel Housing Seal Bore—Specification

Maximum Permissible Run-Out............................... 0.152 mm (0.006 in.)

8. Install crankshaft rear oil seal assembly. (See INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE earlier in this group.)

9. If torque converter access hole plug was removed, apply LOCTITE® 277 to plug and install.

RG,CTM8,GR15,40 –19–29SEP94–5/5

COMPLETE FINAL ASSEMBLY

Use new gaskets and o-rings during final engine assembly. Clean all engine components as necessary prior to assembly.

1. Install oil by-pass valve assembly in front face of block (if equipped). (Group 20).
2. Install front plate, balancer shafts (if equipped), timing gear train, and camshaft. (Group 16).
3. Install oil pump assembly. (Group 20).
4. Install oil deflector. (Group 16).
5. Install timing gear cover gasket, timing gear cover, oil pressure regulating valve assembly, and front oil seal. (Groups 15 and 16).
6. Install oil pan. (Group 20).
7. Install crankshaft pulley, or vibration damper. (Group 15).
8. Install push rods, and rocker arm assembly. (Groups 05).
9. Install fuel supply pump and injection pump. (Group 35).
10. Install starting motor. (Group 40).
11. Adjust valve clearance. (Group 05).
12. Install and adjust fan belts. (Group 25).
13. Fill engine with clean oil and proper coolant. (Group 02).
14. Perform engine break-in. (Group 05).

CTM8,GR15,9 –19–16FEB95–1/1

ESSENTIAL TOOLS

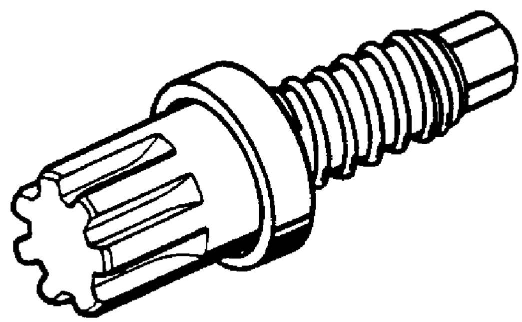
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,351 –19–13SEP98–1/10

Flywheel Turning Tool JDG820

Used to rotate flywheel on engines with 129-tooth flywheel ring gears and a 29.9 mm (1.18 in.) ID flywheel housing guide bore diameter. JDE81-1 may be used also if JDG820 is not available.



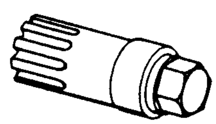
RG7056

RG7056 –UN–05DEC97

DPSG,OUO1004,351 –19–13SEP98–2/10

Flywheel Turning Tool JDE83

Used to rotate flywheel on engines with 142-tooth flywheel ring gears and a 26.5 mm (1.04 in.) ID flywheel housing guide bore diameter.



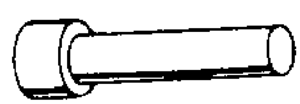
RG6251 –UN–22JUL92

DPSG,OUO1004,351 –19–13SEP98–3/10

RG5068 –UN–05DEC97

Timing Pin JDE81-4

Lock engine at TDC when installing injection pump or timing valve train. Use with JDG820, JDE81-1 or JDE83 Flywheel Turning Tool.



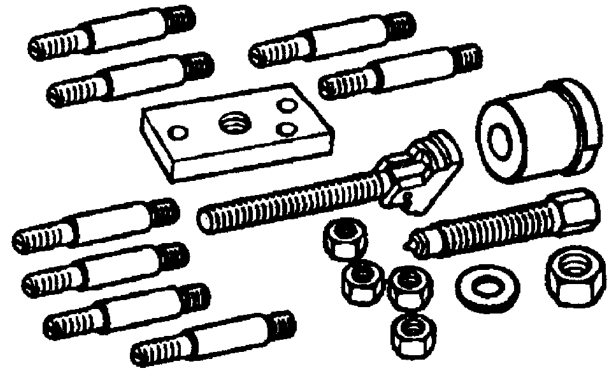
RG5068

Continued on next page

DPSG,OUO1004,351 –19–13SEP98–4/10

Camshaft Bushing Service Kit JDG739B

Used to remove and install front camshaft bushing.



RG9121 –UN–22APR98

DPSG,OUO1004,351 –19–13SEP98–5/10

Balancer Shaft Bushing Driver JD249

Replace balancer shaft bushings.

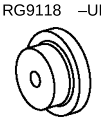
RG5120

RG5120 –UN–05DEC97

DPSG,OUO1004,351 –19–13SEP98–6/10

RG9118 –UN–17APR98

Idler Gear Bushing Driver JD252

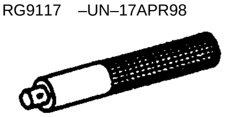


Use with JDG537 Handle to remove and install idler gear bushings.

DPSG,OUO1004,351 –19–13SEP98–7/10

RG9117 –UN–17APR98

Handle JDG537 (OTC815)



Use with JD252 Bushing Driver to remove and install idler gear bushings.

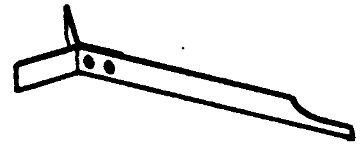
Continued on next page

DPSG,OUO1004,351 –19–13SEP98–8/10

RG5118 –UN–23AUG88

Gear Timing Tool JD254A

Time camshaft gear, injection pump gear and balancer shafts.



DPSG,OUO1004,351 –19–13SEP98–9/10

RG6478 –UN–26OCT92

Idler Gear Installer Pilot JDG791A

Guide upper idler gear onto idler shaft on engines with spur gears and 70 mm (2.75 in.) idler bushing, .

DPSG,OUO1004,351 –19–13SEP98–10/10

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,OUO1004,352 –19–13SEP98–1/3

Magnetic Follower Holder Kit D15001NU

Hold cam followers when removing and installing cam.

DPSG,OUO1004,352 –19–13SEP98–2/3

Balancer Shaft Holding Tool JD247

Hold balancer shaft while pressing gear on shaft.

DPSG,OUO1004,352 –19–13SEP98–3/3

OTHER MATERIAL

Number	Name	Use
TY6333 (U.S.)	High-Temperature Grease	Coat cam followers, cam lobes, journals, bushings and camshaft gear during installation. Coat idler gear, bushing, and shaft during installation. Coat internal splines of auxiliary output gear.
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to screw-in type tachometer drive gear and idler gear cap screws. Apply to front plate studs and set screw plugs.
TY6304 (U.S.) TY9484 (Canadian) 515 (LOCTITE®)	Flexible Sealant	Front plate gasket, oil filler neck gasket, and timing gear cover gasket.

LOCTITE is a registered trademark of Loctite Corp.

DPSG,OUO1004,353 –19–13SEP98–1/1

CAMSHAFT, BALANCER SHAFTS AND TIMING GEAR TRAIN SPECIFICATIONS

Item	Measurement	Specification
Intake Valves	Valve Lift [at 0.00 mm (in.) Valve Clearance]	11.56—12.37 mm (0.455—0.487 in.)
	Wear Limit	11.13 mm (0.438 in.)
Exhaust Valves	Valve Lift [at 0.00 mm (in.) Valve Clearance]	11.28—12.12 mm (0.444—0.477 in.)
	Wear Limit	10.85 mm (0.427 in.)
Camshaft	End Play	0.08—0.23 mm (0.003—0.009 in.)
	Wear Limit	0.38 mm (0.015 in.)
Balancer Shaft	End Play	0.05—0.26 mm (0.002—0.010 in.)
	Wear Limit	0.38 mm (0.015 in.)
Upper and Lower Idler Gear	End Play	0.14—0.29 mm (0.006—0.012 in.)
	Wear Limit	0.40 mm (0.016 in.)
Helical Gears:		
Camshaft-to-Upper Idler (A)	Backlash	0.07—0.35 mm (0.003—0.014 in.)
	Wear Limit	0.51 mm (0.020 in.)
Injection Pump-to-Upper Idler (B)	Backlash	0.07—0.35 mm (0.003—0.014 in.)
	Wear Limit	0.51 mm (0.020 in.)
Upper Idler-to-Crankshaft (C)	Backlash	0.07—0.30 mm (0.003—0.012 in.)
	Wear Limit	0.40 mm (0.016 in.)
Crankshaft-to-Lower Idler (D)	Backlash	0.07—0.35 mm (0.003—0.014 in.)
	Wear Limit	0.51 mm (0.020 in.)
Balancer Shaft-to-Oil Pump (4-Cyl Only) (E)	Backlash	0.05—0.36 mm (0.002—0.015 in.)
	Wear Limit	0.51 mm (0.020 in.)

Continued on next page

DPSG,OUO1004,490 –19–08NOV98–1/9

Item	Measurement	Specification
Oil Pump-to-Lower Idler (F)	Backlash	0.04—0.36 mm (0.0016—0.015 in.)
	Wear Limit	0.40 mm (0.016 in.)
Lower Idler-to-Balancer Shaft (4-Cyl Only) (G)	Backlash	0.05—0.40 mm (0.002—0.016 in.)
	Wear Limit	0.51 mm (0.020 in.)
Spur Gears (Saran-Built Engines): 5300 Tractors (—242551), 5200/5400 Tractors and All 3-Cyl Engines (—270818), 5500 Tractors and All 4-Cyl Engines (—286631)		
Camshaft-to-Upper Idler (A)	Backlash	0.08—0.45 mm (0.003—0.018 in.)
	Wear Limit	0.85 mm (0.033 in.)
Injection Pump-to-Upper Idler (B)	Backlash	0.08—0.45 mm (0.003—0.018 in.)
	Wear Limit	0.85 mm (0.033 in.)
Upper Idler-to-Crankshaft (C)	Backlash	0.04—0.35 mm (0.0016—0.014 in.)
	Wear Limit	0.60 mm (0.024 in.)
Crankshaft-to-Lower Idler (D)	Backlash	0.04—0.35 mm (0.0016—0.014 in.)
	Wear Limit	0.65 mm (0.025 in.)
Oil Pump-to-Lower Idler (F)	Backlash	0.08—0.40 mm (0.003—0.016 in.)
	Wear Limit	0.75 mm (0.030 in.)
Camshaft-to-Auxiliary Drive	Backlash	0.09—1.24 mm (0.004—0.049 in.)
	Wear Limit	1.34 mm (0.053 in.)

Continued on next page DPSG,OUO1004,490 –19–08NOV98–2/9

Item	Measurement	Specification
Spur Gears (Saran-Built Engines): 5300 Tractors (242552—), 5200/5400 Tractors and All 3-Cyl Engines (270819—), 5500 Tractors and All 4-Cyl Engines (286632—)		
Camshaft-to-Upper Idler (A)	Backlash	0.01—0.52 mm (0.000—0.20 in.)
Injection Pump-to-Upper Idler (B)	Backlash	0.01—0.52 mm (0.000—0.020 in.)
Upper Idler-to-Crankshaft (C)	Backlash	0.01—0.49 mm (0.000—0.019 in.)
Crankshaft-to-Lower Idler (D)	Backlash	0.01—0.46 mm (0.000—0.018 in.)
Balancer Shaft-to-Oil Pump (4-Cyl Only) (E)	Backlash	0.01—0.47 mm (0.000—0.018 in.)
Oil Pump-to-Lower Idler (F)	Backlash	0.01—0.49 mm (0.000—0.019 in.)
Lower Idler to Balancer Shaft(4-Cyl Only) (G)	Backlash	0.01—0.53 mm (0.000—0.020 in.)
Camshaft-to-Auxiliary Drive	Backlash	0.01—0.54 mm (0.000—0.021 in.)
Camshaft Thrust Plate	Clearance	0.08—0.23 mm (0.003—0.009 in.)
	Wear Limit	0.38 mm (0.015 in.)
Camshaft Thrust Plate	Thickness	3.96—4.01 mm (0.156—0.158 in.)
	Wear Limit	3.83 mm (0.151 in.)

Continued on next page DPSG,OUO1004,490 –19–08NOV98–3/9

Item	Measurement	Specification
Camshaft Bearing Bores and Journals		
Camshaft Journal	OD	55.872—55.898 mm (2.1997—2.2007 in.)
	Wear Limit	55.85 mm (2.199 in.)
Camshaft Bore (All Except No. 1 Camshaft Gear-Driven Aux. Drive)	ID	55.986—56.012 mm (2.2042—2.2052 in.)
Camshaft Bore-to-Journal Clearance (All Except No. 1 Camshaft Gear-Driven Aux. Drive)	Oil Clearance	0.10—0.15 mm (0.004—0.006 in.)
	Wear Limit	0.18 mm (0.007 in.)
Camshaft Bore, Front No. 1 in Block (Camshaft Gear-Driven Aux. Drive Without Bushing Installed)	ID	59.961—59.987 mm (2.3607—2.3617 in.)
Camshaft Bore, Front No. 1 in Block (Camshaft Gear-Driven Aux. Drive With Bushing Installed)	ID	55.948—56.000 mm (2.2026—2.2047 in.)
Camshaft Journal-to-Bushing, Clearance, Front No. 1 in Block (Camshaft Gear-Driven Aux. Drive)	Oil Clearance	0.05—0.13 mm (0.002—0.005 in.)
	Wear Limit	0.18 mm (0.007 in.)
Camshaft Intake Lobe	Height	6.93—7.42 mm (0.273—0.292 in.)
	Wear Limit	6.68 mm (0.263 in.)
Camshaft Exhaust Lobe	Height	6.76—7.26 mm (0.266—0.286 in.)
	Wear Limit	6.50 mm (0.256 in.)
Fuel Supply Pump Camshaft Lobe	Diameter	42.72—42.98 mm (1.682—1.692 in.)
Camshaft Follower	OD	31.61—31.64 mm (1.245—1.246 in.)
Camshaft Follower Bore in Block	ID	31.70—31.75 mm (1.248—1.250 in.)

Continued on next page

DPSG,OUO1004,490 –19–08NOV98–4/9

Item	Measurement	Specification
Camshaft Follower-to-Bore	Clearance	0.06—0.13 mm (0.002—0.005 in.)
Screw-In Type Tachometer Drive Gear	Torque	20 N•m (15 lb-ft)
Tachometer Drive Gear (knurled end)	OD	12.88—12.92 mm (0.506—0.508 in.)
Balancer Shaft Bushing (New)	ID	38.177—38.237 mm (1.5030—1.5054 in.)
Balancer Shaft Journal	OD	38.137—38.163 mm (1.5014—1.5024 in.)
Balancer Shaft Journal-to-Bushing	Oil Clearance	0.024—0.100 mm (0.001—0.004 in.)
	Maximum Allowable Oil Clearance	0.15 mm (0.006 in.)
Cylinder Block Bore for Oversize Balancer Shaft Bushings (D)	ID	43.236—43.264 mm (1.7022—1.7033 in.)
Cylinder Block Bore for Standard Balancer Shaft Bushing (D)	ID	41.262—41.288 mm (1.6245—1.6255 in.)
Balancer Shaft Thrust Plate (New)	Thickness	2.97—3.02 mm (0.117—0.119 in.)
Balancer Shaft Assembly	Thrust Plate-to-Gear Clearance	0.05—0.26 mm (0.002—0.010 in.)
Upper Idler Gear Bushing New Part (Helical Gears)	ID	44.48—44.53 mm (1.751—1.753 in.)
	Wear Limit	44.56 mm (1.754 in.)
Upper Idler Gear Bushing New Part (Spur Gears)	ID	69.825—69.850 mm (2.7490—2.7499 in.)
Lower Idler Gear Bushing New Part	ID	44.48—44.53 mm (1.751—1.753 in.)
	Wear Limit	44.56 mm (1.754 in.)
Upper Idler Gear Shaft New Part (Helical Gears)	OD	44.43—44.46 mm (1.749—1.750 in.)
	Wear Limit	44.40 mm (1.748 in.)

Continued on next page

DPSG,OUO1004,490 –19–08NOV98–5/9

Item	Measurement	Specification
Upper Idler Gear Shaft New Part (Spur Gears)	OD	69.76—69.78 mm (2.746—2.747 in.)
Lower Idler Gear Shaft New Part	OD	44.43—44.46 mm (1.749—1.750 in.)
	Wear Limit	44.40 mm (1.748 in.)
Upper Idler Gear Bushing-to-Shaft New Part (Helical Gears)	Oil Clearance	0.02—0.10 mm (0.001—0.004 in.)
	Wear Limit	0.15 mm (0.006 in.)
Upper Idler Gear Bushing-to-Shaft New Part (Spur Gears)	Oil Clearance	0.05—0.09 mm (0.002—0.004 in.)
Lower Idler Gear Bushing-to-Shaft New Part	Oil Clearance	0.02—0.10 mm (0.001—0.004 in.)
	Wear Limit	0.15 mm (0.006 in.)
Idler Gear Hub	Width	21.98—22.03 mm (0.865—0.867 in.)
	Wear Limit	21.93 mm (0.863 in.)
Idler Shaft Hub	Width	22.17—22.27 mm (0.873—0.877 in.)
Upper and Lower Idler Gear New Part	End Play	0.14—0.29 mm (0.006—0.012 in.)
	Wear Limit	0.40 mm (0.016 in.)
Lower Idler Shaft Spring Pin (A)	Protrusion	5.0—7.0 mm (0.20—0.28 in.)
Upper Idler Shaft Spring Pin (Dubuque-Built Engines) (B)	Protrusion	3.5—4.5 mm (0.14—0.18 in.)
Upper Idler Shaft Spring Pin (Saran-Built Engines) (B)	Protrusion	7.5—8.5 mm (0.295—0.335 in.)
Front Plate Mounting Cap Screws	Torque	34 N•m (25 lb-ft)
Balancer Shaft Thrust Plate Cap Screws	Torque	47 N•m (35 lb-ft)
Balancer Shaft Weight Cap Screws/Nuts	Torque	60 N•m (45 lb-ft)

Continued on next page

DPSG,OUO1004,490 –19–08NOV98–6/9

Item	Measurement	Specification
Idler Gear Cap Screws/Nuts	Torque	110 N•m (80 lb-ft)
Oil Pump Gear Retaining Nut	Torque	75 N•m (55 lb-ft)
Fuel Injection Pump-to-Front Plate Hex Nuts	Torque	27 N•m (20 lb-ft)
Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut [8 mm (0.315 in.) Thick Nut]	Torque	60 N•m (45 lb-ft)
Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut [11 mm (0.394 in.) Thick Nut]	Torque	125 N•m (90 lb-ft)
Stanadyne DB4 and DM4 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut	Torque	195 N•m (145 lb-ft)
Lucas Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut	Torque	80 N•m (60 lb-ft)
Camshaft Thrust Plate Cap Screws	Torque	47 N•m (35 lb-ft)
Upper Idler Gear Retaining Cap Screw	Torque	100 N•m (75 lb-ft)
Aluminum Oil Filler Neck or Cover Plate	Torque	47 N•m (35 lb-ft)
Composite Material Oil Filler Neck	Torque	30 N•m (22 lb-ft)
Injection Pump Drive Gear Cover Plate	Torque	24 N•m (18 lb-ft)
Injection Pump Drive Gear Threaded Cap	Torque	30 N•m (22 lb-ft)

Continued on next page
DPSG,OUO1004,490 –19–08NOV98–7/9

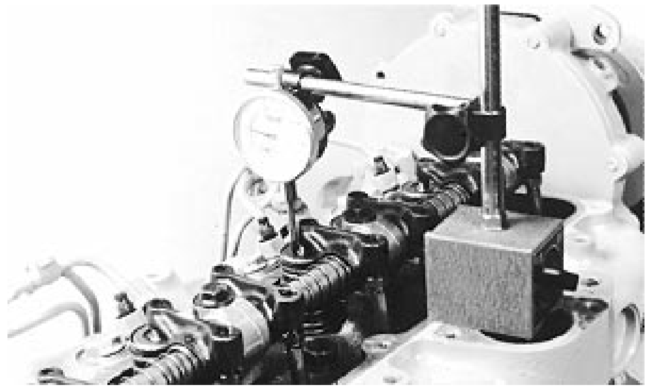
Item	Measurement	Specification
Aluminum Timing Gear Cover Cap Screws (Dubuque-Built Covers and Saran-Built Covers With Auxiliary Drive)		
Timing Gear Cover-to-Front Plate Cap Screws	Torque	47 N•m (35 lb-ft)
Oil Pan-to-Timing Gear Cover Cap Screws	Torque	37 N•m (27 lb-ft)
Electronic Tachometer (Magnetic Pick-up) Sensor	Torque	15 N•m (11 lb-ft)
Oil Pressure Regulating Valve	Torque	95 N•m (70 lb-ft)
Alternator Mounting Bracket Cap Screws (Aluminum Timing Gear Covers)	Torque	47 N•m (35 lb-ft)
Belt Tensioner Mounting Cap Screw (Aluminum Timing Gear Covers)	Torque	47 N•m (35 lb-ft)
Aluminum Timing Gear Cover Cap Screws (Saran-Built Covers Without Auxiliary Drive)		
Timing Gear Cover-to-Front Plate Cap Screws (1—17)	Torque	47 N•m (35 lb-ft)
Oil Pan-to-Timing Gear Cover Cap Screws (18—23)	Torque	37 N•m (27 lb-ft)
Electronic Tachometer (Magnetic Pick-up) Sensor (A)	Torque	15 N•m (11 lb-ft)
Injection Pump Gear Plug (B)	Torque	30 N•m (22 lb-ft)
Oil Pressure Regulating Valve (C)	Torque	95 N•m (70 lb-ft)

Continued on next page

Item	Measurement	Specification
Composite Timing Gear Cover Cap Screws		
Electronic Tachometer (Magnetic Pick-Up) Sensor (C)	Torque	15 N•m (11 lb-ft)
Plug-to-Access Injection Pump Drive Gear Nut (D)	Torque	30 N•m (22 lb-ft)
Oil Pan-to-Timing Gear Cover Cap Screws (18-23)	Torque	30 N•m (22 lb-ft)
Timing Gear Cover-to-Front Plate Cap Screws (1-17)	Torque	45 N•m (33 lb-ft)
Oil Pressure Regulating Valve (E)	Torque	30 N•m (22 lb-ft)
Alternator Mounting Bracket Cap Screws (Composite Material Timing Gear Covers)	Torque	30 N•m (22 lb-ft)
Belt Tensioner Mounting Cap Screw (Composite Material Timing Gear Covers)	Torque	30 N•m (22 lb-ft)
Auxiliary Drive Gear Cover Cap Screws	Torque	47 N•m (35 lb-ft)

DPSG,OUO1004,490 –19–08NOV98–9/9

MEASURE VALVE LIFT


RG6308 –UN–03AUG92

IMPORTANT: For a more accurate measurement, measure valve lift at 0.00 mm (in.) rocker arm-to-valve tip clearance.

NOTE: Measuring valve lift provides an indication of wear on camshaft lobes and cam followers or push rods.

1. Remove rocker arm cover.

2. Using JDG820 or JDE83 Flywheel Turning Tool and JDE81-4 Timing Pin, lock No. 1 piston at TDC compression stroke.

   See CHECK AND ADJUST VALVE CLEARANCE in Group 05 for engine valve locations.

3. Set rocker arm-to-valve tip clearance to 0.00 mm (in.) for:

   - No. 1 and 2 exhaust and No. 1 and 3 intake valves on 3-cylinder engines.
   - No. 1 and 3 exhaust and No. 1 and 2 intake valves on 4-cylinder engines.
   - No. 1, 3, and 5 exhaust and No. 1, 2, and 4 intake valves on 6-cylinder engines.

4. Place dial indicator tip on top of valve spring retainer or rotator. Preload indicator tip and set dial at 0.0 mm (in.).

5. Remove timing pin from flywheel and manually rotate engine one full revolution (360°) in running direction .

6. Observe dial indicator reading as valve is moved to full open. Record maximum reading and compare with specifications given below.

Intake Valves—Specification

Valve Lift [at 0.00 mm (in.) Valve Clearance]	11.56—12.37 mm (0.455—0.487 in.)
Wear Limit	11.13 mm (0.438 in.)

Continued on next page
RG,CTM8,GR16,51 –19–29SEP94–1/2

Exhaust Valves—Specification

Valve Lift [at 0.00 mm (in.) Valve Clearance]	11.28—12.12 mm (0.444—0.477 in.)
Wear Limit	10.85 mm (0.427 in.)

7. If valve lift on all valves is within specifications, adjust valve lash to specified clearance. (See CHECK AND ADJUST VALVE CLEARANCE in Group 05.)

   If valve lift on one or more valves is not within specification, remove and inspect entire valve train and camshaft.

8. Rotate engine one full revolution (360°). Lock engine at:

   - TDC No. 1 exhaust stroke for 3-cylinder engines.
   - TDC No. 4 compression stroke for 4-cylinder engines.
   - TDC No. 6 compression stroke for 6-cylinder engines.

9. Set rocker arm-to-valve tip clearance to 0.0 mm (in.) for:

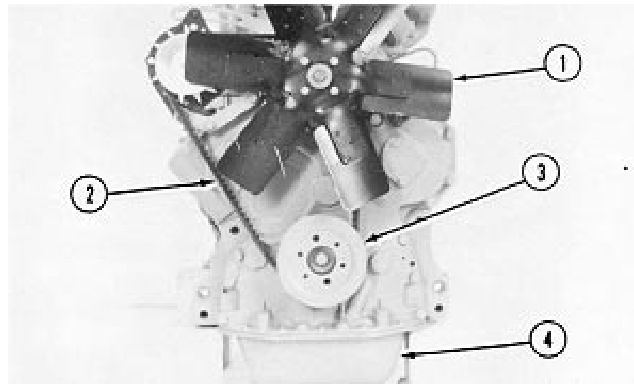
   - No. 3 exhaust and No. 2 intake valves on 3-cylinder engines.
   - No. 2 and 4 exhaust and No. 3 and 4 intake valves on 4-cylinder engines.
   - No. 2, 4, and 6 exhaust and No. 3, 5, and 6 intake valves on 6-cylinder engines.

10. Repeat steps 4—7.

RG,CTM8,GR16,51 –19–29SEP94–2/2

REMOVE TIMING GEAR COVER

1. Drain oil from engine crankcase.
2. Remove fan (1), fan belt (2), and water pump, if necessary. (See Group 25.)
3. Remove alternator, alternator mounting bracket, and belt tensioner (if equipped).
4. Remove crankshaft pulley or damper (3). (See Group 15.)
5. Remove oil pan (4). (See Group 20.)



T79150 –UN–07NOV88

1—Fan
2—Fan Belt
3—Crankshaft Pulley or Damper
4—Oil Pan

CTM8,GR16,23 –19–16SEP92–1/3

6. Unscrew oil pressure regulating valve plug and remove spring and valve.

NOTE: All 300 Series engines are equipped with the plug in the timing gear cover, however earlier 4045 and 6068 engines are not equipped with the pressure regulating valve and spring in the front cover. (See GENERAL LUBRICATION SYSTEM INFORMATION in Group 20.)

7. Remove auxiliary drive gears, if equipped, as described later in this group.

NOTE: Mark and identify location of timing gear cover hardware before removal to aid in reassembly.

8. Remove timing gear cover-to-cylinder block cap screws and nuts. Remove cover.

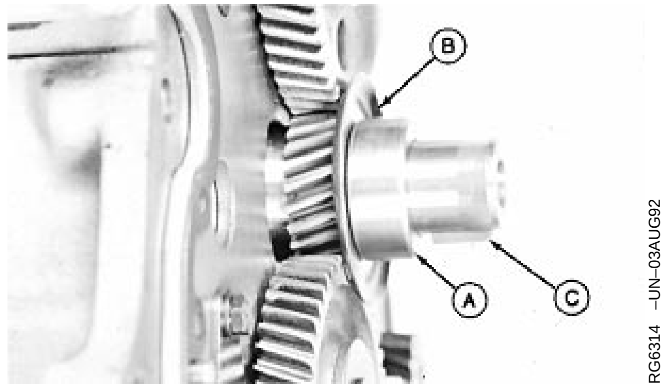
RG6313 –UN–03AUG92

Continued on next page

CTM8,GR16,23 –19–16SEP92–2/3

9. Remove Woodruff key (C), wear ring (A), and oil deflector (B) from crankshaft (if equipped).

NOTE: Some engines use an O-ring behind the wear ring. Auxiliary drive engines have wear surface on front pulley.



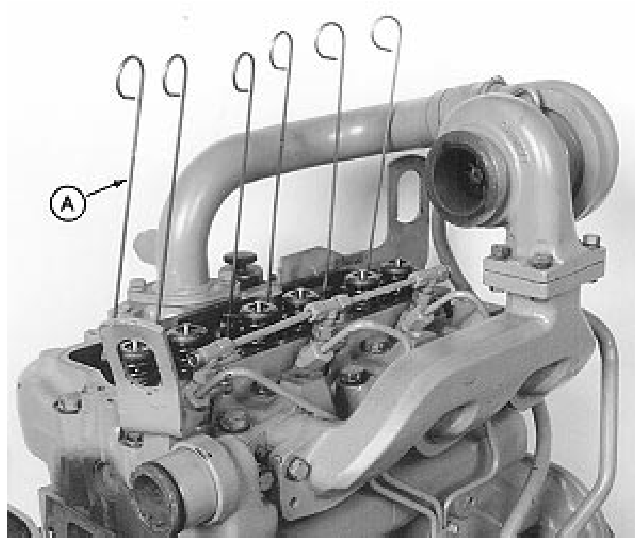
A—Wear Ring
B—Oil Deflector
C—Woodruff Key

CTM8,GR16,23 –19–16SEP92–3/3

REMOVE AND INSTALL CAMSHAFT BUSHING WITH FRONT PLATE INSTALLED CAMSHAFT GEAR-DRIVEN AUXILIARY DRIVE ENGINES, SARAN BUILT ENGINES SERIAL NO. (138541—)

NOTE: A camshaft bushing is used in front (No. 1) camshaft bore on engines equipped with camshaft gear-driven auxiliary drive.

On Saran built engines (Serial No. 138541—), the front plate has a chamfered edge allowing camshaft bushing removal and installation with the front plate installed.



A—Magnetic Holding Set

REMOVE CAMSHAFT BUSHING

1. Set engine at No. 1 “TDC” compression.

2. On turbocharged engines, disconnect the turbocharger oil inlet line. (See DISCONNECT TURBOCHARGER OIL INLET LINE in Group 03.)

3. Remove timing gear cover, as described earlier in this group.

4. Remove rocker arm cover and rocker arm assembly. (See procedure in Group 05.)

5. Remove push rods. (See procedure in Group 05.)

6. Remove camshaft driven fuel supply pump (if equipped).

7. Turn engine front side up and hold camshaft followers away from camshaft lobes using D15001NU Magnetic Holding Set (A).

NOTE: If D15001NU Magnetic Holding Set is not available, revolve engine so oil pan is facing up and camshaft followers fall away from camshaft.

Continued on next page

RG,CTM8,DX158 –19–08FEB95–1/3

8. Remove camshaft. (See procedure later in this group.)

IMPORTANT: Engine MUST remain in a position where camshaft followers rest against cylinder head or are held in up position by magnetic holders so that followers do not fall into engine crankcase. If camshaft followers fall into crankcase, cylinder head removal will be required.

9. Place engine in upright position and remove countersunk Allen-head cap screw (A, shown removed). Install threaded countersunk spacer (B) from JDG739B Camshaft Bushing Service Kit into hole that has chamfered screw and star washer.

IMPORTANT: Block must be replaced if camshaft bore is damaged. Be careful when removing or installing bushing.

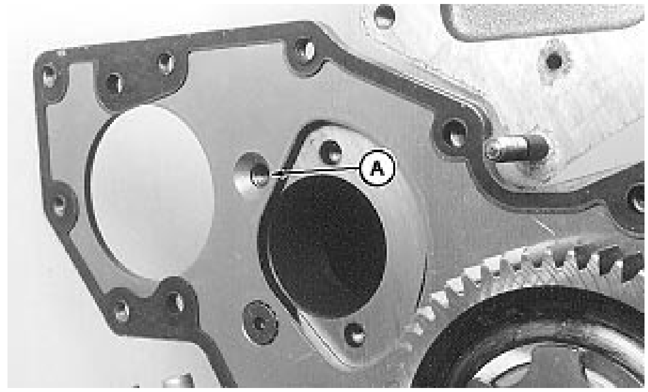
10. Install remaining threaded spacers and forcing plate (C) to cylinder block so plate is centered over camshaft bore. Tighten spacers and nuts securely.

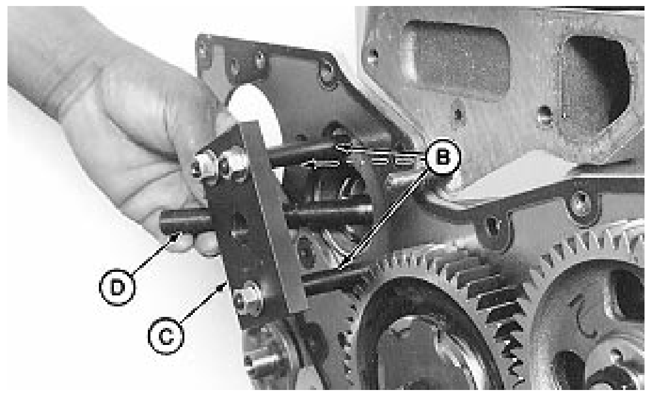
11. Insert bushing puller (D) into camshaft bore so puller pilots in bushing ID and screw extends through plate.

IMPORTANT: Cylinder block bore may be damaged if puller is not properly piloted in bushing. Be sure puller is properly piloted before pulling bushing.

12. Install thrust washer and hex nut. Tighten hex nut until bushing is free of block bore. Remove puller and discard bushing.

13. Clean and inspect bore in cylinder block. If bore is damaged, replace cylinder block.





A—Cap Screw
B—Spacer
C—Forcing Plate
D—Puller

Continued on next page RG,CTM8,DX158 –19–08FEB95–2/3

INSTALL CAMSHAFT BUSHING

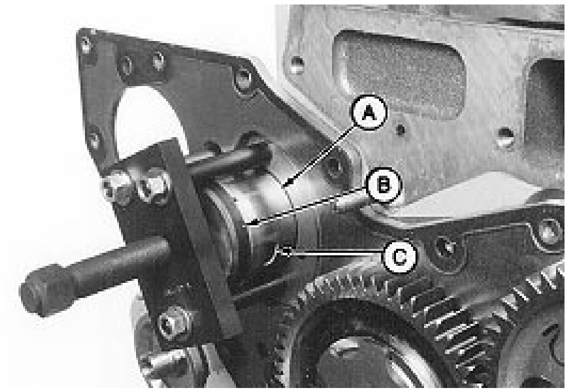
IMPORTANT: Bushings must be installed so oil supply hole aligns with oil drilling in block bore.

1. Mark orientation of oil supply hole (C) on front face of block to help with bushing alignment during installation.

2. Apply TY6333 grease to ID and OD of new bushing (A), and to ID of bushing bore. Slide bushing onto driver (B) so notched end of bushing will be toward front end of engine when installed.

3. Thread forcing screw into forcing plate. With bushing started, square in bore and oil hole aligned, tighten forcing screw until flange of bushing driver bottoms against face of block.

4. Remove bushing tool from cylinder block and check oil supply hole for correct alignment. If holes are not aligned, remove and discard bushing. Install new bushing.



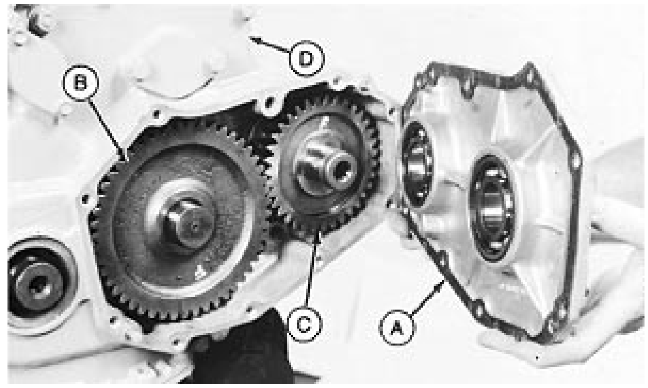
RG7118 –UN–05JAN95

A—Bushing
B—Driver
C—Oil Supply Hole

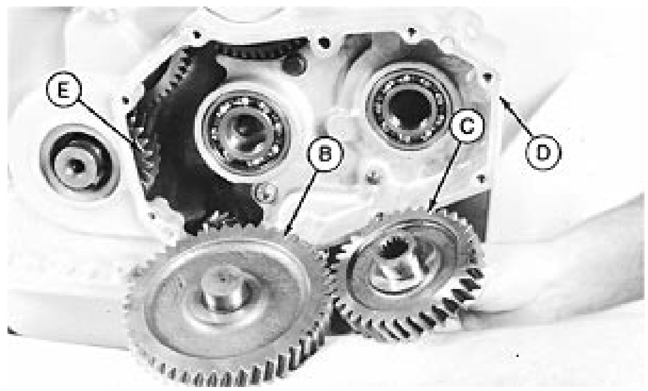
RG,CTM8,DX158 –19–08FEB95–3/3

REMOVE AUXILIARY DRIVE GEARS (ENGINES WITH AUXILIARY GEAR DRIVE OPTION)

1. Remove auxiliary drive gear cover (A) with bearings.
2. Remove auxiliary idler (B) and output drive (C) gears.
3. Remove timing gear cover (D) nuts and cap screws. Remove crankshaft (drive) gear (E) and collet.
4. Replace worn or damaged bearings.
5. Clean covers and inspect for cracks or damage.



RG6315 –UN–03AUG92



RG6316 –UN–03AUG92

A—Auxiliary Drive Gear Cover
B—Auxiliary Idler Gear
C—Output Drive Gear
D—Timing Gear Cover
E—Crankshaft (Drive) Gear

CTM8,GR16,24 –19–03JAN95–1/1

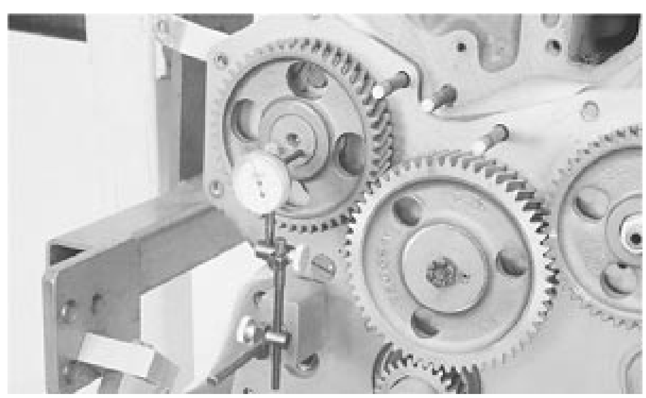
MEASURE CAMSHAFT END PLAY

Measure camshaft end play.

Camshaft—Specification

End Play .... 0.08—0.23 mm (0.003—0.009 in.)
Wear Limit .... 0.38 mm (0.015 in.)

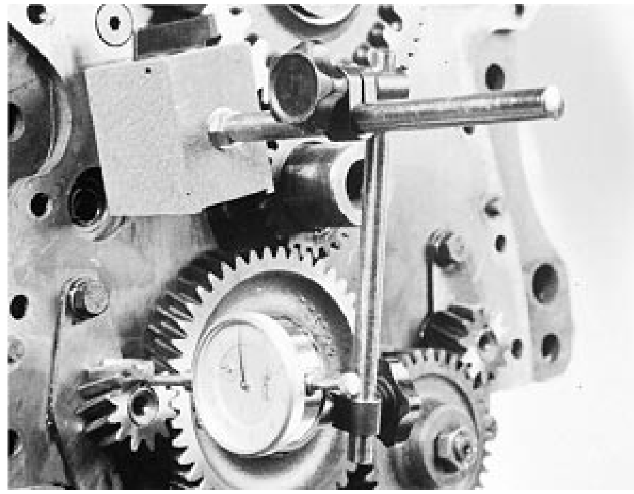
If end play is excessive, check thrust plate thickness with camshaft removed. (See MEASURE CAMSHAFT THRUST PLATE CLEARANCE later in this group.)



T90982 –UN–07NOV88

RG,CTM8,GR16,34 –19–11OCT94–1/1

MEASURE BALANCER SHAFT END PLAY (4-CYLINDER ENGINES)



RG6320 –UN–21AUG92

Measure balancer shaft end play.

Balancer Shaft—Specification

End Play	0.05—0.26 mm (0.002—0.010 in.)
Wear Limit	0.38 mm (0.015 in.)

If balancer shaft end play exceeds specifications, check thrust plate thickness. (See INSPECT BALANCER SHAFT GEARS AND THRUST PLATES later in this group.)

RG,CTM8,GR16,35 –19–29SEP94–1/1

MEASURE IDLER GEAR END PLAY

T81269 –UN–09NOV88

Check end play of upper and lower idler gears.

Upper and Lower Idler Gear—Specification

End Play	0.14—0.29 mm (0.006—0.012 in.)
Wear Limit	0.40 mm (0.016 in.)

If idler gear end play does not meet specifications, check idler gear, idler shaft, and thrust washer for wear. (See MEASURE IDLER GEAR, BUSHING AND SHAFT later in this group.)

RG,CTM8,GR16,36 –19–11OCT94–1/1

MEASURE TIMING GEAR BACKLASH

Spur gears (A) have different backlash specifications than helical gears (B).

Only earlier Saran-built engines had spur timing gears. All Dubuque-built engines and later Saran-built engines have helical timing gears.

RG6323 –UN–03AUG92

A—Spur Gear
B—Helical Gear

Continued on next page RG,CTM8,GR16,37 –19–19OCT92–1/4

HELICAL TIMING GEARS

Measure timing gear backlash.

For engines with helical gears, compare measurements taken to the following specifications:

Camshaft-to-Upper Idler (A)—Specification

Backlash .... 0.07—0.35 mm (0.003—0.014 in.)
Wear Limit .... 0.51 mm (0.020 in.)

Injection Pump-to-Upper Idler (B)—Specification

Backlash .... 0.07—0.35 mm (0.003—0.014 in.)
Wear Limit .... 0.51 mm (0.020 in.)

Upper Idler-to-Crankshaft (C)—Specification

Backlash .... 0.07—0.30 mm (0.003—0.012 in.)
Wear Limit .... 0.40 mm (0.016 in.)

Crankshaft-to-Lower Idler (D)—Specification

Backlash .... 0.07—0.35 mm (0.003—0.014 in.)
Wear Limit .... 0.51 mm (0.020 in.)

Balancer Shaft-to-Oil Pump (4-Cyl Only) (E)—Specification

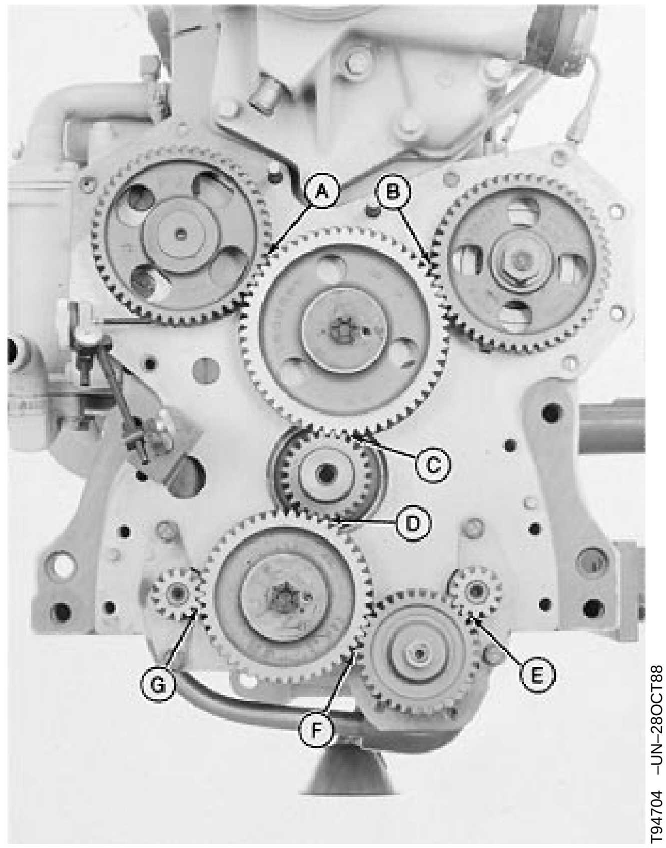
Backlash .... 0.05—0.36 mm (0.002—0.015 in.)
Wear Limit .... 0.51 mm (0.020 in.)

Oil Pump-to-Lower Idler (F)—Specification

Backlash .... 0.04—0.36 mm (0.0016—0.015 in.)
Wear Limit .... 0.40 mm (0.016 in.)

Lower Idler-to-Balancer Shaft (4-Cyl Only) (G)—Specification

Backlash .... 0.05—0.40 mm (0.002—0.016 in.)
Wear Limit .... 0.51 mm (0.020 in.)



A—Camshaft Gear-to-Upper Idler Gear
B—Injection Pump Gear-to-Upper Idler Gear
C—Upper Idler Gear-to-Crankshaft Gear
D—Crankshaft Gear-to-Lower Idler Gear
E—Balancer Shaft Gear-to-Oil Pump Gear[1]
F—Oil Pump Gear-to-Lower Idler Gear
G—Lower Idler Gear-to-Balancer Shaft Gear[1]

[1] *4-cylinder engine only*

Continued on next page

SPUR TIMING GEARS

For the following Saran-built engines with spur gears, compare measurements taken to specifications listed:
5300 Tractors (—242551)
5200/5400 Tractors and All 3-Cyl Engines (—270818)
5500 Tractors and All 4-Cyl Engines (—286631)

Camshaft-to-Upper Idler (A)—Specification

Backlash .... 0.08—0.45 mm (0.003—0.018 in.)
Wear Limit .... 0.85 mm (0.033 in.)

Injection Pump-to-Upper Idler (B)—Specification

Backlash .... 0.08—0.45 mm (0.003—0.018 in.)
Wear Limit .... 0.85 mm (0.033 in.)

Upper Idler-to-Crankshaft (C)—Specification

Backlash .... 0.04—0.35 mm (0.0016—0.014 in.)
Wear Limit .... 0.60 mm (0.024 in.)

Crankshaft-to-Lower Idler (D)—Specification

Backlash .... 0.04—0.35 mm (0.0016—0.014 in.)
Wear Limit .... 0.65 mm (0.025 in.)

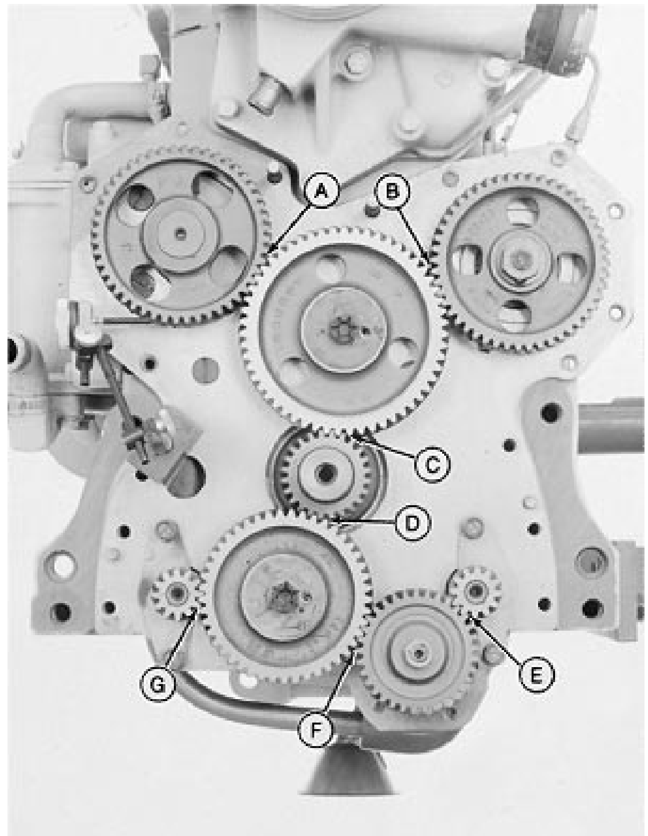
Oil Pump-to-Lower Idler (F)—Specification

Backlash .... 0.08—0.40 mm (0.003—0.016 in.)
Wear Limit .... 0.75 mm (0.030 in.)

Camshaft-to-Auxiliary Drive—Specification

Backlash .... 0.09—1.24 mm (0.004—0.049 in.)
Wear Limit .... 1.34 mm (0.053 in.)

For the following Saran-built engines with spur gears, compare measurements taken to specifications listed on the following page:
5300 Tractors (242552—)
5200/5400 Tractors and All 3-Cyl Engines (270819—)
5500 Tractors and All 4-Cyl Engines (286632—)



T94704 –UN–28OCT88

A—Camshaft Gear-to-Upper Idler Gear
B—Injection Pump Gear-to-Upper Idler Gear
C—Upper Idler Gear-to-Crankshaft Gear
D—Crankshaft Gear-to-Lower Idler Gear
E—Balancer Shaft Gear-to-Oil Pump Gear[1]
F—Oil Pump Gear-to-Lower Idler Gear
G—Lower Idler Gear-to-Balancer Shaft Gear[1]

[1] *4-cylinder engine only*

Continued on next page

Camshaft-to-Upper Idler (A)—Specification

Backlash .... 0.01—0.52 mm
(0.000—0.20 in.)

Injection Pump-to-Upper Idler (B)—Specification

Backlash .... 0.01—0.52 mm
(0.000—0.020 in.)

Upper Idler-to-Crankshaft (C)—Specification

Backlash .... 0.01—0.49 mm
(0.000—0.019 in.)

Crankshaft-to-Lower Idler (D)—Specification

Backlash .... 0.01—0.46 mm
(0.000—0.018 in.)

Balancer Shaft-to-Oil Pump (4-Cyl Only) (E)—Specification

Backlash .... 0.01—0.47 mm
(0.000—0.018 in.)

Oil Pump-to-Lower Idler (F)—Specification

Backlash .... 0.01—0.49 mm
(0.000—0.019 in.)

Lower Idler to Balancer Shaft (4-Cyl Only) (G)—Specification

Backlash .... 0.01—0.53 mm
(0.000—0.020 in.)

Camshaft-to-Auxiliary Drive—Specification

Backlash .... 0.01—0.54 mm
(0.000—0.021 in.)

RG,CTM8,GR16,37 –19–19OCT92–4/4

REMOVE CAMSHAFT

NOTE: It is not necessary to remove cylinder head from engine for camshaft removal. If push rods are bent or show excessive scuffing or if camshaft lobes show excessive wear, remove cylinder head for inspection of block, head and cam followers. (See REMOVE CYLINDER HEAD in Group 05.)

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

2. Measure valve lift. (See MEASURE VALVE LIFT earlier in this group).

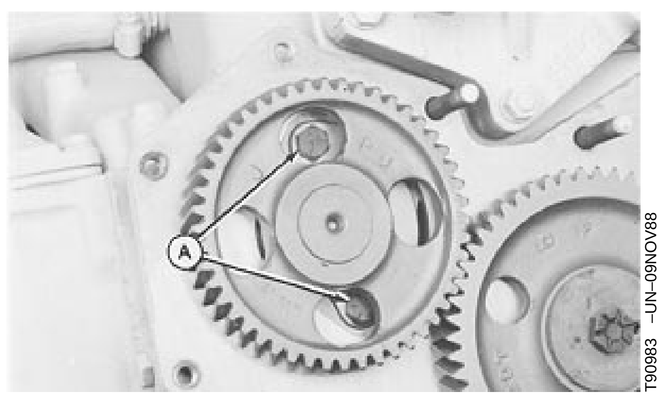
3. Remove rocker arm assembly and push rods. (See Group 05.)

4. Remove timing gear cover. (See REMOVE TIMING GEAR COVER earlier in this group.)

5. Remove camshaft activated fuel supply pump, if equipped.

RG,CTM8,GR16,38 –19–03JAN95–1/4

6. Turn crankshaft until cap screws (A) can be removed.



A—Cap Screws

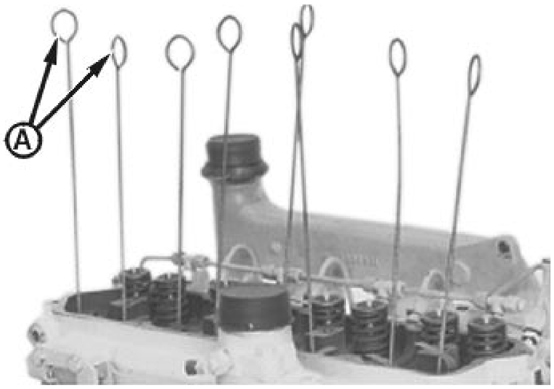
Continued on next page

RG,CTM8,GR16,38 –19–03JAN95–2/4

IMPORTANT: Engine MUST remain in a position where camshaft followers rest against cylinder head or are held in up position with magnetic holders so that followers do not fall into engine crankcase. If camshaft followers fall into crankcase, cylinder head removal is required.

NOTE: D1500NU Magnetic Follower Holder Kit (A) may also be used to hold camshaft followers away from lobes.

7. Revolve engine on repair stand to an angle where camshaft followers fall away from camshaft lobes.



RG9465 –UN–23OCT98

RG,CTM8,GR16,38 –19–03JAN95–3/4

IMPORTANT: DO NOT allow camshaft lobes to drag in bushing or honed bores.

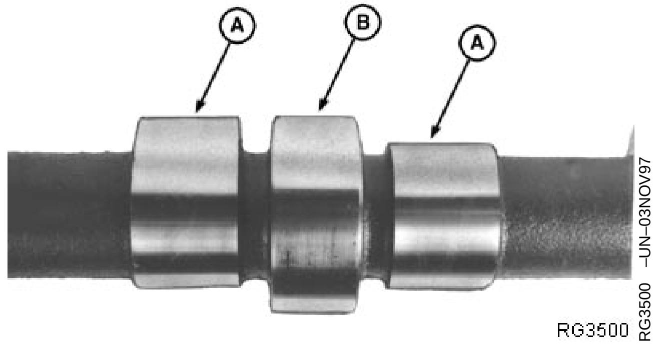
8. Carefully pull camshaft straight up, out of cylinder block. Remove thrust plate.

NOTE: Rotate camshaft carefully to aid in removing.

T81258 –UN–01NOV88

RG,CTM8,GR16,38 –19–03JAN95–4/4

VISUALLY INSPECT CAMSHAFT



A—Lobes
B—Journals

1. Clean camshaft in solvent. Dry with compressed air.

2. Inspect camshaft lobes (A) and journals (B) for wear or damage. Replace as necessary.

IMPORTANT: New camshaft followers can be used with old camshaft. DO NOT reuse old camshaft followers with a new camshaft. (See Group 05 for camshaft follower replacement.)

NOTE: Very light score marks are acceptable if valve lift is within specification. If pitting or galling exists, replace camshaft. (See MEASURE VALVE LIFT earlier in this group.)

3. Inspect tachometer drive for wear. Replace as necessary. (See REPLACE TACHOMETER DRIVE GEAR later in this group.)

RG,CTM8,GR16,41 –19–11OCT94–1/1

MEASURE CAMSHAFT THRUST PLATE CLEARANCE AND THICKNESS

Clean camshaft thrust plate and check clearance using a feeler gauge. Replace parts as necessary.

Camshaft Thrust Plate—Specification

Clearance .... 0.08—0.23 mm (0.003—0.009 in.)
Wear Limit .... 0.38 mm (0.015 in.)

NOTE: Thrust plate clearance determines camshaft end play.

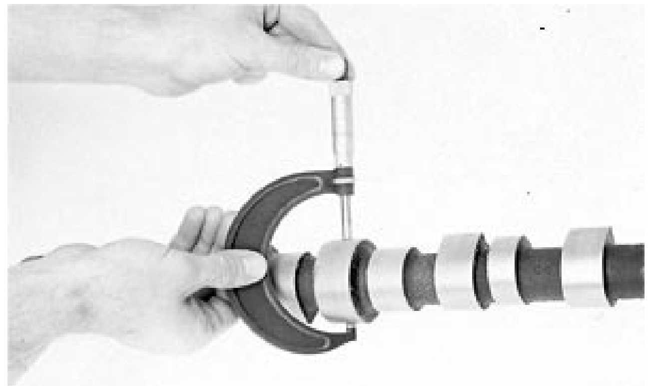
Check thrust plate thickness.

Camshaft Thrust Plate—Specification

Thickness... 3.96—4.01 mm (0.156—0.158 in.)
Wear Limit .... 3.83 mm (0.151 in.)

RG,CTM8,GR16,42 –19–16SEP92–1/1

INSPECT AND MEASURE CAMSHAFT BEARING BORE ID AND JOURNAL OD


T81260 –UN–07NOV88

All engine camshafts ride in machined bores of cylinder block except for engines equipped with camshaft gear-driven auxiliary drive. These engines have a (replaceable) bushing installed in No. 1 camshaft bore.

1. Measure camshaft journals. If a camshaft journal is damaged or does not meet specification, install a new camshaft.

2. Measure camshaft bore ID in cylinder block. If camshaft bore is damaged or is not within specification, install a new cylinder block or short block assembly.

3. If No. 1 camshaft bushing ID does not meet specifications, replace camshaft bushing. (See REMOVE AND INSTALL CAMSHAFT BUSHING later in this group.)

Camshaft Journal—Specification

OD .... 55.872—55.898 mm (2.1997—2.2007 in.)
Wear Limit .... 55.85 mm (2.199 in.)

Camshaft Bore (All Except No. 1 Camshaft Gear-Driven Aux. Drive)—Specification

ID .... 55.986—56.012 mm (2.2042—2.2052 in.)

Camshaft Bore-to-Journal Clearance (All Except No. 1 Camshaft Gear-Driven Aux. Drive)—Specification

Oil Clearance.. 0.10—0.15 mm (0.004—0.006 in.)
Wear Limit .... 0.18 mm (0.007 in.)

Camshaft Bore, Front No. 1 in Block (Camshaft Gear-Driven Aux. Drive Without Bushing Installed)—Specification

ID .... 59.961—59.987 mm (2.3607—2.3617 in.)

Continued on next page

Camshaft Bore, Front No. 1 in Block (Camshaft Gear-Driven Aux. Drive With Bushing Installed)—Specification

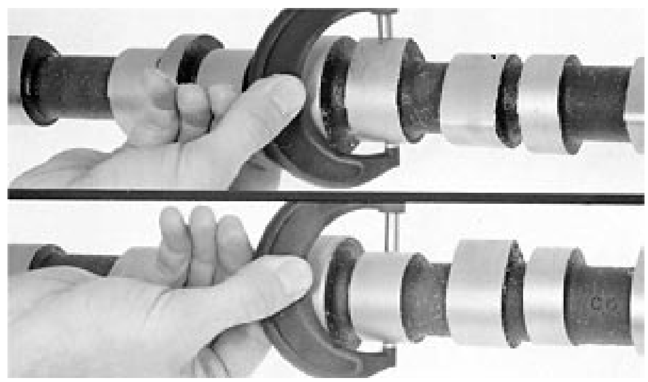
ID .... 55.948—56.000 mm (2.2026—2.2047 in.)

Camshaft Journal-to-Bushing, Clearance, Front No. 1 in Block (Camshaft Gear-Driven Aux. Drive)—Specification

Oil Clearance... 0.05—0.13 mm (0.002—0.005 in.)
Wear Limit .... 0.18 mm (0.007 in.)

RG,CTM8,GR16,43 –19–16FEB95–2/2

MEASURE CAMSHAFT LOBE HEIGHT



T81262 –UN–01NOV88

Measure each camshaft lobe at highest point and at narrowest point. The difference between these dimensions is camshaft lobe height. If height is not within specification on any lobe, install a new camshaft.

Camshaft Intake Lobe—Specification

Height .... 6.93—7.42 mm (0.273—0.292 in.)
Wear Limit .... 6.68 mm (0.263 in.)

Camshaft Exhaust Lobe—Specification

Height .... 6.76—7.26 mm (0.266—0.286 in.)
Wear Limit .... 6.50 mm (0.256 in.)

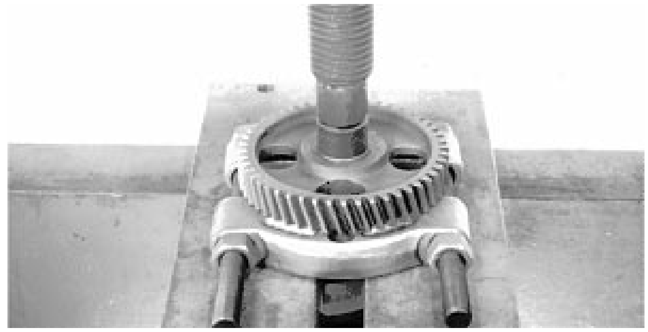
Measure fuel supply pump camshaft lobe diameter. If diameter is not within specification or lobe surface is grooved, install a new camshaft.

Fuel Supply Pump Camshaft Lobe—Specification

Diameter .... 42.72—42.98 mm (1.682—1.692 in.)

CTM8,GR16,6 –19–29SEP94–1/1

REMOVE AND INSTALL CAMSHAFT GEAR



T88696 –UN–28OCT88

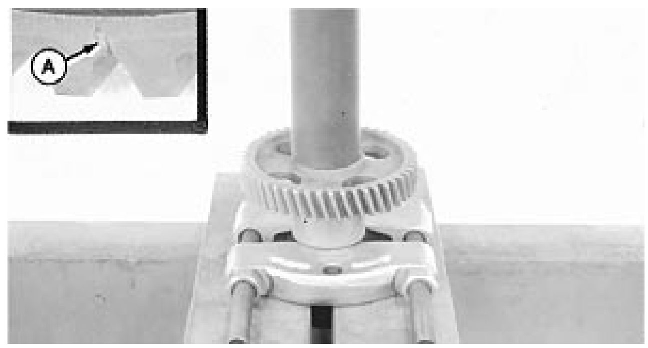
IMPORTANT: Camshaft must be replaced if dropped or damaged, do not allow camshaft to strike floor when removing gear.

1. Press camshaft out of gear.

2. Clean camshaft and gears in solvent. Dry with compressed air.

3. Inspect cam journals for nicks and scratches. Replace camshaft if damage is found.

RG,CTM8,GR16,44 –19–19OCT92–1/2



T88697 –UN–28OCT88

A—Timing Mark

4. Apply TY6333 grease to camshaft nose and gear ID to ease installation.

5. Support camshaft under first bearing journal in a hydraulic press.

6. Heat gear to 66—93°C (140—160°F) in heated oil or oven before pressing onto shaft to prevent metal transfer.

7. Install Woodruff key in camshaft nose.

8. Install gear with timing mark (A) away from camshaft (towards front timing gear cover). Press gear onto camshaft with a tubular driver until gear bottoms against camshaft shoulder.

RG,CTM8,GR16,44 –19–19OCT92–2/2

INSPECT CAMSHAFT FOLLOWERS


RG6324 –UN–23NOV97

NOTE: Cylinder head must be removed before camshaft followers can be removed from engine. (See Group 05.)

1. Inspect followers for uneven wear or damage. Also inspect corresponding camshaft lobe for wear or damage. Replace as necessary.

2. Measure follower OD and follower bore ID in cylinder block.

Camshaft Follower—Specification

OD .... 31.61—31.64 mm (1.245—1.246 in.)

Camshaft Follower Bore in Block—Specification

ID .... 31.70—31.75 mm (1.248—1.250 in.)

Camshaft Follower-to-Bore—Specification

Clearance .... 0.06—0.13 mm (0.002—0.005 in.)

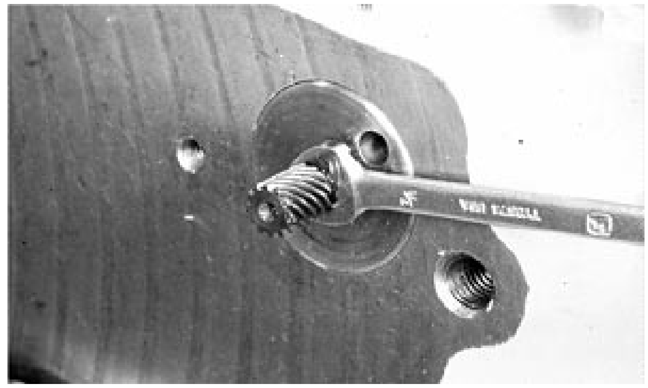
Replace cam followers that are not within specification.

Replace cylinder block if any one cam follower bore is not within specification.

RG,CTM8,GR16,46 –19–16SEP92–1/1

REPLACE TACHOMETER DRIVE GEAR

NOTE: If the camshaft is not removed from the engine, the flywheel and flywheel housing must be removed before the tachometer drive gear can be replaced.



RG5641 –UN–02APR90

SCREW-IN TYPE TACHOMETER DRIVE GEAR

1. Remove failed tachometer drive gear.

2. Apply LOCTITE® 242 (TY9370) Thread Lock and Sealer to threads of new tachometer drive gear and tighten to specifications.

Screw-In Type Tachometer Drive Gear—Specification

Torque .... 20 N•m (15 lb-ft)

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

CTM8,GR16,26 –19–03JAN95–1/2

PRESS-IN TYPE TACHOMETER DRIVE GEAR (SARAN ENGINES ONLY)

IMPORTANT: The tachometer drive gear is tightly pressed into the camshaft. Follow removal and installation procedures carefully. Failure to do so will result in a broken or damaged gear and in most cases will require camshaft replacement.

1. Break off or saw off gear so shaft stub can be drilled.
2. If camshaft is not removed from engine, protect vital areas such as rear camshaft bore, crankshaft bearings, crankcase, etc. from metal shavings.
3. Drill and tap a hole 6.0 mm (0.250 in.) diameter and 12.7 mm (0.050 in.) deep in the center of the gear shaft.
4. Using an appropriate cap screw (A) and spacer (B) (or several washers), engage the cap screw until it bottoms or until stub (C) comes out. If cap screw bottoms, add more washers until shaft stub is free from camshaft bore.
5. Before installing tachometer drive gear, make sure that the knurled gear end is within specifications to prevent excessive press-fit and damage to the camshaft.

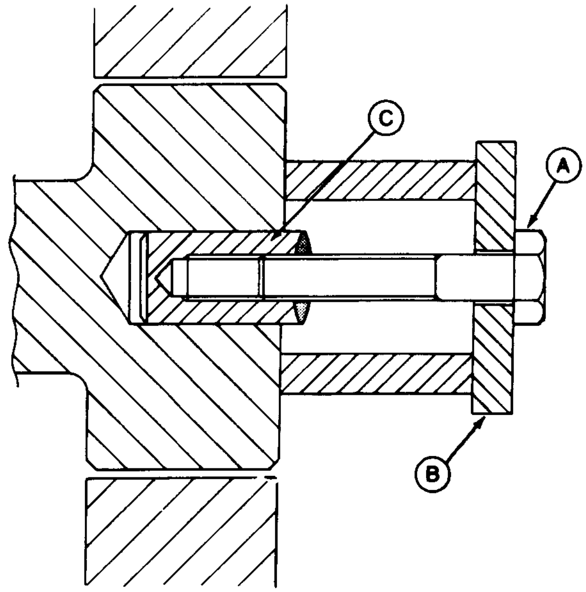
Tachometer Drive Gear (knurled end)—Specification

OD .... 12.88—12.92 mm (0.506—0.508 in.)

If diameter exceeds specifications, rework the shaft.

IMPORTANT: When installing tachometer drive gear, support front end of camshaft so that front thrust plate is not damaged.

6. Install tachometer drive gear. Press only on shaft portion of gear.



A—Cap Screw
B—Spacer
C—Stub

CTM8,GR16,26 –19–03JAN95–2/2

REMOVE AND INSTALL CAMSHAFT BUSHING WITH FRONT PLATE REMOVED ENGINE SERIAL NO. (—138540)

On Saran-built engines prior to (Serial No. —138540), the front plate has to be removed when replacing camshaft bushing unless a more recent service front plate has been installed.

Use JDG739B Camshaft Bushing Service Set to remove and install camshaft bushing from No. 1 camshaft bore of engines equipped with camshaft gear-driven auxiliary drive.

RG,CTM8,GR16,47 –19–08FEB95–1/3

IMPORTANT: Block must be replaced if camshaft bore is damaged. Be careful when removing or installing bushing.

REMOVE CAMSHAFT BUSHING

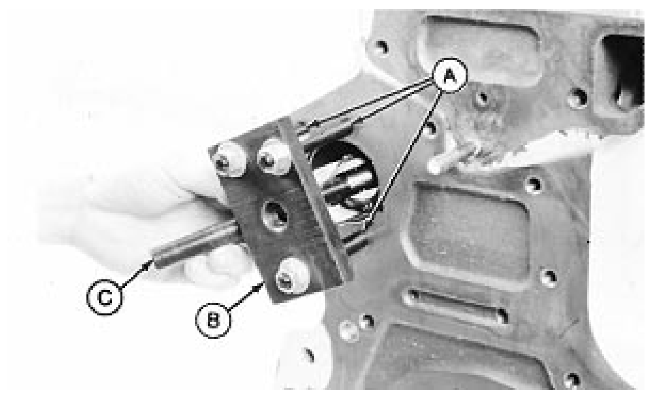
1. Assemble threaded spacers (A), and forcing plate (B) to cylinder block so plate is centered over camshaft bore. Tighten spacers and nuts securely.

2. Insert bushing puller (C) into camshaft bore so puller pilots in bushing ID and screw extends through plate.

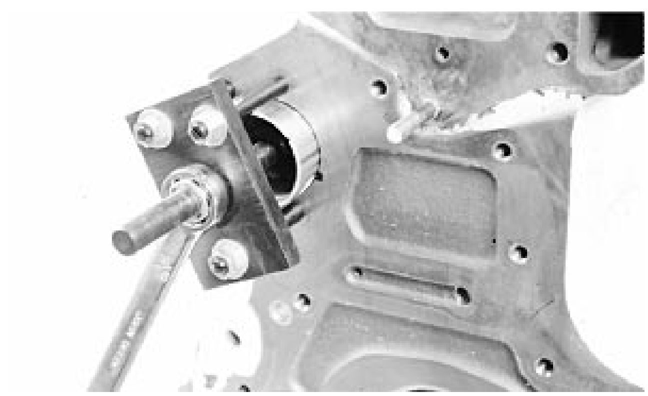
IMPORTANT: Cylinder block bore may be damaged if puller is not properly piloted in bushing. Be sure puller is properly piloted before pulling bushing.

3. Install thrust washer and hex nut. Tighten hex nut until bushing is free of block bore. Remove puller and discard bushing.

4. Clean and inspect bore in cylinder block. If bore is damaged, replace the cylinder block.



RG6325 –UN–03AUG92



RG6326 –UN–03AUG92

A—Threaded Spacers
B—Forcing Plate
C—Bushing Puller

Continued on next page

RG,CTM8,GR16,47 –19–08FEB95–2/3

INSTALL CAMSHAFT BUSHING

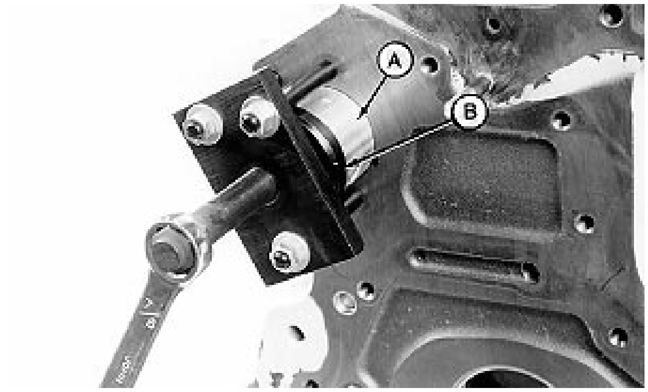
IMPORTANT: Bushing must be installed so oil supply hole aligns with oil drilling in block bore.

1. Mark orientation of oil supply hole (C) on front face of block to help with bushing alignment during installation.

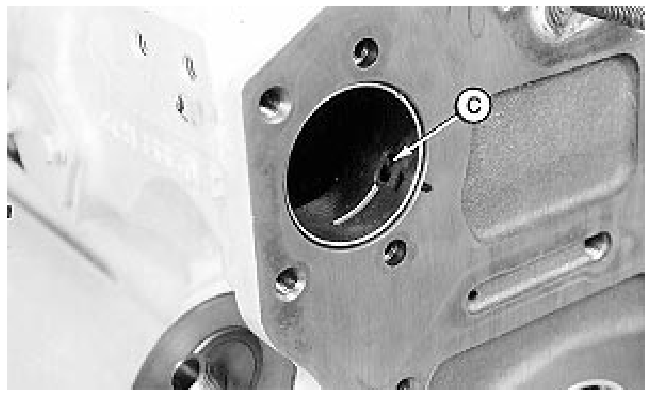
2. Apply TY6333 grease to ID and OD of new bushing (A), and to ID of bushing bore. Slide bushing onto driver (B) so notched end of bushing will be toward front end of engine when installed.

3. Thread forcing screw into forcing plate. With bushing started square in bore and oil holes aligned, tighten forcing screw until flange of bushing driver bottoms against face of block.

4. Remove bushing tool from cylinder block and check oil supply hole for correct alignment. If holes are not aligned, remove and discard bushing. Install a new bushing.



RG6327 –UN–20FEB95



RG6328 –UN–20FEB95

A—Bushing
B—Driver
C—Oil Supply Hole

RG,CTM8,GR16,47 –19–08FEB95–3/3

REMOVE BALANCER SHAFTS—IF EQUIPPED (4-CYLINDER ENGINES)

IMPORTANT: During removal, identify left and right balancer shafts to ensure correct reassembly. Journals are lapped for one direction of rotation. Interchanging shaft locations could cause premature wear on shafts and bushings.

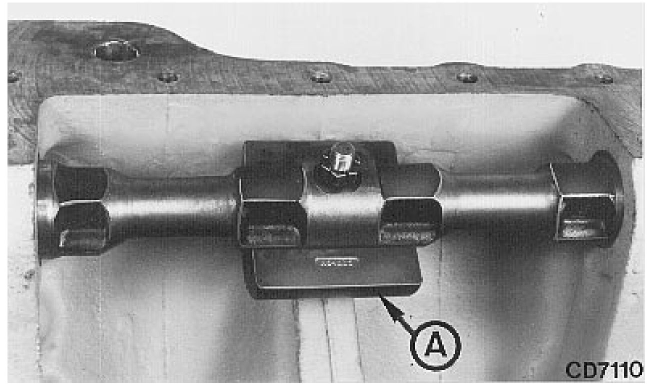
Both Dubuque-built and Saran-built 4-cylinder engines are available without balancer shafts. Dubuque-built 4-cylinder engines without balancer shafts will have the balancer shaft bores machined in the cylinder block. However, the bushings will be installed so the oil holes do not align in the block. Saran-built 4-cylinder engines without balancer shafts will not have the balancer shaft oil holes drilled in block.

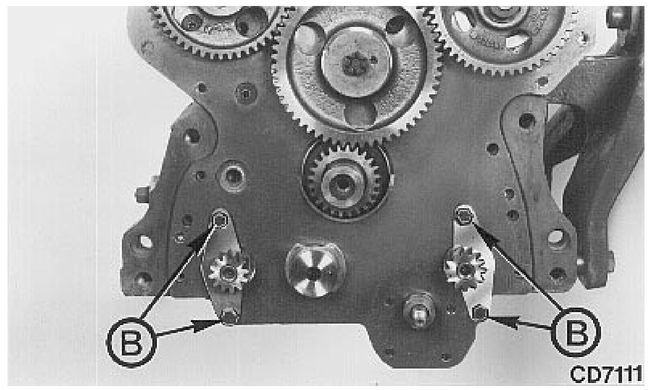
1. Remove lower idler gear and oil pump gear.

2. Remove balancer shaft weights (A), if equipped and discard cap screws and nuts.

3. Loosen cap screws (B) and remove balancer shafts.

NOTE: Use care when removing balancer shafts that neither shaft journals nor bushings in cylinder block are damaged.





A—Balancer Shaft Weights
B—Cap Screws

CTM8,GR16,27 –19–12JAN95–1/1

INSPECT AND MEASURE BALANCER SHAFT BUSHINGS AND JOURNALS

1. Inspect, measure and record bushing ID (A) at all locations..

2. Measure balancer shaft journal OD. Difference between journal OD and bushing ID is oil clearance.

   If oil clearance is not within specification, install new bushings and, if necessary, new balancer shaft.

Balancer Shaft Bushing (New)—Specification

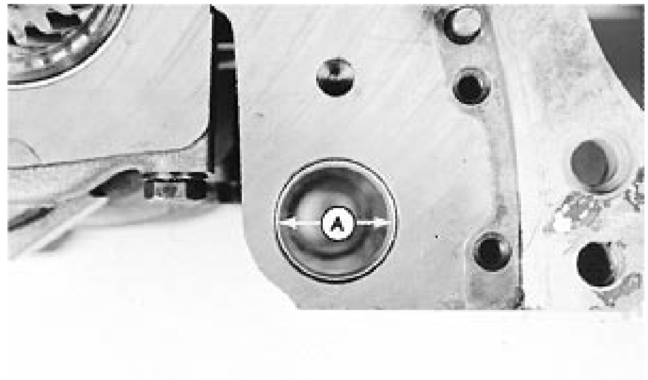
ID .... 38.177—38.237 mm (1.5030—1.5054 in.)

Balancer Shaft Journal—Specification

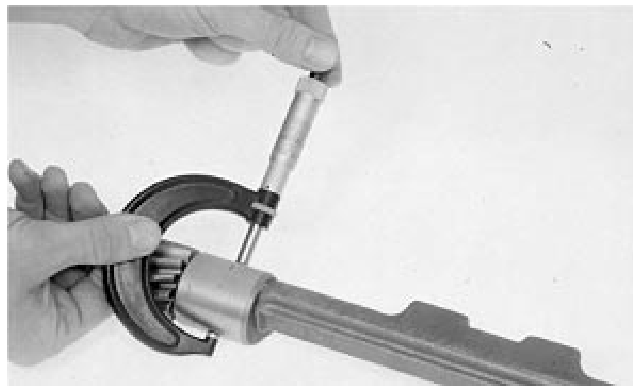
OD .... 38.137—38.163 mm (1.5014—1.5024 in.)

Balancer Shaft Journal-to-Bushing—Specification

Oil Clearance .... 0.024—0.100 mm (0.001—0.004 in.)
Maximum Allowable Oil Clearance .... 0.15 mm (0.006 in.)



RG6330 –UN–03AUG92

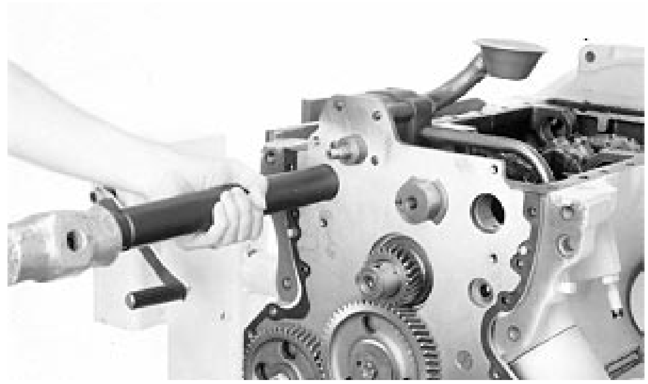


T81899 –UN–09NOV88

A—Balancer Shaft Bushing

CTM8,GR16,7 –19–29SEP94–1/1

REMOVE AND INSTALL BALANCER SHAFT BUSHINGS (4-CYLINDER ENGINES)


T81898 –UN–07NOV88

1. Remove bushings from block with JD249 Balancer Shaft Bushing Driver. To remove the rear (third) bushing, the flywheel housing must be removed.

2. Install new bushings in block with JD249 Balancer Shaft Bushing Driver.

IMPORTANT: Make sure oil holes in bushing and block are aligned for proper bushing and journal lubrication.

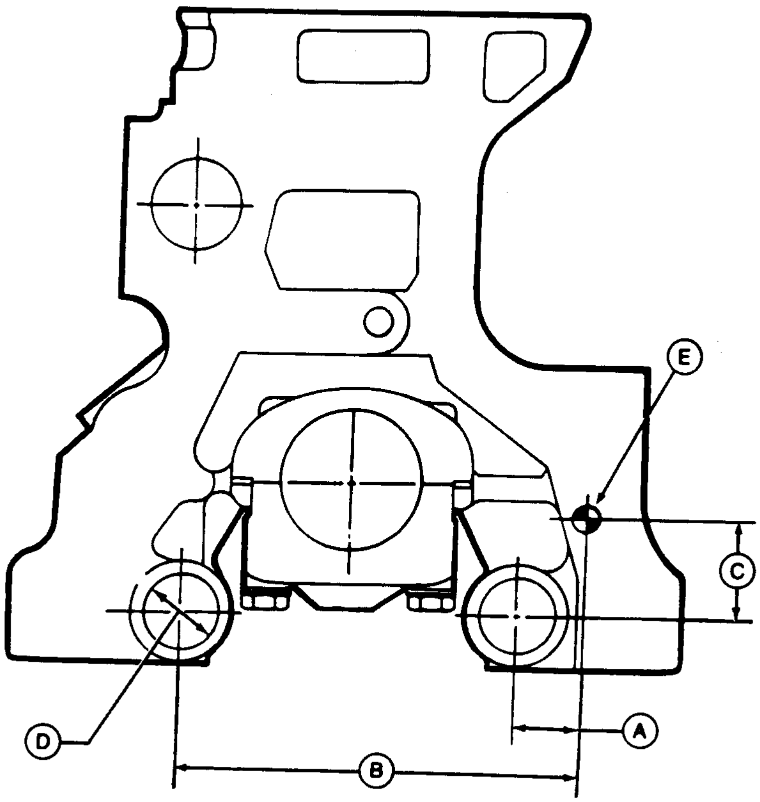
NOTE: Cylinder block must be line bored if oversize bushings are to be installed. (See INSTALL OVERSIZE BALANCER SHAFT BUSHINGS IN CYLINDER BLOCK later in this group.)[1].

3. Insert balancer shaft to check for bushing-to-shaft clearance. If shaft can be rotated by hand with a slight-to-moderate drag, adequate bushing-to-balancer shaft clearance exists. It is not necessary to hone bushings to obtain specified oil clearance. Excessive clearance can result in shaft seizure.

[1]For 4039 engines only. Oversize balancer shaft bushings are not recommended for use in 4045 engines. Never use oversize balancer shaft bushings with bolt-on balancer shaft weights. Oversize bushings should only be used with one-piece balancer shafts.

CTM8,GR16,28 –19–12JAN95–1/1

INSTALL OVERSIZE BALANCER SHAFT BUSHINGS IN CYLINDER BLOCK (4039 ENGINES)



RG5585 –UN–09OCT89

IMPORTANT: DO NOT use oversize balancer shaft bushings in 4045 engines with bolt-on balancer shaft weights. Oversize bushings should only be used in 4039 engines with one-piece balancer shafts.

1. Remove bushings and check for cracked or broken block bosses.

2. Line bore cylinder block as specified in following table.

IMPORTANT: Reference all line boring dimensions from front left dowel pin (E).

3. Make a chamfer 20—25° x 1.5 mm (0.060 in.) toward front of engine for front and middle bores and toward rear of engine for rear bore to make bushing installation easier.

4. Install new bushings. (See REMOVE AND INSTALL BALANCER SHAFT BUSHINGS earlier in this group.)

BALANCER SHAFT BUSHING LINE BORING SPECIFICATIONS

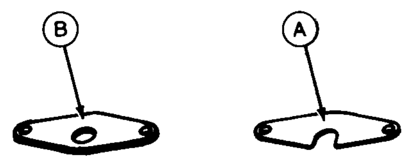
A	41.985—42.035 mm (1.653—1.655 in.)
B	257.985—258.035 mm (10.157—10.159 in.)
C	64.986—65.036 mm (2.558—2.560 in.)

Continued on next page

Item	Measurement	Specification
Cylinder Block Bore for Oversize Balancer Shaft Bushings (D)	ID	43.236—43.264 mm (1.7022—1.7033 in.)
Cylinder Block Bore for Standard Balancer Shaft Bushing (D)	ID	41.262—41.288 mm (1.6245—1.6255 in.)

CTM8,GR16,9 –19–29SEP94–2/2

INSPECT BALANCER SHAFT GEARS AND THRUST PLATES



RG4742 –UN–20FEB95

A—Slotted Hole Thrust Plate
B—Non-Slotted Hole Thrust Plate

1. Inspect for broken, cracked or excessively worn gears. Check thrust plate for scoring or excessive wear.

   Engines built prior to March 1990: Thrust plates with slotted hole (A) were used on Option Code 4501 (60 percent balance-4039T) and Code 4502 (full balance-4039D). The slotted hole allows for removal of thrust plate without removing gear. Thrust plates with non-slotted hole (B) were used on Option Code 4502 (full balance-4039T and 4045 Engines). Gear removal is required for thrust plate removal.

   Engines built after March 1990: Thrust plates with non-slotted hole are used on all production engines. A new plate without the slotted hole replaces both the slotted and non-slotted types previously used. Gear removal is required for thrust plate removal.

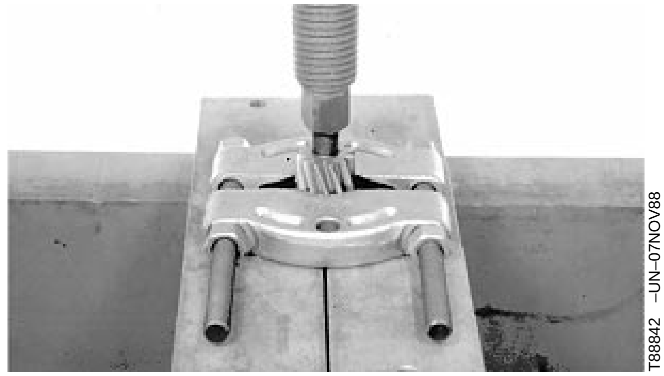
2. Inspect thrust plate for wear.

Balancer Shaft Thrust Plate (New)—Specification

Thickness.. 2.97—3.02 mm (0.117—0.119 in.)

CTM8,GR16,10 –19–23FEB95–1/1

REMOVE AND INSTALL BALANCER SHAFT GEARS



IMPORTANT: DO NOT intermix gears and shafts. Balancer shafts must be installed in the location from which removed. Reversing shaft locations could result in excessive bushing and shaft wear. If in doubt about proper shaft locations, replace the balancer shaft bushings.

NOTE: Balancer shaft kits provided for service are delivered without gear. These shafts are finish-lapped in different directions, therefore it is important to note the letter stamped at the rear of the shafts:

- *"R" for right-hand side shaft*
- *"L" for left-hand side shaft*

1. Support back side of gear in a press and push on balancer shaft to remove gear.

2. Inspect Woodruff key, gear, and thrust plate for cracks and wear. Replace if necessary.

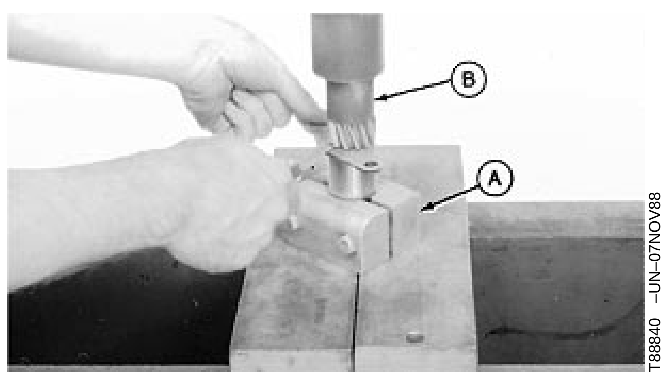
S11,2016,AA –19–12JAN95–1/2

3. Position balancer shaft in JD247 Balancer Shaft Holding Tool (A).

4. Install thrust plate.

5. Use woodruff key to index gear on balancer shaft. Be sure timing mark is on front face of gear.

6. Press gear onto shaft with a tube-type driver (B) until proper clearance between thrust plate and gear is obtained.



A—JD247 Holding Tool
B—Tube-Type Driver

Balancer Shaft Assembly—Specification

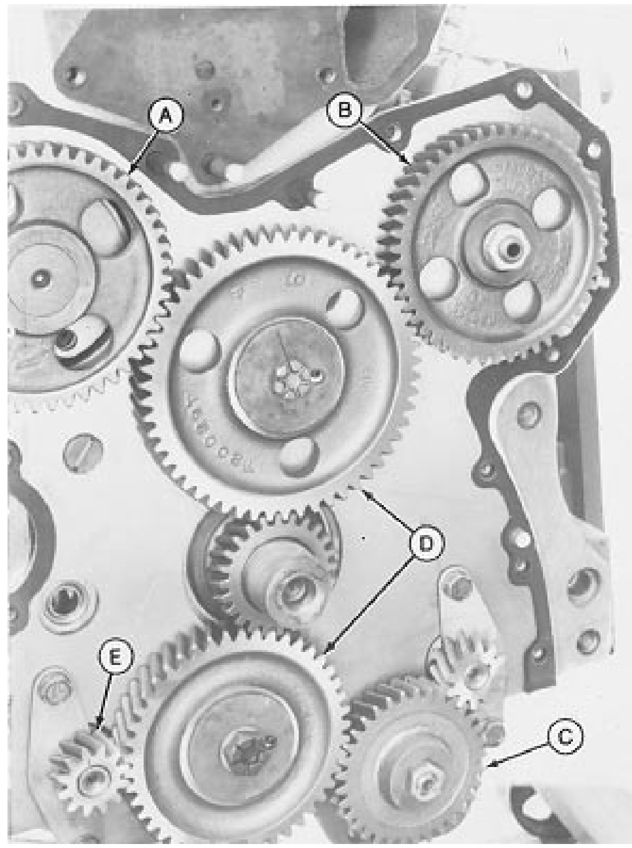
Thrust Plate-to-Gear Clearance .... 0.05—0.26 mm (0.002—0.010 in.)

S11,2016,AA –19–12JAN95–2/2

REMOVE CYLINDER BLOCK FRONT PLATE

Before the front plate can be removed, the following components must first be removed:

- Timing gear cover.
- Camshaft and gear (A)
- Injection pump drive gear (B)
- Injection pump (See Group 35.)
- Oil pump drive gear (C)
- Oil pump (See Group 20.)
- Idler gears (D)
- Balancer shafts (E)



T90985 –UN–09NOV88

A—Camshaft and Gear
B—Injection Pump Drive Gear
C—Oil Pump Drive Gear
D—Idler Gears
E—Balancer Shafts

S11,2016,AC –19–22JUL92–1/3

1. Remove five countersunk, flat-head screws and remove front plate.

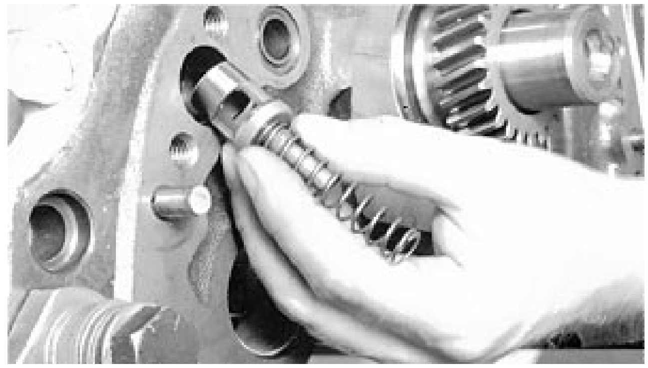
T90986 –UN–07NOV88

Continued on next page

S11,2016,AC –19–22JUL92–2/3

2. Remove oil by-pass valve and spring.

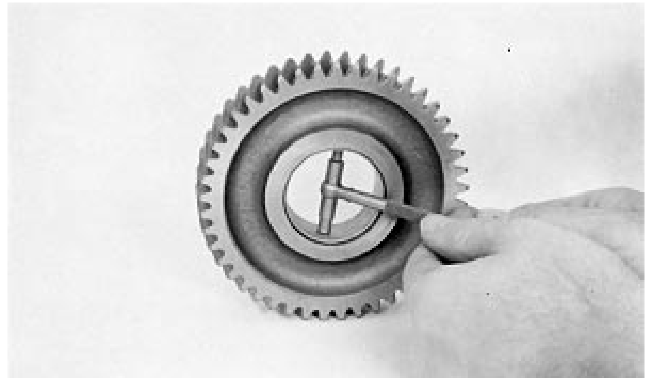
NOTE: Earlier 4045 and 6068 engines are not equipped with oil by-pass valve in front face of cylinder block. (See GENERAL LUBRICATION SYSTEM INFORMATION, in Group 20.)



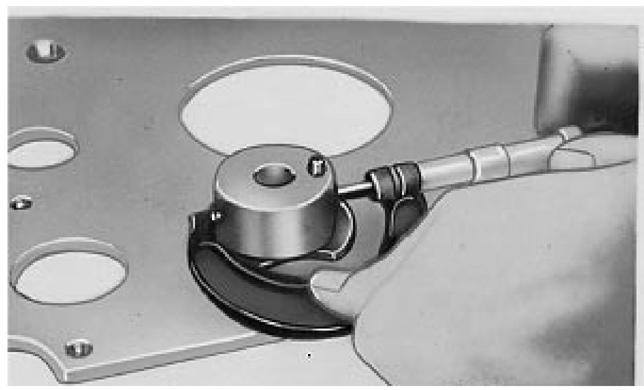
T87436 –UN–09NOV88

S11,2016,AC –19–22JUL92–3/3

MEASURE IDLER GEAR BUSHING AND SHAFT



T81273 –UN–09NOV88



T81347 –UN–09NOV88

1. Measure idler gear bushing ID and shaft OD to determine oil clearance. If oil clearance exceeds specification, replace worn parts.

Upper Idler Gear Bushing New Part (Helical Gears)—Specification

ID .... 44.48—44.53 mm (1.751—1.753 in.)
Wear Limit .... 44.56 mm (1.754 in.)

Upper Idler Gear Bushing New Part (Spur Gears)—Specification

ID .... 69.825—69.850 mm (2.7490—2.7499 in.)

Lower Idler Gear Bushing New Part—Specification

ID .... 44.48—44.53 mm (1.751—1.753 in.)
Wear Limit .... 44.56 mm (1.754 in.)

Upper Idler Gear Shaft New Part (Helical Gears)—Specification

OD .... 44.43—44.46 mm (1.749—1.750 in.)
Wear Limit .... 44.40 mm (1.748 in.)

Upper Idler Gear Shaft New Part (Spur Gears)—Specification

OD .... 69.76—69.78 mm (2.746—2.747 in.)

Lower Idler Gear Shaft New Part—Specification

OD .... 44.43—44.46 mm (1.749—1.750 in.)
Wear Limit .... 44.40 mm (1.748 in.)

Upper Idler Gear Bushing-to-Shaft New Part (Helical Gears)—Specification

Oil Clearance...................................... 0.02—0.10 mm (0.001—0.004 in.)
Wear Limit .... 0.15 mm (0.006 in.)

Upper Idler Gear Bushing-to-Shaft New Part (Spur Gears)—Specification

Oil Clearance.. 0.05—0.09 mm (0.002—0.004 in.)

Continued on next page

RG,CTM8,GR16,49 –19–16FEB95–1/2

Lower Idler Gear Bushing-to-Shaft New Part—Specification

Oil Clearance....................................... 0.02—0.10 mm (0.001—0.004 in.)
Wear Limit .... 0.15 mm (0.006 in.)

Idler Gear Hub—Specification

Width.. 21.98—22.03 mm (0.865—0.867 in.)
Wear Limit .... 21.93 mm (0.863 in.)

Idler Shaft Hub—Specification

Width.. 22.17—22.27 mm (0.873—0.877 in.)

Upper and Lower Idler Gear New Part—Specification

End Play .... 0.14—0.29 mm (0.006—0.012 in.)
Wear Limit .... 0.40 mm (0.016 in.)

2. If idler gear end play, measured earlier in this group, was out of specification, remove idler shaft and thrust washer from front plate. (See REMOVE LOWER AND UPPER IDLER SHAFTS later in this group.)

3. Check thrust washer for wear.

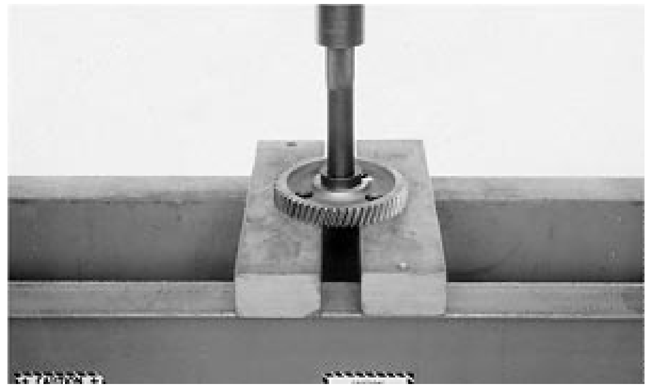
4. Measure idler gear hub width and shaft width and compare to specifications above. Replace worn parts that are out of specification.

RG,CTM8,GR16,49 –19–16FEB95–2/2

REMOVE AND INSTALL IDLER GEAR BUSHINGS

NOTE: 70 mm (2.75 in.) diameter upper idler gear bushings used with spur gears are not available for service. Install a new idler gear/bushing assembly.

1. Press worn idler gear bushing out of gear [44.5 mm (1.75 in.) bushing only].

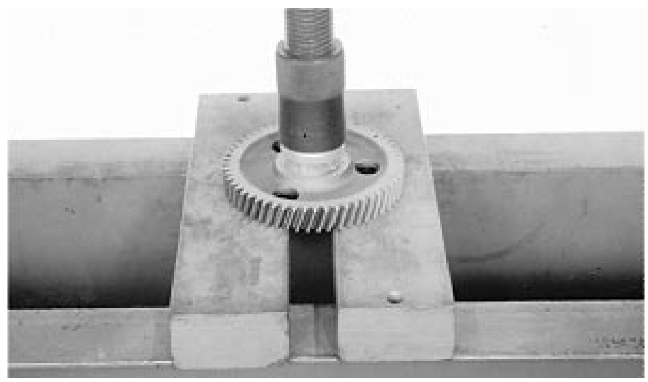


T88701 –UN–09NOV88

RG,CTM8,GR16,62 –19–19OCT92–1/2

IMPORTANT: Bushing failure will result if upper and lower bushings are interchanged. Lower idler gear bushings are splash lubricated and have a spiral oil groove; upper idler gear bushings are pressure lubricated and DO NOT have oil grooves.

2. Coat ID and OD of idler gear bushing and ID of gear with TY6333 grease. Install bushing into idler gear using JD252 Driver and JDG537 (OTC815) Handle.



T88702 –UN–28OCT88

RG,CTM8,GR16,62 –19–19OCT92–2/2

REMOVE LOWER AND UPPER IDLER SHAFTS

1. Remove lower idler shaft and thrust washer by driving or pressing on shaft from block side of front plate.

2. Remove upper idler shaft and thrust washer by driving or pressing on shaft from block side of front plate.

T88704 –UN–09NOV88

CTM8,GR16,12 –19–16SEP92–1/1

CLEAN AND INSPECT FRONT PLATE

IMPORTANT: All surfaces must be free of oil and dirt.

1. Clean front plate with hot soapy water.

2. Rinse well with plain water to remove all soap residue from gasket surface.

3. Inspect front plate for damage.

S11,2016,AK –19–04SEP92–1/1

REPLACE ENGINE FRONT PLATE

1. Consult parts catalog for correct replacement front plate for your engine. Installing the wrong front plate will result in inability to properly time the fuel injection pump.

   Three replacement front plates are available through service parts:

   One plate is used for Lucas-CAV (4-cylinder and 6-cylinder) injection pumps and Stanadyne Model DB2, and DB4 injection pumps.

   A second plate is used for Stanadyne Model DM4 injection pumps.

   A third plate is used for engines equipped with camshaft gear-driven auxiliary drive.

IMPORTANT: Replacement front plates do not have a reference timing mark for the fuel injection pump. Timing mark must be transferred from existing front plate.

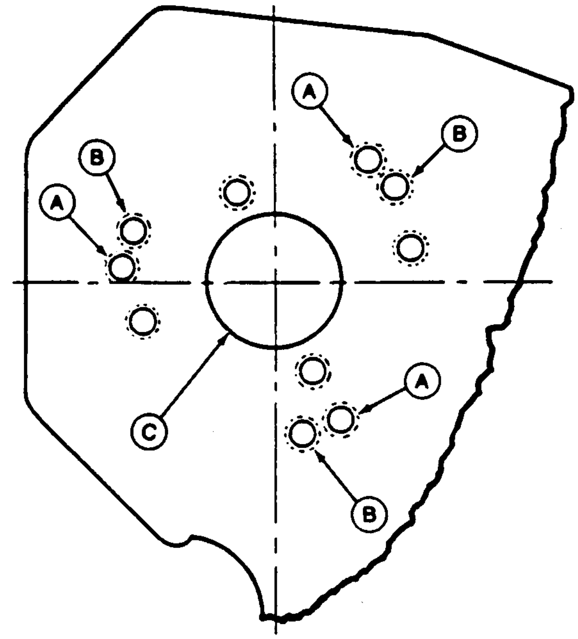
2. Apply LOCTITE® 242 (TY9370) Thread Lock and Sealer to studs and set screw plugs before installing in front plate.

   Install mounting studs in appropriate location on front plate for your pump application.

3. Install set screw plugs in ALL threaded holes not used for mounting studs.

4. Accurately transfer injection pump timing mark from original front plate onto replacement plate as outlined later in this group. (See TRANSFER FUEL INJECTION PUMP TIMING MARK ONTO REPLACEMENT FRONT PLATE, later in this group.)

5. Install front plate. (See INSTALL ENGINE FRONT PLATE, later in this group.)



RG6265 –UN–22JUL92

Front Plate (Viewed From Pump Side)

A—Stud Holes (All Stanadyne and all 3- and 6-cyl. CAV pumps. Also for CAV 4-cyl. pumps on 6000 Series Tractors.)
B—Stud Holes (All CAV 4-cyl. pumps except 6000 Series Tractors.)
C—50 mm (1.97 in.) Pump Pilot Bore Diameter

LOCTITE is a registered trademark of the Loctite Corp.

RG,CTM8,GR16,61 –19–16FEB95–1/1

TRANSFER FUEL INJECTION PUMP TIMING MARK ONTO REPLACEMENT FRONT PLATE

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

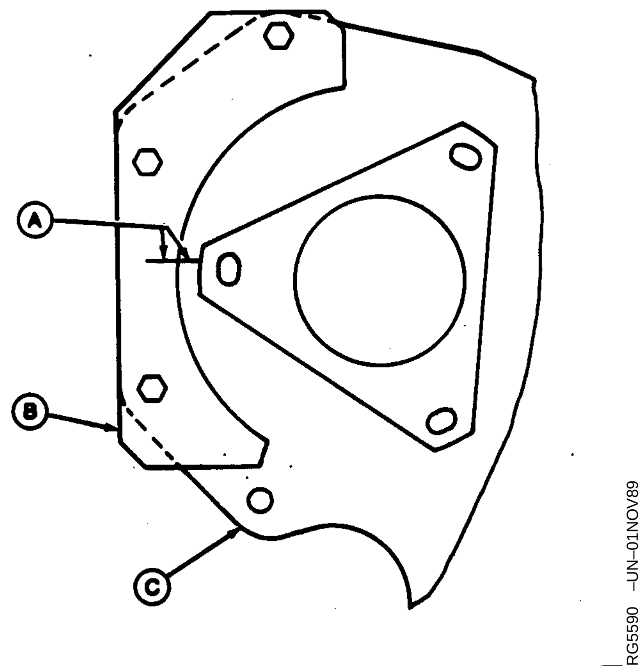
1. Position DFRG2 Aluminum Template (B) onto original front plate (C) as shown. (See Group 199, Dealer Fabricated Tools for manufacturing detail.) Install and tighten three 3/8-16 cap screws securely.

2. Transfer injection pump timing mark (A) from previous front plate onto template using a fine tip marker and straightedge. Remove template from front plate being replaced.

3. Attach template (with timing mark) to new replacement front plate and tighten cap screws securely.

4. Transfer timing mark from the template to the new front plate using a scribe. Scribe deep enough so mark becomes a permanent reference.

5. Remove template from front plate and refer to Group 16 for front plate installation procedures.



Front Plate (Viewed From Pump Side)

A—Timing Mark
B—Aluminum Template
C—Original Front Plate

RG,CTM8,G35,33 –19–29SEP94–1/1

INSTALL IDLER SHAFT SPRING PINS (IF EQUIPPED)

NOTE: Dubuque-built engines can be equipped with spring pins in upper and lower idler shafts. Saran-built engines with spur gears (except early 3029's) are equipped with a spring pin in the upper idler shaft only.

If equipped, install spring pin.

Lower Idler Shaft Spring Pin (A)—Specification

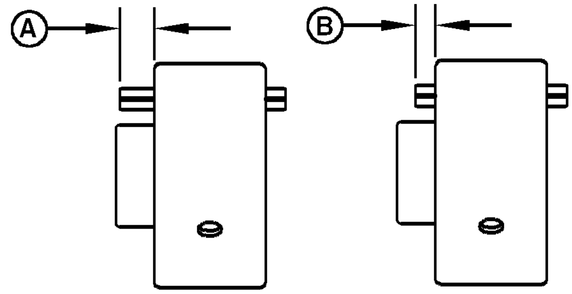
Protrusion .... 5.0—7.0 mm (0.20—0.28 in.)

Upper Idler Shaft Spring Pin (Dubuque-Built Engines) (B)—Specification

Protrusion .... 3.5—4.5 mm (0.14—0.18 in.)

Upper Idler Shaft Spring Pin (Saran-Built Engines) (B)—Specification

Protrusion .... 7.5—8.5 mm (0.295—0.335 in.)

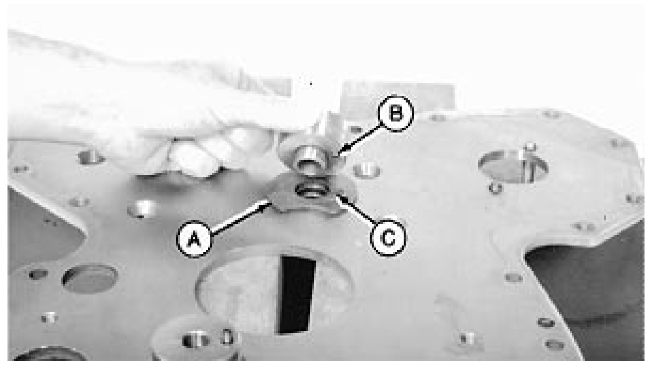


RG9458 –UN–02SEP98

A—Lower Idler Shaft
B—Upper Idler Shaft

RG,CTM8,GR16,50 –19–18JAN95–1/1

INSTALL UPPER IDLER SHAFT IN FRONT PLATE

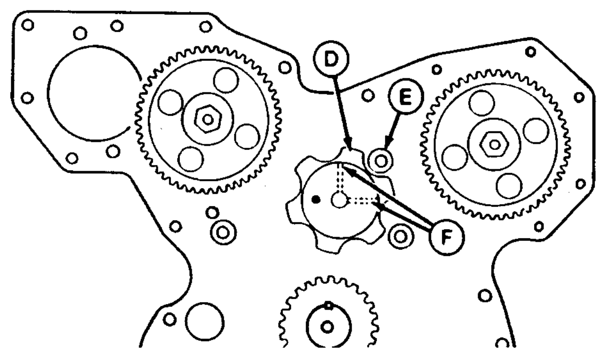


IMPORTANT: Oil holes in idler shaft must be properly indexed to provide adequate lubrication to idler gear bushing.

ENGINES WITH HELICAL GEARS

1. Install thrust washer (A) and upper idler shaft into front plate so oil hole is located at 12 O'clock position (toward top of front plate).

2. Press shaft into front plate until thrust washer is fully seated. Spring pin (B, if equipped) must be located in thrust washer notch (C).



ENGINES WITH SPUR GEARS

IMPORTANT: Thrust washer ears must not interfere with countersunk front plate screw.

1. Install thrust washer over spring pin (if equipped) so ears (D) will be located to either side of front plate screw (E).

2. Install idler shaft over spring pin (if equipped) so oil holes (F) are located at 12 O'clock and 3 O'clock positions. Press shaft into plate until thrust washer is fully seated.

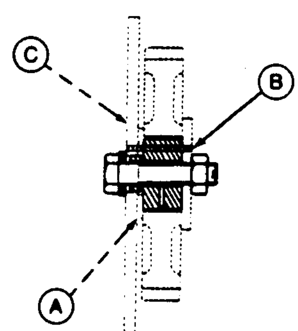
A—Thrust Washer
B—Spring Pin
C—Thrust Washer Notch
D—Thrust Washer Ears
E—Front Plate Screw
F—Oil Holes

RG,CTM8,GR16,65 –19–16FEB95–1/1

INSTALL LOWER IDLER SHAFT IN FRONT PLATE

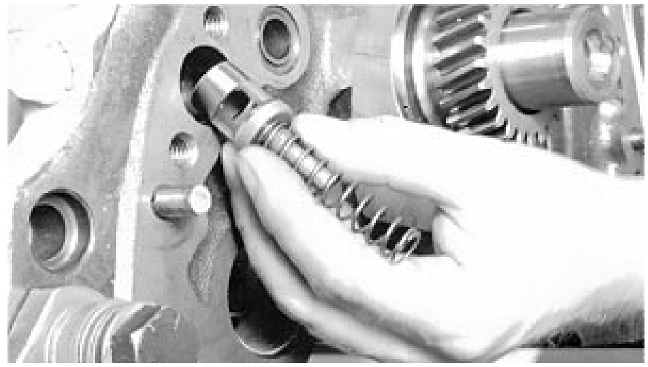
IMPORTANT: ALWAYS discard and replace hex head screw and lock nut whenever removed.

Install thrust washer (A) and lower idler shaft with spring pin (B, if equipped). Drive shaft into plate (C) until thrust washer is fully seated.



CTM8,GR16,16 –19–16SEP92–1/1

INSTALL ENGINE FRONT PLATE



T87436 –UN–09NOV88

NOTE: Earlier 4045 and 6068 engines are not equipped with oil by-pass valve in front face of block. (See GENERAL LUBRICATION SYSTEM INFORMATION in Group 20.)

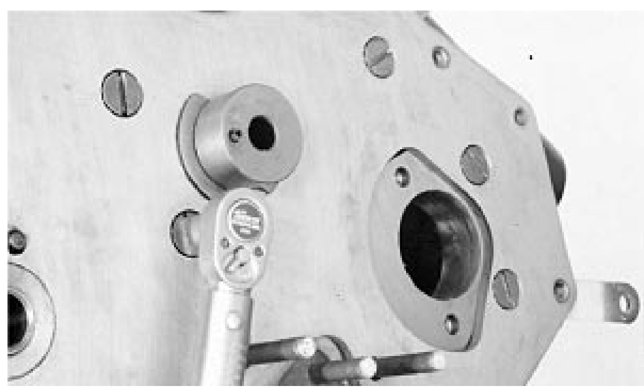
1. Install oil by-pass valve and spring.

2. If not previously done, use a brass scraper and remove any previously applied sealant.

IMPORTANT: Be sure cylinder block and front plate surfaces are free of oil, dirt, previously applied sealant, and cleaning agents.

3. Wash gasket surfaces with a steam cleaner using hot soapy water. Rinse well with plain water to remove all soap residue from gasket surface.

CTM8,GR16,17 –19–29SEP94–1/2



T81348 –UN–09NOV88

4. Apply LOCTITE® 515 (TY6304) Flexible Sealant to cylinder block side of new gasket.

5. Install gasket and front plate.

6. Inspect external-tooth (star) washers. Replace as necessary. Install washers on screws and tighten screws to specifications.

Front Plate Mounting Cap Screws—Specification

Torque .... 34 N•m (25 lb-ft)

IMPORTANT: Do not cut off protruding edge of gasket until timing gear cover has been installed and all cap screws tightened.

LOCTITE is a registered trademark of the Locite Corp.

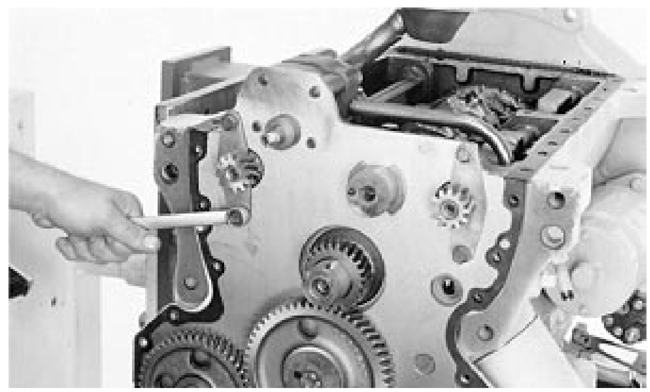
CTM8,GR16,17 –19–29SEP94–2/2

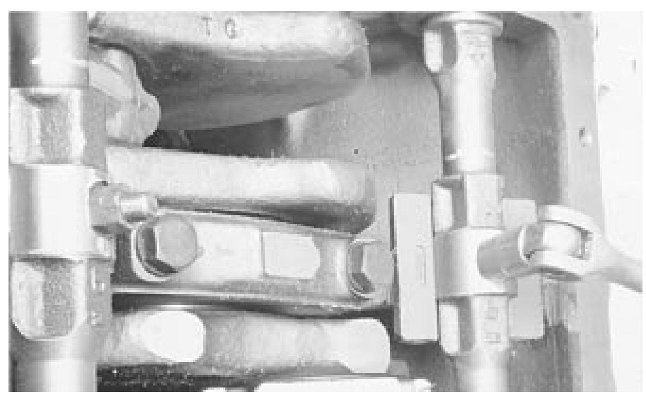
INSTALL AND TIME BALANCER SHAFTS—IF EQUIPPED (4-CYLINDER ENGINES)


T90969 –UN–10NOV88

1. Using JDG820 or JDE83 Flywheel Turning Tool and JDE81-4 Timing Pin, lock No. 1 piston at TDC compression stroke.

S11,2016,AR –19–12JAN95–1/4


T82116 –UN–09NOV88


T91157 –UN–09NOV88

2. Lubricate balancer shaft bushings and journals with clean engine oil.

IMPORTANT: Balancer shafts MUST BE installed in the location from which removed. Reversing shaft locations could result in excessive bushing and shaft wear. If in doubt about proper shaft locations, replace the balancer shaft and bushings.

3. Install balancer shafts and thrust plates. Tighten thrust plate cap screws to specifications.

Balancer Shaft Thrust Plate Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

IMPORTANT: Balancer shaft kits for service are delivered without gear. These shafts are finish-lapped in different directions, therefore it is important to note the letter stamped at the rear of the shafts:

- **"R" for right side**
- **"L" for left side**

4. If equipped, install balancer shaft weights. Use new cap screws and nuts each time weights are installed. Tighten nuts to specifications.

Balancer Shaft Weight Cap Screws/Nuts—Specification

Torque .... 60 N•m (45 lb-ft)

Continued on next page S11,2016,AR –19–12JAN95–2/4

5. Turn right (camshaft side) balancer shaft so timing mark (A) is under JD254A Timing Tool. Timing mark on balancer shaft gear must point to centerline of crankshaft when correctly timed.

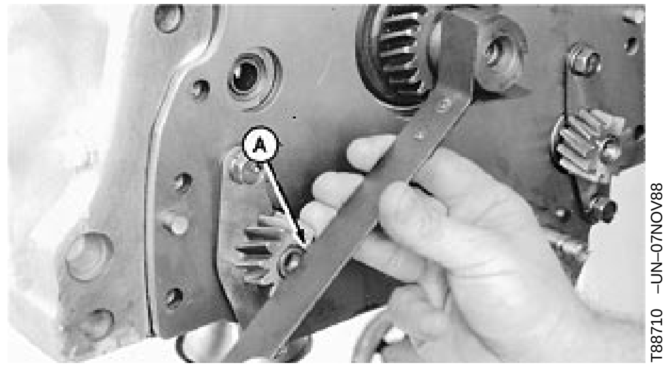
6. Apply TY6333 grease to idler gear bushing ID and shaft OD. Install lower idler gear without turning balancer shaft.

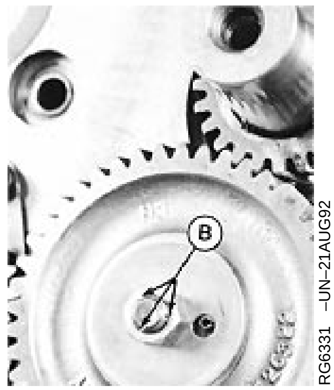
7. Install new bolt with washer from oil pump side. Install washer, with sharp edge toward timing gear cover, and new nut on gear side. Tighten bolt/nut to specifications.

Idler Gear Cap Screws/Nuts—Specification

Torque .... 110 N•m (80 lb-ft)

8. Stake nut to cap screw by applying three center punch marks (B).





A—JD254A Timing Tool
B—Center Punch Marks

Continued on next page S11,2016,AR –19–12JAN95–3/4

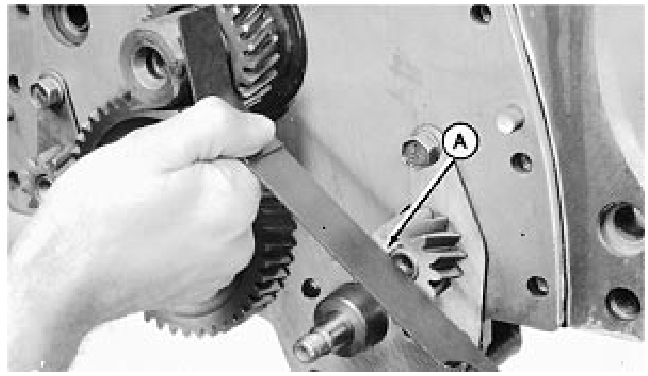
9. Turn left (injection pump side) balancer shaft so timing mark (A) is under JD254A Timing Tool.

10. Install oil pump and oil pump gear. Tighten gear retaining nut to specifications. Stake nut to shaft in three places (B) using a punch and hammer. (See Group 20 for oil pump installation.)

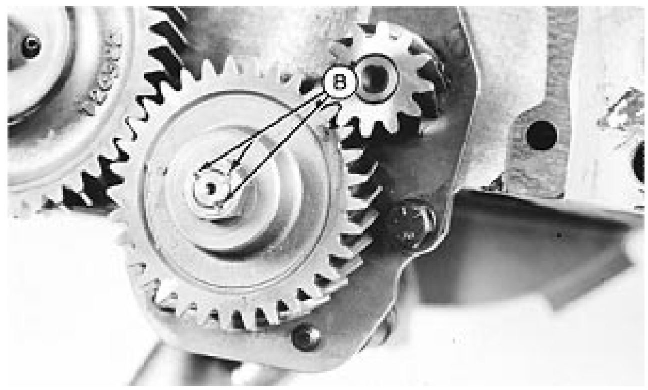
Oil Pump Gear Retaining Nut—Specification

Torque .... 75 N•m (55 lb-ft)

11. Recheck gear timing for both balancer shafts.



T88712 –UN–09NOV88

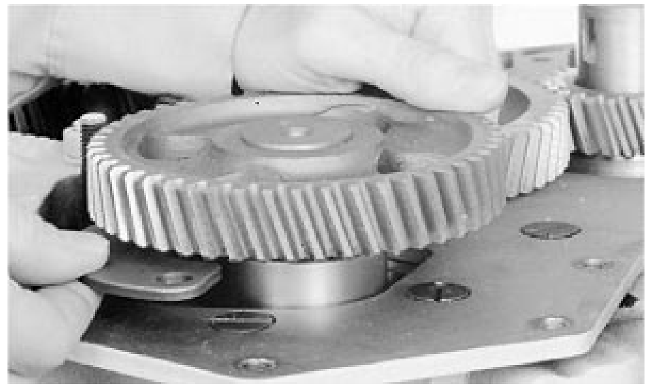


RG6332 –UN–03AUG92

A—Timing Mark
B—Staked Nut

S11,2016,AR –19–12JAN95–4/4

INSTALL AND TIME CAMSHAFT AND FUEL INJECTION PUMP


T94700 –UN–28OCT88

1. Using JDG820 or JDE83 Flywheel Turning Tool and JDE81-4 Timing Pin, lock No. 1 piston at TDC compression stroke.

2. Install fuel injection pump on front plate.

3. Install fuel injection pump drive gear and new retaining nut. Time injection pump to engine. (See Group 35 for injection pump timing.)

4. Tighten injection pump-to-front plate hex nuts to specifications.

Fuel Injection Pump-to-Front Plate Hex Nuts—Specification

Torque .... 27 N•m (20 lb-ft)

Tighten drive gear retaining nut to specifications.

**Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut
[8 mm (0.315 in.) Thick Nut]—Specification**

Torque .... 60 N•m (45 lb-ft)

Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut [11 mm (0.394 in.) Thick Nut]—Specification

Torque .... 125 N•m (90 lb-ft)

Stanadyne DB4 and DM4 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut—Specification

Torque .... 195 N•m (145 lb-ft)

Lucas Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut—Specification

Torque .... 80 N•m (60 lb-ft)

5. Lubricate camshaft bearing journals, lobes, and followers with TY6333 high-temperature grease.

Continued on next page CTM8,GR16,21 –19–12JAN95–1/4

IMPORTANT: DO NOT allow camshaft lobes to drag on camshaft bore or bushing surfaces while installing camshaft. Bearing surfaces may become scratched or scored. Rotate camshaft during installation to avoid obstruction in any bore.

6. Install camshaft and thrust plate in cylinder block. Be careful not to damage bushing ID on 3029 engines.

7. Install thrust plate cap screws and tighten to specifications.

Camshaft Thrust Plate Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

Continued on next page CTM8,GR16,21 –19–12JAN95–2/4

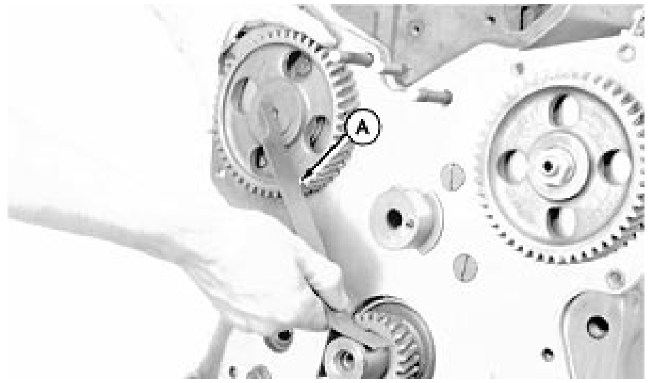
8. With JD254A Timing Tool resting on nose of crankshaft and center of camshaft (as shown), turn camshaft until timing mark (A) aligns with timing tool.

IMPORTANT: Use the timing mark corresponding to the number of cylinders the engine has that is being timed.

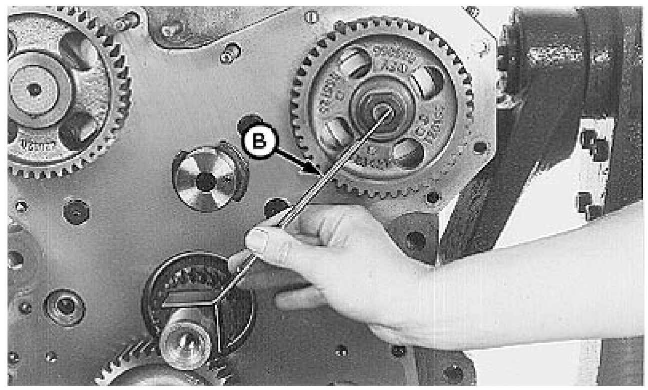
9. Check injection pump gear timing with JD254A Timing Tool resting on nose of crankshaft and center of injection pump shaft. Timing mark (B), with “3”, “4”, “6” beside it, must align with timing tool (as shown).

NOTE: On 5500/5500N Tractors with Saran Engine CD4039TLV01 (—308582) and 6200/6200L, 6400/6400L and 6500/6500L tractors, use “4M” timing mark (C).

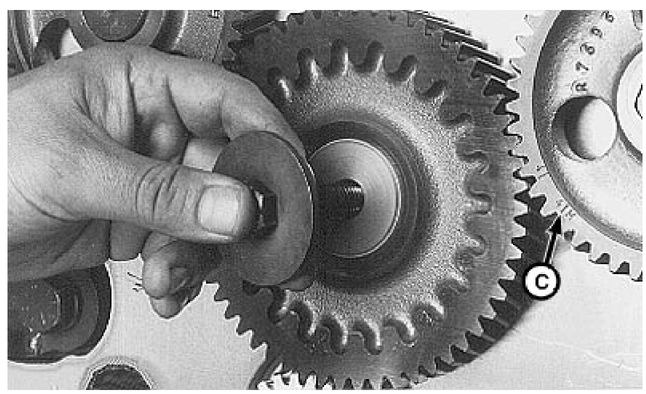
On 6-cylinder Dubuque engines with Stanadyne DB2 and DB4 pumps, use “6A” timing mark (C).



T88698 –UN–28OCT88



RG9457 –UN–02SEP98



RG9454 –UN–02SEP98

A—Camshaft Timing Mark
B—Injection Pump Timing Mark
C—Injection Pump Timing Mark

Continued on next page

CTM8,GR16,21 –19–12JAN95–3/4

NOTE: If gear is equipped with cogs (A) for magnetic speed sensor, it must be installed with cogs facing away from the cylinder block and toward the gear cover. If installed incorrectly, no speed signal will be produced.

IMPORTANT: To ensure proper lubrication of new upper idler gear bushing and camshaft bushing, install new upper idler gear with the reference number facing away from engine.

10. Lubricate upper idler gear bushing ID and shaft OD with TY6333 grease. Install idler gear without turning camshaft gear or injection pump gear.

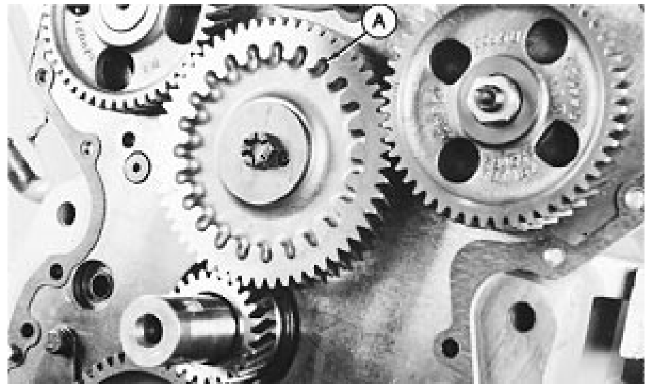
    On engines with spur gears and 70 mm (2.75 in.) idler bushing, use JDG791A Pilot Tool (B) to guide gear onto shaft (C).

11. Install thrust washer, and backing washer (used on spur gears only). Install cap screw and tighten to specifications.

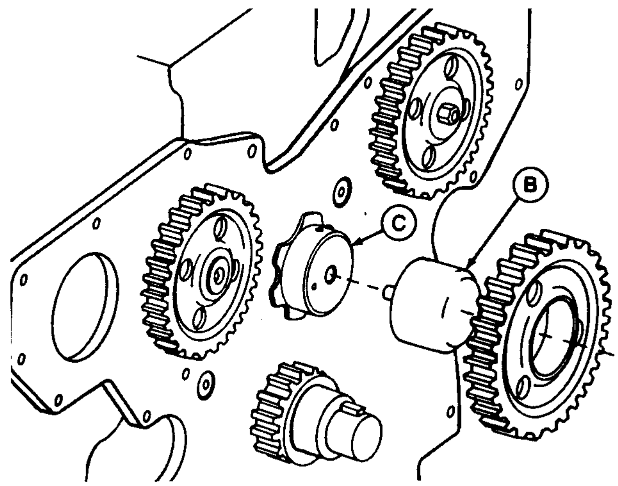
Upper Idler Gear Retaining Cap Screw—Specification

Torque .... 100 N•m (75 lb-ft)

12. Recheck gear timing to make sure it is correct.



RG6333 –UN–03AUG92



RG6348 –UN–26OCT92

A—Gear Cogs
B—JDG791A Pilot Tool
C—Idler Gear Shaft

CTM8,GR16,21 –19–12JAN95–4/4

CLEAN AND INSPECT TIMING GEAR COVER

1. Drive crankshaft front oil seal out of cover.

2. Remove material and sealant from cylinder block and timing gear cover gasket surfaces. If necessary, remove oil filler neck and gasket and injection pump drive gear nut cover plate and gasket.

CAUTION: Do not spin ball bearings when drying with compressed air.

3. If engine is equipped with the Auxiliary Gear Drive Option, remove ball bearings from timing gear cover and auxiliary cover. Clean bearings in solvent. Dry with compressed air. Replace bearings that are not serviceable. (See INSTALL BALL BEARINGS AND DOWELS later in this group.)

4. Clean cover in solvent. Dry with compressed air.

5. Inspect cover for cracks or damage. Make sure seal bore is clean and free of nicks.

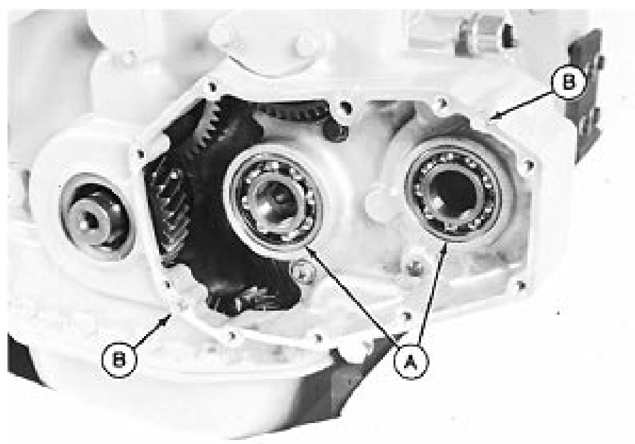
RG,CTM8,GR16,52 –19–29SEP94–1/1

INSTALL BALL BEARINGS AND DOWELS (ENGINES WITH CRANKSHAFT-DRIVEN AUXILIARY GEAR DRIVE OPTION)

1. Lubricate OD of ball bearings (A) with clean engine oil.

2. Press bearings into timing gear cover and front auxiliary drive gear cover. Press only on outer bearing race; stop pressing when bearing is tight against shoulder of bearing bore.

3. If dowel pins (B) were removed from the timing gear cover, install replacement pins so top of dowels are 11—12 mm (0.430—0.470 in.) above surface of cover.

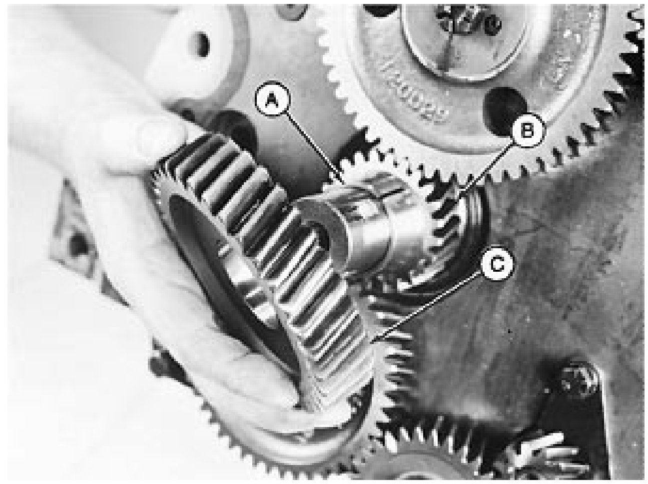


RG6337 –UN–03AUG92

A—Ball Bearings
B—Dowel Pins

RG,CTM8,GR16,57 –19–12JAN95–1/1

INSTALL DRIVE GEAR (ENGINES WITH CRANKSHAFT-DRIVEN AUXILIARY GEAR DRIVE OPTION)



A—Collet
B—Drive Gear
C—Drive Gear

1. Lubricate OD and ID of collet (A) with engine oil. Slide collet onto nose of crankshaft with large end toward drive gear (B).

NOTE: On engines equipped with special washer and O-ring on damper cap screw, O-ring on crankshaft is not needed.

2. Install O-ring on crankshaft and position against front edge of collet.

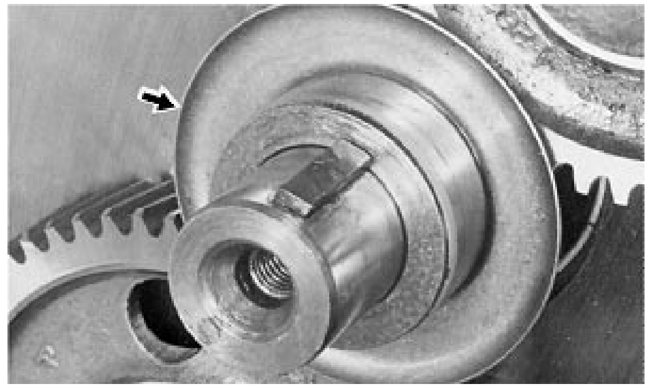
3. Lubricate ID of auxiliary drive gear (C) with engine oil and place on collet.

4. Using JDG794 Crankshaft Gear Installer, push drive gear onto collet by tightening nut to 150 N•m (110 lb-ft). Remove JDG794 tool.

5. Install vibration damper. See INSTALLING VIBRATION DAMPER ON ENGINES WITH CRANKSHAFT GEAR DRIVEN PTO in Group 15.

RG,CTM8,GR16,53 –19–16FEB95–1/1

INSTALL TIMING GEAR COVER



1. Make sure gasket surfaces on cover and front plate are clean. See CLEAN AND INSPECT ENGINE FRONT PLATE, earlier in this group.

2. Install oil filler neck or cover plate using a new gasket. If a composite oil filler neck is to be used on an aluminum timing gear cover, apply LOCTITE® 515 Flexible Sealant (General Purpose) to new gasket. Tighten screws to the following specifications.

Aluminum Oil Filler Neck or Cover Plate—Specification

Torque .... 47 N•m (35 lb-ft)

Composite Material Oil Filler Neck—Specification

Torque .... 30 N•m (22 lb-ft)

3. Install injection pump drive gear cover plate using a new gasket. Tighten screws to specifications.

Injection Pump Drive Gear Cover Plate—Specification

Torque .... 24 N•m (18 lb-ft)

If a threaded cap is used instead of a cover plate. Tighten cap to specifications.

Injection Pump Drive Gear Threaded Cap—Specification

Torque .... 30 N•m (22 lb-ft)

NOTE: Oil deflector is not used on engines with crankshaft gear-driven auxiliary drive option.

4. Install oil deflector (bold arrow) on crankshaft so concave side faces away from crankshaft gear.

IMPORTANT: Do not install wear ring or Woodruff key until oil seal has been installed in timing gear cover.

5. On engines without crankshaft gear-driven auxiliary drive, install O-ring on crankshaft nose against oil deflector.

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

RG,CTM8,DX134 –19–16FEB95–1/7

ALUMINUM TIMING GEAR COVER (DUBUQUE-BUILT ENGINES AND SARAN-BUILT ENGINES WITH AUXILIARY DRIVE):

1. Apply a light coating of LOCTITE® 515 Flexible Sealant (General Purpose) to block side of a new gasket. Position gasket on front plate.

2. Install timing gear cover on engine and apply the following torques:

Timing Gear Cover-to-Front Plate Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

Oil Pan-to-Timing Gear Cover Cap Screws—Specification

Torque .... 37 N•m (27 lb-ft)

Electronic Tachometer (Magnetic Pick-up) Sensor—Specification

Torque .... 15 N•m (11 lb-ft)

Oil Pressure Regulating Valve—Specification

Torque .... 95 N•m (70 lb-ft)

3. Install alternator mounting bracket, belt tensioner (if equipped), gear cover cap screws, nuts, and washers. Tighten screws to specifications.

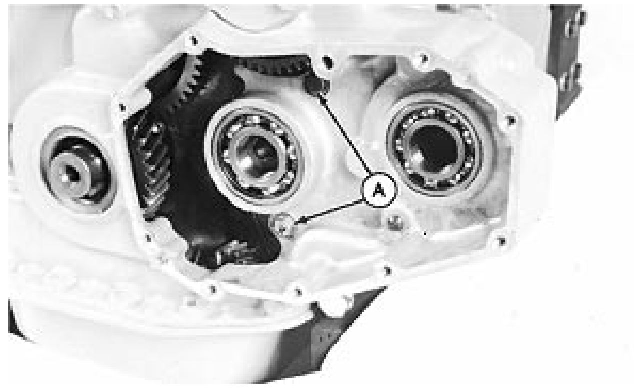
Alternator Mounting Bracket Cap Screws (Aluminum Timing Gear Covers)—Specification

Torque .... 47 N•m (35 lb-ft)

Belt Tensioner Mounting Cap Screw (Aluminum Timing Gear Covers)—Specification

Torque .... 47 N•m (35 lb-ft)

4. On engines equipped with crankshaft gear-driven auxiliary drive, be sure to install the cap screws (A) and washers securing the timing gear cover to front plate and engine block. These screws are located behind the auxiliary idler gear.



RG6340 –UN–03AUG92

A—Cap Screws

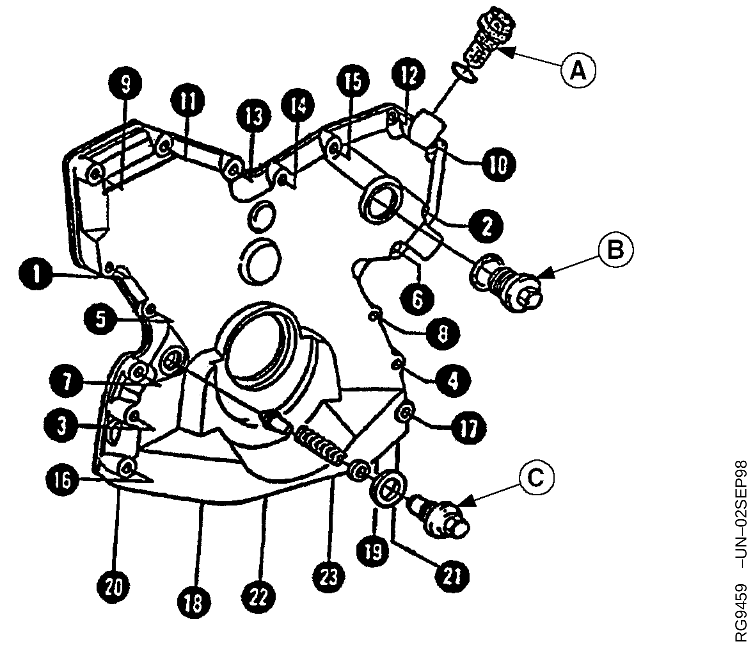
LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

RG,CTM8,DX134 –19–16FEB95–2/7

5. Install crankshaft front oil seal and wear sleeve. (See REPLACE CRANKSHAFT FRONT OIL SEAL AND WEAR SLEEVE in Group 15.)

Continued on next page RG,CTM8,DX134 –19–16FEB95–3/7



A—Magnetic Pick-Up
B—Injection Pump Gear Plug
C—Oil Pressure Valve Plug

ALUMINUM TIMING GEAR COVER (SARAN-BUILT ENGINES WITHOUT AUXILIARY DRIVE):

1. Apply a light coating of LOCTITE® 515 Flexible Sealant (General Purpose) to block side of a new gasket. Position gasket on front plate.

2. Install cap screws according to the following chart and illustration:

Saran Aluminum Timing Gear Cover Cap Screws	
Key	**Length**
2, 6, 10, 12, 15	51 mm (2 in.)
3, 4, 8, 14	60 mm (2.35 in.)
1, 13	57 mm (2.25 in.)
16, 17	63.5 mm (2.5 in)
5, 7	48 mm (1.9 in.)
24	22 mm (0.85 in.)

3. Apply the following torques according to numerical order given in illustration:

Timing Gear Cover-to-Front Plate Cap Screws (1—17)—Specification

Torque.. 47 N•m (35 lb-ft)

Oil Pan-to-Timing Gear Cover Cap Screws (18—23)—Specification

Torque.. 37 N•m (27 lb-ft)

Electronic Tachometer (Magnetic Pick-up) Sensor (A)—Specification

Torque.. 15 N•m (11 lb-ft)

Injection Pump Gear Plug (B)—Specification

Torque.. 30 N•m (22 lb-ft)

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

Oil Pressure Regulating Valve (C)—Specification

Torque.. 95 N•m (70 lb-ft)

4. Install alternator mounting bracket and belt tensioner (if equipped). Tighten screws to specifications.

Alternator Mounting Bracket Cap Screws (Aluminum Timing Gear Covers)—Specification

Torque.. 47 N•m (35 lb-ft)

Belt Tensioner Mounting Cap Screw (Aluminum Timing Gear Covers)—Specification

Torque.. 47 N•m (35 lb-ft)

5. Install crankshaft front oil seal and wear sleeve. (See REPLACE CRANKSHAFT FRONT OIL SEAL AND WEAR SLEEVE in Group 15.)

Continued on next page

RG,CTM8,DX134 –19–16FEB95–5/7

COMPOSITE MATERIAL TIMING GEAR COVER:

1. The sealing ring is reusable. When replacement is needed, proceed as follows:

   - Remove previous sealing ring from cover (do not use any cutting tool to avoid cover damage).

CAUTION: Do not use any other industrial solvent which might not be compatible with composite material.

   - Clean groove with acetone (follow recommended precautions and safe operating practices) then dry with compressed air.
   - Install the new sealing ring starting at one edge of the cover. Place the thinner area of the sealing ring toward the cover.
   - If properly installed, the sealing ring may protrude up to 30 mm (1.18 in.) at the other edge (A). If NOT, restart procedure.
   - Cut away excess sealing ring.

2. Apply a bead of LOCTITE® 515 Flexible Sealant on bottom face (B) which is in contact with oil pan.

NOTE: A tube of LOCTITE® 515 Flexible Sealant is provided with overhaul gasket set. This tube is also available under part number TY6304.

3. Coat the oil pan gasket top face with engine oil where the timing gear cover will be installed.

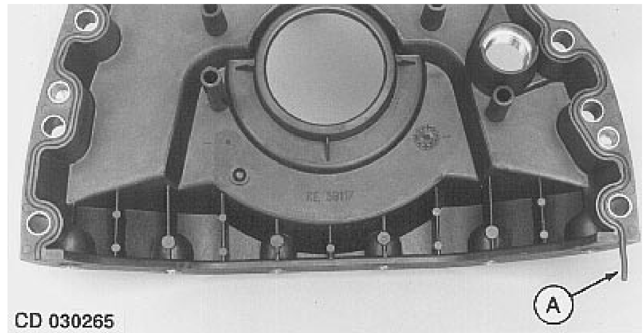
4. Install cover and tighten cap screws to specifications given using the sequence shown:

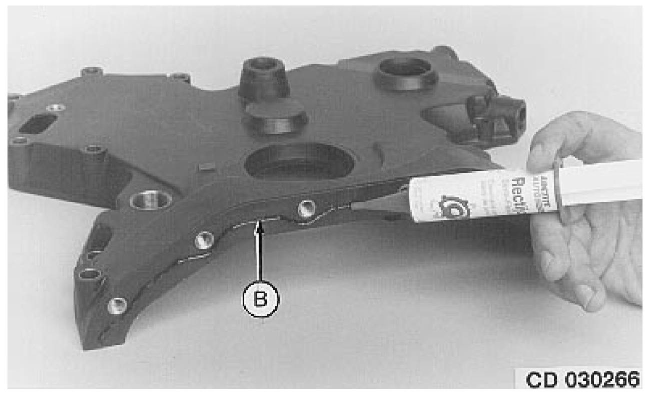
Electronic Tachometer (Magnetic Pick-Up) Sensor (C)—Specification

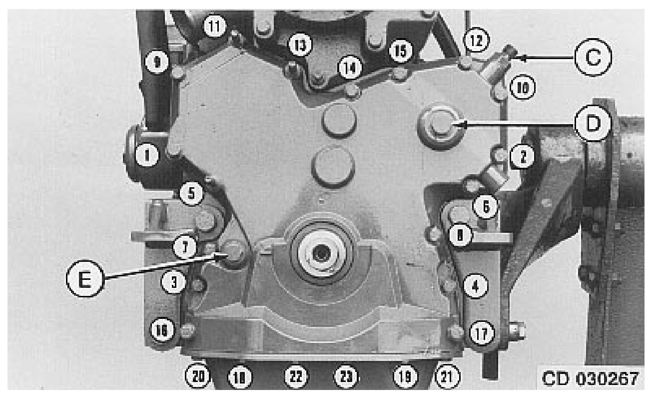
Torque .... 15 N•m (11 lb-ft)

Plug-to-Access Injection Pump Drive Gear Nut (D)—Specification

Torque .... 30 N•m (22 lb-ft)







A—Timing Gear Cover Outer Edge
B—Timing Gear Cover Bottom Face
C—Magnetic Pick-up
D—Plug-to-Access Injection Pump Drive Gear Nut
E—Oil Pressure Regulating Valve Plug

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

Oil Pan-to-Timing Gear Cover Cap Screws (18-23)—Specification

Torque .... 30 N•m (22 lb-ft)

Timing Gear Cover-to-Front Plate Cap Screws (1-17)—Specification

Torque .... 45 N•m (33 lb-ft)

Oil Pressure Regulating Valve (E)—Specification

Torque .... 30 N•m (22 lb-ft)

5. Install alternator mounting bracket, belt tensioner (if equipped), gear cover cap screws, nuts, and washers. Tighten cap screws specifications.

Alternator Mounting Bracket Cap Screws (Composite Material Timing Gear Covers)—Specification

Torque .... 30 N•m (22 lb-ft)

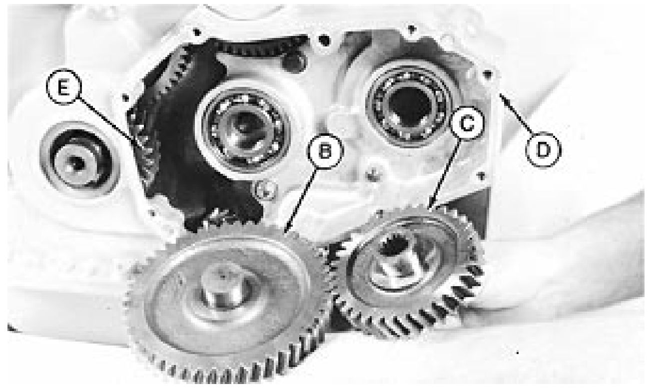
Belt Tensioner Mounting Cap Screw (Composite Material Timing Gear Covers)—Specification

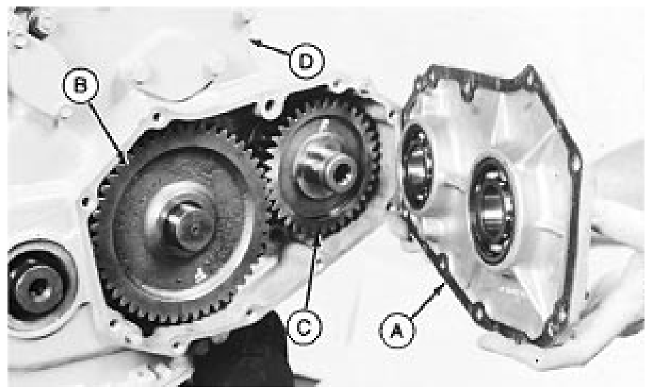
Torque .... 30 N•m (22 lb-ft)

6. Install crankshaft front oil seal and wear sleeve. (See REPLACE CRANKSHAFT FRONT OIL SEAL AND WEAR SLEEVE in Group 15.)

RG,CTM8,DX134 –19–16FEB95–7/7

INSTALL IDLER GEAR AND OUTPUT GEAR (ENGINES WITH AUXILIARY GEAR DRIVE OPTION)





A—Front Auxiliary Gear Cover
B—Idler Gear
C—Output Gear
D—Timing Gear Cover
E—Auxiliary Drive Gear

1. Lubricate auxiliary drive shafts with engine oil.

2. Place idler gear (B) in timing gear cover (D) so that shaft enters bore of bearing and gear meshes with auxiliary drive gear (E).

3. Install output gear (C) so small 9-tooth spline faces front of engine and large 13-tooth spline faces rear of engine. Apply TY6333 High temperature grease to internal splines.

4. Place a new gasket over dowels on timing gear cover. Install the front auxiliary gear cover (A) on timing gear cover. When both shafts have entered their respective bearings, align cover with dowel pins and push in place against timing gear cover.

5. Tighten cap screws to specifications.

Auxiliary Drive Gear Cover Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

6. Install front and/or rear output shaft cover plates (if used) using a new gasket.

RG,CTM8,GR16,55 –19–16FEB95–1/1

COMPLETE FINAL ASSEMBLY

1. If a new front plate-to-engine block gasket was installed, trim off protruding portion and apply LOCTITE® 515 (TY6304) Flexible Sealant.

2. Install oil pan. (See Group 20.)

3. Install pulley or damper on crankshaft (see Group 15).

4. Install oil pressure regulating valve assembly. (See Group 20.)

5. Install fuel transfer pump. (See Group 35.)

6. Remove cam follower lifting tools (if used for camshaft removal).

7. Install push rods and rocker arm assembly. (See Group 05.)

8. Install alternator, fan belts, and fan. (See Group 25.)

9. Fill engine crankcase with clean oil having correct viscosity and grade specifications. (See Group 02.)

10. Adjust valve clearance. (See Group 05.)

11. Install rocker arm cover and new gasket. (See Group 05.)

12. Perform engine break-in as outlined in Group 05.

LOCTITE is a registered trademark of the Loctite Corp.

RG,CTM8,DY037 –19–16FEB95–1/1

ESSENTIAL TOOLS

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

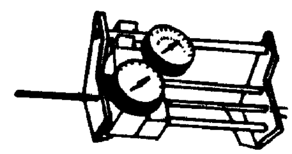
SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,355 –19–13SEP98–1/3

RG5061 –UN–05DEC97

Spring Compression Tester D01168AA

Test oil bypass valve and oil pressure regulating valve spring compression.



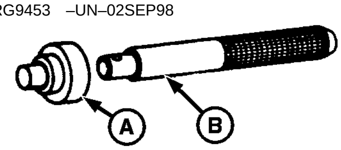
RG5061

DPSG,OUO1004,355 –19–13SEP98–2/3

RG9453 –UN–02SEP98

Bushing Driver . . JD248A Driver (A) / JDG536 Handle (B)

Use to install oil pressure relief valve seat.



DPSG,OUO1004,355 –19–13SEP98–3/3

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

Continued on next page

DPSG,OUO1004,356 –19–13SEP98–1/2

Blind Hole Puller Set D01061AA

Remove oil pressure regulating valve seat and dipstick tube from block.

DPSG,OUO1004,356 –19–13SEP98–2/2

OTHER MATERIAL

Number	Name	Use
TY6304 (U.S.) TY9484 (Canadian) 515 (LOCTITE®)	Flexible Sealant (General Purpose)	To seal oil pan gasket surfaces, dipstick nipple threads and oil fill/dipstick tube.
TY15934 (U.S.)	PERMATEX™ AVIATION (Form-A-Gasket No. 3) (OR)	To seal oil pan gasket surfaces and dipstick nipple threads.
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	To seal oil pan elbow drain fitting.

LOCTITE is a registered trademark of Loctite Corp.
Permatex is a trademark of Deere & Company.

DPSG,OUO1004,357 –19–13SEP98–1/1

LUBRICATION SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Standard Flow Oil Cooler Nipple	Torque	37 N•m (27 lb-ft)
Standard-Flow Oil Cooler Adapter Fitting	Torque	37 N•m (27 lb-ft)
High-Flow Oil Cooler Cover Cap Screws	Torque	37 N•m (27 lb-ft)
High-Flow Oil Cooler Housing Cap Screws	Torque	47 N•m (35 lb-ft)
High-Flow Oil Filter Base Cap Screws	Torque	37 N•m (27 lb-ft)
Oil Cooler Base Adapter (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)	Torque	37 N•m (27 lb-ft)
Oil Filter Housing (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)	Torque	47 N•m (35 lb-ft)
Oil Cooler Holding Screw (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)	Torque	37 N•m (27 lb-ft)
Oil Filter Adapter (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)	Torque	47 N•m (35 lb-ft)
Oil Cooler Housing Cap Screws (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)	Torque	47 N•m (35 lb-ft)
Oil Filter Housing Cap Screws (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)	Torque	47 N•m (35 lb-ft)
Oil Cooler Holding Screw (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)	Torque	37 N•m (27 lb-ft)

Continued on next page DPSG,OUO1004,492 –19–08NOV98–1/5

Item	Measurement	Specification
Oil Filter Adapter (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)	Torque	47 N•m (35 lb-ft)
Oil Cooler/Filter Housing Holding Screw (Engine w/Cam Driven Auxiliary Drive)	Torque	37 N•m (27 lb-ft)
Oil Cooler/Filter Housing Cap Screws (Engine w/Cam Driven Auxiliary Drive)	Torque	47 N•m (35 lb-ft)
Oil Cooler-to-Housing Adapter (Engine w/Cam Driven Auxiliary Drive)	Torque	47 N•m (35 lb-ft)
Oil Filter-to-Oil Cooler Nipple (Engine w/Cam Driven Auxiliary Drive)	Torque	37 N•m (27 lb-ft)
Oil Cooler/Adapter Holding Screw (Remote Oil Filter)	Torque	35 N•m (25 lb-ft)
Pre-Common Lube Block Oil Bypass Valve Springs (3029/4039/4045/6068/6059)	Free Length Spring Load at 34 mm (1.34 in.) Compressed Length	59 mm (2.32 in.) 92—112 N (21—25 lb-force)
Common Lube Block Oil Bypass Valve Springs (4039/6059/4045/6068)	Free Length Spring Load at 29 mm (1.14 in.) Compressed Length	51 mm (2.00 in.) 87.8 N (20 lb-force)
Common Lube Block Oil Pressure Regulating Valve Spring	Spring Free Length Spring Tension at 42.5 mm (1.68 in.)	120 mm (4.72 in.) 60—75 N (13.5—16.5 lb-force)
Common Lube Block Oil Pressure Regulating Valve Plug (Aluminum Timing Gear Cover)	Torque	95 N•m (70 lb-ft)

Continued on next page

Item	Measurement	Specification
Common Lube Block Oil Pressure Regulating Valve Plug (Composite Material Timing Gear Cover)	Torque	30 N•m (22 lb-ft)
Pre-Common Lube Block Pressure Regulating Valve Spring (4045/6068)	Spring Free Length	59 mm (2.32 in.)
	Spring Tension at 34 mm (1.34 in.)	92—112 N (21—25 lb-force)
High-Flow Oil Cooler Housing Cap Screw	Torque	47 N•m (35 lb-ft)
High-Flow Oil Filter Base Cap Screw	Torque	37 N•m (27 lb-ft)
Oil Pan Mounted Oil Fill/Dipstick Tube	Torque	47 N•m (35 lb-ft)
Oil Pump Pick-Up Tube Cap Screws	Torque	47 N•m (35 lb-ft)
Standard Capacity Oil Pump Gears	Thickness	41.156—41.206 mm (1.6203—1.6223 in.)
	Wear Limit	41.106 mm (1.6183 in.)
Standard Capacity Oil Pump Gears	Axial Clearance	0.031—0.157 mm (0.0012—0.0062 in.)
	Wear Limit	0.22 mm (0.0085 in.)
Standard Capacity Oil Pump Gears	Radial Clearance	0.10—0.16 mm (0.004—0.006 in.)
	Wear Limit	0.20 mm (0.008 in.)
Standard Capacity Oil Pump Bore in Housing	ID	16.059—16.083 mm (0.6322—0.6332 in.)
	Wear Limit	16.163 mm (0.6362 in.)
Standard Capacity Oil Pump Drive Shaft	OD	16.022—16.032 mm (0.6308—0.6312 in.)
	Wear Limit	15.997 mm (0.6298 in.)
Standard Capacity Oil Pump Idler Shaft	OD	12.319—12.329 mm (0.4850—0.4854 in.)
	Wear Limit	12.306 mm (0.4845 in.)

Continued on next page

DPSG,OUO1004,492 –19–08NOV98–3/5

Item	Measurement	Specification
Standard Capacity Oil Pump Mounting Cap Screws (3029 Engines)	Torque	41 N•m (30 lb-ft)
Standard Capacity Oil Pump Mounting Cap Screws (4039, 6059, 4045 Engines)	Torque	47 N•m (35 lb-ft)
Standard Capacity Oil Pump Gear Staked Retaining Nut	Torque	75 N•m (55 lb-ft)
High Capacity Oil Pump Gears	Thickness	50.975—51.025 mm (2.007—2.009 in.)
	Wear Limit	50.925 mm (2.005 in.)
High Capacity Oil Pump Gears	Axial Clearance	0.042—0.168 mm (0.0016—0.0066 in.)
	Wear Limit	0.22 mm (0.0085 in.)
High Capacity Oil Pump Gears	Radial Clearance	0.08—0.18 mm (0.003—0.007 in.)
	Wear Limit	0.203 mm (0.009 in.)
High Capacity Oil Pump Drive Shaft Bore in Pump Cover	ID	16.058—16.084 mm (0.6322—0.6332 in.)
	Wear Limit	16.16 mm (0.636 in.)
High Capacity Oil Pump Drive Shaft (Cover End) (A)	OD	16.022—16.032 mm (0.6308—0.6312 in.)
	Wear Limit	15.997 mm (0.6298 in.)
High Capacity Oil Pump Drive Shaft Bore in Pump Housing	ID	12.281—12.307 mm (0.4835—0.4845 in.)
	Wear Limit	12.323 mm (0.4850 in.)
High Capacity Oil Pump Drive Shaft (Housing End) (B)	OD	12.256—12.266 mm (0.4825—0.4829 in.)
	Wear Limit	12.231 mm (0.4815 in.)
High Capacity Oil Pump Idler Shaft	OD	12.319—12.329 mm (0.4850—0.4854 in.)
	Wear Limit	12.306 mm (0.4845 in.)

Continued on next page

DPSG,OUO1004,492 –19–08NOV98–4/5

Item	Measurement	Specification
High Capacity Oil Pump Mounting Cap Screws	Torque	47 N•m (35 lb-ft)
High Capacity Oil Pump Gear Staked Retaining Nut	Torque	75 N•m (55 lb-ft)
Cast Iron SAE 5 Oil Pan-to-Block and Flywheel Housing Cap Screws (3 Dashes)	Torque	47 N•m (35 lb-ft)
Cast Iron SAE 6 Cap Screws Oil Pan-to-Block and Flywheel Housing (6 Dashes)	Torque	70 N•m (52 lb-ft)
Aluminum or Sheet Metal Oil Pan-to-Block Cap Screws	Torque	47 N•m (35 lb-ft)
Aluminum or Sheet Metal Oil Pan-to-Flywheel Housing Cap Screws	Torque	47 N•m (35 lb-ft)
Aluminum or Sheet Metal Oil Pan-to-Aluminum Timing Gear Cover Cap Screws	Torque	37 N•m (27 lb-ft)
Aluminum or Sheet Metal Oil Pan-to-Composite Timing Gear Cover Cap Screws	Torque	30 N•m (22 lb-ft)
Oil Pan Drain Plug		
Cylindrical Plug	Torque	68 N•m (50 lb-ft)
Conical Plug	Torque	55 N•m (40 lb-ft)

DPSG,OUO1004,492 –19–08NOV98–5/5

GENERAL LUBRICATION SYSTEM INFORMATION

The following 300 Series Liter engines are equipped with a "Common Lube" cylinder block.

Saran Engines:

- 4039TL004
- 4039TL007
- 4045TL002
- All Saran engines (112176—)

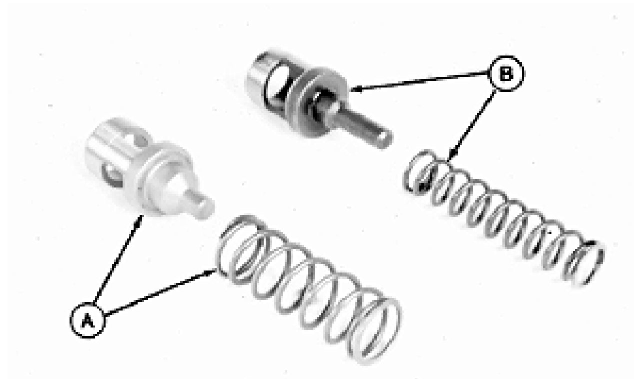
Dubuque Engines (Engine Serial Numbers):

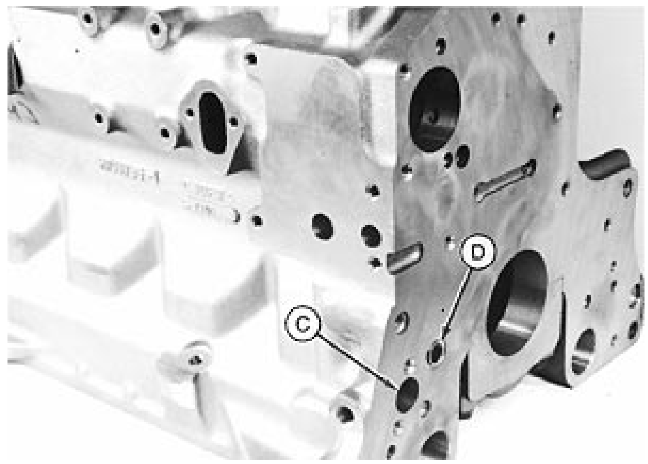
- 4039 (362469—)
- 6059 (362802—)
- 4045 (366582—)
- 6068 (364490—)

The "Common Lube" block design allows 4045 and 6068 (long stroke) engines to use the same oil bypass and pressure regulator valves and springs as 4039 and 6059 (short stroke) engines. (See HOW THE LUBRICATION SYSTEM WORKS in Group 105, for further illustrations.)

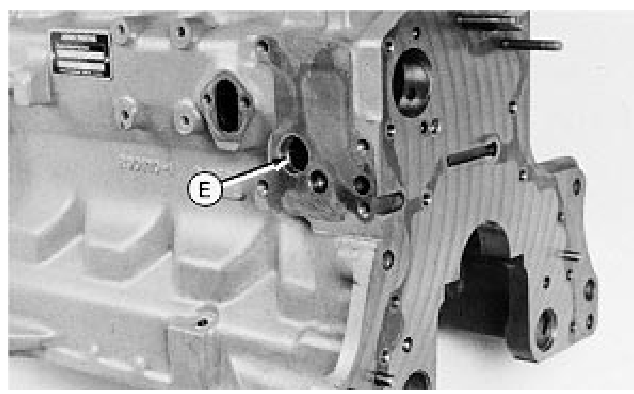
With the introduction of the common lube block on short stroke engines, a new bypass valve and spring (A) were adopted. The new bypass valve is shorter with a larger diameter spring than the bypass valve and spring (B) used in earlier short stroke engines, but is in the same location on the engine.

With the introduction of the common lube block on Dubuque-built long stroke engines, the regulator valve and new bypass valve from short stroke engines were adopted and placed in locations (C & D, respectively) in front face of the block. This eliminates the bypass valve in the oil cooler housing, and the regulator valve (E) in the oil cooler mounting face of the block, used on "Pre-Common Lube" long stroke engines.





Common Lube Block



Pre-Common Lube Block

A—New "Common Lube" Bypass Valve and Spring
B—Old Bypass Valve and Spring
C—Bypass Valve Location (Common Lube)
D—Regulator Valve Location (Common Lube)
E—Regulator Valve (Pre-Common Lube)

RG,CTM8,GR20,60 –19–13JAN95–1/1

OIL COOLER IDENTIFICATION

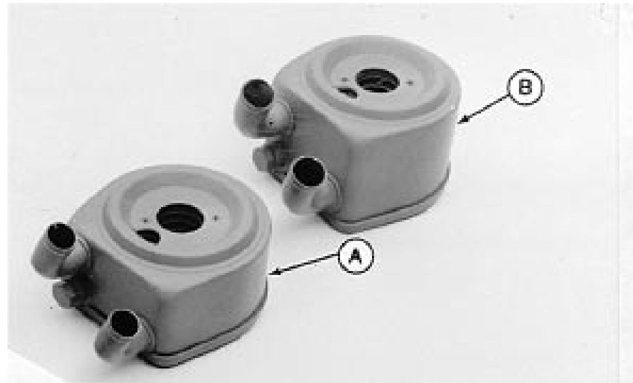
Two types of oil coolers are installed on 300 Series engines:

STANDARD-FLOW OIL COOLER

Standard-flow oil coolers are used primarily on 3029, 4039, and 6059 (short stroke) engines, and are normally positioned between the oil filter and cylinder block or adapter housing. The standard-flow oil cooler may be a 6-plate, 8-plate (A), or 10-plate (B) cooler.

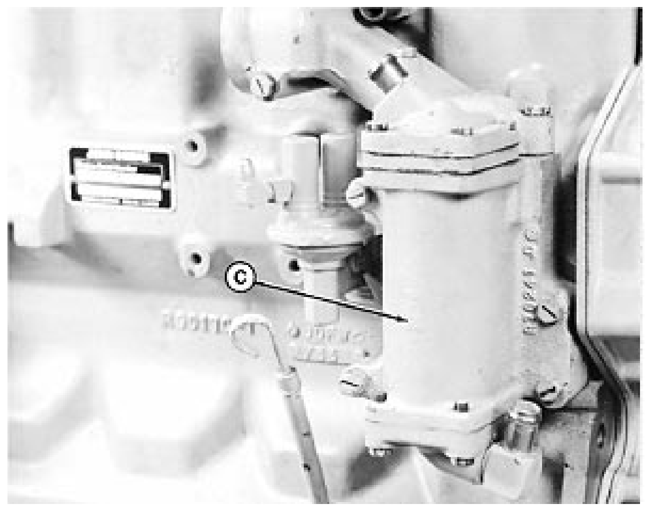
HIGH-FLOW OIL COOLER

High-flow oil coolers (C) are used on most 4045 and 6068 (long stroke) engines.



RG5618 –UN–10MAR90

Standard-Flow Oil Cooler



RG6350 –UN–03AUG92

High-Flow Oil Cooler

A—8-Plate Cooler
B—10-Plate Cooler
C—High-Flow Cooler

CTM8,GR20,9 –19–18FEB95–1/1

REMOVE, INSPECT, AND INSTALL STANDARD-FLOW OIL COOLER

Inspect coolant hoses. Replace if cracked or damaged.

1. Drain coolant. A drain plug is located on side of oil cooler base.

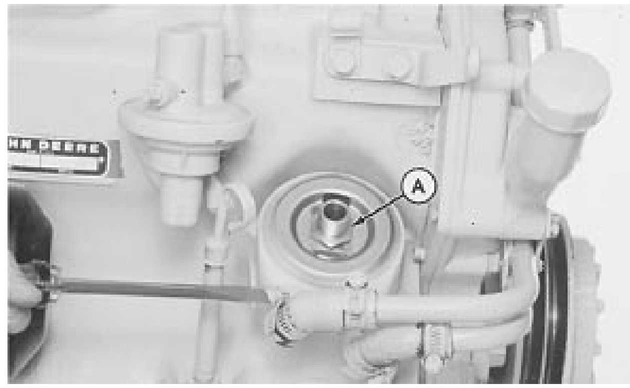
2. Disconnect coolant hoses.

3. Remove oil filter and nipple (A) to remove oil cooler. On engines equipped with an oil cooler cover plate, remove adapter (B) and cover plate (C) to remove oil cooler.

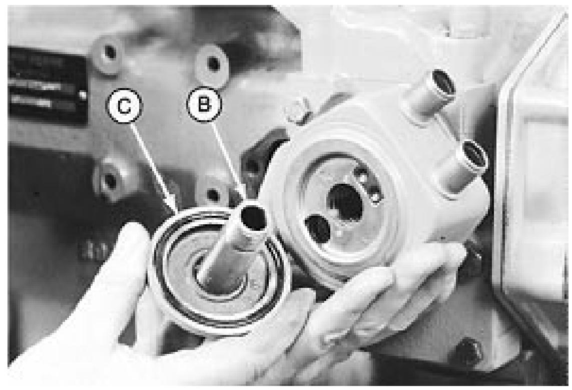
4. On engines with remote oil filter, replace packing and O-ring on oil filter adapter. See REPLACE OIL FILTER ADAPTER ON ENGINE WITH REMOTE OIL FILTER later in thie group.

5. If engine oil was contaminated with metallic particles, discard oil cooler (puncture to prevent accidental reuse) and install a new one.

6. Check coolant passage through cooler for a restriction. Use compressed air and blow through passage to make sure it is open.



T91327 –UN–09NOV88



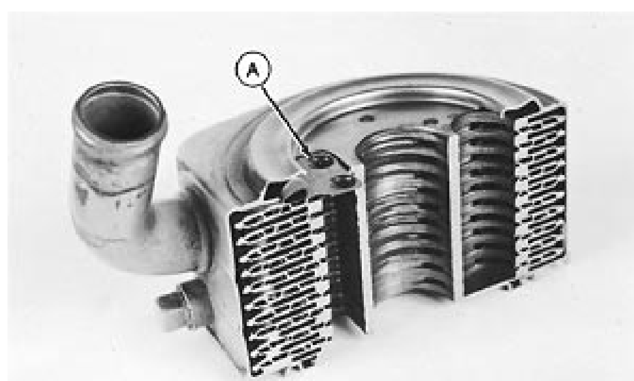
RG6352 –UN–03AUG92

A—Nipple
B—Adapter
C—Cover Plate

CTM8,GR20,10 –19–16SEP92–1/3

7. Remove and inspect oil cooler relief valve (A).

8. Install relief valve.



RG6353 –UN–03AUG92

Cross-Sectional View

A—Oil Cooler Relief Valve

Continued on next page

CTM8,GR20,10 –19–16SEP92–2/3

9. Install oil cooler on cylinder block using a new packing. Tighten oil cooler nipple to specifications.

T91329 –UN–09NOV88

Standard Flow Oil Cooler Nipple—Specification

Torque .... 37 N•m (27 lb-ft)

On engines with an oil cooler cover plate, install cover plate using a new packing. Insert adapter fitting, with new O-rings, through cover plate and oil cooler. Tighten adapter fitting to specifications.

Standard-Flow Oil Cooler Adapter Fitting—Specification

Torque .... 37 N•m (27 lb-ft)

10. Install hoses and clamps on oil cooler pipes.

11. Install a new oil filter.

12. Fill cooling system.

CTM8,GR20,10 –19–16SEP92–3/3

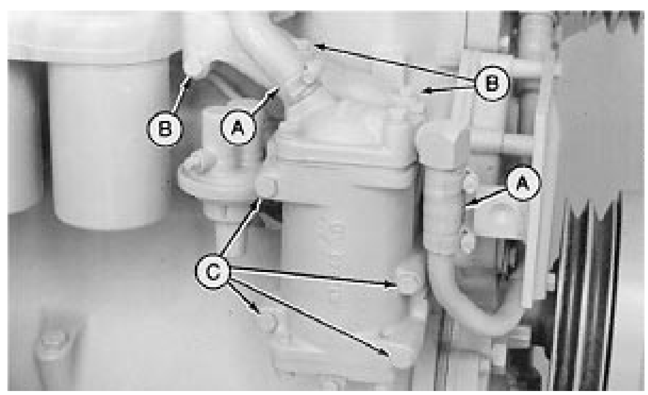
REMOVE AND INSTALL HIGH-FLOW OIL COOLER

1. Drain engine coolant.

2. Disconnect the coolant lines (A).

3. Remove cap screws (B) to remove filter base.

4. Remove cap screws (C) to remove oil cooler.



T6078AA –UN–25OCT88

A—Coolant Lines
B—Cap Screws
C—Cap Screws

Continued on next page CTM8,GR20,15 –19–16SEP92–1/4

5. Remove covers from both ends.

6. Remove oil cooler from housing.

NOTE: Oil cooler bypass valve in oil cooler housing (on Pre-Common Lube engines[1]) is not serviced separately. If damaged, oil cooler housing must be replaced. (SEE REMOVE AND INSTALL OIL BYPASS VALVE later in this group.)

T91332 –UN–25OCT88

[1]See GENERAL LUBRICATION SYSTEM INFORMATION earlier in this group for an explanation of "Common Lube".

CTM8,GR20,15 –19–16SEP92–2/4

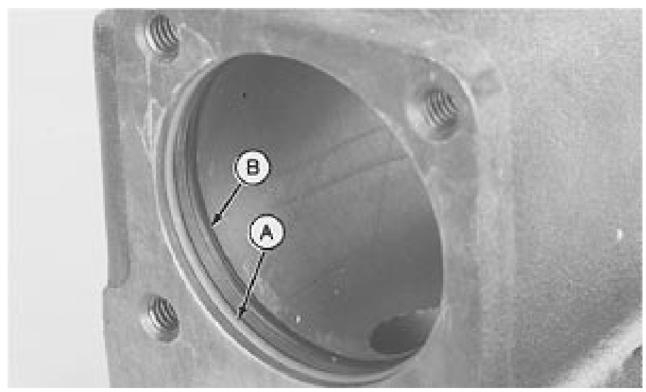
7. Install a new red O-ring in the lower groove (A) and black O-ring in the upper groove (B). O-rings must be installed in the proper grooves.

8. Install oil cooler element in housing.

9. Install covers with new gaskets. Tighten cap screws to specifications.

High-Flow Oil Cooler Cover Cap Screws—Specification

Torque .... 37 N•m (27 lb-ft)



T91337 –UN–25OCT88

A—Lower Groove
B—Upper Groove

Continued on next page

CTM8,GR20,15 –19–16SEP92–3/4

10. Before installing oil cooler housing, clean gasket material from cylinder block, filter base and oil cooler housing.

11. Check hoses for cracks, brittleness, or any other defects. Replace if questionable.

12. Install O-ring on pressure regulating valve (A) (on Pre-Common Lube blocks)[1].

13. Install new gaskets or O-rings, as equipped, on mounting face (B) and oil filter adapter mounting surface (C) of oil cooler housing.

14. Install the oil cooler housing and filter base. Tighten cap screw for oil cooler first then the filter base. Tighten oil cooler housing cap screws to specifications.

High-Flow Oil Cooler Housing Cap Screws—Specification

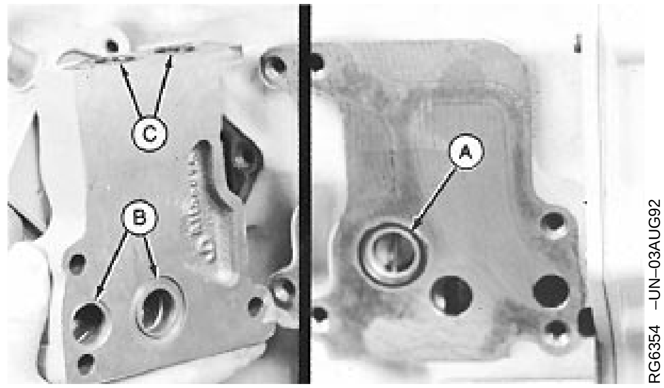
Torque .... 47 N•m (35 lb-ft)

Tighten oil filter base cap screw to specifications.

High-Flow Oil Filter Base Cap Screws—Specification

Torque .... 37 N•m (27 lb-ft)

15. Connect the lines. Fill radiator with proper coolant. (See Group 02.)



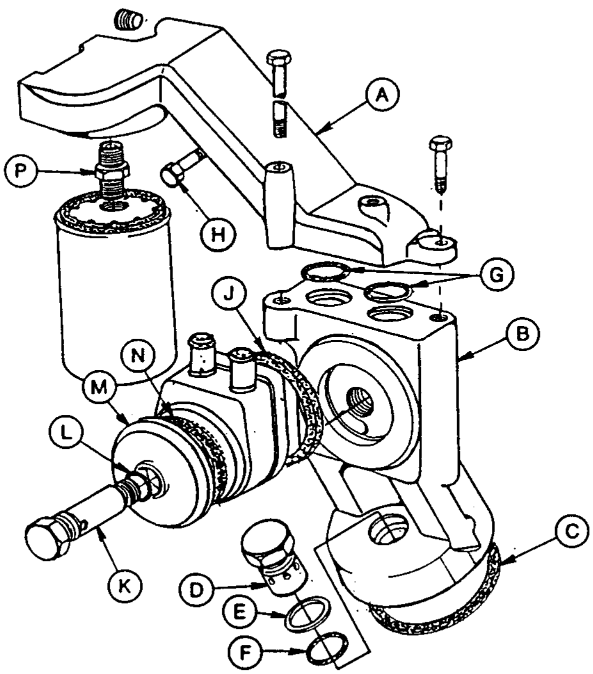
A—Pressure Regulating Valve Bore
B—Mounting Face
C—Oil Filter Adapter Mounting Surface

[1] *See GENERAL LUBRICATION SYSTEM INFORMATION earlier in this group for an explanation of "Common Lube" blocks.*

CTM8,GR20,15 –19–16SEP92–4/4

REPLACING STANDARD OIL COOLER/OIL FILTER HOUSINGS

Engine without camshaft-gear-driven auxiliary drive and housing installed on sloped base of cylinder block.



CD30408 –UN–25OCT94

A—Oil Filter Housing
B—Oil Cooler Housing
C—O-Ring
D—Adapter
E—Washer
F—O-Ring
G—O-Ring
H—Cap Screw
J—Packing
K—Holding Screw
L—O-Ring
M—Cover
N—O-Ring
P—Adapter

1. Remove oil filter housing (A) and oil cooler housing (B).
2. Clean and inspect parts.
3. Install oil cooler housing with a new O-ring (C). Tighten adapter (D) to specifications.

Oil Cooler Base Adapter (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)—Specification

Torque .... 37 N•m (27 lb-ft)

4. Install oil filter housing (A) with O-rings (G). Tighten cap screws (3 used) to specifications.

Oil Filter Housing (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)—Specification

Torque .... 47 N•m (35 lb-ft)

NOTE: Apply sealing compound on thread of cap screw (H).

5. Install new packing (J) between oil cooler and housing.
6. Attach oil cooler with holding screw (K), cover (M) and O-rings (L and N). Tighten to specifications.

Oil Cooler Holding Screw (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)—Specification

Torque .... 37 N•m (27 lb-ft)

7. Connect coolant lines to oil cooler.
8. Install oil filter adapter (P). Tighten to specifications.

Oil Filter Adapter (Cooler Installed on Sloped Base w/o Cam Driven Auxiliary Drive)—Specification

Torque .... 47 N•m (35 lb-ft)

Continued on next page

RG,CTM8,DX163 –19–21FEB95–1/3

Engine without camshaft-gear-driven auxiliary drive and housing installed on vertical base of cylinder block.

1. Remove oil filter housing (A) and oil cooler housing (B).

2. Clean and inspect parts.

3. Install oil cooler housing (B) with a new gasket (C). Tighten cap screws to specifications.

Oil Cooler Housing Cap Screws (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)—Specification

Torque .... 47 N•m (35 lb-ft)

4. Install oil filter housing (A) with a new gasket (D). Tighten cap screws (3 used) to specifications.

Oil Filter Housing Cap Screws (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)—Specification

Torque .... 47 N•m (35 lb-ft)

NOTE: Apply sealing compound on thread of cap screw (E).

5. Install new packing (F) between oil cooler (G) and housing.

6. Attach oil cooler with holding screw (H), cover (J) and O-rings (K and L). Tighten to specifications.

Oil Cooler Holding Screw (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)—Specification

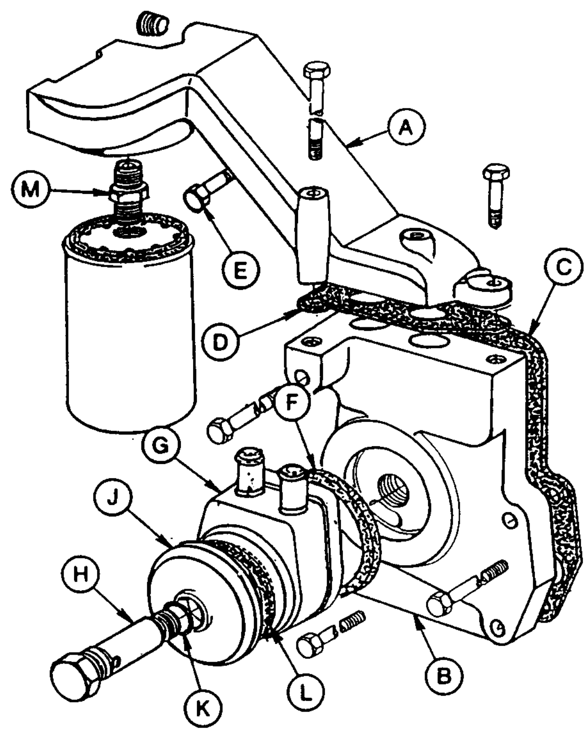
Torque .... 37 N•m (27 lb-ft)

7. Connect coolant lines to oil cooler.

8. Install oil filter adapter (M). Tighten to specifications.

Oil Filter Adapter (Cooler Installed on Vertical Base w/o Cam Driven Auxiliary Drive)—Specification

Torque .... 47 N•m (35 lb-ft)



CD30409 –UN–25OCT94

A—Oil Filter Housing
B—Oil Cooler Housing
C—Gasket
D—Gasket
E—Cap Screw
F—Packing
G—Oil Cooler
H—Holding Screw
J—Cover
K—O-Ring
L—O-Ring
M—Adapter

Continued on next page

RG,CTM8,DX163 –19–21FEB95–2/3

Engine with camshaft-gear-driven auxiliary drive.

1. Remove oil cooler/filter housing (A).

2. Clean and check parts.

3. Install housing (A) with a new packing (B) or gasket (C). Tighten holding screw (D) or cap screws (E) to specifications.

Oil Cooler/Filter Housing Holding Screw (Engine w/Cam Driven Auxiliary Drive)—Specification

Torque .... 37 N•m (27 lb-ft)

Oil Cooler/Filter Housing Cap Screws (Engine w/Cam Driven Auxiliary Drive)—Specification

Torque .... 47 N•m (35 lb-ft)

4. Install adapter (F) onto housing. Tighten to specifications.

Oil Cooler-to-Housing Adapter (Engine w/Cam Driven Auxiliary Drive)—Specification

Torque .... 47 N•m (35 lb-ft)

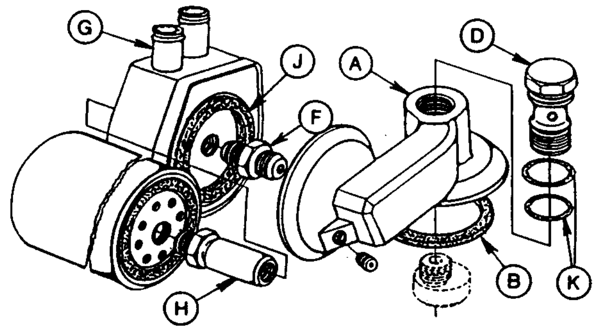
5. Install a new packing (J) between oil cooler (G) and housing.

6. Attach oil cooler with nipple (H). Tighten to specifications.

Oil Filter-to-Oil Cooler Nipple (Engine w/Cam Driven Auxiliary Drive)—Specification

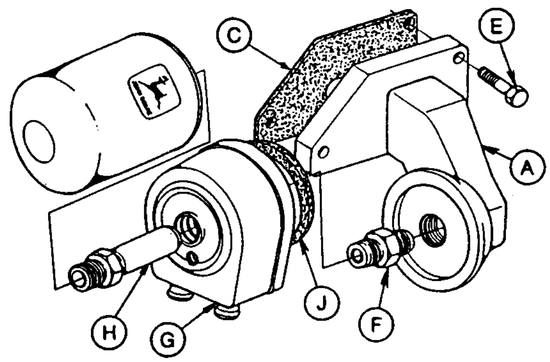
Torque .... 37 N•m (27 lb-ft)

7. Connect coolant lines to oil cooler.



CD30410 –UN–25OCT94

Short Stroke Engine



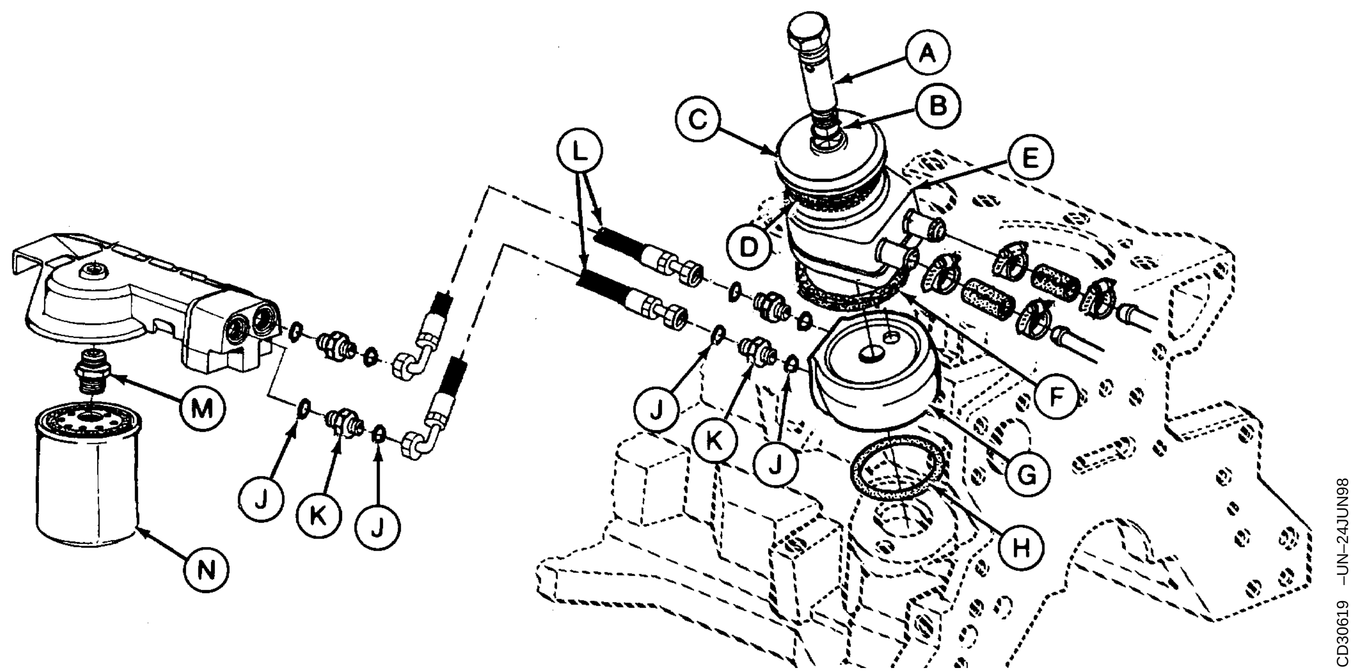
CD30411 –UN–25OCT94

Long Stroke Engine

A—Oil Cooler/Filter Housing
B—Packing
C—Gasket
D—Holding Screw
E—Cap Screw (3 used)
F—Adapter
G—Oil Cooler
H—Nipple
J—Packing
K—O-Rings

RG,CTM8,DX163 –19–21FEB95–3/3

REPLACE OIL FILTER ADAPTER ON ENGINE WITH REMOTE OIL FILTER



A—Holding Screw
B—O-Ring
C—Cover
D—O-Ring
E—Oil Cooler
F—Packing
G—Oil Filter Adapter
H—O-Ring
J—O-Ring
K—Fitting
L—Oil Hose
M—Fitting
N—Oil Filter

1. Remove special screw (A) holding the the oil cooler (E) and the oil filter adapter (G).

2. Disconnect oil hoses (L) from adapter.

3. Clean and inspect parts.

4. Install adapter with new O-ring (H), then attach oil cooler with packing (F), cover (C) and O-rings (D) and (B). Tighten holding screw (A) to specifications.

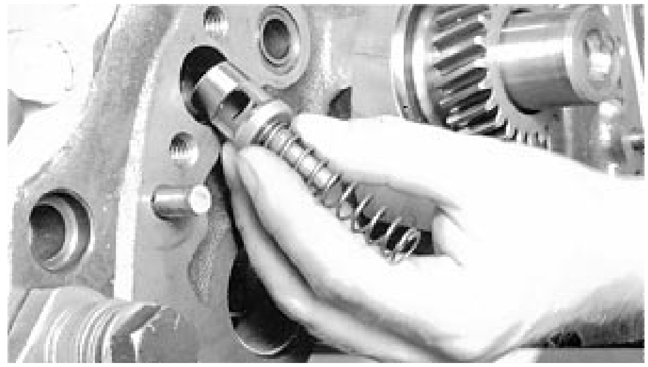
Oil Cooler/Adapter Holding Screw (Remote Oil Filter)—Specification

Torque.. 35 N•m (25 lb-ft)

5. Reconnect oil hoses to adapter and coolant lines to oil cooler.

DPSG,OUO1004,491 –19–08NOV98–1/1

REMOVE, INSPECT, AND INSTALL OIL BYPASS VALVE—3029, 4039, AND 6059 ENGINES AND 4045 AND 6068 ENGINES WITH COMMON LUBE BLOCK[1]



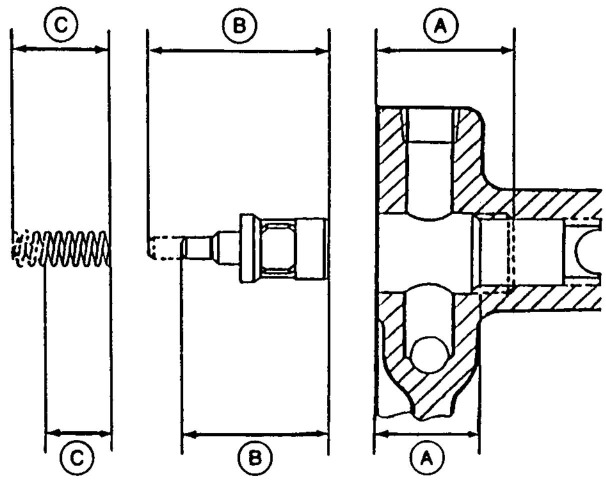
T87436 –UN–09NOV88

1. Remove timing gear cover and front plate as described in Group 16.
2. Remove oil bypass valve and spring.
3. Inspect valve and spring for damage. Replace parts if necessary.

NOTE: Bypass valves and springs of two lengths may be installed on engine.

4. Check the relationship between the block bore depth (A), valve length (B) and spring free length (C).

Block Bore Depth	Valve Length	Spring Free Length
41.5 mm (1.63 in.)	49.5 mm (1.95 in.)	59.0 mm (2.32 in.)
33.0 mm (1.30 in.)	41.0 mm ((1.61 in)	51.0 mm (2.00 in.)



CD30415 –UN–25OCT94

A—Block Bore Depth
B—Valve Length
C—Spring Free Length

5. Check bypass valve spring free length and compression strength using D01168AA Spring Compression Tester. Replace parts if not within specification.

Pre-Common Lube Block Oil Bypass Valve Springs (3029/4039/4045/6068/6059)—Specification

Free Length .... 59 mm (2.32 in.)
Spring Load at 34 mm (1.34 in.) Compressed Length .... 92—112 N (21—25 lb-force)

Common Lube Block Oil Bypass Valve Springs (4039/6059/4045/6068)—Specification

Free Length .... 51 mm (2.00 in.)
Spring Load at 29 mm (1.14 in.) Compressed Length .... 87.8 N (20 lb-force)

6. Install oil bypass valve and spring in cylinder block.

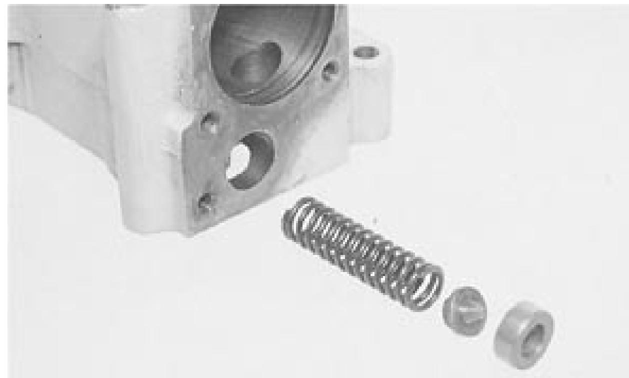
[1] See GENERAL LUBRICATION SYSTEM INFORMATION earlier in this group for an explanation of "Common-Lube" blocks.

Continued on next page

7. Install front plate and timing gear cover as described earlier in Group 16.

CTM8,GR20,17 –19–18FEB95–2/2

REMOVE AND INSTALL OIL BYPASS VALVE—4045 AND 6068 ENGINES WITH PRE-COMMON LUBE BLOCK[1]



T91330 –UN–25OCT88

The oil bypass valve assembly is located in a bottom bore of oil cooler housing. The spring and valve are retained in housing by the pressed-in seat.

If spring, valve, or seat are damaged, or require replacement, install a new oil cooler housing. (See REMOVE AND INSTALL HIGH-FLOW OIL COOLER—4045 AND 6068 ENGINES earlier in this group.

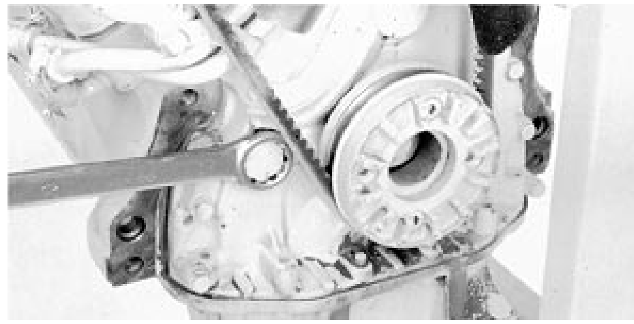
NOTE: Since the spring, valve, and seat are not easily removed and seldom require replacement, these parts are not serviced separately. The cooler housing provided for service includes the valve assembly.

[1] *See GENERAL LUBRICATION SYSTEM INFORMATION earlier in this group for an explanation of "Common-Lube" blocks.*

CTM8,GR20,18 –19–28SEP94–1/1

REMOVE AND INSTALL OIL PRESSURE REGULATING VALVE AND SEAT—3029, 4039, AND 6059 ENGINES AND 4045 AND 6068 ENGINES WITH COMMON LUBE BLOCK[1]

1. Remove oil pressure regulating valve plug.


T88877 –UN–09NOV88

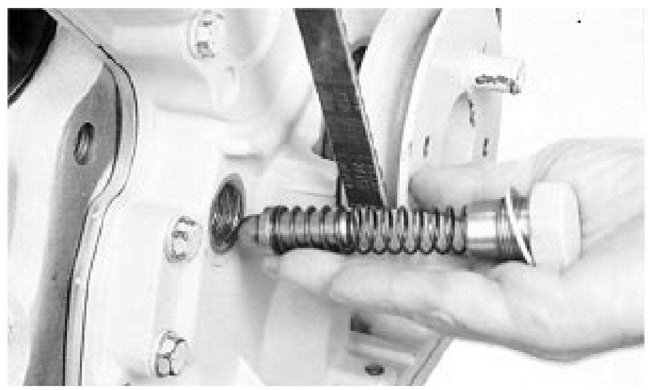
[1]*See GENERAL LUBRICATION SYSTEM INFORMATION earlier in this group for an explanation of "Common-Lube" blocks.*

CTM8,GR20,19 –19–28SEP94–1/5

2. Remove oil pressure regulating valve and spring. Check valve cone for excessive wear and damaged sealing face.

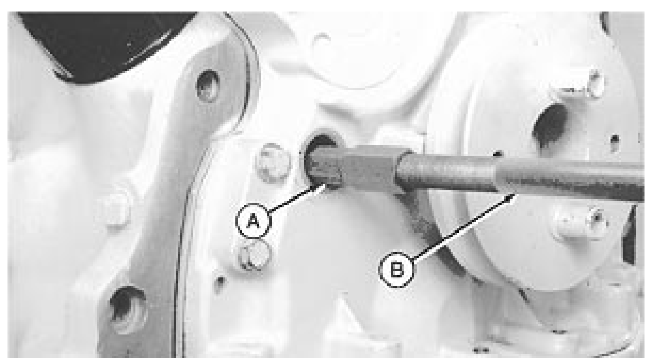
Common Lube Block Oil Pressure Regulating Valve Spring—Specification

Spring Free Length	120 mm (4.72 in.)
Spring Tension at 42.5 mm (1.68 in.)	60—75 N (13.5—16.5 lb-force)


T81788 –UN–09NOV88

CTM8,GR20,19 –19–28SEP94–2/5

3. Pull valve seat out of cylinder block with JT01727 Collet (A) and JT01718 slide hammer (B) from D01061AA Blind-Hole Puller Set, or equivalent.



T88878 –UN–25OCT88

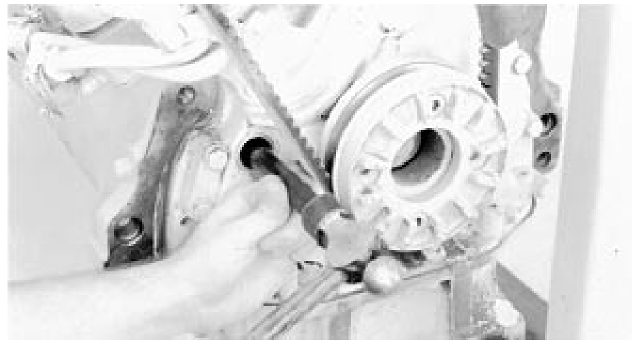
A—JT01727 Collet
B—JT01718 Slide Hammer

Continued on next page

CTM8,GR20,19 –19–28SEP94–3/5

IMPORTANT: DO NOT drive against raised inner rim of valve seat so that valve seat bore is not damaged.

4. Drive valve seat into cylinder block with JD248A Oil Pressure Relief Valve Bushing Driver and JDG536 (OTC813) Handle until the seat bottoms.



T88879 –UN–25OCT88

CTM8,GR20,19 –19–28SEP94–4/5

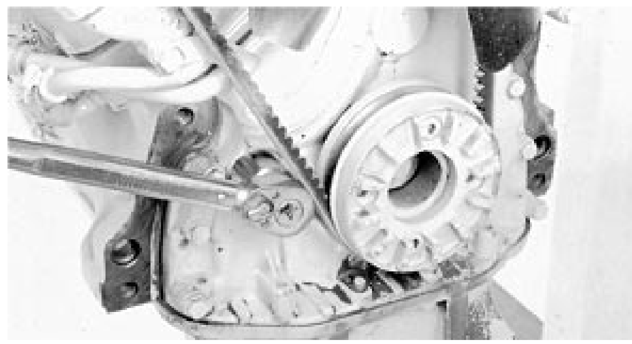
5. Install valve, spring, washer, and plug in timing gear cover. Tighten plug to specifications.

Common Lube Block Oil Pressure Regulating Valve Plug (Aluminum Timing Gear Cover)—Specification

Torque .... 95 N•m (70 lb-ft)

Common Lube Block Oil Pressure Regulating Valve Plug (Composite Material Timing Gear Cover)—Specification

Torque .... 30 N•m (22 lb-ft)



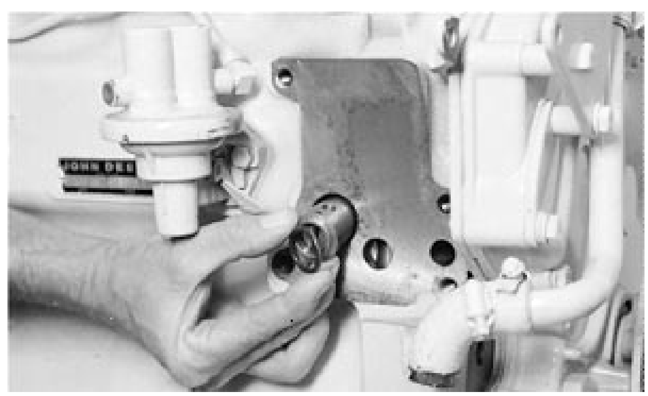
T88873 –UN–09NOV88

CTM8,GR20,19 –19–28SEP94–5/5

REMOVE, INSPECT, AND INSTALL OIL PRESSURE REGULATING VALVE—4045 AND 6068 ENGINES WITH PRE-COMMON LUBE BLOCK[1]

1. Remove oil filter and oil cooler assembly from cylinder block. (See REMOVE AND INSTALL HIGH-FLOW OIL COOLER earlier in this group.)

2. Remove pressure regulating valve.



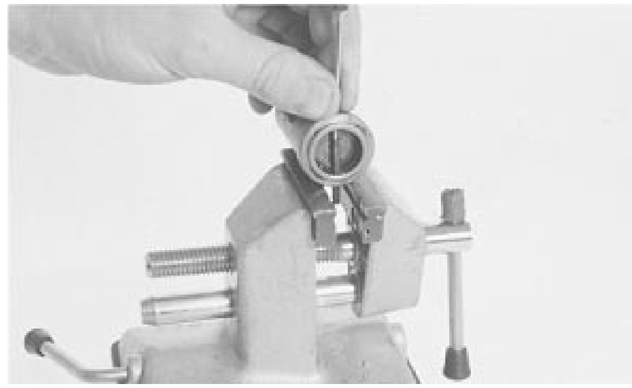
T94572 –UN–25OCT88

[1] *See GENERAL LUBRICATION SYSTEM INFORMATION earlier in this group for an explanation of "Common-Lube" blocks.*

Continued on next page

CTM8,GR20,20 –19–28SEP94–1/5

3. Remove spring pin to remove valve and spring.



T91271 –UN–25OCT88

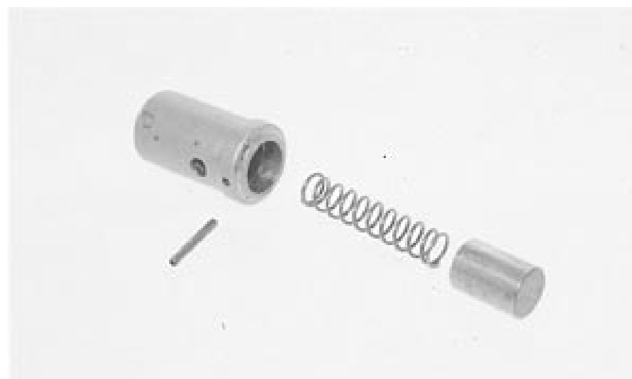
CTM8,GR20,20 –19–28SEP94–2/5

4. Check valve spring using spring compression tester.

Pre-Common Lube Block Pressure Regulating Valve Spring (4045/6068)—Specification

Spring Free Length	59 mm (2.32 in.)
Spring Tension at 34 mm (1.34 in.)	92—112 N (21—25 lb-force)

5. Inspect valve and housing bore for damage. Valve must slide freely in bore.



T91264 –UN–25OCT88

CTM8,GR20,20 –19–28SEP94–3/5

6. Install spring and valve. Compress spring and install punch.

7. Install spring pin and remove punch.

T91272 –UN–25OCT88

Continued on next page

CTM8,GR20,20 –19–28SEP94–4/5

8. Install valve into hole in cylinder block, and install a new O-ring.

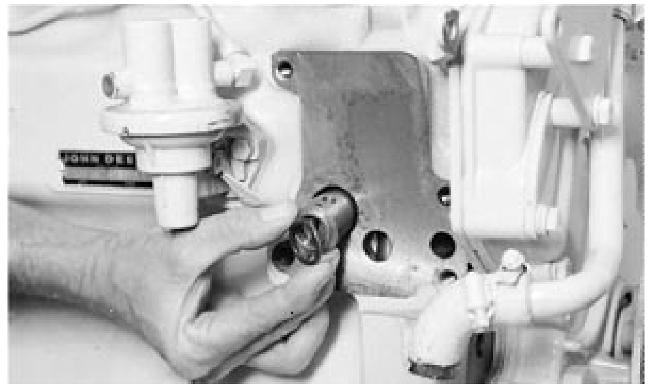
9. Install new gaskets. Install the oil cooler and filter assembly. (See REMOVE AND INSTALL HIGH-FLOW OIL COOLER earlier in this group.) Tighten oil cooler housing and filter base cap screws to specifications.

High-Flow Oil Cooler Housing Cap Screw—Specification

Torque .... 47 N•m (35 lb-ft)

High-Flow Oil Filter Base Cap Screw—Specification

Torque .... 37 N•m (27 lb-ft)



T94572 –UN–25OCT88

CTM8,GR20,20 –19–28SEP94–5/5

REMOVE AND INSTALL OIL FILTER NIPPLE—3029, 4039, 6059 ENGINES

1. Remove engine oil filter, oil cooler (if equipped), and oil filter adapter housing (3029 engines).

RG6355 –UN–03AUG92

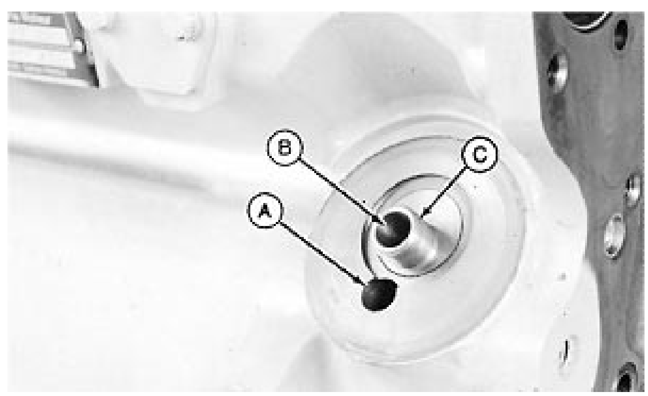
CTM8,GR20,22 –19–16SEP92–1/4

2. Fill holes (A) and (B) with grease to catch shavings.

3. Thread I.D. of nipple with appropriate size tap.

4. Install cap screw into tapped hole. Use slide hammer to remove nipple (C).

5. Clean grease and shavings from both holes.



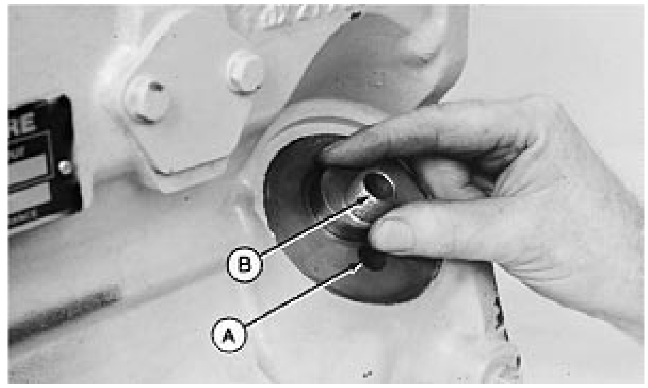
RG6407 –UN–21AUG92

A—Hole
B—Hole
C—Nipple

Continued on next page

CTM8,GR20,22 –19–16SEP92–2/4

6. Put the new oil filter nipple over its bore in the cylinder block so hole (B) is as close to hole (A) as possible.

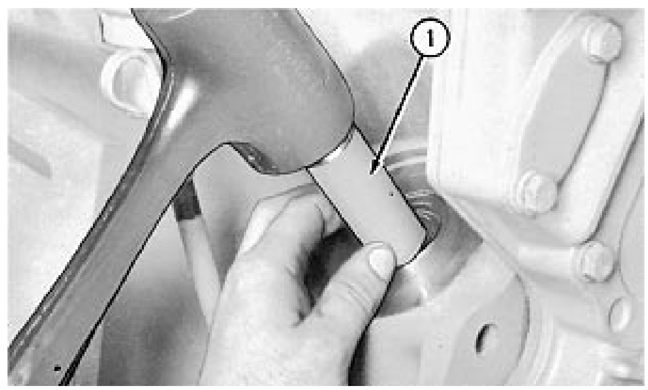


A—Hole
B—Hole

CTM8,GR20,22 –19–16SEP92–3/4

7. Using a tubular driver (1), push the oil filter nipple into the cylinder block until it is flush with the block surface.

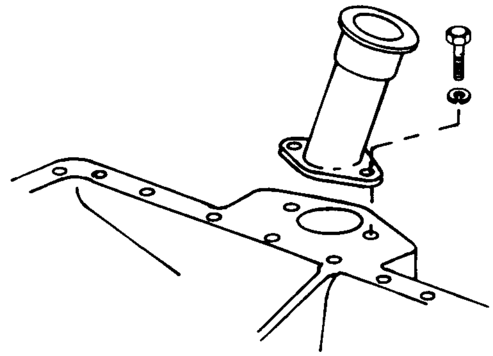
8. Install the oil filter adapter housing (3029 engines), oil cooler (if equipped), and oil filter as described earlier in this group.



1—Driver

CTM8,GR20,22 –19–16SEP92–4/4

REMOVE AND INSTALL OIL PAN MOUNTED OIL FILL/DIPSTICK TUBE



RG7304 –UN–21FEB95

NOTE: This type of dipstick tube also acts as an oil filler neck.

1. Remove dipstick tube.

2. Clean oil pan sealing surface.

NOTE: On some applications where an O-ring is used, sealant is not required.

3. Apply a bead of LOCTITE® 515 (TY6304) Flexible Sealant, then install dipstick tube.

4. Tighten cap screws to specifications.

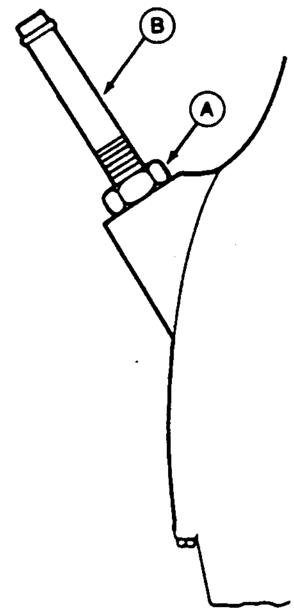
Oil Pan Mounted Oil Fill/Dipstick Tube—Specification

Torque .... 47 N•m (35 lb-ft)

LOCTITE is a registered trademark of the Loctite Corp.

CTM8,GR20,35 –19–21FEB95–1/1

REMOVE, INSTALL, AND ADJUST DIPSTICK NIPPLE



A—Lock Nut
B—Dipstick Nipple

1. Loosen lock nut (A) and screw dipstick nipple (B) out of cylinder block.

2. Replace dipstick nipple if damaged.

3. With lock nut installed on dipstick nipple, apply LOCTITE® 515 (TY6304) Flexible Sealant to threads of dipstick nipple. Screw nipple into block until nipple is at correct height. Tighten lock nut.

4. Check dipstick calibration. Adjust nipple height as required.

   The preferred method for adjusting dipstick nipple is to:

   a. Run engine to circulate oil.

   b. Drain crankcase and replace filter.

   c. Allow engine to cool, then fill crankcase with the correct amount of new engine oil.

   d. Adjust nipple to have oil level at full mark on dipstick.

LOCTITE is a registered trademark of the Loctite Corp.

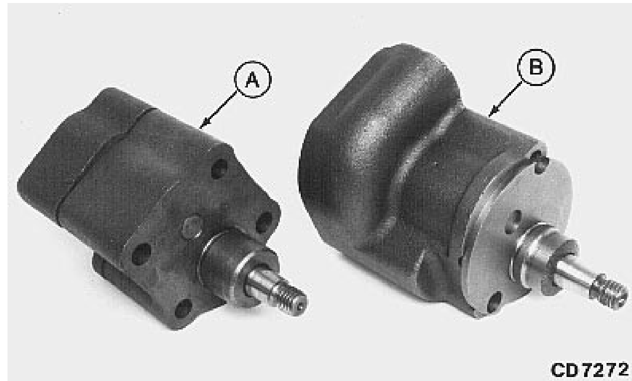
RG,CTM8,GR20,44 –19–07OCT94–1/1

GENERAL OIL PUMP INFORMATION

Two types of oil pumps are used:

3029, 4039, and 6059 engines are normally equipped with the standard capacity pump (A). A limited number of 4039 and 6059 engines may have the high capacity pump (B).

4045 and 6068 engines are normally equipped with the high capacity pump. A limited number of 4045 engines may have the standard capacity pump.



CD7272 –UN–23MAY95

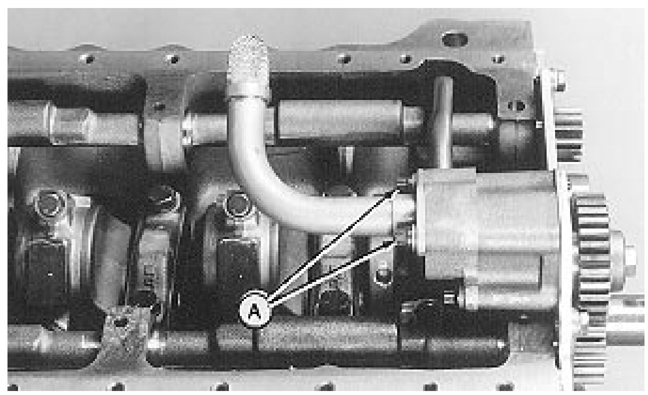
A—Capacity 0.88 L/S (14 GPM)
B—Capacity 1.01 L/S (16 GPM)

CTM8,GR20,24 –19–25JUN92–1/1

REMOVE, INSPECT AND INSTALL OIL PUMP PICK-UP TUBE ASSEMBLY

A loose or damaged suction tube or O-ring can cause a temporary loss of prime for the engine oil pump at start-up. There will be low or no oil pressure at starting, followed by normal engine oil pressure.

NOTE: If the pick-up tube is to be inspected only and not removed, verify mounting cap screw torque to insure proper seating and seal.



RG7299 –UN–17FEB95

Standard Capacity Oil Pump Shown

A—Cap Screws

1. Remove oil pan.

2. Loosen cap screws (A) and remove oil pump pick-up tube assembly.

3. Inspect pick-up tube for cracks, restrictions or damage. Replace if necessary.

4. Install assembly with new O-ring and tighten cap screws to specifications.

Oil Pump Pick-Up Tube Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

5. Reinstall oil pan. See INSTALL OIL PAN, as described later in this group.

RG,CTM8,DX167 –19–18FEB95–1/1

REMOVE STANDARD CAPACITY OIL PUMP

T81790 –UN–09NOV88

1. Drain oil and disconnect turbocharger oil inlet line at the turbocharger.
2. Remove oil pan. Remove gasket from oil pan and pan rail.

NOTE: To aid reassembly of 4-cylinder engines with balancer shafts, lock the crankshaft with No. 1 piston at TDC compression stroke. Then, using lock-grip pliers, lock the balancer shaft so it cannot turn when oil pump gear is removed.

3. Remove nut and pull gear from pump shaft.

   If a suitable puller is not available, loosen nut several turns and apply force between the front plate and gear on two sides of gear with small pry bars. Strike the nut on end of shaft with a lead hammer while applying force to gear until gear is free of tapered shaft.

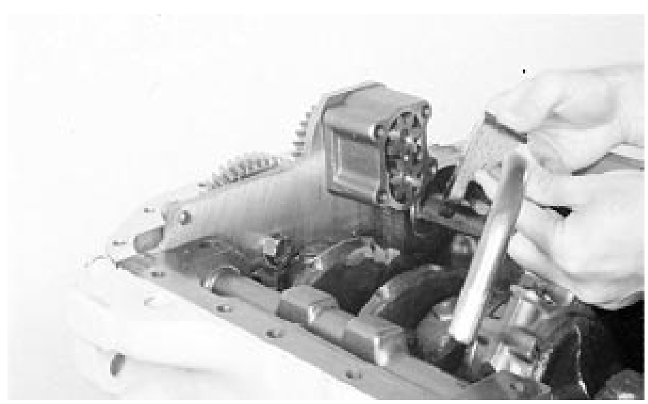
CTM8,GR20,31 –19–16SEP92–1/3

T81956 –UN–31OCT88

4. Remove the oil pump-to-front plate cap screws.

NOTE: Standard-flow pumps on Saran-built engines (Serial No. 106774—) use only three oil pump-to-front plate cap screws.

CTM8,GR20,31 –19–16SEP92–2/3



T81957 –UN–31OCT88

5. Remove cover and outlet tube.
6. Remove housing assembly and drive gear from front plate.
7. Remove O-ring from tube bore in block.

CTM8,GR20,31 –19–16SEP92–3/3

INSPECT AND MEASURE CLEARANCES (STANDARD CAPACITY OIL PUMP)

T81779 –UN–09NOV88

Inspect oil pump components for excessive wear. Replace parts or oil pump assembly, as necessary.

1. Check gear-to-pump cover axial clearance.

Standard Capacity Oil Pump Gears—Specification

Thickness	41.156—41.206 mm (1.6203—1.6223 in.)
Wear Limit	41.106 mm (1.6183 in.)

Standard Capacity Oil Pump Gears—Specification

Axial Clearance	0.031—0.157 mm (0.0012—0.0062 in.)
Wear Limit	0.22 mm (0.0085 in.)

RG,CTM8,GR20,45 –19–16SEP92–1/3

2. Check gear-to-pump housing radial clearance.

T81780 –UN–09NOV88

Standard Capacity Oil Pump Gears—Specification

Radial Clearance	0.10—0.16 mm (0.004—0.006 in.)
Wear Limit	0.20 mm (0.008 in.)

Continued on next page

RG,CTM8,GR20,45 –19–16SEP92–2/3

3. Check housing bore ID and pump shaft OD.

Standard Capacity Oil Pump Bore in Housing—Specification

ID .... 16.059—16.083 mm (0.6322—0.6332 in.)
Wear Limit .... 16.163 mm (0.6362 in.)

Standard Capacity Oil Pump Drive Shaft—Specification

OD .... 16.022—16.032 mm (0.6308—0.6312 in.)
Wear Limit .... 15.997 mm (0.6298 in.)

Standard Capacity Oil Pump Idler Shaft—Specification

OD .... 12.319—12.329 mm (0.4850—0.4854 in.)
Wear Limit .... 12.306 mm (0.4845 in.)

T81953 –UN–09NOV88

T81781 –UN–09NOV88

RG,CTM8,GR20,45 –19–16SEP92–3/3

COMPLETE STANDARD CAPACITY OIL PUMP DISASSEMBLY

1. Remove outlet tube from cover.

2. Remove and discard O-ring.

T81791 –UN–01NOV88

Continued on next page

S11,2020,EX –19–16SEP92–1/2

3. Remove O-ring (A) from pick-up tube.

4. Clean all oil pump parts in solvent. Use compressed air to dry parts.

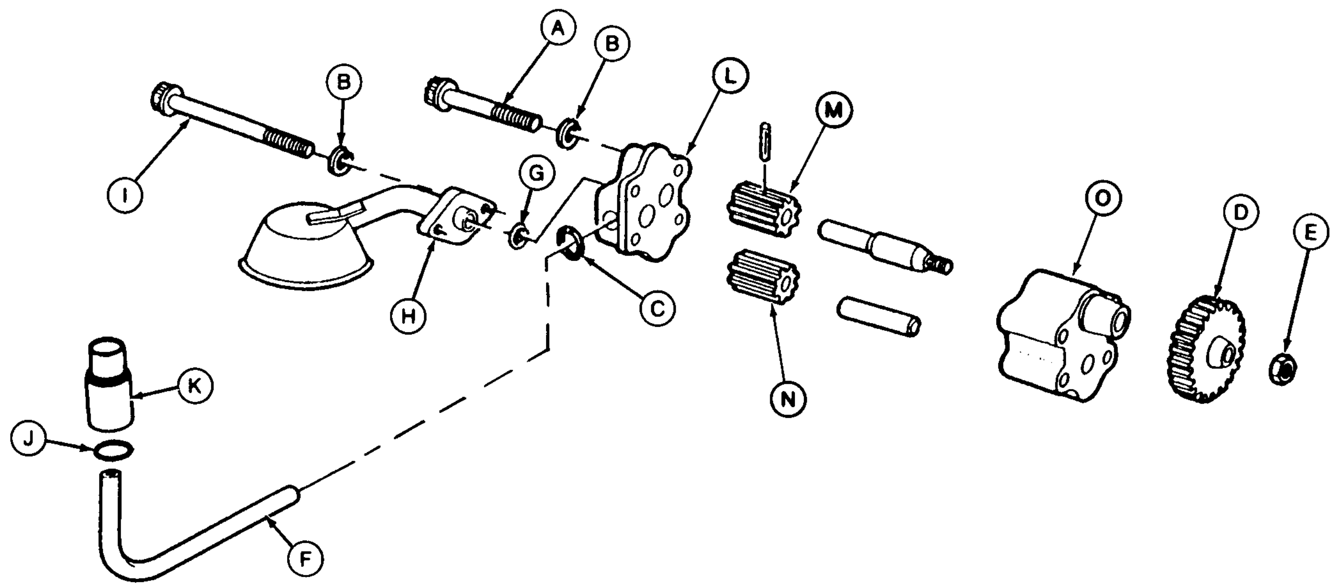
5. Inspect pick-up tube. Check flange-to-tube weld for cracks. If cracks or other defects are found, replace pick-up tube. See REPLACE OIL PUMP PICK-UP TUBE ASSEMBLY, earlier in this group.

T88882 –UN–25OCT88

A—O-ring

S11,2020,EX –19–16SEP92–2/2

ASSEMBLE STANDARD CAPACITY OIL PUMP



A—Cap Screw (4 used)
B—Washer (6 used)
C—O-Ring
D—Gear
E—Nut
F—Outlet Tube
G—O-Ring
H—Intake Pick-up Tube
I—Cap Screw (2 used)
J—O-Ring
K—Inlet Tube
L—Cover
M—Drive Gear
N—Idler Gear
O—Pump Housing

IMPORTANT: Lubricate gears and shaft with clean engine oil before assembling.

1. Install new O-ring (C) in cover (L).

2. Install new O-ring (G) in oil intake pick-up tube (H).

3. Put idler gear (N) and drive gear (M) in pump housing (O). Gears must turn freely.

NOTE: The outlet tube for long stroke engines (4045 and 6068), 6200/6200L and 6300/6330L tractors (—221092), 6400/6400L, 6500/6500L and all Saran-built 4045 engines with standard capacity pumps, has a paint mark to allow a quicker identification. This tube being almost similar to other tubes, can be installed on a wrong engine and can cause engine failure.

4. Install outlet tube (F) in cover.

RG,CTM8,DX162 –19–18FEB95–1/1

INSTALL STANDARD CAPACITY OIL PUMP

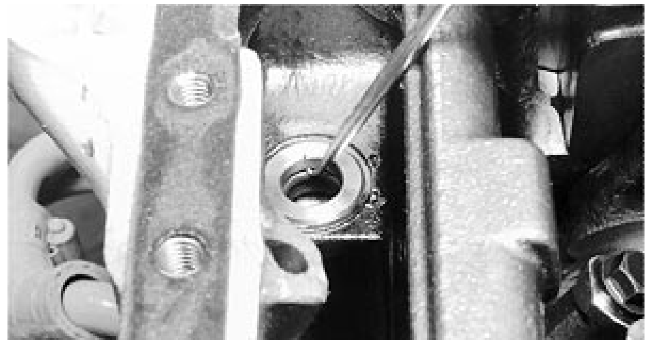
NOTE: This procedure is for installing the oil pump with timing gear cover installed. If timing gear cover is removed from the engine, refer to INSTALL AND TIME BALANCER SHAFT in Group 16 (for 4-cylinder engines only).

1. On 4-cylinder engines with balancer shafts, lock No. 1 piston at TDC compression stroke.

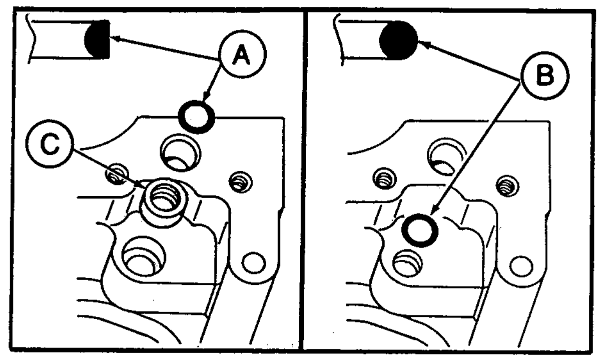
2. Install new seal in cylinder block.

NOTE: Depending on the machining of the cylinder block, two types of seals can be used:

- *Type (A) for cylinder block with bushing (C).*
- *Type (B) for cylinder block without bushing.*



T88931 –UN–09NOV88



CD30417

CD30417 –UN–10MAY95

A—Oil Seal
B—Oil Seal
C—Bushing

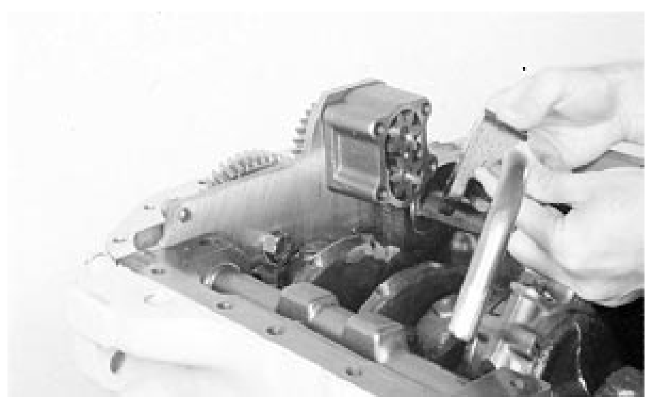
CTM8,GR20,25 –19–05OCT94–1/4

IMPORTANT: On 4-cylinder engines, the key slot in the balancer shafts must be at the 12 o'clock position (timing marks on both balancer shaft gears facing inboard toward crankshaft centerline), when No. 1 piston is at TDC compression stroke.

3. Install oil pump drive gear so it meshes with balancer shaft gear and idler gear WITHOUT altering the timing position of the balancer shaft.

4. While holding drive gear in place, install housing on front plate.

5. Install pump cover with outlet tube and pick-up tube.



T81957 –UN–31OCT88

Continued on next page

CTM8,GR20,25 –19–05OCT94–2/4

6. Install the pump-to-front plate cap screws and tighten to specifications.

Standard Capacity Oil Pump Mounting Cap Screws (3029 Engines)—Specification

Torque .... 41 N•m (30 lb-ft)

Standard Capacity Oil Pump Mounting Cap Screws (4039, 6059, 4045 Engines)—Specification

Torque .... 47 N•m (35 lb-ft)

NOTE: Standard-flow pumps on Saran-built engines (Serial No. 106774—) and some Dubuque-built 6059 engines use only three oil pump-to-front plate cap screws instead of four.

7. Rotate oil pump shaft by hand to be sure it turns easily.

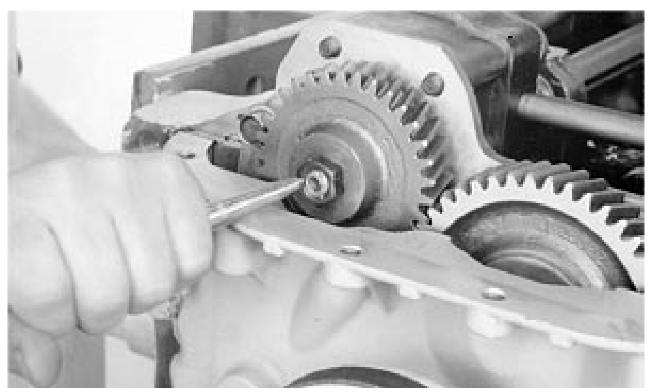
CTM8,GR20,25 –19–05OCT94–3/4

8. Install and tighten retaining nut to specifications.

Standard Capacity Oil Pump Gear Staked Retaining Nut—Specification

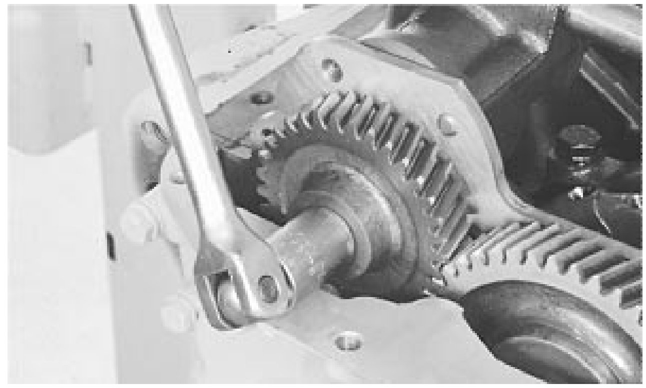
Torque .... 75 N•m (55 lb-ft)

9. Stake nut to shaft by applying three center punch marks near ID of the nut.



CTM8,GR20,25 –19–05OCT94–4/4

REMOVE HIGH CAPACITY OIL PUMP



T92913 –UN–25OCT88

1. Drain oil and disconnect turbocharger oil inlet line at the turbocharger.

2. Remove oil pan. Remove gasket from oil pan and oil pan rail.

NOTE: To aid reassembly of 4-cylinder engines with balancer shafts, lock the crankshaft with No. 1 piston at TDC compression stroke.. Then, using lock-grip pliers, lock the balancer shaft so it cannot turn when oil pump gear is removed.

3. Remove nut and pull gear from oil pump drive shaft.

   If a suitable puller is not available, loosen nut several turns and apply force between the front plate and gear on two sides of gear with small pry bars. Strike the nut on end of shaft with a lead hammer while applying force to gear until gear is free of tapered shaft.

Continued on next page

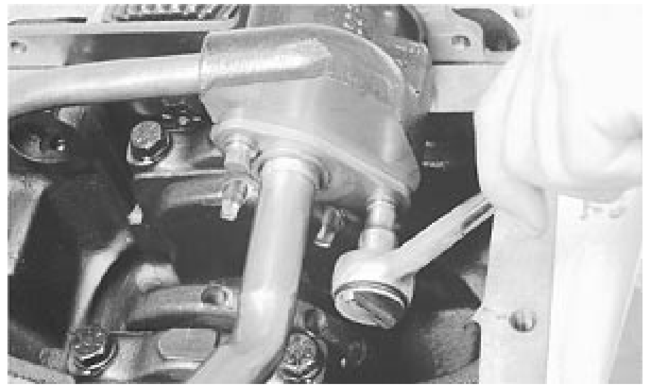
CTM8,GR20,26 –19–16SEP92–1/2

4. Remove the two oil pump-to-front plate cap screws. Lift pick-up tube off oil pump.

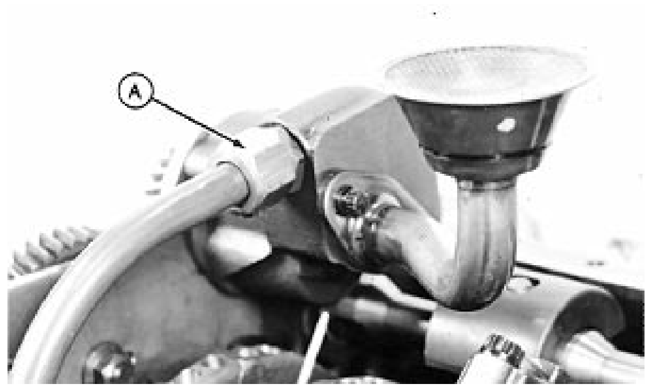
5. Lift oil pump, with outlet tube, off engine.

6. Pull outlet tube out of pump housing.

NOTE: On some engines, the oil pump outlet tube may be retained in pump by a gland nut (A).



T92914 –UN–25OCT88

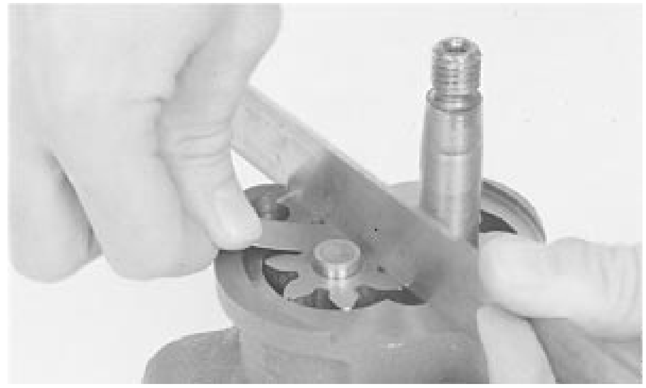


RG6362 –UN–17AUG92

A—Gland Nut

CTM8,GR20,26 –19–16SEP92–2/2

INSPECT AND MEASURE CLEARANCES (HIGH CAPACITY OIL PUMP)



T91275 –UN–25OCT88

Inspect oil pump components for excessive wear. Replace parts or oil pump assembly, as necessary.

1. Check gear-to-pump cover axial clearance.

High Capacity Oil Pump Gears—Specification

Thickness..50.975—51.025 mm (2.007—2.009 in.)
Wear Limit .... 50.925 mm (2.005 in.)

High Capacity Oil Pump Gears—Specification

Axial Clearance .... 0.042—0.168 mm (0.0016—0.0066 in.)
Wear Limit .... 0.22 mm (0.0085 in.)

RG,CTM8,GR20,53 –19–16SEP92–1/3

2. Check gear-to-pump housing radial clearance.

T91276 –UN–25OCT88

High Capacity Oil Pump Gears—Specification

Radial Clearance .... 0.08—0.18 mm (0.003—0.007 in.)
Wear Limit .... 0.203 mm (0.009 in.)

Continued on next page

RG,CTM8,GR20,53 –19–16SEP92–2/3

3. Check housing and cover bore ID and shaft OD.

High Capacity Oil Pump Drive Shaft Bore in Pump Cover—Specification

ID	16.058—16.084 mm (0.6322—0.6332 in.)
Wear Limit	16.16 mm (0.636 in.)

High Capacity Oil Pump Drive Shaft (Cover End) (A)—Specification

OD	16.022—16.032 mm (0.6308—0.6312 in.)
Wear Limit	15.997 mm (0.6298 in.)

High Capacity Oil Pump Drive Shaft Bore in Pump Housing—Specification

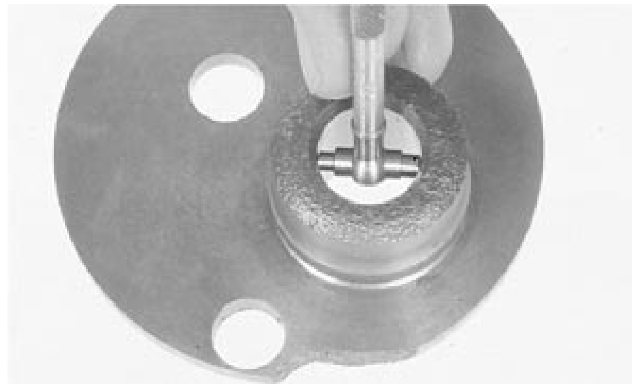
ID	12.281—12.307 mm (0.4835—0.4845 in.)
Wear Limit	12.323 mm (0.4850 in.)

High Capacity Oil Pump Drive Shaft (Housing End) (B)—Specification

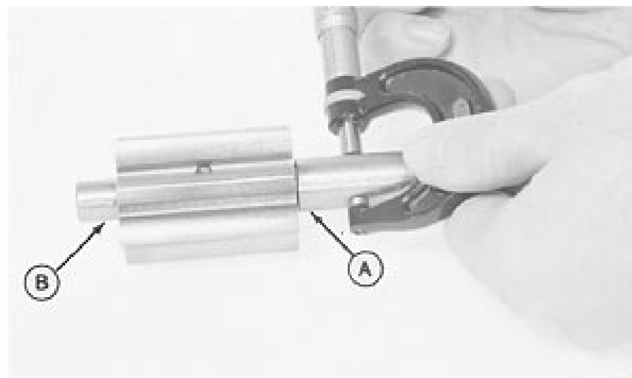
OD	12.256—12.266 mm (0.4825—0.4829 in.)
Wear Limit	12.231 mm (0.4815 in.)

High Capacity Oil Pump Idler Shaft—Specification

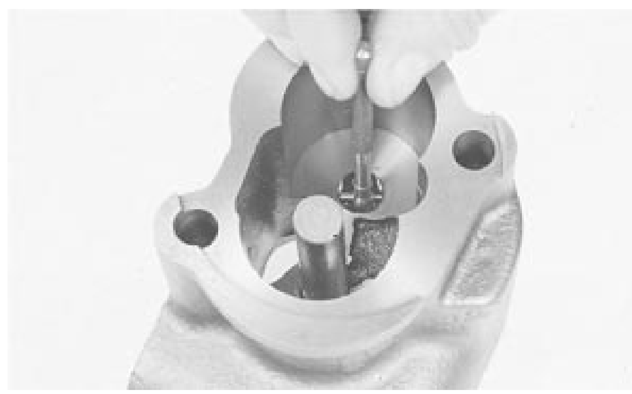
OD	12.319—12.329 mm (0.4850—0.4854 in.)
Wear Limit	12.306 mm (0.4845 in.)



T91266 –UN–25OCT88



T91265 –UN–25OCT88

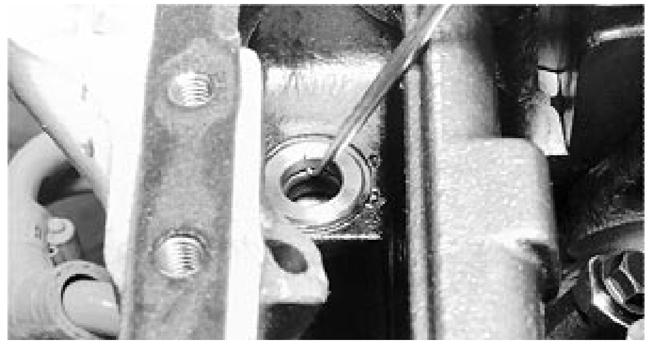


T91267 –UN–25OCT88

A—Drive Shaft OD
B—Drive Shaft OD

RG,CTM8,GR20,53 –19–16SEP92–3/3

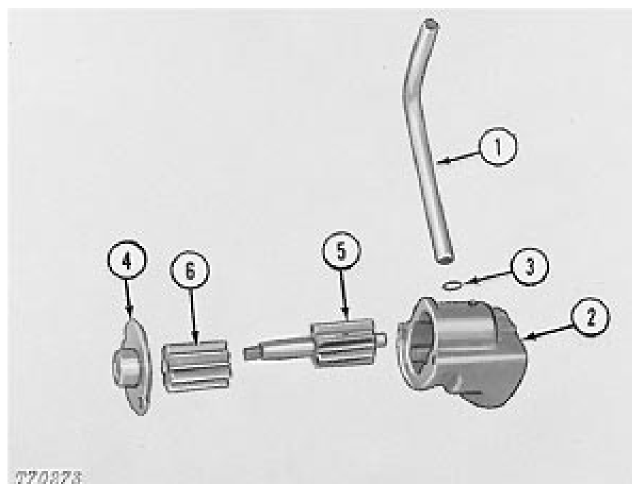
COMPLETE HIGH CAPACITY OIL PUMP DISASSEMBLY


T88931 –UN–09NOV88

1. Remove O-ring from pump housing and cylinder block (for outlet tube).
2. Remove O-ring from oil pick-up tube.
3. Clean oil pump parts in solvent. Dry with compressed air.

RG,CTM8,GR20,56 –19–18FEB95–1/1

ASSEMBLE HIGH CAPACITY OIL PUMP



T70273 –UN–10FEB89

1—Outlet Tube
2—Oil Pump Housing
3—O-Ring
4—Cover
5—Drive Gear
6—Idler Gear

IMPORTANT: Lubricate gears and shaft with clean engine oil before assembling.

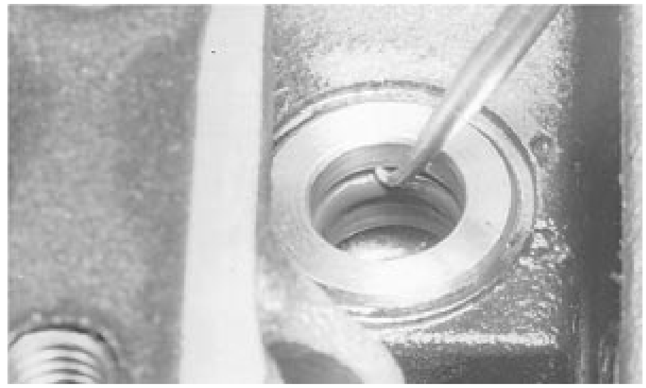
1. Install new O-ring (3) in pump housing (2); or new packing in flex fitting (as equipped).
2. Put idler gear (6) and drive gear (5) in pump housing.
3. Install outlet tube (1) in pump housing.
4. Put cover (4) on pump housing.

CTM8,GR20,27 –19–18FEB95–1/1

INSTALL HIGH CAPACITY OIL PUMP

NOTE: This procedure is for installing the oil pump with timing gear cover installed. If timing gear cover is removed from engine, refer to INSTALL AND TIME BALANCER SHAFTS in Group 16 (for 4-cylinder engines only).

1. On 4-cylinder engines with balancer shafts, lock No. 1 piston at TDC compression stroke.
2. Install a new O-ring in cylinder block (for outlet tube).
3. Install a new O-ring on oil pick-up tube.

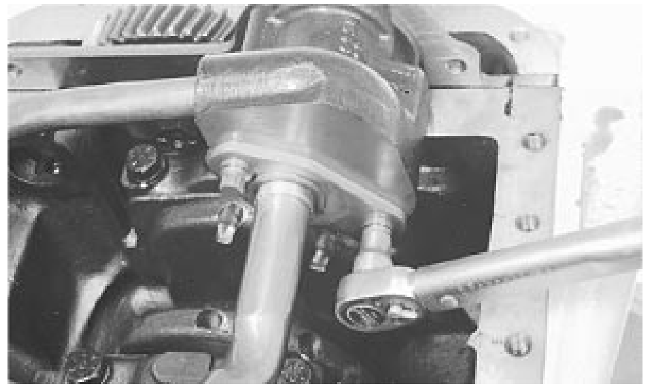


T92915 –UN–25OCT88

Continued on next page

RG,CTM8,GR20,57 –19–18FEB95–1/2

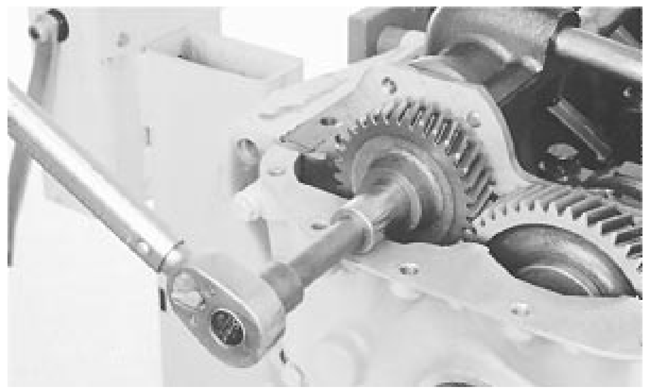
IMPORTANT: On 4-cylinder engines, the key slot in the balancer shafts must be at the 12 O'clock position (timing marks on both shaft gears facing inboard toward crankshaft centerline), and engine locked with No. 1 piston at TDC compression stroke.



T92916 –UN–25OCT88

4. Install oil pump drive gear so it meshes with balancer shaft gear and idler gear WITHOUT altering the timing position of the balancer shaft gear.

5. While holding drive gear in place, mount oil pump assembly, including outlet tube and oil intake pick-up tube on engine. Install cap screws and tighten to specifications.



T92917 –UN–25OCT88

High Capacity Oil Pump Mounting Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

6. Rotate oil pump shaft by hand to be sure it turns easily.

7. Install and tighten retaining nut to specifications.

High Capacity Oil Pump Gear Staked Retaining Nut—Specification

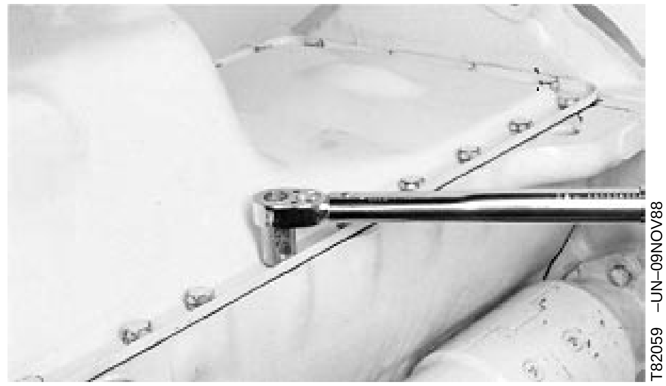
Torque .... 75 N•m (55 lb-ft)

8. Stake nut to shaft by applying three center punch marks near the ID of the nut.

9. Tighten gland nut on pump outlet tube securely (if equipped).

RG,CTM8,GR20,57 –19–18FEB95–2/2

INSTALL OIL PAN



1. Apply Permatex Aviation (Form-A-Gasket No. 3) or LOCTITE® 515 Flexible Sealant on oil pan rail where flywheel housing, front plate, and timing gear cover attach to cylinder block.

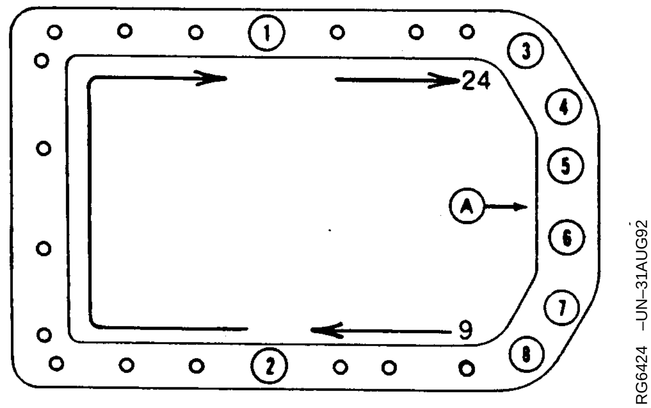
2. Select and install correct gasket for oil pan being used.

   Cork gasket - Use on sheet metal oil pan. Apply a bead of non-hardening sealant to both sides of gasket. Retorque oil pan cap screws after engine break-in.

   All other gaskets - Use on aluminum oil pans. Install dry (no sealant).

IMPORTANT: Do not overtighten the oil pan-to-timing gear cover cap screws.

3. Install oil pan and tighten cap screws to value shown in table, in the sequence shown. "A" points toward front of engine.



3-Cylinder Engine

Cast Iron SAE 5 Oil Pan-to-Block and Flywheel Housing Cap Screws (3 Dashes)—Specification

Torque .... 47 N•m (35 lb-ft)

Cast Iron SAE 6 Cap Screws Oil Pan-to-Block and Flywheel Housing (6 Dashes)—Specification

Torque .... 70 N•m (52 lb-ft)

Aluminum or Sheet Metal Oil Pan-to-Block Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

Aluminum or Sheet Metal Oil Pan-to-Flywheel Housing Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

Aluminum or Sheet Metal Oil Pan-to-Aluminum Timing Gear Cover Cap Screws—Specification

Torque .... 37 N•m (27 lb-ft)

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

Aluminum or Sheet Metal Oil Pan-to-Composite Timing Gear Cover Cap Screws—Specification

Torque .... 30 N•m (22 lb-ft)

CTM8,GR20,30 –19–18FEB95–2/3

T81958 –UN–31OCT88

4. Install aluminum or copper washer on drain plug with raised center against plug. Install plug in oil pan. Tighten drain plug to specification.

Cylindrical Plug—Specification

Torque .... 68 N•m (50 lb-ft)

Conical Plug—Specification

Torque .... 55 N•m (40 lb-ft)

If equipped with elbow drain fittings, the threads and sealing surfaces must be free of oil film to insure an effective seal. Apply LOCTITE® 592 (TY9374) Pipe Sealant to fitting except for the leading one to three threads. Install and tighten fitting.

5. Fill engine crankcase with correct grade and viscosity engine oil. (See FUELS, LUBRICANTS AND COOLANT in Group 02.)

LOCTITE is a registered trademark of the Loctite Corp.

CTM8,GR20,30 –19–18FEB95–3/3

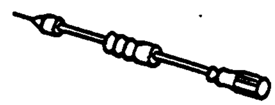
ESSENTIAL TOOLS

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,OUO1004,360 –19–13SEP98–1/5

RG5109 –UN–23AUG88

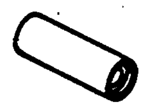


Seal Remover JDG22

Remove oil seal from heavy-duty water pump.

DPSG,OUO1004,360 –19–13SEP98–2/5

RG5132 –UN–23AUG88

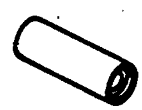


Bearing Driver JDE74

Install water pump bearing on standard-duty high flow and modular style water pumps.

DPSG,OUO1004,360 –19–13SEP98–3/5

RG5132 –UN–23AUG88



Bearing Driver JD262A

Install water pump bearing on low flow water pumps.
Install impeller onto water pump shaft.

DPSG,OUO1004,360 –19–13SEP98–4/5

RG5588 –UN–13SEP89

Belt Tension Gauge. JDST28

Use with a straightedge to check fan belt tension.

DPSG,OUO1004,360 –19–13SEP98–5/5

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,OUO1004,361 –19–13SEP98–1/5

17-1/2 and 30-Ton Puller Set. D01047AA

Remove pulley and impeller from water pump shaft.

DPSG,OUO1004,361 –19–13SEP98–2/5

Bushing, Bearing and Seal Driver Set D01045AA

Remove and install inner seal on heavy-duty high flow water pump.

DPSG,OUO1004,361 –19–13SEP98–3/5

Belt Tension Gauge. JDG529

Check fan belt tension on standard V-belts.

DPSG,OUO1004,361 –19–13SEP98–4/5

Belt Tension Gauge. JT05975

Check fan belt tension on 8-rib poly V-belts.

DPSG,OUO1004,361 –19–13SEP98–5/5

OTHER MATERIAL

Number	Name	Use
PT507 (U.S.)	Multi-Purpose Grease	Lubricate water manifold/thermostat housing O-rings.
TY6341 (U.S.)	High Temperature Grease	Pack heavy-duty pump bearings.

DPSG,OUO1004,362 –19–13SEP98–1/1

COOLING SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Thermostat (All engines except 6059DF001, TF001, and TF004 with option code 2007)	Opening Temperature	82°C (180°F)
Thermostat (6059DF001, TF001, and TF004 with option code 2007)	Opening Temperature	94°C (202°F)
Thermostat Composite Material Cover	Torque	30 N•m (22 lb-ft)
Thermostat Aluminum Cover	Torque	34 N•m (25 lb-ft)
Thermostat Cast Iron Cover	Torque	47 N•m (35 lb-ft)
Water Manifold/Thermostat Housing Mounting Cap Screws	Torque	47 N•m (35 lb-ft)
Low Position Centerline of Crankshaft-to-Water Pump Shaft	Distance	290 mm (11.4 in.)
Medium Position Centerline of Crankshaft-to-Water Pump Shaft	Distance	338 mm (13.3 in.)
High Position Centerline of Crankshaft-to-Water Pump Shaft	Distance	404 mm (15.9 in.)
Special Applications Centerline of Crankshaft-to-Water Pump Shaft (6059DF001/TF001/TF004 Engines Equipped with Option Code 2007)	Distance	404 mm (15.9 in.)
Water Pump Impeller Bore (All Pumps)	ID	15.85—15.88 mm (0.6242—0.6252 in.)
Water Pump Bearing Shaft Impeller End (All Pumps)	OD	15.90—15.92 mm (0.6262—0.6267 in.)
Water Pump Bearing Shaft Pulley End Low Flow (Except 6059TN002)	OD	18.95—18.96 mm (0.7460—0.7465 in.)

Continued on next page

DPSG,OUO1004,494 –19–08NOV98–1/5

Item	Measurement	Specification
Water Pump Bearing Shaft Pulley End Low Flow (6059TN002), Modular Style, and Standard-Duty High Flow	OD	25.39—25.40 mm (0.9995—1.0000 in.)
Water Pump Bearing Shaft Pulley End Heavy-Duty High Flow (Except 6059DF001, TF001 and TF004 with Option Code 2007)	OD	30.22—30.23 mm (1.1897—1.1903 in.)
Water Pump Bearing Shaft Pulley End Heavy-Duty High Flow (6059DF001, TF001 and TF004 with Option Code 2007)	OD	28.99—29.01 mm (1.1414—1.1421 in.)
Water Pump Pulley Bore Low Flow (Except 6059TN002)	ID	18.91—18.93 mm (0.7445—0.7455 in.)
Water Pump Pulley Bore Low Flow (6059TN002), Modular Style and Standard-Duty High Flow	ID	25.31—25.34 mm (0.9965—0.9975 in.)
Water Pump Pulley Bore Heavy-Duty High Flow (Except 6059DF001, TF001 and TF004 with Option Code 2007)	ID	30.13—30.19 mm (1.1864—1.1886 in.)
Water Pump Pulley Bore Heavy-Duty High Flow (6059DF001, TF001 and TF004 with Option Code 2007)	ID	28.91—28.93 mm (1.138—1.139 in.)
Low Flow Water Pump Housing Gasket Surface-to-Impeller (B)	Distance	0.0—0.25 mm (0.0—0.01 in.)
Standard-Duty High Flow Pump Housing-to-Impeller	Clearance	0.39—0.89 mm (0.015—0.035 in.)
Modular Style Pump Housing-to-Impeller (A)	Clearance	1.016—1.270 mm (0.040—0.050 in.)

Continued on next page

DPSG,OUO1004,494 –19–08NOV98–2/5

Item	Measurement	Specification
Water Pump Cover-to-Housing Cap Screws	Torque	47 N•m (35 lb-ft)
Water Pump Rotating Assembly-to-Housing Cap Screws	Torque	27 N•m (20 lb-ft)
Water Pump Pulley-to-Hub Cap Screws	Torque	27 N•m (20 lb-ft)
Heavy-Duty High Flow Water Pump Shaft	End Play (Maximum)	0.25 mm (0.010 in.)
Heavy-Duty High Flow Pump Housing Gasket Surface-to-Impeller (Except 6059DF001, TF001, and TF004 with Option Code 2007)	Distance (B)	0.0— 0.38 mm (0.0—0.015 in.)
Heavy-Duty High Flow Pump Housing-to-Impeller (A) (6059DF001, TF001, and TF004 with Option Code 2007)	Clearance (A)	0.39—0.89 mm (0.015—0.035 in.)
Heavy-Duty High Flow Water Pump Pulley Cap Screw	Torque	115 N•m (85 lb-ft)
Heavy-Duty High Flow Water Pump Housing Cover Cap Screws	Torque	47 N•m (35 lb-ft)
Water Pump-to-Cylinder Block (SAE Grade 5 Cap Screw)	Torque	47 N•m (35 lb-ft)
Water Pump-to-Cylinder Block (SAE Grade 8 Cap Screw)	Torque	54 N•m (40 lb-ft)
Water Pump-to-Cylinder Block (Retaining Nut with Fine Thread)	Torque	40 N•m (30 lb-ft)
Fan-to-Pulley Hub 5/16 in. Cap Screw	Torque	27 N•m (20 lb-ft)
Fan-to-Pulley Hub 3/8 in. Cap Screw	Torque	47 N•m (35 lb-ft)

Continued on next page DPSG,OUO1004,494 –19–08NOV98–3/5

Item	Measurement	Specification
Fan Belt Tension (Standard V-Belts) (Using JDG529 Gauge)		
Single Belt (New)	Tension	578—622 N (130—140 lb-force)
Single Belt (Used)	Tension	378—423 N (85—94 lb-force)
Dual Belt (New)	Tension	423—467 N (95—104 lb-force)
Dual Belt (Used)	Tension	378—423 N (85—94 lb-force)
Fan Belt Tension (Standard V-Belts) (Using JDST28 Gauge and Straightedge)		
Fan Belt	Tension	19 mm (3/4 in.) deflection with an 89 N (20 lb-force) halfway between pulleys
Fan Belt Tension (8-Rib Poly V-Belts) (Using JT05975 Gauge)		
Single Belt (New)	Tension	890—1068 N (200—240 lb-force)
Single Belt (Used)	Tension	800—979 N (180—220 lb-force)
Fan Belt Tension (8-Rib Poly V-Belts) (Using JDST28 Gauge and Straightedge)		
Fan Belt	Tension	13 mm (1/2 in.) deflection with a 130 N (30 lb-force) halfway between pulleys
Coolant Heater Lock Nut (Dubuque-Built Engines)	Torque	34 N•m (25 lb-ft)

Continued on next page DPSG,OUO1004,494 –19–08NOV98–4/5

Item	Measurement	Specification
Coolant Heater Adapter (Saran-Built Engines)	Torque	45 N•m (33 lb-ft)

DPSG,OUO1004,494 –19–08NOV98–5/5

REMOVE, TEST, AND INSTALL THERMOSTATS

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Do not drain coolant until coolant temperature is below operating temperature. Always loosen cooling system filler cap, radiator cap, or drain valve slowly to relieve pressure.

1. Visually inspect area around water manifold for leaks. Partially drain coolant from system.

NOTE: On some engines, the thermostat housing/water manifold is an integral part of the cylinder head.

2. Remove thermostat cover (A). Different styles of thermostat housings may be found, depending on application.

3. Remove thermostat(s).

NOTE: Engines may be equipped with one or two thermostats.

4. Test in hot water and compare to following specifications for correct opening temperatures. Replace if defective.

Thermostat (All engines except 6059DF001, TF001, and TF004 with option code 2007)—Specification

Opening Temperature .... 82°C (180°F)

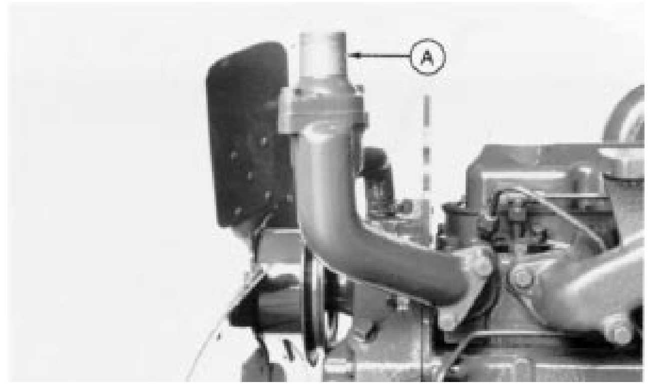
Thermostat (6059DF001, TF001, and TF004 with option code 2007)—Specification

Opening Temperature .... 94°C (202°F)

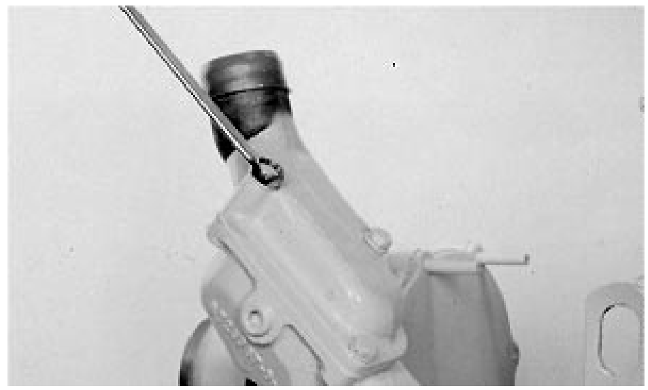
NOTE: Deaeration is accomplished by a jiggle wire or groove in thermostat flange area.

5. Remove gasket material from gasket surfaces. Clean and inspect housing for cracks or damage.

6. Install thermostat(s) and thermostat cover using a new gasket. Tighten cover cap screws to specifications.



CD7369 –UN–23FEB89



T90486 –UN–25OCT88

T90487 –UN–25OCT88

A—Thermostat Cover

Continued on next page

RG,CTM8,GR25,3 –19–18FEB95–1/2

Thermostat Composite Material Cover—Specification

Torque .... 30 N•m (22 lb-ft)

Thermostat Aluminum Cover—Specification

Torque .... 34 N•m (25 lb-ft)

Thermostat Cast Iron Cover—Specification

Torque .... 47 N•m (35 lb-ft)

IMPORTANT: Air must be expelled from cooling system when filling. Loosen temperature sending unit fitting at rear of cylinder head or plug in thermostat housing to allow air to escape when filling system. Tighten fitting or plug when all air has been expelled.

RG,CTM8,GR25,3 –19–18FEB95–2/2

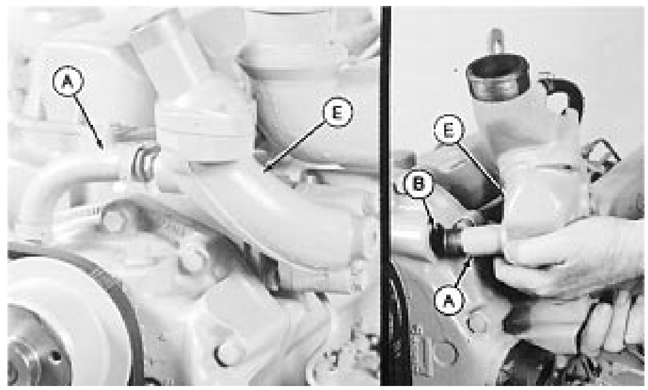
REMOVE AND INSTALL WATER MANIFOLD/THERMOSTAT HOUSING


TS281 –UN–23AUG88

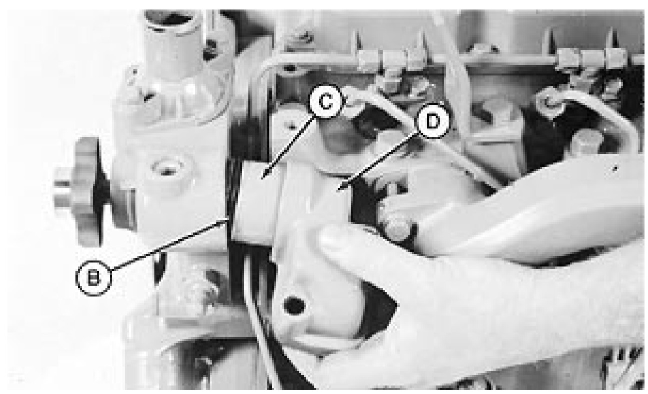
CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Do not drain coolant until coolant temperature is below operating temperature. Always loosen cooling system filler cap, radiator cap, or drain valve slowly to relieve pressure.

NOTE: On some engines the thermostat housing/water manifold is an integral part of the cylinder head.

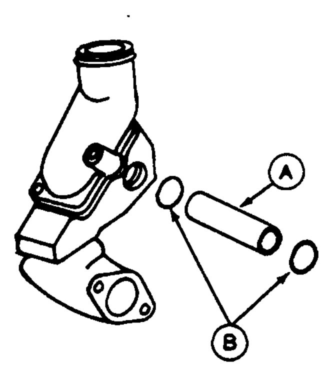
1. Drain coolant.
2. Disconnect hoses.
3. Remove water manifold-to-cylinder head cap screws.
4. Remove thermostat housing (E) or water manifold (D) (as equipped) from cylinder head.
5. Remove thermostat housing-to-water pump tube (A) or water manifold-to-thermostat housing tube (C), as equipped.
6. Remove O-rings (B) and clean gasket surfaces.
7. Lubricate new O-rings with PT507 Multi-Purpose Grease. Install O-rings in thermostat housing and water pump. Insert tube in water manifold or thermostat housing.



RG6364 –UN–17AUG92



RG6363 –UN–17AUG92



RG4792 –UN–14DEC88

A—Thermostat Housing-to-Water Pump Tube
B—O-Ring
C—Water Manifold-to-Thermostat Housing Tube
D—Water Manifold
E—Thermostat Housing

Continued on next page
RG,CTM8,GR25,4 –19–18JAN95–1/2

NOTE: If it is necessary to hold thermostat in housing during installation, use guide studs to install gasket and housing with thermostat.

8. Install housing with new gasket onto cylinder head. (Make sure tube correctly enters water pump and that gasket is oriented so that water passages are not restricted.) Tighten cap screws to specifications.

Water Manifold/Thermostat Housing Mounting Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

9. Connect hoses.

10. Fill cooling system and check for leaks.

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

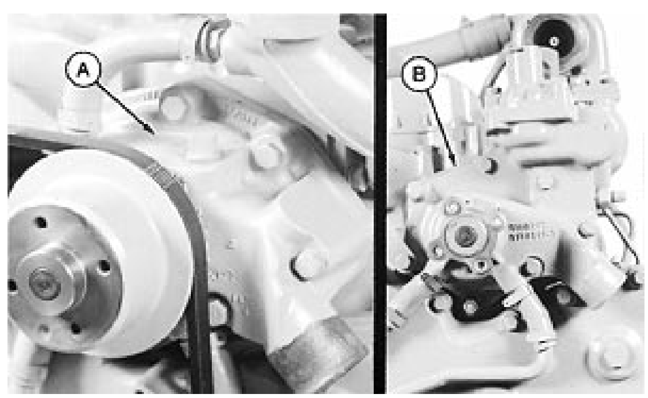
RG,CTM8,GR25,4 –19–18JAN95–2/2

GENERAL WATER PUMP INFORMATION

300 Series engines are equipped with one of the following belt-driven water pumps.

LOW FLOW

Low flow water pumps use a one-piece bearing and shaft assembly with a pressed-on pulley or hub. The pump housing will be similar to (A) or (B).



Low Flow Pumps

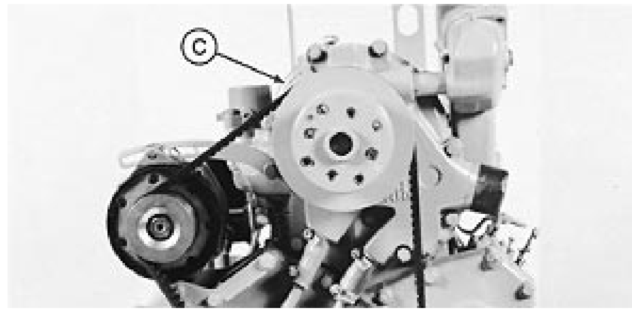
A—Low-Flow Water Pump
B—Low-Flow Water Pump

Continued on next page

CTM8,GR25,7 –19–18FEB95–1/4

STANDARD-DUTY HIGH FLOW

Standard-duty high flow water pumps (C) use a one-piece bearing and shaft assembly with a pressed-on pulley or hub. Standard-duty pumps use the same impeller and are similar in appearance to heavy-duty high flow water pumps.



RG6366 –UN–17AUG92

Standard-Duty High Flow Pumps

C—Standard-Duty High Flow Water Pump

CTM8,GR25,7 –19–18FEB95–2/4

HEAVY-DUTY HIGH FLOW

Heavy-duty high flow water pumps (D) use a separate shaft with two heavy-duty ball bearings pressed on the shaft. The pulley is retained by a cap screw (E) threaded into the end of the pump shaft, except for pumps used on T06059DF001, TF001, and TF004 engines with option code 2007. Most heavy-duty high flow water pumps use the same impeller and are similar in appearance to standard-duty high flow water pumps.

RG6367 –UN–17AUG92

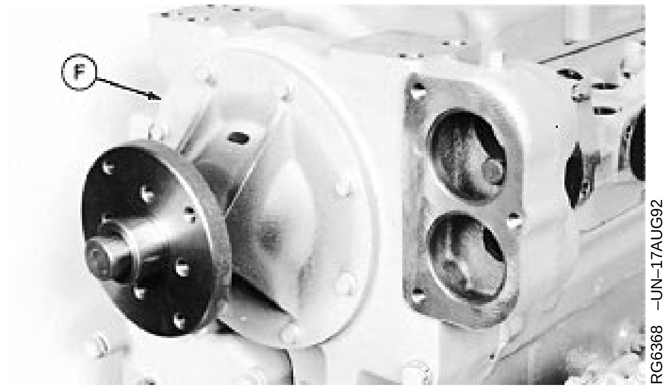
Heavy-Duty High Flow Pumps

D—Heavy-Duty High Flow Water Pump
E—Cap Screws

Continued on next page CTM8,GR25,7 –19–18FEB95–3/4

MODULAR STYLE PUMP

Modular style water pumps use a two-piece pump assembly. The rotating assembly (F) can be removed from the pump housing and replaced without removing pump-mounted accessories, coolant lines, or hoses. The rotating assembly uses a one-piece bearing and shaft assembly with a pressed-on pulley hub and is available in high flow or low flow configurations.



Modular Style Pump

F—Rotating Assembly

WATER PUMP MOUNTING POSITIONS

Water pumps are available in the following mounting positions:

Low Position Centerline of Crankshaft-to-Water Pump Shaft—Specification

Distance.. 290 mm (11.4 in.)

Medium Position Centerline of Crankshaft-to-Water Pump Shaft—Specification

Distance.. 338 mm (13.3 in.)

High Position Centerline of Crankshaft-to-Water Pump Shaft—Specification

Distance.. 404 mm (15.9 in.)

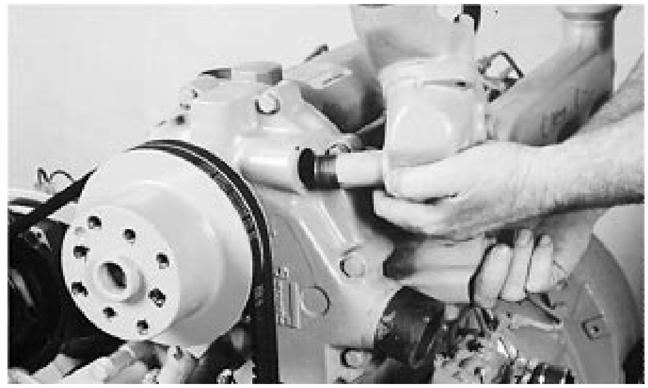
Special Applications Centerline of Crankshaft-to-Water Pump Shaft (6059DF001/TF001/TF004 Engines Equipped with Option Code 2007)—Specification

Distance.. 404 mm (15.9 in.)

CTM8,GR25,7 –19–18FEB95–4/4

REMOVE WATER PUMP

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Do not drain coolant until the coolant temperature is below operating temperature. Always loosen cooling system filler cap, radiator cap, or drain valve slowly to relieve pressure.

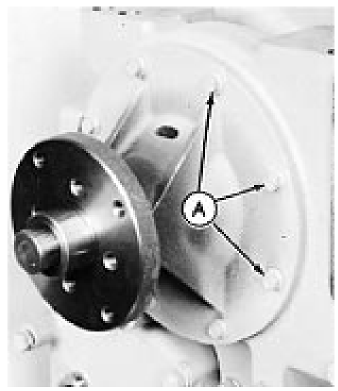


RG6369 –UN–17AUG92

1. Drain coolant.

2. Remove fan and fan belt(s). If a sheet metal or bolt-on pulley is used, remove from pump.

NOTE: Rotating assembly can be removed from Modular Style water pumps without further disassembly. Remove cap screws (A), rotating assemby, and O-ring.



RG6370 –UN–17AUG92

A—Cap Screws

3. Remove inlet and outlet hoses from water pump.

4. Remove water manifold or thermostat housing (as required).

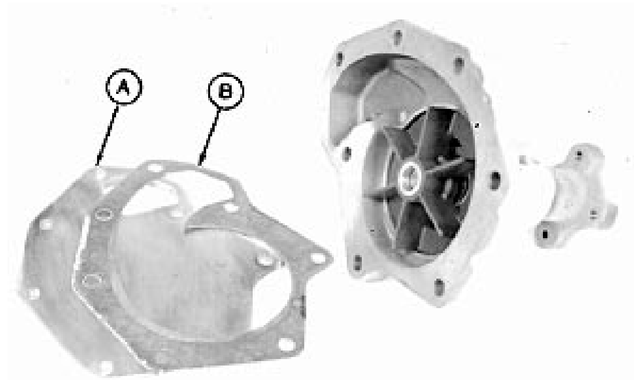
5. Remove water pump.

RG,CTM8,GR25,6 –19–18FEB95–1/1

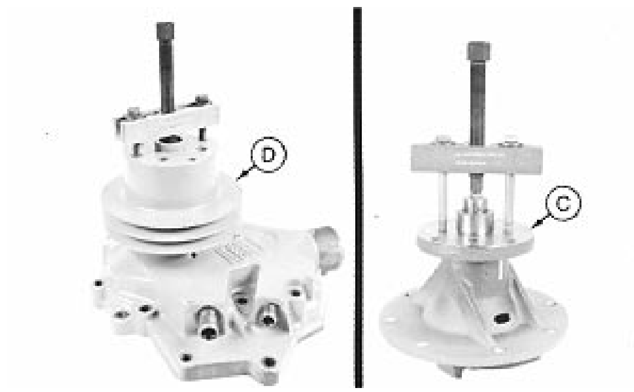
DISASSEMBLE LOW FLOW, STANDARD-DUTY HIGH FLOW, AND MODULAR STYLE WATER PUMPS

1. Remove rear cover (A, if equipped) and discard gasket (B).

2. Using a suitable puller from D01047AA 17-1/2 and 30-Ton Puller Set, remove water pump pulley (D) or hub (C) from bearing shaft.



RG6372 –UN–17AUG92



RG6371 –UN–17AUG92

A—Rear Cover
B—Cover Gasket
C—Pulley Hub
D—Pulley

Continued on next page

RG,CTM8,GR25,7 –19–16SEP92–1/2

3. If impeller (A) is equipped with tapped holes, use a suitable puller to remove impeller from shaft.

   If impeller does not have tapped holes, impeller will be removed in the next step.

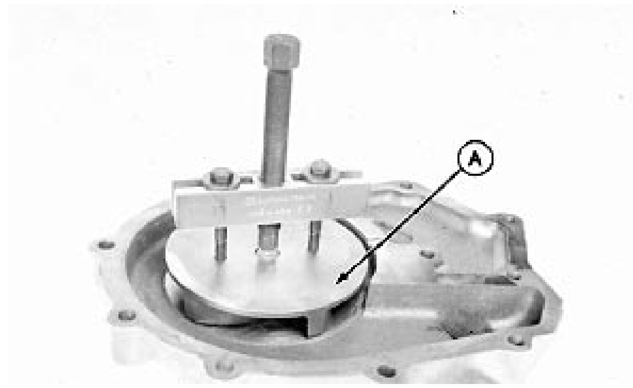
IMPORTANT: Pressing bearing out of housing in the wrong direction may result in a broken pump housing.

If plastic impeller breaks while pressing shaft through impeller, remove brass bushing from shaft before pressing shaft through rest of housing. Use a knife-edge puller to remove bushing.

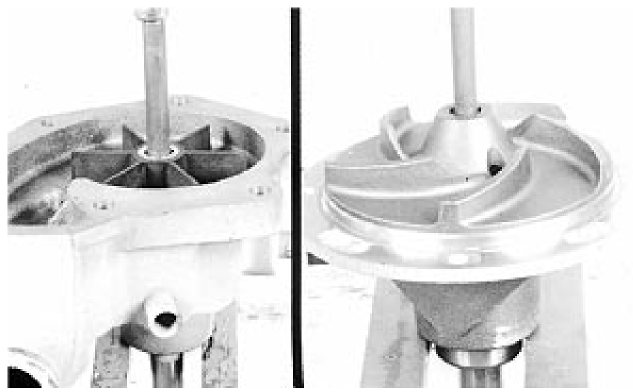
4. Support water pump on pulley end of housing. Remove the bearing and shaft from the impeller and pump housing by pressing on impeller end of bearing shaft with a 13 mm (0.5 in.) x 76 mm (3.0 in.) driver. Discard bearing and impeller.

NOTE: Cast iron impellers may be reusable. (See INSPECT AND CLEAN WATER PUMP PARTS later in this group.) Plastic and powdered metal impellers are not reusable.

5. Using a suitable driver, remove water (coolant) seal from pump housing and discard.



RG6373 –UN–17AUG92



RG6374 –UN–17AUG92

A—Impeller

RG,CTM8,GR25,7 –19–16SEP92–2/2

DISASSEMBLE HEAVY-DUTY HIGH FLOW WATER PUMP

NOTE: 6059DF001, TF001, AND TF004 engines with option code 2007 use a different style heavy-duty pump than other engine applications with the heavy-duty pump. Basic repair information which follows applies to all applications with the heavy-duty pump. When required, differences are noted.

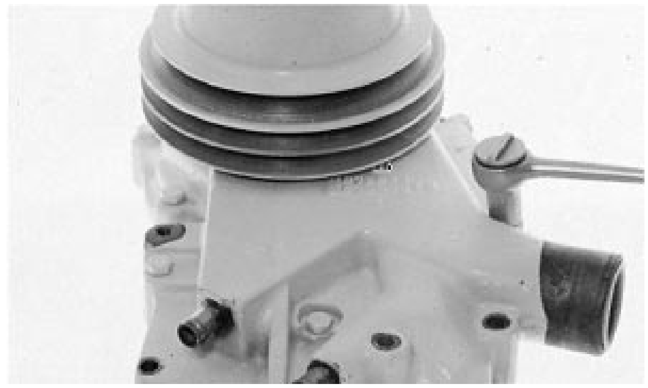
1. Remove cap screws, cover plate, and gasket. Discard gasket.

2. Using a suitable puller, remove impeller from shaft.

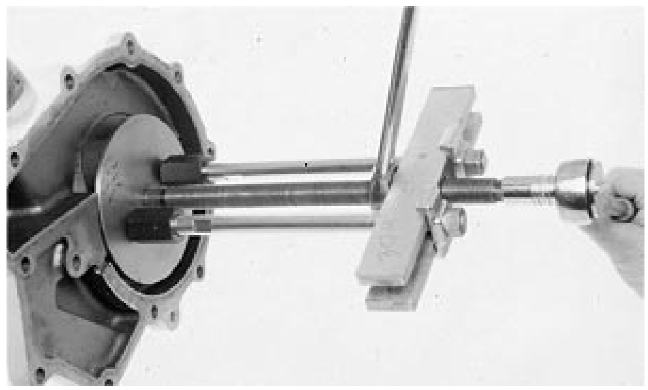
3. Remove cap screw and washer from pulley end of shaft.

NOTE: Cap screw and washer are not used on 6059DF001, TF001, and TF004 engines with option code 2007.

4. Using a suitable puller from D01047AA 17-1/2 and 30-Ton Puller Set, remove pulley from pump shaft.



T90458 –UN–25OCT88



T5820BV –UN–25OCT88

T5820BY –UN–25OCT88

Continued on next page

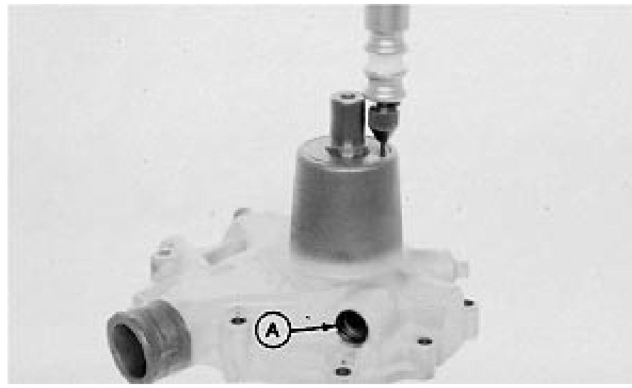
RG,CTM8,GR25,9 –19–16SEP92–1/4

5. Using JDG22 Seal Remover, remove oil seal.

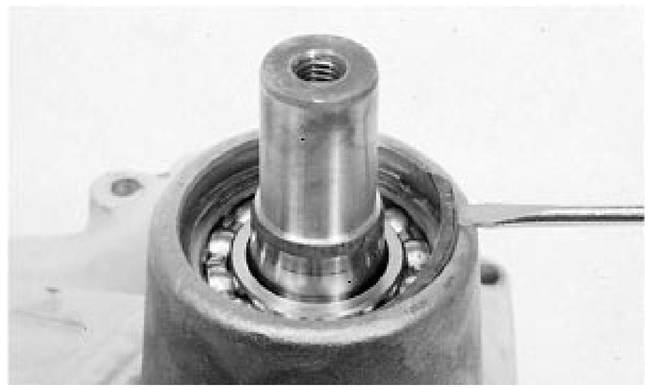
6. Remove O-ring (A).

NOTE: Oil seal is not used on 6059DF001, TF001, and TF004 engines with option code 2007.

7. Remove bearing retaining ring.



T5823AC –UN–25OCT88



T5823AE –UN–25OCT88

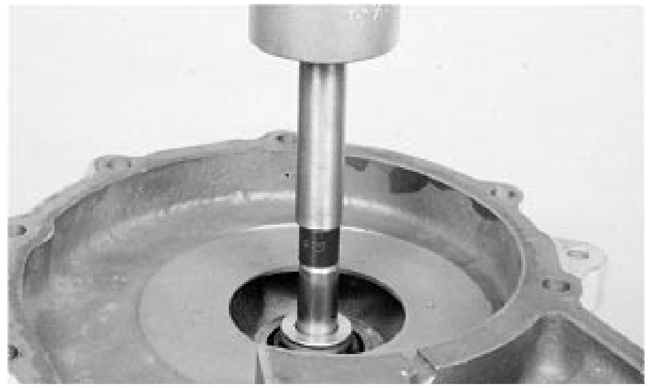
A—O-ring

Continued on next page RG,CTM8,GR25,9 –19–16SEP92–2/4

IMPORTANT: Do not attempt to push shaft from pulley end. Removal in the wrong direction may result in a broken housing.

8. Support pulley end of pump housing. Using a 13 mm (0.5 in.) diameter driver, push against impeller end of shaft to remove bearings and shaft from housing.

9. Remove water pump seal using a suitable driver.



T5823AB –UN–25OCT88

T5824AA –UN–25OCT88

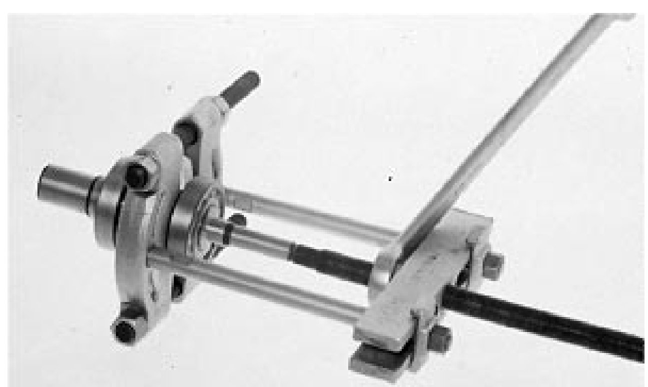
RG,CTM8,GR25,9 –19–16SEP92–3/4

10. Remove inner oil seal using a suitable driver from D01045AA Bushing, Bearing and Seal Driver Set.

NOTE: Inner oil seal is not used on 6059DF001, TF001, TF004 engines with option code 2007.

11. Remove bearings from shaft using a suitable bearing puller.

T5823AA –UN–25OCT88



T90466 –UN–25OCT88

RG,CTM8,GR25,9 –19–16SEP92–4/4

INSPECT AND CLEAN WATER PUMP PARTS

RG6409 –UN–21AUG92

RG6410 –UN–21AUG92

1. Inspect water pump housing, cover, impeller (cast iron only), and pulley for wear, debris, cracks, or damage. Replace as necessary.

2. On Heavy-Duty High Flow pumps, inspect shaft and bearings for wear or damage. Clean non-sealed bearings and determine if they are reusable. Replace as necessary.

Water Pump Impeller Bore (All Pumps)—Specification

ID .... 15.85—15.88 mm (0.6242—0.6252 in.)

Water Pump Bearing Shaft Impeller End (All Pumps)—Specification

OD .... 15.90—15.92 mm (0.6262—0.6267 in.)

Water Pump Bearing Shaft Pulley End Low Flow (Except 6059TN002)—Specification

OD .... 18.95—18.96 mm (0.7460—0.7465 in.)

Water Pump Bearing Shaft Pulley End Low Flow (6059TN002), Modular Style, and Standard-Duty High Flow—Specification

OD .... 25.39—25.40 mm (0.9995—1.0000 in.)

Water Pump Bearing Shaft Pulley End Heavy-Duty High Flow (Except 6059DF001, TF001 and TF004 with Option Code 2007)—Specification

OD .... 30.22—30.23 mm (1.1897—1.1903 in.)

Water Pump Bearing Shaft Pulley End Heavy-Duty High Flow (6059DF001, TF001 and TF004 with Option Code 2007)—Specification

OD .... 28.99—29.01 mm (1.1414—1.1421 in.)

Continued on next page

RG,CTM8,GR25,13 –19–13JAN95–1/2

**Water Pump Pulley Bore
Low Flow (Except 6059TN002)—Specification**

ID .... 18.91—18.93 mm
(0.7445—0.7455 in.)

Water Pump Pulley Bore Low Flow (6059TN002), Modular Style and Standard-Duty High Flow—Specification

ID .... 25.31—25.34 mm
(0.9965—0.9975 in.)

**Water Pump Pulley Bore
Heavy-Duty High Flow
(Except 6059DF001, TF001 and TF004
with Option Code 2007)—Specification**

ID .... 30.13—30.19 mm
(1.1864—1.1886 in.)

**Water Pump Pulley Bore
Heavy-Duty High Flow
(6059DF001, TF001 and TF004
with Option Code 2007)—Specification**

ID .... 28.91—28.93 mm
(1.138—1.139 in.)

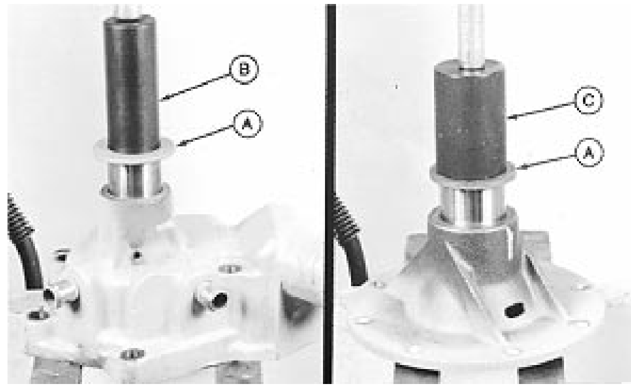
NOTE: Sealed bearings are used on 6059DF001, TF001, and TF004 engines with option code 2007. Sealed bearings cannot be cleaned.

3. Clean parts with solvent. Dry with compressed air.

4. Clean out weep hole. Remove gasket material from water pump housing and cover.

RG,CTM8,GR25,13 –19–13JAN95–2/2

ASSEMBLE LOW FLOW, STANDARD-DUTY HIGH FLOW, AND MODULAR STYLE WATER PUMPS



A—Flat Washer
B—JD262A
C—JDE74

1. Place pump housing with impeller side down on a press.

NOTE: Bearing shaft is installed from pulley end of pump housing.

2. Place a large flat washer (A) over pulley end of new bearing. Check washer to make sure it does not contact protruding-type bearing seals. (Washer will act as a stop on pump housing when pressing bearing into housing.)

IMPORTANT: Do not push against end of bearing shaft. Push against outer race only.

3. Press bearing into pump housing until washer bottoms against nose of housing.

   Use JD262A Driver (B) for low flow pumps.

   Use JDE74 Driver (C) for standard-duty high flow pumps and modular style pumps.

Continued on next page RG,CTM8,GR25,14 –19–16SEP92–1/6

NOTE: Water pumps have either a unitized (one-piece) water seal (A), or a three-piece water seal (B). Only the unitized (one-piece) water (coolant) seal is provided for service.

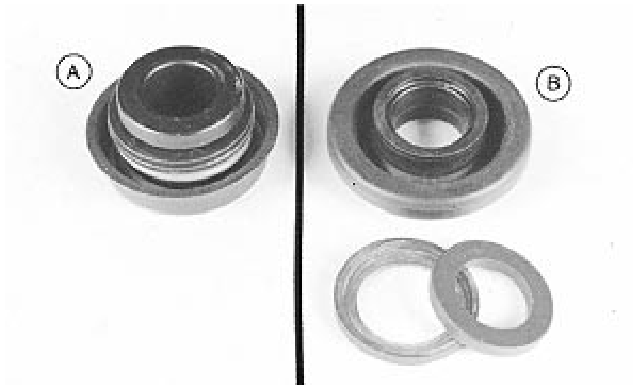
4. Install water pump seal.

Unitized (one-piece) water seal:

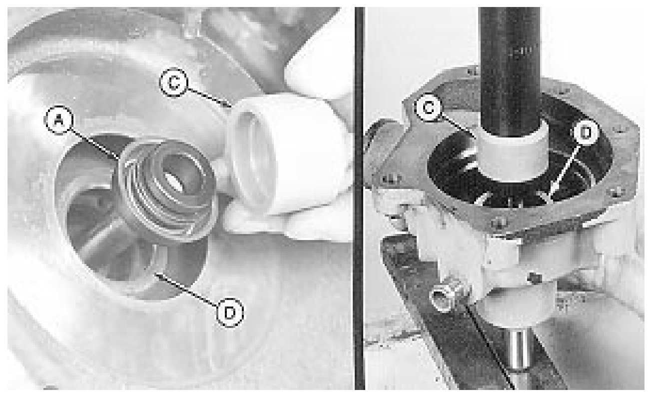
IMPORTANT: Use Installation Tool (C), that is included in seal kit, to drive seal into pump housing. This tool installs seal to correct height.

Shaft and seal must be free of grease and debris. Do not use sealant on any portion of unitized seal.

Support water pump on nose of pump housing or on shaft. Using special tool included in seal kit, install water pump seal over shaft until seal bottoms on shoulder (D) of housing.



RG6389 –UN–21AUG92



RG6376 –UN–03FEB95

One-Piece Seal

A—One-Piece Water Seal
B—Three-Piece Water Seal
C—Installation Tool
D—Water Pump Housing Shoulder

Continued on next page

RG,CTM8,GR25,14 –19–16SEP92–2/6

5. Place pump housing under a press and support on pulley end of shaft.

6. Using special tool JD262A, press impeller onto pump shaft to the specified dimension.

Low Flow Water Pump Housing Gasket Surface-to-Impeller (B)—Specification

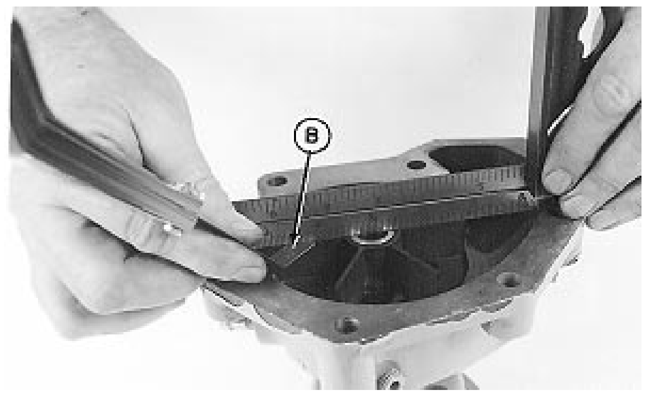
Distance... 0.0—0.25 mm (0.0—0.01 in.)

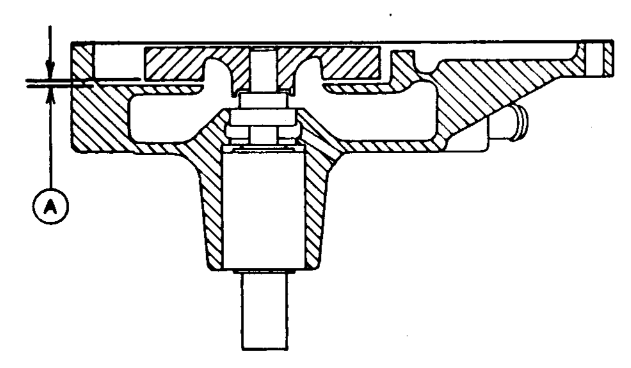
Standard-Duty High Flow Pump Housing-to-Impeller—Specification

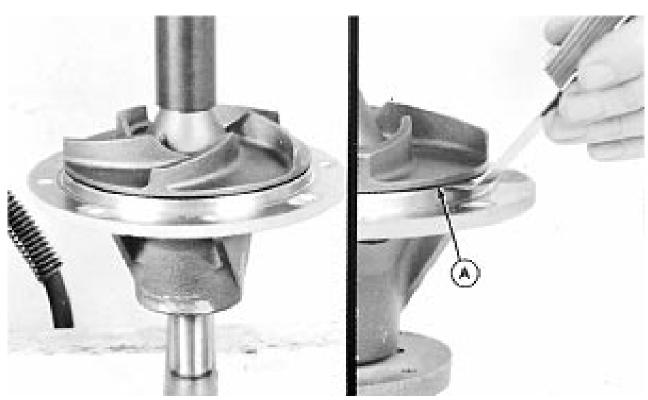
Clearance .... 0.39—0.89 mm (0.015—0.035 in.)

Modular Style Pump Housing-to-Impeller (A)—Specification

Clearance .... 1.016—1.270 mm (0.040—0.050 in.)







A—Housing-to-Impeller Clearance
B—Housing Gasket-to-Impeller Clearance

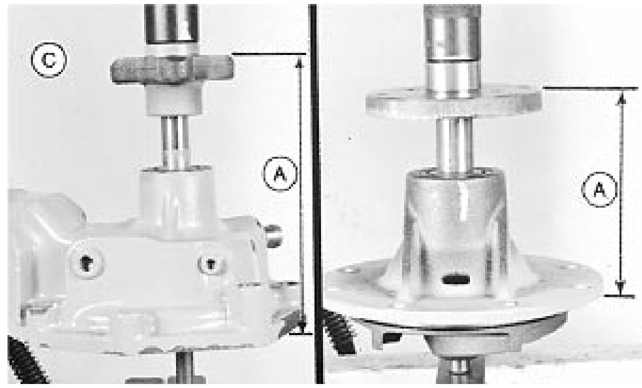
Continued on next page

IMPORTANT: Water pump must be supported on impeller end of shaft when installing pulley or hub. Bearing will be damaged if not supported on shaft face only.

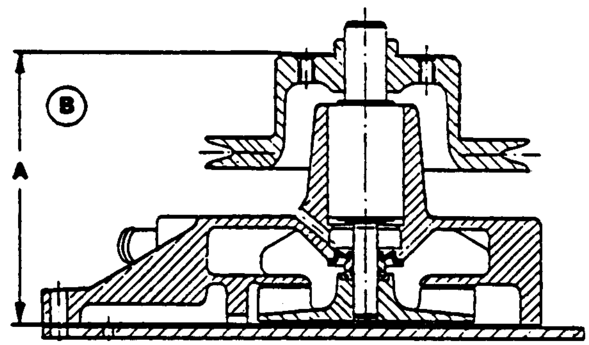
7. Place pump housing under a press and support on impeller end of shaft

8. Install water pump pulley or hub to the specified dimension "A". See WATER PUMP PULLEY OR HUB-TO-REAR FACE OF HOUSING DIMENSIONS, later in this group for the correct dimension.

9. Turn pulley or hub by hand to make sure shaft turns freely.



RG6382 –UN–17AUG92



RG5596 –UN–01NOV89

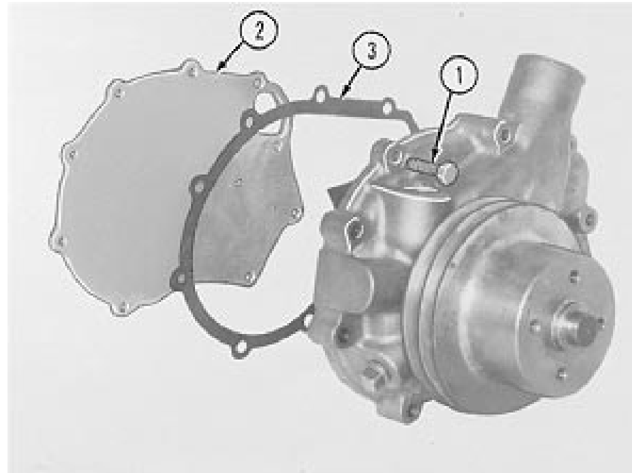
A—Distance From Pump Housing Sealing Face-to-Pulley or Hub
B—Water Pump With Cast Iron Pulley
C—Water Pump With Sheet Metal Pulley

Continued on next page RG,CTM8,GR25,14 –19–16SEP92–4/6

10. Install cover plate (2), using a new gasket (3). (Also install alternator adjusting strap.) Tighten cap screws (1) to specifications.

Water Pump Cover-to-Housing Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)



T70288 –UN–23FEB89

1—Cap Screws
2—Cover Plate
3—Gasket

Continued on next page RG,CTM8,GR25,14 –19–16SEP92–5/6

11. On Modular Style pumps, lubricate a new O-ring (A) with engine oil and install in pump housing (B). Install rotating assembly (C) in pump housing. Tighten cap screws to specifications.

Water Pump Rotating Assembly-to-Housing Cap Screws—Specification

Torque .... 27 N•m (20 lb-ft)

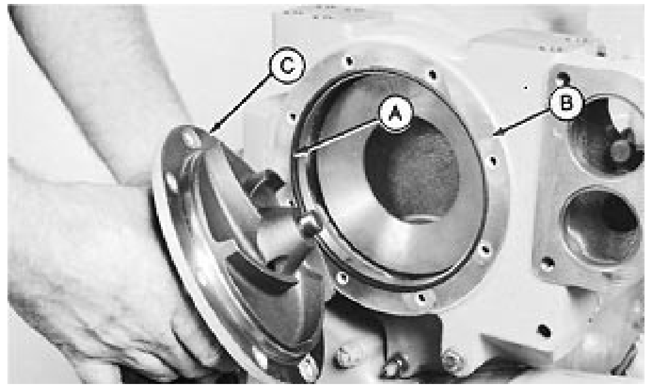
12. Rotate pulley or hub by hand. If impeller drags on cover plate, remove cover and recheck impeller position.

    On Modular Style pumps, if impeller drags on pump housing, remove rotating assembly and recheck impeller position.

13. On water pumps equipped with a hub, install pulley and tighten cap screws to specifications.

Water Pump Pulley-to-Hub Cap Screws—Specification

Torque .... 27 N•m (20 lb-ft)



RG6411 –UN–21AUG92

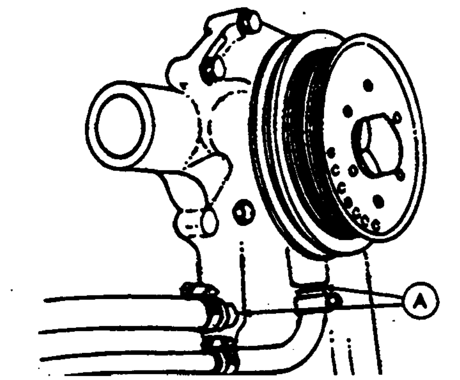
A—O-ring
B—Pump Housing
C—Rotating Assembly

RG,CTM8,GR25,14 –19–16SEP92–6/6

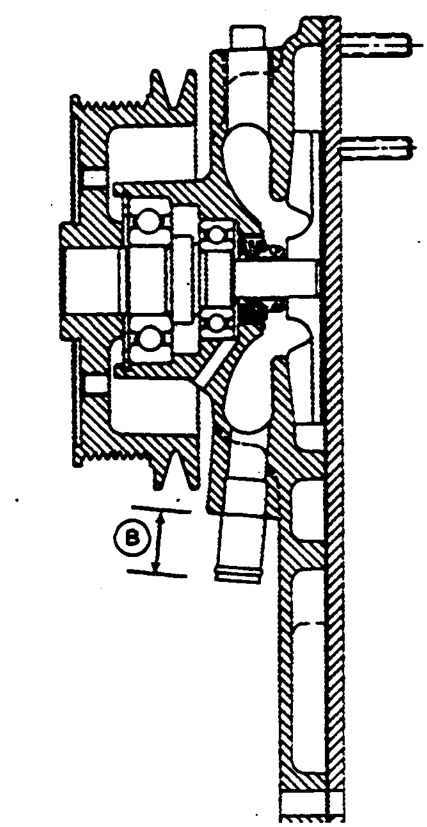
ASSEMBLE HEAVY-DUTY HIGH FLOW WATER PUMP

NOTE: If necessary to replace nipples (A) on 6059DF001, TF001, and TF004 engines with option code 2007, apply a light coating of sealant around OD of nipple for a distance of 10 mm (0.4 in.) from housing end. Using a suitable driver and disks from D01045AA Bushing, Bearing, and Seal Driver Set, install both nipples so that there is 29 mm (1.14 in.) length (B) available for attaching hoses.

Use this sectional view of Water Pump (6059DF001, TF001, and TF004 engine with option code 2007), as a guide when assembling pump along with instructions for all heavy-duty high flow pumps which follow.



RG5087 –UN–14DEC88



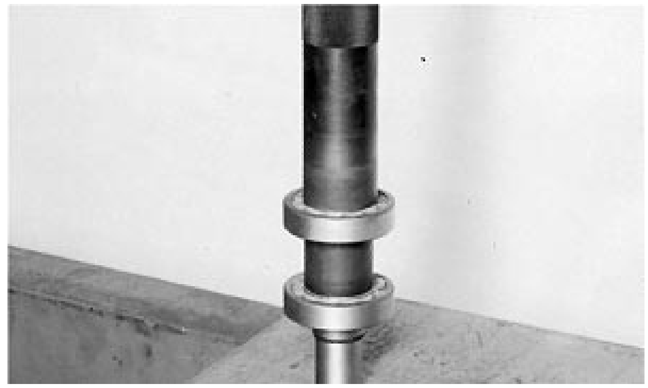
RG5088 –UN–14DEC88

A—Nipples
B—29 mm (1.14 in.)

Continued on next page

CTM8,GR25,16 –19–16SEP92–1/10

1. Press bearings on shaft using a tubular driver that contacts the inner bearing race only.



T90467 –UN–25OCT88

CTM8,GR25,16 –19–16SEP92–2/10

2. Install inner oil seal with metal side toward impeller end of pump using 18 mm and 41 mm disk from D01045AA Bushing, Bearing, and Seal Driver Set.

NOTE: *Inner oil seal is not used on 6059DF001, TF001, and TF004 engines with option code 2007.*

T5823AD –UN–25OCT88

CTM8,GR25,16 –19–16SEP92–3/10

3. Pack bearings and area between bearings with TY6341 High Temperature Grease.

NOTE: *High flow heavy-duty pumps on 6059DF001, TF001, and TF004 engines with option code 2007 do not use grease. They are equipped with sealed bearings.*

4. Install shaft and bearing assembly in housing and install snap ring. On water pump for 6059DF001, TF001, and TF004 engines with option code 2007, install snap ring with OD chamfer facing outward.

T90478 –UN–25OCT88

Continued on next page

CTM8,GR25,16 –19–16SEP92–4/10

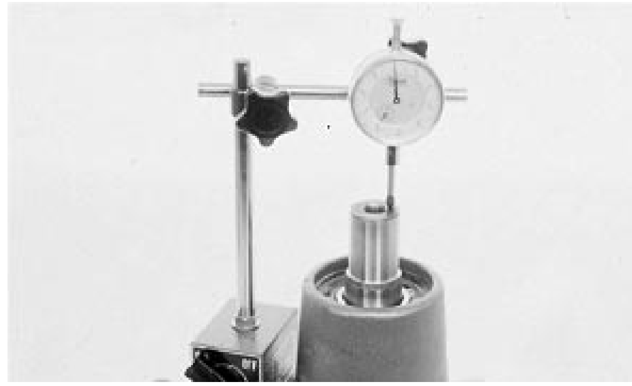
5. Measure shaft end play.

Heavy-Duty High Flow Water Pump Shaft—Specification

End Play (Maximum).. 0.25 mm (0.010 in.)

If end play is greater than specification, install an oversize snap ring.

NOTE: Snap rings are available in 0.3, 0.5, and 0.8 mm (0.010, 0.020, and 0.030 in.) oversizes.



T5824AB –UN–25OCT88

CTM8,GR25,16 –19–16SEP92–5/10

6. Use a seal driver of approximately 50 mm (2 in.) I.D. and 72 mm (2.8 in.) O.D. to install outer seal against snap ring.

NOTE: Seal is not used on 6059DF001, TF001, and TF004 engines with option code 2007.

RG6388 –UN–17AUG92

Continued on next page

CTM8,GR25,16 –19–16SEP92–6/10

7. Support pulley end of shaft and housing using a piece of pipe with a minimum ID of 2-3/4 in. and a maximum ID of 3 in.

8. Install water pump seal.

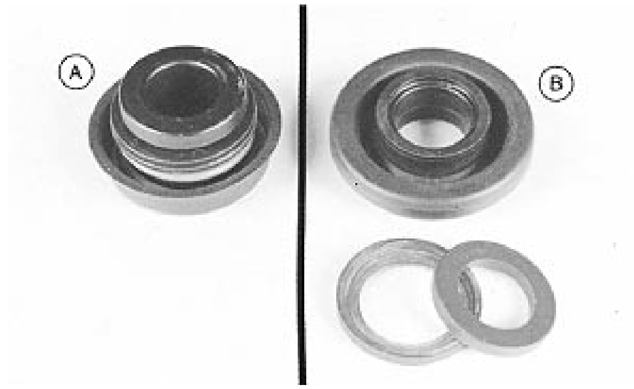
Unitized (one-piece) water seal:

IMPORTANT: Use Installation Tool (C), that is included in seal kit, to drive seal into water pump housing. This tool will install seal to correct height.

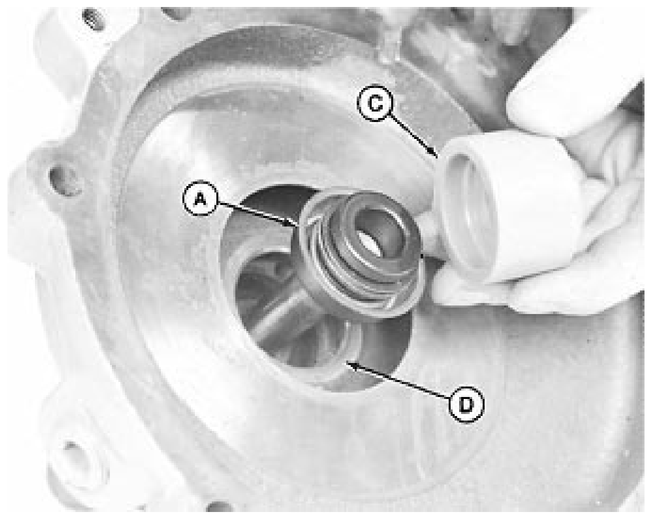
Shaft and seal must be free of grease and debris. Do not use sealant on any portion of unitized seal.

NOTE: Water pumps have either a unitized (one-piece) water seal (A), or a three-piece water seal (B). Only the unitized (one-piece) water (coolant) seal is provided for service.

Using installation tool included in seal kit, install water pump seal over shaft until seal bottoms on shoulder (D) of housing.



RG6389 –UN–21AUG92



RG6390 –UN–17AUG92

A—One-Piece Water Seal
B—Three-Piece Water Seal
C—Installation Tool
D—Water Pump Housing Shoulder

Continued on next page

CTM8,GR25,16 –19–16SEP92–7/10

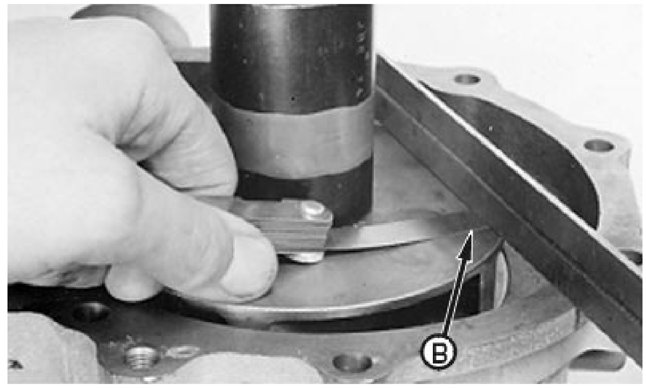
9. Using JD262A Bearing Driver, press impeller onto pump shaft to the specified dimension.

Heavy-Duty High Flow Pump Housing Gasket Surface-to-Impeller (Except 6059DF001, TF001, and TF004 with Option Code 2007)—Specification

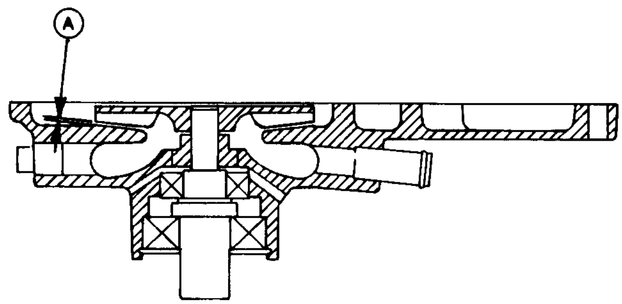
Distance (B)... 0.0— 0.38 mm (0.0—0.015 in.)

Heavy-Duty High Flow Pump Housing-to-Impeller (A) (6059DF001, TF001, and TF004 with Option Code 2007)—Specification

Clearance (A)...................................... 0.39—0.89 mm (0.015—0.035 in.)



RG9464 –UN–23OCT98



RG6281 –UN–17AUG92

A—Pump Housing-to-Impeller Clearance
B—Pump Housing Gasket-to-Impeller Distance

Continued on next page CTM8,GR25,16 –19–16SEP92–8/10

IMPORTANT: Water pump must be supported on impeller end of shaft when installing pulley or hub. Bearings will be damaged if not supported on shaft face only.

10. Place pump housing under a press and support on impeller end of shaft.

11. Install water pump pulley to the specified pulley-to-housing rear face dimension. See WATER PUMP PULLEY OR HUB-TO-REAR FACE OF HOUSING DIMENSIONS, later in this group for the correct dimension.

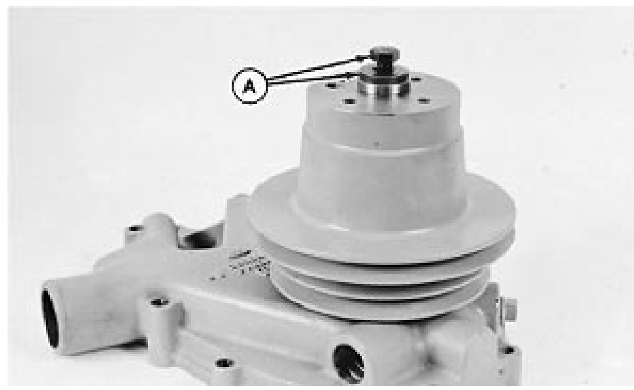
12. Turn pulley by hand to make sure shaft turns freely.

13. Install cap screw and washer (A) in pulley end of shaft. Tighten to specifications.

Heavy-Duty High Flow Water Pump Pulley Cap Screw—Specification

Torque .... 115 N•m (85 lb-ft)

T5827AA –UN–25OCT88



RG6412 –UN–21AUG92

A—Cap Screw and Washer

Continued on next page

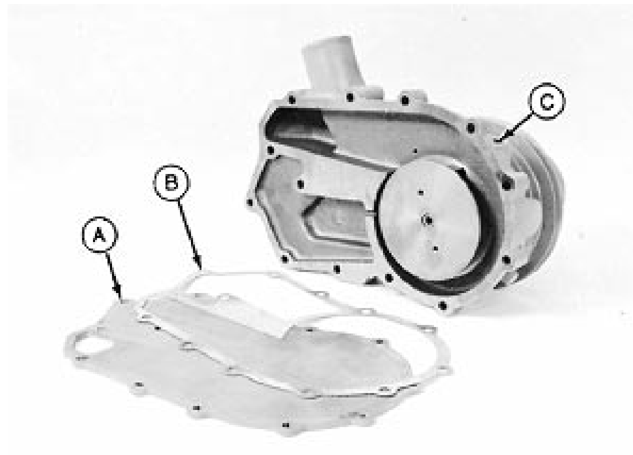
CTM8,GR25,16 –19–16SEP92–9/10

14. Install a new gasket (B) and housing cover (A). Install cap screws and tighten to specifications.

Heavy-Duty High Flow Water Pump Housing Cover Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

15. Install new O-ring in port (C, where used).



RG6413 –UN–21AUG92

A—Housing Cover
B—Gasket
C—O-Ring Port

CTM8,GR25,16 –19–16SEP92–10/10

PULLEY OR HUB-TO-REAR FACE OF WATER PUMP HOUSING DIMENSIONS

NOTE: Dimensions listed are for 7 mm thick cover plates. If a 6 mm cover plate is used, add 1 mm to the listed dimension.

PULLEY OR HUB-TO-REAR FACE OF WATER PUMP HOUSING DIMENSION

Combines	
T06068HH001	162.0 mm (6.38 in.)
Cotton Picker/Stripper	
T06059TN002	181.5 mm (7.15 in.)
Self-Propelled Sprayer	
T04039DN003	137.5 mm (5.41 in.)
T04039TN001	137.5 mm (5.41 in.)
Tractors	
CD3029DLV01	136.5 mm (5.37 in.)
CD3029DLV02	136.5 mm (5.37 in.)
CD3029TLV01	136.5 mm (5.37 in.)
CD4039TLV01 (—248699)	139 mm (5.47 in.)
CD4039TLV01 (248700—)	137 mm (5.39 in.)
CD4039TL004 (cast iron pulley)	94.0 mm (3.70 in.)
CD4039TL004 (sheet metal pulley)	97.5 mm (3.84 in.)
CD4039TL007 (cast iron pulley)	94.0 mm (3.70 in.)
CD4039TL007 (sheet metal pulley)	97.5 mm (3.84 in.)
CD4045TL002 (cast iron pulley)	94.0 mm (3.70 in.)
CD4045TL002 (sheet metal pulley)	97.5 mm (3.84 in.)
CD4045TL004 (cast iron pulley)	97.5 mm (3.84 in.)
CD4045TL004 (sheet metal pulley)	97.5 mm (3.84 in.)
T06068TRW01	94.0 mm (3.70 in.)
T06068TRW02	94.1 mm (3.71 in.)
T06059TRW01	94.1 mm (3.71 in.)
Windrowers	
T04039DE001	153.5 mm (6.04 in.)
T04039TE001	159.5 mm (6.28 in.)

Continued on next page

DPSG,OUO1004,337 –19–01SEP98–1/6

PULLEY OR HUB-TO-REAR FACE OF WATER PUMP HOUSING DIMENSIONS (Continued)

4-Wheel Drive Loaders	
T04045DT002	180.0 mm (7.09 in.)
T04045TT004	180.0 mm (7.09 in.)
T06059TDW02	209.5 mm (8.25 in.)
T06059TDW03	209.5 mm (8.25 in.)
T06059TDW04	209.5 mm (8.25 in.)
T06068TDW04	193.5 mm (7.62 in.)
T06068TDW05	193.5 mm (7.62 in.)
Crawlers	
T04039DT005	139.0 mm (5.47 in.)
T04045DT004	162.0 mm (6.38 in.)
T04045DT006	162.0 mm (6.38 in.)
T04045TT005	162.0 mm (6.38 in.)
T04045TT006	162.0 mm (6.38 in.)
T04045TT007	162.0 mm (6.38 in.)
T06068TT001	206.4 mm (8.13 in.)
T06068TT002	206.4 mm (8.13 in.)
T06068TT004	206.4 mm (8.13 in.)
Excavators	
T04039DT004	139.0 mm (5.47 in.)
T04039DT006	139.0 mm (5.47 in.)
T04045DT003	162.0 mm (6.38 in.)
T04045TT008	214.0 mm (8.43 in.)
T04045TT009	182.4 mm (7.18 in.)
T06068TDW03	170.5 mm (6.71 in.)
T06068TDW07	182.4 mm (7.18 in.)
T06068TT005	182.4 mm (7.18 in.)
Motor Graders	
T06059DDW01	168.5 mm (6.63 in.)
T06059TDW01	168.5 mm (6.63 in.)
T06068TDW02	180.0 mm (7.09 in.)
Skidders	
T04045TDW01	162.0 mm (6.38 in.)
T04045TDW02	162.0 mm (6.38 in.)
T04045TDW03	193.5 mm (7.62 in.)
T06068TDW01	pulley against shoulder
T06068TDW06	193.5 mm (7.62 in.)
Feller Bunchers	
T06068TT003	193.5 mm (7.62 in.)
T06068TDW03	170.5 mm (6.71 in.)
T06068TDW08	170.5 mm (6.71 in.)
Fork Lift	
T04039DT001	137.5 mm (5.41 in.)
T04039DT002	137.5 mm (5.41 in.)

Continued on next page DPSG,OUO1004,337 –19–01SEP98–2/6

PULLEY OR HUB-TO-REAR FACE OF WATER PUMP HOUSING DIMENSIONS (Continued)

OEM Engines

CD3029DF, DFOO1, DF002..., DF031, DF032...Engines with water pump option code:

2004	140.0 mm (5.51 in.)
2005	140.0 mm (5.51 in.)
2007	140.0 mm (5.51 in.)
2014	137.0 mm (5.39 in.)
2033	165.0 mm (6.50 in.)

CD3029DF120, DF00121..., DF160, DF161...Engines with water pump option code:

2010	137 mm (5.39 in.)
2020	140 mm (5.51 in.)
2021	140 mm (5.51 in.)
2022	137 mm (5.39 in.)
2023	165 mm (6.5 in.)
2024	137 mm (5.39 in.)
2034	140 mm (5.51 in.)

CD3029TF, TF001, TF002..., TF031, TF032...Engines with water pump option code:

2004	140.0 mm (5.51 in.)
2005	140.0 mm (5.51 in.)
2011	140.0 mm (5.51 in.)
2014	137.0 mm (5.39 in.)
2033	165.0 mm (6.50 in.)

CD3029TF120, TF00121..., TF160, TF161...Engines with water pump option code:

2010	137 mm (5.39 in.)
2021	140 mm (5.51 in.)
2022	137 mm (5.39 in.)
2023	165 mm (6.5 in.)
2024	137 mm (5.39 in.)

CD4039DF, DF001, DF002..., DF031, DF032...Engine with water pump option code:

2004	140.0 mm (5.51 in.)
2005	140.0 mm (5.51 in.)
2007	140.0 mm (5.51 in.)
2013	140.0 mm (5.51 in.)
2014	137.0 mm (5.39 in.)
2021	163.5 mm (6.44 in.)
2022	163.5 mm (6.44 in.)
2026	137 mm (5.39 in.)
2033	165.0 mm (6.50 in.)

T04039DF001 Engines with water pump option code:

2003	162.5 mm (6.40 in.)
2004	137.5 mm (5.41 in.)
2005	139.0 mm (5.47 in.)
2008	162.5 mm (6.40 in.)
2021 (Sheet Metal Pulley)	162.5 mm (6.40 in.)
2021 (Integral Pulley)	164 mm (6.46 in.)
2021 (Cast Iron Pulley)	155 mm (6.10 in.)
2022 (Sheet Metal Pulley)	162.5 mm (6.40 in.)
2022 (Integral Pulley)	164 mm (6.46 in.)
2022 (Cast Iron Pulley)	155 mm (6.10 in.)
2023	187.5 mm (7.38 in.)

Continued on next page

DPSG,OUO1004,337 –19–01SEP98–3/6

PULLEY OR HUB-TO-REAR FACE OF WATER PUMP HOUSING DIMENSIONS (Continued)

OEM Engines (Continued)

T04039DFM01 Engines with water pump option code:

2010	162.0 mm (6.38 in.)
2012	187.5 mm (7.38 in.)

CD4039TF, TF001, TF002..., TF031, TF032...Engines with water pump option code:

2004	163.5 mm (6.44 in.)
2005	140.0 mm (5.51 in.)
2013	140.0 mm (5.51 in.)
2014	137.0 mm (5.39 in.)
2021	163.5 mm (6.44 in.)
2022	163.5 mm (6.44 in.)
2023	188.5 mm (7.42 in.)
2026	140.0 mm (5.51 in.)
2027	137.0 mm (5.39 in.)

T04039TF001 Engines with water pump option code:

2004	162.5 mm (6.40 in.)
2005	139.0 mm (5.47 in.)
2008	162.5 mm (6.40 in.)

T04039TF001 Engines with water pump option code: (continued)

2021 (Sheet Metal Pulley)	162.5 mm (6.40 in.)
2021 (Integral Pulley)	164 mm (6.46 in.)
2021 (Cast Iron Pulley)	155 mm (6.10 in.)
2022 (Sheet Metal Pulley)	162.5 mm (6.40 in.)
2022 (Integral Pulley)	164 mm (6.46 in.)
2022 (Cast Iron Pulley)	155 mm (6.10 in.)
2023	187.5 mm (7.38 in.)
2026	137.5 mm (5.41 in.)

T04039TF002 Engines with water pump option code:

2026	137.5 mm (5.41 in.)

T04039TF003 Engines with water pump option code:

2004	162.5 mm (6.40 in.)

CD4045DF Engines with water pump option code:

2004	163.5 mm (6.44 in.)
2016	140.0 mm (5.51 in.)
2017	140.0 mm (5.51 in.)
2019	163.5 mm (6.44 in.)
2023	188.5 mm (7.42 in.)

T04045DF001 Engines with water pump option code:

2001	137.5 mm (5.41 in.)
2003	162.0 mm (6.38 in.)
2020 (Sheet Metal Pulley)	162.5 mm (6.40 in.)
2020 (Integral Pulley)	164 mm (6.46 in.)
2020 (Cast Iron Pulley)	155 mm (6.10 in.)
2022 (Sheet Metal Pulley)	162.5 mm (6.40 in.)
2022 (Integral Pulley)	164 mm (6.46 in.)
2022 (Cast Iron Pulley)	155 mm (6.10 in.)
2023	187.5 mm (7.38 in.)
2026	137.5 mm (5.41 in.)

Continued on next page

DPSG,OUO1004,337 –19–01SEP98–4/6

PULLEY OR HUB-TO-REAR FACE OF WATER PUMP HOUSING DIMENSIONS (Continued)

OEM Engines (Continued)

CD4045TF Engines with water pump option code:	
2004	163.5 mm (6.44 in.)
2016	140.0 mm (5.51 in.)
2017	140.0 mm (5.51 in.)
2019	163.5 mm (6.44 in.)
2023	188.5 mm (7.42 in.)
T04045TF001 Engines with water pump option code:	
2001	162.0 mm (6.38 in.)
2020 (Sheet Metal Pulley)	162.5 mm (6.40 in.)
2020 (Integral Pulley)	164 mm (6.46 in.)
2020 (Cast Iron Pulley)	155 mm (6.10 in.)
2021	137.5 mm (5.41 in.)
2023	187.5 mm (7.38 in.)
T04045TFM01 Engines with water pump option code:	
2002	187.5 mm (7.38 in.)
2009	162.0 mm (6.38 in.)
CD6059DF Engines with water pump option code:	
2004	163.5 mm (6.44 in.)
2008	163.5 mm (6.44 in.)
2023	188.5 mm (7.42 in.)
2033	165.0 mm (6.50 in.)
T06059DF001 Engines with water pump option code:	
2004	162.5 mm (6.40 in.)
2007	105.7 mm (4.16 in.)
2008	162.5 mm (6.40 in.)
2023	187.5 mm (7.38 in.)
CD6059TF, TF001, TF002...Engines with water pump option code:	
2004	163.5 mm (6.44 in.)
2005	162.0 mm (6.38 in.)
2008	163.5 mm (6.44 in.)
2023	188.5 mm (7.42 in.)
2033	165.0 mm (6.50 in.)
T06059TF001 Engines with water pump option code:	
2004	162.5 mm (6.40 in.)
2007	105.7 mm (4.16 in.)
2008	162.5 mm (6.40 in.)
2023	187.5 mm (7.38 in.)
T06059TF002 Engines with water pump option code:	
2002	162.5 mm (6.40 in.)
T06059TF003 Engines with water pump option code:	
2004	162.5 mm (6.40 in.)
T06059TF004 Engines with water pump option code:	
2007	105.7 mm (4.16 in.)

Continued on next page

DPSG,OUO1004,337 –19–01SEP98–5/6

PULLEY OR HUB-TO-REAR FACE OF WATER PUMP HOUSING DIMENSIONS (Continued)

OEM Engines (Continued)

CD6068DF Engines with water pump option code:

2004	163.5 mm (6.44 in.)
2008	163.5 mm (6.44 in.)
2023	188.5 mm (7.42 in.)

T06068DF001 Engines with water pump option code:

2001	162.0 mm (6.38 in.)
2023	187.5 mm (7.38 in.)

CD6068TF, TF001, TF002...Engines with water pump option code:

2004	163.5 mm (6.44 in.)
2005	162.0 mm (6.38 in.)
2008	163.5 mm (6.44 in.)
2023	188.5 mm (7.42 in.)

T06068TF001 Engines with water pump option code:

2001	162.0 mm (6.38 in.)
2023	187.5 mm (7.38 in.)

DPSG,OUO1004,337 –19–01SEP98–6/6

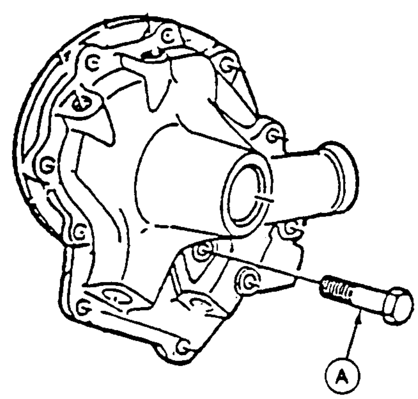
CHECK WATER PUMP CAP SCREW PROTRUSION

NOTE: On Saran OEM Engines— 4039TF, 4045DF, and 4045TF with option code 2004 or 2003

6059DF, 6059TF, 6068DF, and 6068TF with option code 2004, 2008 or 2023

6059AF with option code 2004 or 2023

Cap screw (A), when used with service water pump, may interfere with cylinder block. As a result coolant will leak from service water pump.



A—Cap Screw

Continued on next page

RG,CTM8,DX349 –19–18FEB95–1/2

To increase the depth of the cap screw in the water pump cover (A), the counterbore height on the water pump housing has been reduced from 32 mm (1.26 in.) (B) to 30.5 mm (1.20 in.) (C). This reduced counterbore height may cause the water pump cap screw to protrude beyond the water pump cover.

To assure proper installation of the service water pump, it is necessary to perform the following procedures:

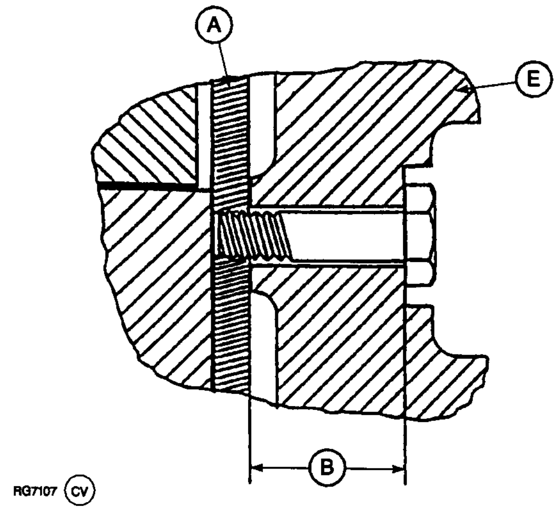
1. Measure previous dimension (B) of water pump being replaced.

2. Measure new dimension (C) of service water pump.

   If previous dimension (B) is 32 mm (1.26 in.) and new dimension (C) is 30.5 mm (1.20 in.), it will be necessary to machine the cylinder block (G) to avoid any contact with the cap screw.

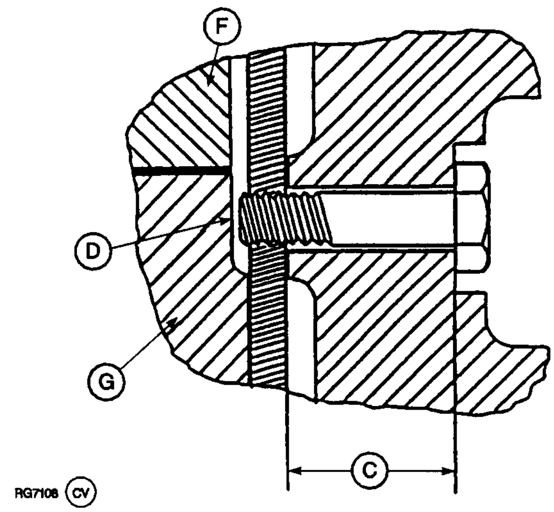
   If previous dimension (B) and new dimension (C) are 30.5 mm, make sure a recess (D) exists on cylinder block.

NOTE: The length of cap screw is 38 mm (1.50 in.). Cap screw is to be used without a washer.



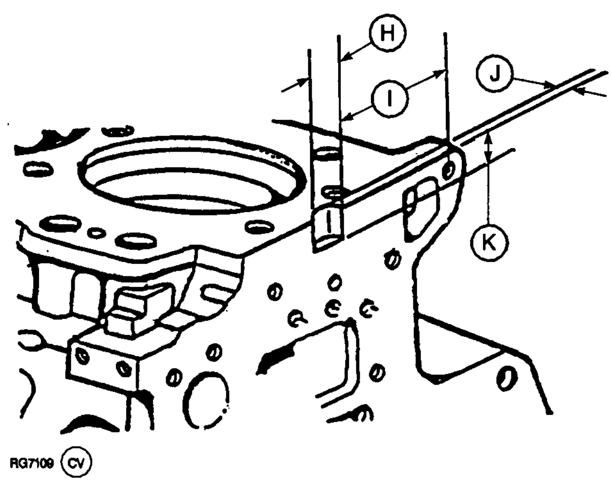
RG7107 –UN–30SEP94

Previous



RG7108 –UN–10OCT94

New

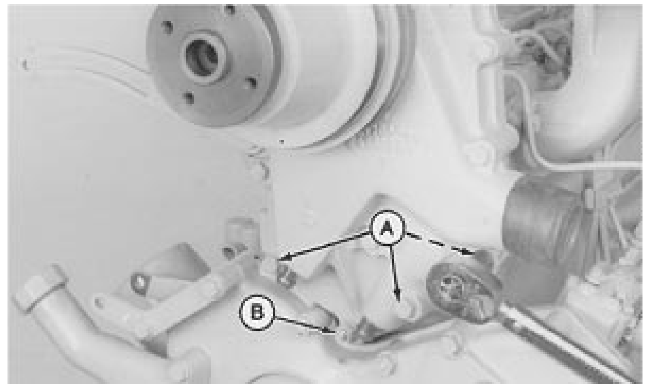


RG7109 –UN–10OCT94

A—Water Pump Cover
B—Previous Dimension [32 mm (1.26 in.)]
C—New Dimension [30.5 mm (1.20 in.)]
D—Recess
E—Water Pump
F—Cylinder Head
G—Cylinder Block
H—14 mm (0.55 in.)
I—90 mm (3.50 in.)
J—4 mm (0.15 in.)
K—25 mm (1.0 in.)

RG,CTM8,DX349 –19–18FEB95–2/2

INSTALL WATER PUMP



A—Cap Screw
B—Retaining Nut

1. Clean gasket surfaces. Install a new gasket and water pump. Tighten cap screw (A) and retaining nut (B) to the following specification.

Water Pump-to-Cylinder Block (SAE Grade 5 Cap Screw)—Specification

Torque .... 47 N•m (35 lb-ft)

Water Pump-to-Cylinder Block (SAE Grade 8 Cap Screw)—Specification

Torque .... 54 N•m (40 lb-ft)

Water Pump-to-Cylinder Block (Retaining Nut with Fine Thread)—Specification

Torque .... 40 N•m (30 lb-ft)

2. Install water manifold or thermostat housing. (See REMOVE AND INSTALL WATER MANIFOLD OR THERMOSTAT HOUSING earlier in this group.)

3. Install coolant lines, hoses, and pump mounted brackets.

4. Install alternator (if removed) and fan belt(s). Adjust belt tension. (See ADJUST FAN BELT TENSION later in this group.)

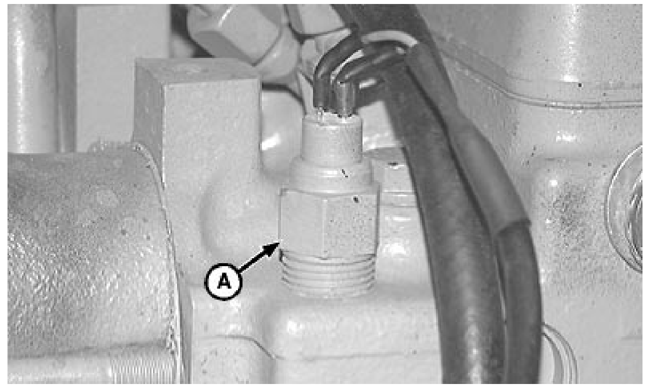
5. Fill cooling system with proper coolant. (See FUELS, LUBRICANTS, AND COOLANT-Group 02.)

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

RG,CTM8,GR25,26 –19–18FEB95–1/1

COOLING SYSTEM DEAERATION

Deaeration is normally accomplished by the jiggle pin in the thermostat flange. However, a pocket of air can stay on the top rear of the engine. When refilling the cooling system, loosen the coolant temperature sensor (A) or plug at the rear of the cylinder head to allow air to escape.



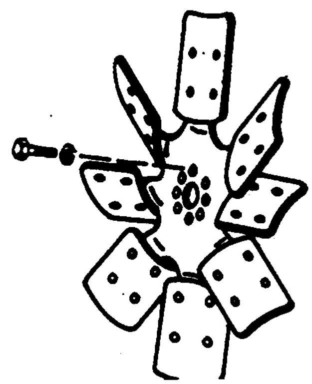
RG9076 –UN–12MAR98

A—Coolant Temperature Sensor

DPSG,OUO1004,321 –19–26AUG98–1/1

INSPECT AND INSTALL FAN BLADE ASSEMBLY

Several fan drive ratios are available allowing a closer matching of fan speed to application.



RG4797 –UN–14DEC88

1. Inspect fan blades for bent or damaged condition. Bent blades reduce cooling system efficiency and throw the fan out of balance. Replace fan if blades are bent or damaged.

NOTE: Engines may be equipped with either suction-type fan or a blower-type fan, depending on application.

2. Install fan on pulley or pulley hub. Tighten cap screws (with lock washers) to specification.

Fan-to-Pulley Hub 5/16 in. Cap Screw—Specification

Torque .... 27 N•m (20 lb-ft)

Fan-to-Pulley Hub 3/8 in. Cap Screw—Specification

Torque .... 47 N•m (35 lb-ft)

S11,2025,FT –19–12OCT94–1/1

ADJUST FAN BELT TENSION

NOTE: On engines with dual V-belts, check front belt tension only. Measure tension on long part of belt.

Belts are considered used after 10 minutes of operation.

STANDARD V-BELTS

Check and adjust fan belt tension on standard V-belts using JDG529 Gauge and compare to following specifications.

Single Belt (New)—Specification

Tension .... 578—622 N (130—140 lb-force)

Single Belt (Used)—Specification

Tension .... 378—423 N (85—94 lb-force)

Dual Belt (New)—Specification

Tension .... 423—467 N (95—104 lb-force)

Dual Belt (Used)—Specification

Tension .... 378—423 N (85—94 lb-force)

Check and adjust fan belt tension on standard V-belts using JDST28 Gauge and straightedge and compare to following specifications.

Fan Belt—Specification

Tension ....19 mm (3/4 in.) deflection with an 89 N (20 lb-force) halfway between pulleys

8 RIB POLY V-BELT

Check and adjust fan belt tension on 8 rib poly V-belts using JT05975 Gauge and compare to following specifications.

Single Belt (New)—Specification

Tension .... 890—1068 N (200—240 lb-force)

Single Belt (Used)—Specification

Tension .... 800—979 N (180—220 lb-force)

Check and adjust fan belt tension on 8-rib poly V-belts using JDST28 Gauge and straightedge and compare to following specifications.

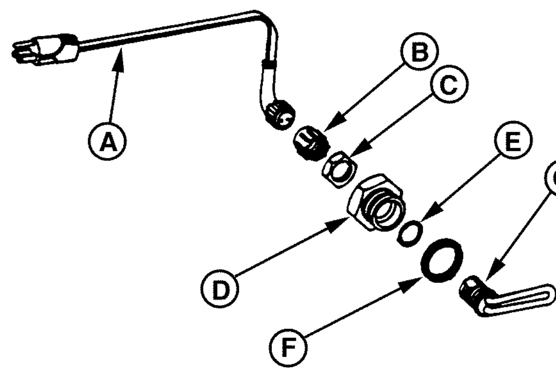
Fan Belt—Specification

Tension ....13 mm (1/2 in.) deflection with a 130 N (30 lb-force) halfway between pulleys

DPSG,OUO1004,359 –19–13SEP98–1/1

REMOVE AND INSTALL COOLANT HEATER (DUBUQUE-BUILT ENGINES)—IF EQUIPPED

CAUTION: To avoid shock or hazardous operation, always use a three-wire heavy-duty electrical cord equipped with three-wire connectors. 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. Sheath could burst and result in personal injury.



A—Cord
B—Dust Cap
C—Retaining Nut
D—Adapter
E—Gasket
F—O-Ring
G—Heater Element

1. Unplug heater from electrical power source.
2. Drain cooling system.
3. Disconnect cord (A) from heater assembly.
4. Loosen retaining nut (C) and remove adapter (D) and heater element from block.
5. Inspect and replace parts as necessary.

NOTE: The heater element (G) cannot be repaired. Replace if defective.

6. Install a new gasket (E) and O-ring (F). Install heater element through adapter (D) and install nut (C) loosely.
7. Install heater into cylinder block with element pointing to the rear.
8. Tighten adapter (D).
9. Turn element clockwise and then counterclockwise until element contacts casting. Move element midway between contact points.
10. Hold element with a wrench and tighten retaining nut (C) to specifications.

Coolant Heater Lock Nut (Dubuque-Built Engines)—Specification

Torque .... 34 N•m (25 lb-ft)

Continued on next page

NOTE: If heater has been ordered as an attachment only, it will include a dust cover (B). The cover is used to protect the electrical connectors when cord assembly (A) has been removed.

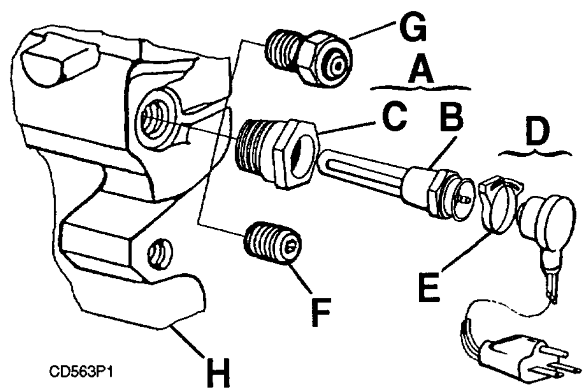
11. Install cord.

12. Service engine with coolant.

CTM8,GR25,21 –19–16SEP92–2/2

REMOVE AND INSTALL COOLANT HEATER (SARAN-BUILT ENGINES)—IF EQUIPPED

CAUTION: To avoid shock or hazardous operation, always use a three-wire heavy-duty electrical cord equipped with three-wire connectors. 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. Sheath could burst and result in personal injury.



CD563P1 –UN–31OCT96

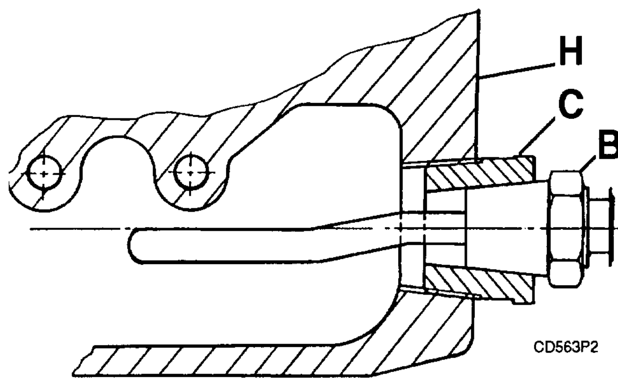
1. Drain coolant system.

2. Remove coolant plug (F) or adapter (G) from the rear side of the cylinder block.

3. Apply sealing compound to the threads of adapter (C) and install it in cylinder block. Tighten to specifications.

Coolant Heater Adapter (Saran-Built Engines)—Specification

Torque .... 45 N•m (33 lb-ft)



CD563P2 –UN–31OCT96

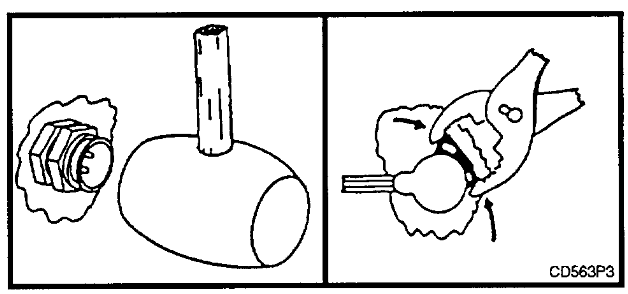
4. Apply sealant to heater element tapered surface and to adapter.

5. Install heater element (B) in cylinder block.

NOTE: Heater element is bent to avoid any interference with the cylinder block (see fig. 2).

6. When heater element is correctly positioned, tap into place with a rubber mallet (see fig. 3).

7. Connect cord (D) on heater element and fix it with clamp (E) using a plier (see fig. 3).



CD563P3 –UN–31OCT96

A—Coolant Heater
B—Heater Element
RE64803 for 3 and 4-cyl. (240 V, 1000 W)
RE64804 for 6-cyl. (240 V, 1500 W)
C—Adapter
D—RE64805 Electrical Cord
E—Clamp
F—Plug
G—Adapter
H—Cylinder Block

DPSG,OUO1004,493 –19–08NOV98–1/1

OTHER MATERIAL

Number	Name	Use
PT569 (U.S.)	NEVER-SEEZNEVER-SEEZ®	Turbine housing-to-center housing cap screws and exhaust manifold-to-cylinder head cap screws.
TY9375 (U.S.) TY9480 (Canadian) 592 (LOCTITE®)	Pipe Sealant	Air heater threads.

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

DPSG,OUO1004,366 –19–13SEP98–1/1

AIR INTAKE AND EXHAUST SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Turbocharger (AiResearch/Garret) (TA25 on 3029 Engines)	Radial Bearing Clearance	0.06—0.13 mm (0.0024—0.0051 in.)
Turbocharger (AiResearch/Garret) (All Except TA25 on 3029 Engines)	Radial Bearing Clearance	0.08—0.18 mm (0.003—0.007 in.)
Turbocharger (Schwitzer S2A)	Radial Bearing Clearance	0.74—0.81 mm (0.029—0.032 in.) maximum
Turbocharger (AiResearch/Garret) (TA25 on 3029 engines)	Axial Bearing End Play	0.025—0.09 mm (0.001—0.0035 in.)
Turbocharger (AiResearch/Garret) (All Except TA25 on 3029 engines)	Axial Bearing End Play	0.025—0.102 mm (0.001—0.004 in.)
Turbocharger (Schwitzer S2A)	Axial Bearing End Play	0.09—0.14 mm (0.004—0.006 in.) maximum
Turbocharger Compressor Housing-to-Center Housing Cap Screw	Initial Torque	10 N•m (7 lb-ft)
Turbocharger Compressor Housing-to-Center Housing Cap Screw (3-Cylinder Engines)	Final Torque	27 N•m (20 lb-ft)
Turbocharger Compressor Housing-to-Center Housing Cap Screw (4- and 6-Cylinder Engines)	Final Torque	17 N•m (13 lb-ft)
Turbine Housing-to-Center Housing Cap Screw		
Turbine Housing-to-Center Housing Cap Screw	Initial Torque	10 N•m (7 lb-ft)
Turbine Housing-to-Center Housing (TA25 Turbochargers on 3029 Engines)	Final Torque	26 N•m (19 lb-ft)

Continued on next page

DPSG,OUO1004,367 –19–13SEP98–1/2

Item	Measurement	Specification
Turbine Housing-to-Center Housing (All Except TA25 Turbochargers on 3029 Engines)	Final Torque	17 N•m (13 lb-ft)
V-Band Clamp TA25 Turbochargers on 3029 Engines	Torque	7 N•m (5 lb-ft)
Turbocharger-to-Exhaust Manifold Nuts	Torque	47 N•m (35 lb-ft)
Turbocharger Oil Return Pipe Cap Screws (4- and 6-Cylinder Engines)	Torque	27 N•m (20 lb-ft)
Turbocharger Oil Tube Connector Cap Screws (3-Cylinder Engines)	Torque	80 N•m (60 lb-ft)
Turbocharger Oil Inlet Line	Torque	24 N•m (18 lb-ft)
Turbocharger and Exhaust Elbow-to-Exhaust Manifold (3-Cylinder Engines)	Torque	30 N•m (22 lb-ft)
Turbocharger and Exhaust Elbow-to-Exhaust Manifold (4- and 6-Cylinder Engines)	Torque	47 N•m (35 lb-ft)
Intake Manifold Cap Screws	Torque	47 N•m (35 lb-ft)
Exhaust Manifold-to-Cylinder Head Cap Screws	Torque	47 N•m (35 lb-ft)
Aftercooler-to-Intake Manifold	Torque	27 N•m (20 lb-ft)
Aftercooler Bracket-to-Cylinder Head	Torque	47 N•m (35 lb-ft)
Aftercooler Adapter Plates	Torque	27 N•m (20 lb-ft)
Aftercooler Intake Manifold-to-Cylinder Head	Torque	47 N•m (35 lb-ft)

DPSG,OUO1004,367 –19–13SEP98–2/2

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 attributed to:

- 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 possible bearing damage. It can also cause carbon and varnish deposits to form.

OIL CONTAMINATION

A second cause of turbocharger failure 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

DPSG,OUO1004,326 –19–27AUG98–1/2

INGESTION OF FOREIGN OBJECTS

The third cause of turbocharger damage is the ingestion of foreign objects. Foreign objects or 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 TEMPERATURE

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 case 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.

DPSG,OUO1004,326 –19–27AUG98–2/2

REMOVE TURBOCHARGER

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

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.)

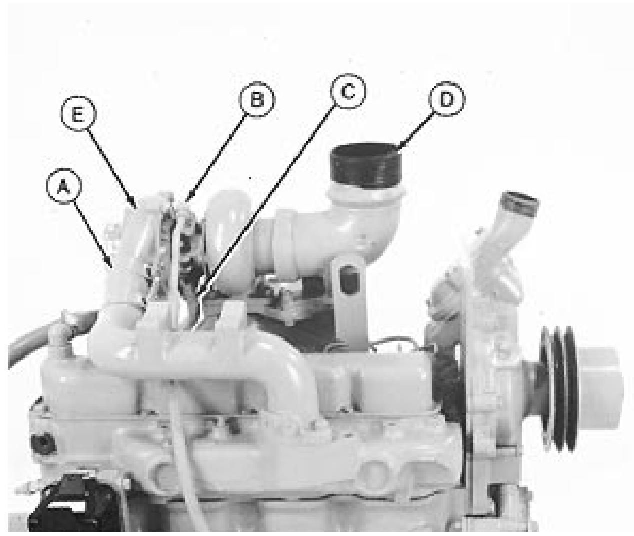
1. Remove air intake hose, exhaust elbow (D), and exhaust adapter. Loosen hose clamps (A).

2. Disconnect oil inlet line (B) and oil return pipe (C) from turbocharger (E).

3. Remove mounting cap screws and nuts and lift turbocharger from exhaust manifold. Remove stainless steel gasket.

4. Place turbocharger on a clean flat surface. Cap or plug all air intake and exhaust openings.

5. Perform turbocharger seven-step inspection as described later, if failure mode has not yet been determined. See TURBOCHARGER SEVEN-STEP INSPECTION in this Group.



RG5660 –UN–12APR90

A—Hose Clamp
B—Oil Inlet Line
C—Oil Return Pipe
D—Exhaust Elbow
E—Turbocharger

CTM8,GR30,2 –19–28SEP94–1/1

TURBOCHARGER FAILURE ANALYSIS

The following is a guide for diagnosing the cause of turbocharger failures after removal from the engine.

COMPRESSOR HOUSING INLET DEFECTS

Problem	Possible Cause	Suggested Remedy
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

Problem	Possible Cause	Suggested Remedy
Oil and/or Dirt in Housing	Restricted air intake system.	Inspect and clean air cleaner.
	Prolonged periods of low RPM engine idling.	Check with operator to confirm conditions. (See operator’s manual.)
	Defective oil seal ring.	Repair as required. (This group.)
	Restricted oil drain line.	Inspect and clear oil drain line as required.

TURBINE HOUSING INLET DEFECTS

Problem	Possible Cause	Suggested Remedy
Oil in Housing	Internal engine failure.	Inspect and repair engine as required.
	Oil leaking from compressor housing seal.	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.

TURBINE HOUSING OUTLET DEFECTS

Problem	Possible Cause	Suggested Remedy
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.	Verify with operator to run engine underload or at a higher RPM. (Operator’s Manual.)
	Restricted oil drain line.	Inspect and clear oil drain line as required.

Continued on next page
DPSG,OUO1004,327 –19–27AUG98–1/2

EXTERNAL CENTER HOUSING AND JOINT DEFECTS

Problem	Possible Cause	Suggested Remedy
Leaks from Casting	Defective casting.	Replace turbocharger, (this group).
	Defective gasket.	Verify that leaks are not 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

Problem	Possible Cause	Suggested Remedy
Excessive Carbon Build up in Housing or on Shaft	Hot engine shut-down.	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.

DPSG,OUO1004,327 –19–27AUG98–2/2

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.

Continued on next page DPSG,OUO1004,329 –19–27AUG98–1/13

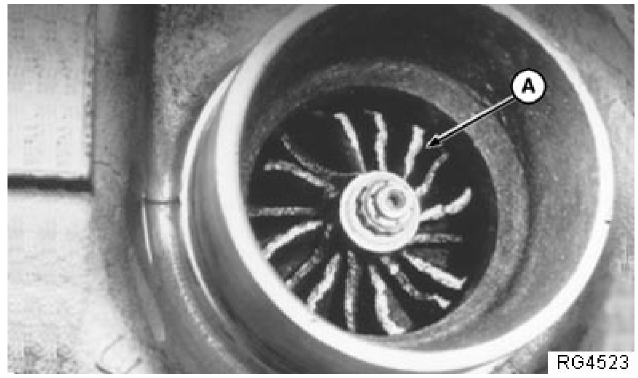
NOTE: To enhance the turbocharger inspection, an inspection sheet (Form No. DF-2280 available from Distribution Service Center—English only) can be used that lists the inspection steps in the proper order and shows potential failure modes for each step. Check off each step as you complete the inspection and record any details or problems obtained during inspection. Retain this with the work order for future reference.

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 damages.

2. Mark findings on your checklist and continue the inspection.



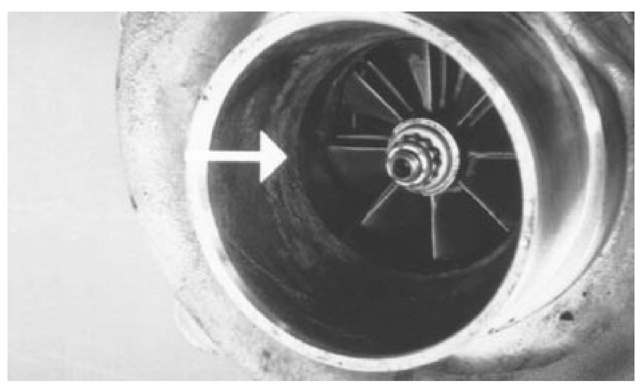
RG4523 –UN–03NOV97

A—Compressor Wheel

DPSG,OUO1004,329 –19–27AUG98–2/13

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.



RG4524 –UN–05DEC97

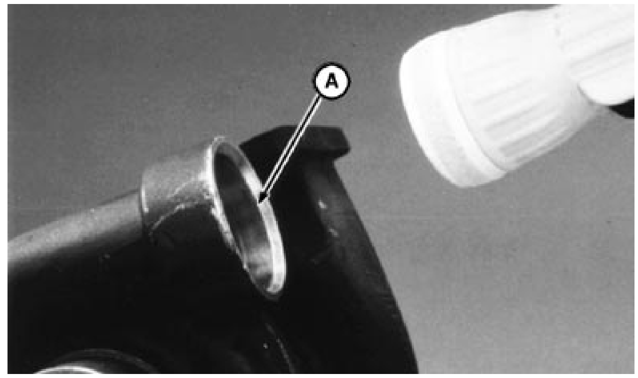
Continued on next page

DPSG,OUO1004,329 –19–27AUG98–3/13

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.



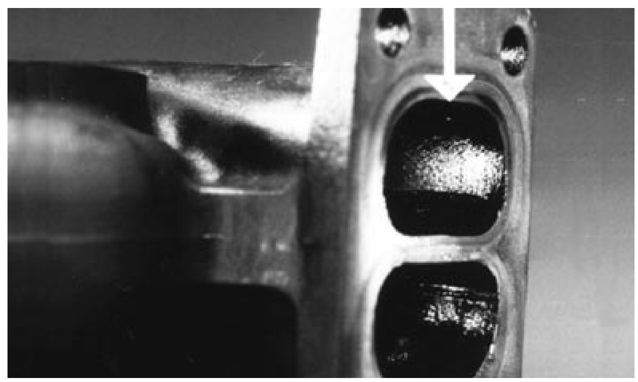
A—Compressor Outlet

DPSG,OUO1004,329 –19–27AUG98–4/13

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.

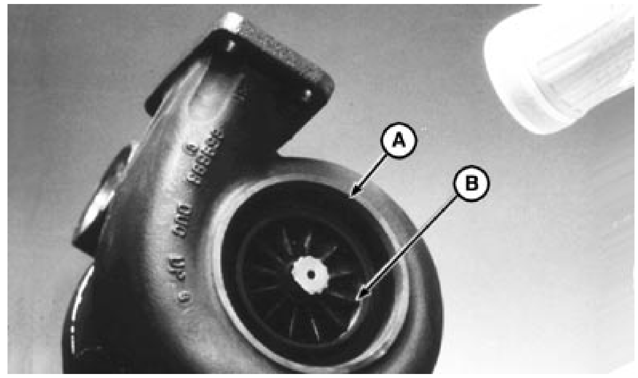


Continued on next page

DPSG,OUO1004,329 –19–27AUG98–5/13

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.

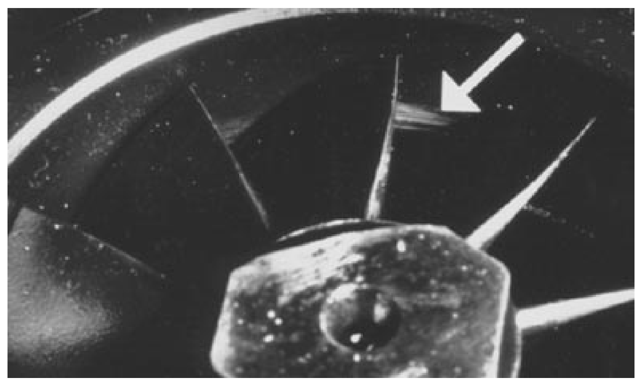


RG4527 –UN–05DEC97

A—Turbine Outlet
B—Turbine Blades

DPSG,OUO1004,329 –19–27AUG98–6/13

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.



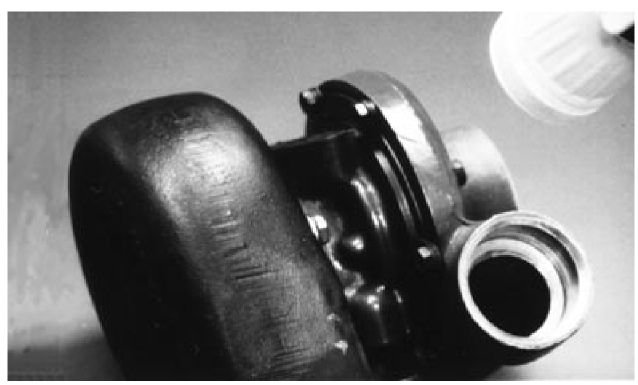
RG4528 –UN–05DEC97

DPSG,OUO1004,329 –19–27AUG98–7/13

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.



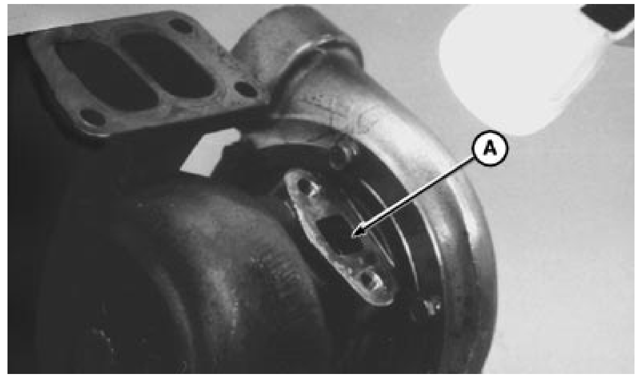
RG4529 –UN–05DEC97

Continued on next page

DPSG,OUO1004,329 –19–27AUG98–8/13

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.

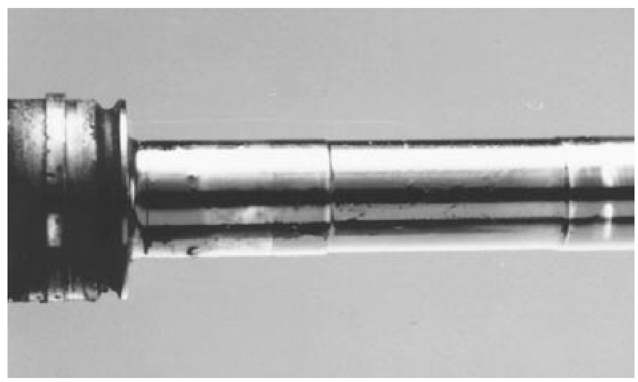


RG4530 –UN–05DEC97

A—Oil Return

DPSG,OUO1004,329 –19–27AUG98–9/13

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.



RG4531 –UN–05DEC97

DPSG,OUO1004,329 –19–27AUG98–10/13

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.

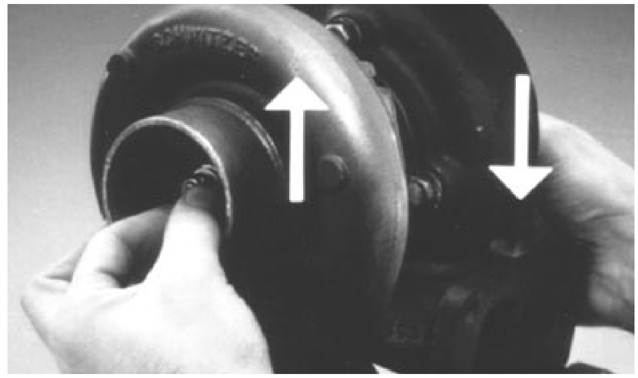
RG4532 –UN–05DEC97

Continued on next page

DPSG,OUO1004,329 –19–27AUG98–11/13

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.



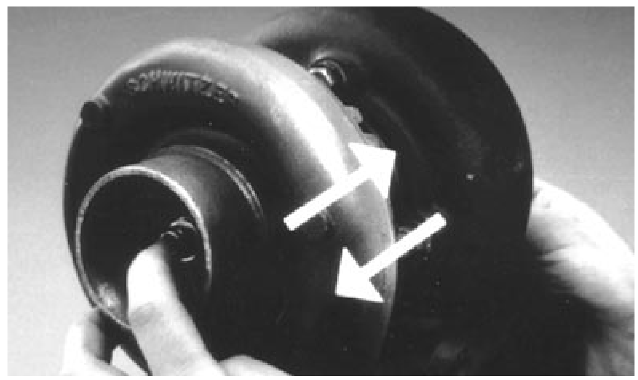
RG4533 –UN–05DEC97

DPSG,OUO1004,329 –19–27AUG98–12/13

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.

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.

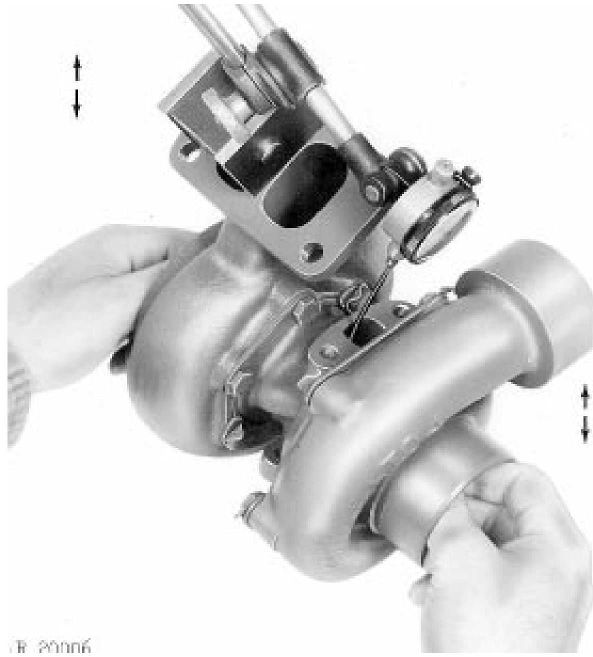
NOTE: These diagnostic procedures will allow you to determine the condition of the turbocharger. If the turbocharger has failed, analysis of your inspection notes should direct you to the specific areas of the engine to correct the problems causing the turbocharger failure (See TURBOCHARGER FAILURE ANALYSIS, 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.



RG4534 –UN–05DEC97

DPSG,OUO1004,329 –19–27AUG98–13/13

PERFORM RADIAL BEARING CLEARANCE TEST



R20006 –UN–20DEC88

This test will give an indication of the condition of the radial bearings within the center housing and rotating assembly.

NOTE: Prelube center housing bearings prior to performing radial clearance test. (See PRELUBE TURBOCHARGER, later in this Group.)

1. Position dial indicator with extension adapter onto center housing so that tip rests on shaft extending through oil return cavity.

IMPORTANT: Use only moderate force (3—4 lbs.) on each end of the shaft when checking clearance.

2. Grasp rotating shaft at both ends and move the shaft toward the indicator then away from the indicator (arrows) using 3—4 lbs. of force.

3. Observe and record total indicator reading. Compare readings to the following specifications.

Turbocharger (AiResearch/Garret) (TA25 on 3029 Engines)—Specification

Radial Bearing Clearance .... 0.06—0.13 mm (0.0024—0.0051 in.)

Turbocharger (AiResearch/Garret) (All Except TA25 on 3029 Engines)—Specification

Radial Bearing Clearance .... 0.08—0.18 mm (0.003—0.007 in.)

For Schwitzer S2A Turbochargers, the radial bearing clearance is as specified below, measured at the compressor nut with the turbocharger shaft vertical, compressor end upwards and using a maximum of 18 N (4 lb) to deflect shaft.

Turbocharger (Schwitzer S2A)—Specification

Radial Bearing Clearance .... 0.74—0.81 mm (0.029—0.032 in.) maximum

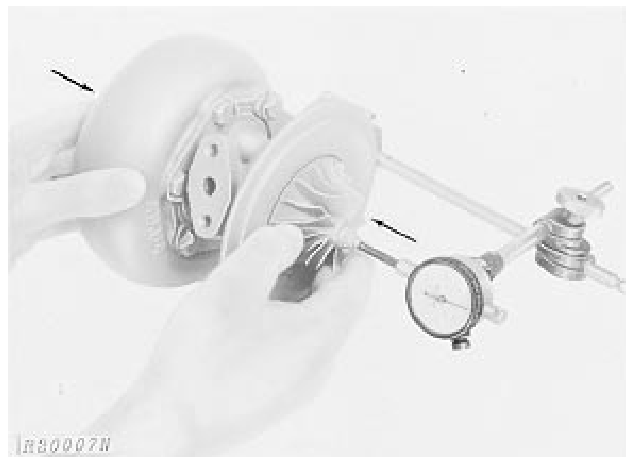
Continued on next page

DPSG,OUO1004,328 –19–27AUG98–1/2

If total indicator reading is not within specification, replace center housing and rotating assembly. (See REPLACE CENTER HOUSING AND ROTATING ASSEMBLY for your model of turbocharger, later in this group.)

DPSG,OUO1004,328 –19–27AUG98–2/2

PERFORM AXIAL BEARING END PLAY TEST



R20007N –UN–20DEC88

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. Use a force of only 3—4 lbs.

3. Observe and record total dial indicator reading and compare to following specifications.

Turbocharger (AiResearch/Garret) (TA25 on 3029 engines)—Specification

Axial Bearing End Play .... 0.025—0.09 mm (0.001—0.0035 in.)

Turbocharger (AiResearch/Garret) (All Except TA25 on 3029 engines)—Specification

Axial Bearing End Play .... 0.025—0.102 mm (0.001—0.004 in.)

Turbocharger (Schwitzer S2A)—Specification

Axial Bearing End Play .... 0.09—0.14 mm (0.004—0.006 in.) maximum

If bearing end play is not within specification, replace center housing and rotating assembly. (See REPLACE CENTER HOUSING AND ROTATING ASSEMBLY for your model of turbocharger, later in this group.)

CTM8,GR30,6 –19–17FEB95–1/1

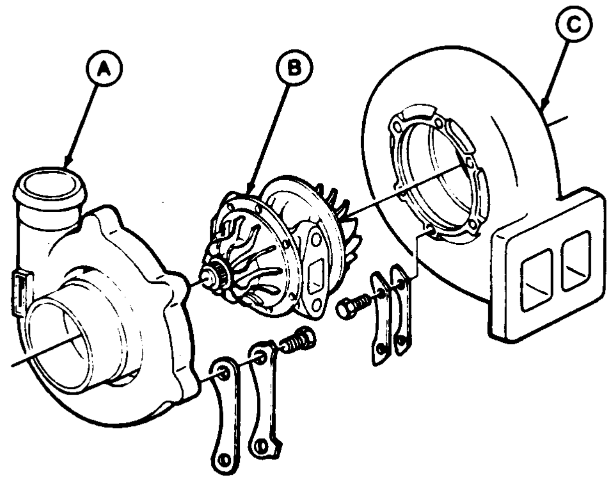
REPAIR TURBOCHARGER

AiResearch/Garrett and Schwitzer turbochargers used on the engines covered in this manual are available through service parts as a complete remanufactured assembly or as a new center housing and rotating assembly only. When a new center housing and rotating assembly are being installed, thoroughly inspect and reuse turbine and compressor housings from existing turbocharger. New mounting hardware MUST be used.

IMPORTANT: Repairing a turbocharger center housing and rotating assembly requires specialized tooling and highly trained personnel and thus it is not recommended that the turbocharger be disassembled completely.

CTM8,GR30,7 –19–13JAN95–1/1

DISASSEMBLE AND INSPECT TURBOCHARGER



A—Compressor Housing
B—Center Housing and Rotating Assembly
C—Turbine Housing

1. Scribe locating marks on turbine housing (C) and compressor housing (A) in reference to any location (eg. oil inlet or return) on center housing and rotating assembly (B). These reference marks are essential for proper indexing during reassembly.

2. Remove compressor housing and turbine housing cap screws with lock plates and clamps.

   If necessary, gently tap turbine housing and compressor housing with a soft hammer and carefully remove turbine housing from center housing.

3. Thoroughly clean compressor and turbine housings using a commercially approved solvent only. A caustic solution may damage housings. Dry housings with compressed air. After a part is cleaned, place it on a clean flat surface and inspect as outlined below.

   Inspect turbine housing for:

   - Wheel rub damage within the contour area that cannot be polished out with 60-grit silicone carbide abrasive cloth.
   - Nicks, dents, or warpage that could prevent proper sealing between the turbine housing and center housing.

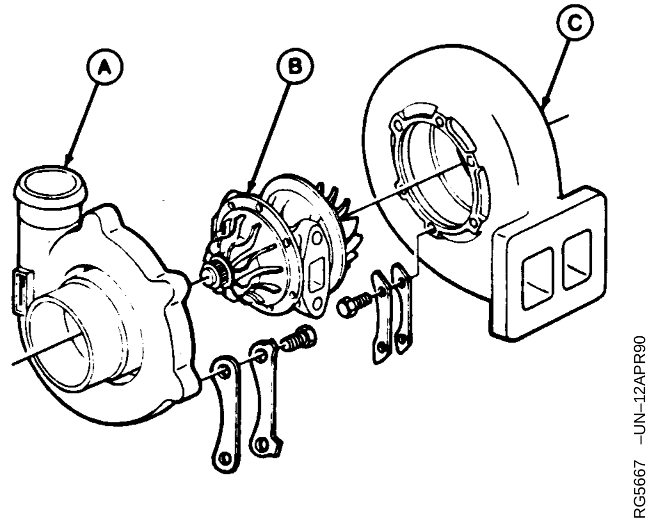
   Inspect compressor housing for:

   - Wheel rub damage within the contour area that cannot be polished out with 80-grit silicone carbide abrasive cloth.
   - Nicks, dents, or warpage that could prevent proper sealing between the compressor housing and center housing.
   - Corroded or stripped center housing mounting holes.

4. Replace either housing if any one of the above defects are found.

CTM8,GR30,8 –19–17FEB95–1/1

REPLACE CENTER HOUSING AND ROTATING ASSEMBLY



A—Compressor Housing
B—Center Housing and Rotating Assembly
C—Turbine Housing

1. Carefully transfer scribed marks from original center housing to replacement assembly, if necessary. Use same procedure for compressor and turbine housings, if replaced.

2. Attach compressor housing (A) to center housing and rotating assembly (B) with cap screws, lock plates, and clamps. Tighten cap screws to specification.

Turbocharger Compressor Housing-to-Center Housing Cap Screw—Specification

Initial Torque .... 10 N•m (7 lb-ft)

Turbocharger Compressor Housing-to-Center Housing Cap Screw (3-Cylinder Engines)—Specification

Final Torque .... 27 N•m (20 lb-ft)

Turbocharger Compressor Housing-to-Center Housing Cap Screw (4- and 6-Cylinder Engines)—Specification

Final Torque .... 17 N•m (13 lb-ft)

3. Attach turbine housing (C) to center housing and rotating assembly. Coat threads of cap screws with PT569 NEVER-SEEZ. Install cap screws, lock plates, and clamps. Tighten cap screws to specification.

Turbine Housing-to-Center Housing Cap Screw—Specification

Initial Torque .... 10 N•m (7 lb-ft)

Turbine Housing-to-Center Housing (TA25 Turbochargers on 3029 Engines)—Specification

Final Torque .... 26 N•m (19 lb-ft)

Turbine Housing-to-Center Housing (All Except TA25 Turbochargers on 3029 Engines)—Specification

Final Torque .... 17 N•m (13 lb-ft)

V-Band Clamp TA25 Turbochargers on 3029 Engines—Specification

Torque .... 7 N•m (5 lb-ft)

Continued on next page

4. After assembly, check the center housing and rotating assembly for binding and wheel rub. If either condition exists, disassemble turbocharger and correct the cause.

5. Bend ears of lock plates against heads of cap screws.

CTM8,GR30,9 –19–17FEB95–2/2

PRELUBE TURBOCHARGER

IMPORTANT: DO NOT spin the rotor assembly with compressed air. Damage to bearing can occur.

Fill oil inlet or drain port with clean oil and turn rotating assembly (by hand) to properly lubricate bearings. If turbocharger is to be stored, lubricate internally and install protective covers on all openings.

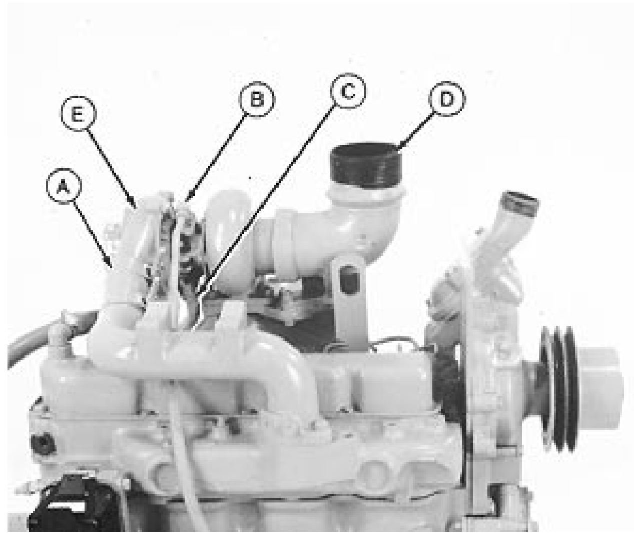
RG6303 –UN–22JUL92

RG,CTM8,G30,R4 –19–11SEP92–1/1

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 the turbocharger lubrication system prior to mounting turbocharger on the engine. Fill the center housing with new engine oil through the oil drain hole. Turn the rotating assembly by hand to lubricate the bearings.



RG5660 –UN–12APR90

A—Hose Clamp
B—Oil Inlet Line
C—Oil Return Pipe
D—Exhaust Elbow
E—Turbocharger

1. Position turbocharger (E) and stainless steel gasket onto mounting studs on exhaust manifold. Tighten stud nuts to specifications.

Turbocharger-to-Exhaust Manifold Nuts—Specification

Torque .... 47 N•m (35 lb-ft)

2. Install oil return pipe (C) to turbocharger. Tighten oil return pipe cap screws on 4- and 6-cylinder engines to the following specifications.

Turbocharger Oil Return Pipe Cap Screws (4- and 6-Cylinder Engines)—Specification

Torque .... 27 N•m (20 lb-ft)

Tighten tube connector on 3-cylinder engines to the following specifications.

Turbocharger Oil Tube Connector Cap Screws (3-Cylinder Engines)—Specification

Torque .... 80 N•m (60 lb-ft)

Connect turbocharger oil inlet line (B) and tighten to the following specifications..

Turbocharger Oil Inlet Line—Specification

Torque .... 24 N•m (18 lb-ft)

3. Connect air inlet hose-to-turbocharger compressor housing. Tighten hose clamps (A) on air inlet line.

Continued on next page

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.

4. Install exhaust adapter and exhaust elbow (D, previous page). The exhaust adapter must have a minimum end play of 0.8—1.6 mm (0.03—0.06 in.). Tighten cap screws to the following specifications.

Turbocharger and Exhaust Elbow-to-Exhaust Manifold (3-Cylinder Engines)—Specification

Torque .... 30 N•m (22 lb-ft)

Turbocharger and Exhaust Elbow-to-Exhaust Manifold (4- and 6-Cylinder Engines)—Specification

Torque .... 47 N•m (35 lb-ft)

RG,CTM8,DX352 –19–17FEB95–2/2

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. Either push the throttle lever to the “STOP” position, hold the engine shut-off knob out, or disconnect electrical wire from injection pump.

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. Start and run engine at low idle while checking oil inlet and air piping connections for leaks.

CTM8,GR30,16A –19–15SEP92–1/1

RECOMMENDATIONS FOR TURBOCHARGER USE

IMPORTANT: Should the engine stall when operating under load, IMMEDIATELY restart the engine to prevent overheating of turbocharger parts.

In most cases, turbocharger damage is caused by improper start-up and shutdown procedures. Always idle the engine for at least 30 seconds (no load) after start-up and before shutdown.

DPSG,OUO1004,330 –19–27AUG98–1/1

REMOVE, INSPECT AND INSTALL INTAKE MANIFOLD

IMPORTANT: All intake manifold connections at the turbocharger and engine cylinder head must be tight to prevent loss of power resulting from lower manifold pressure.

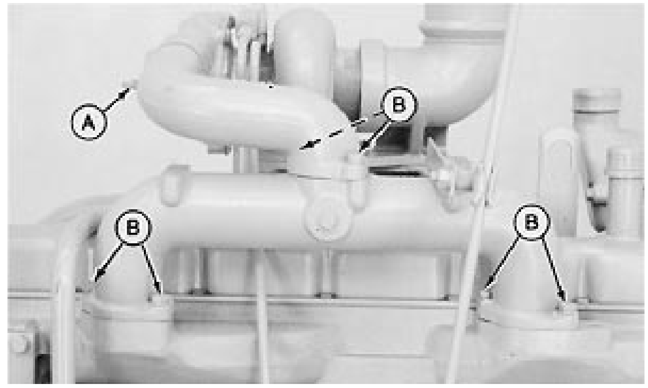
Intake manifold hose and cap screw connections should be inspected periodically for tightness and kept tight.

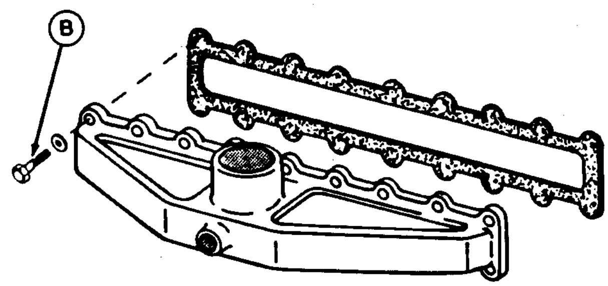
Whenever a tune-up has been performed on a turbocharged engine, or whenever it is suspected that the horsepower output might be low, the intake manifold pressure (turbocharger boost) should be checked. (See CHECK INTAKE MANIFOLD PRESSURE [TURBOCHARGER BOOST] in Group 110.)

1. Loosen hose clamps (A) and remove hose from inlet elbow.
2. Remove cap screws (B) attaching air inlet elbow (if used) and intake manifold.
3. Inspect the intake manifold for serviceability. Replace if it is cracked or otherwise damaged.
4. Inspect the machined mating surfaces of cylinder head and intake manifold. Clean as required using a scraper, wire brush, and compressed air.
5. To install intake manifold, reverse removal procedures and use new gaskets.
6. Make sure air intake hose is in good condition. Tighten hose clamps securely.
7. Coat intake manifold cap screws with PT569 NEVER-SEEZ® Compound and tighten to specifications.

Intake Manifold Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)





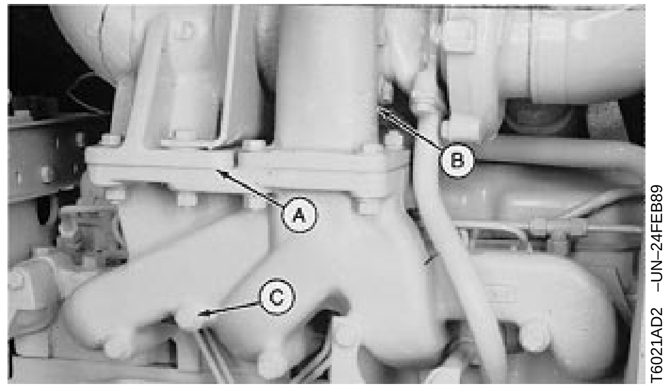
6068H Engines

A—Hose Clamps
B—Cap Screws

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

RG,CTM8,G30,R5 –19–09FEB95–1/1

REMOVE, INSPECT AND INSTALL EXHAUST MANIFOLD



A—Exhaust Elbow
B—Turbocharger
C—Exhaust Manifold

1. Remove turbocharger (B), (if equipped). (See REMOVE TURBOCHARGER earlier in this group.)

2. Remove exhaust elbow (A), or exhaust pipe, and exhaust manifold (C).

3. Inspect exhaust manifold and gasket(s).

4. Thoroughly clean passages in exhaust manifold.

5. Inspect each exhaust manifold for cracks or damage. Inspect machined mounting surfaces for burrs or other defects which might prevent gasket(s) from sealing properly. Replace parts as needed.

6. Reverse removal procedure to install turbocharger.

NOTE: When using gaskets with one steel-backed side, the non-steel backed side must face toward the cylinder head.

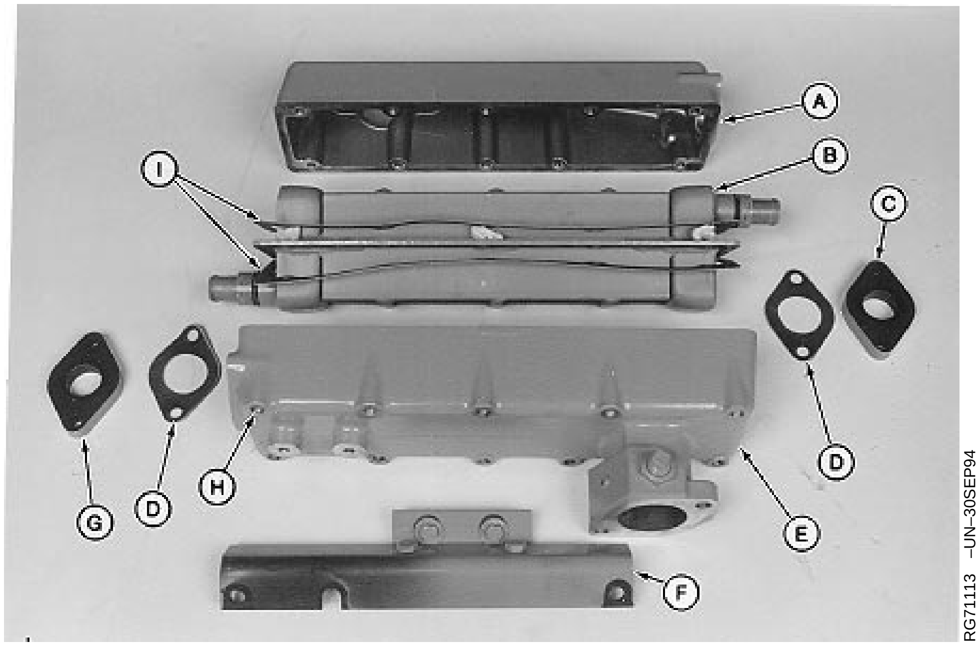
7. Tighten cap screws to specifications.

Exhaust Manifold-to-Cylinder Head Cap Screws—Specification

Torque .... 47 N•m (35 lb-ft)

S11,3005,LM –19–13JAN95–1/1

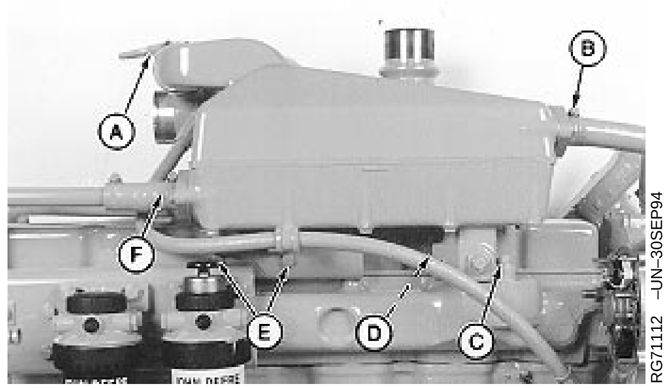
AFTERCOOLER ASSEMBLY



A—Cover
B—Aftercooler
C—Front Adapter Plate
D—Gasket (2 used)
E—Intake Manifold
F—Aftercooler Bracket
G—Rear Adapter Plate
H—Cap Screw (10 used)
I—Gasket (2 used)

RG,CTM8,DX156 –19–13JAN95–1/1

REMOVE AND INSTALL AFTERCOOLER



A—Hose Clamp
B—Hose
C—Cap Screw
D—Cap Screw
E—Cap Screw (2 used)
F—Hose

1. Disconnect hoses (B and F) from end caps.
2. Disconnect air inlet elbow.
3. Disconnect intake manifold-to-cylinder head cap screws (E).
4. Disconnect aftercooler bracket-to-cylinder head cap screws.
5. Loosen hose clamp (A). Remove aftercooler.
6. Remove and discard gaskets and O-rings.
7. Reverse removal procedure and install aftercooler.
8. Coat cap screws with PT569 NEVER-SEEZ® Compound and tighten cap screws to specifications.

Aftercooler-to-Intake Manifold—Specification

Torque .... 27 N•m (20 lb-ft)

Aftercooler Bracket-to-Cylinder Head—Specification

Torque .... 47 N•m (35 lb-ft)

Aftercooler Adapter Plates—Specification

Torque .... 27 N•m (20 lb-ft)

Aftercooler Intake Manifold-to-Cylinder Head—Specification

Torque .... 47 N•m (35 lb-ft)

IMPORTANT: All aftercooler connections at the turbocharger and cylinder head must be tight to prevent loss of power resulting from lower intake manifold pressure.

9. Connect hoses and tighten clamps securely.
10. Fill cooling system with proper clean coolant. (See Group 02.)
11. Start engine and check assembly for leaks.

NEVER-SEEZ is a registered trademark of Emhart Chemical Group

RG,CTM8,DX155 –19–17FEB95–1/1

INSPECT AND REPAIR AFTERCOOLER

1. Inspect aftercooler for overall condition. The fins should be reasonably straight.

2. Inspect aftercooler inlet and outlet hoses. Replace either tube if cracked or damaged.

3. Test aftercooler for leaks by plugging tube port (B).

4. Apply compressed air (A) to the other opening while aftercooler is submerged under water. Use 140—170 kPa (1.4—1.7 bar) (20—25 psi) air pressure for testing.

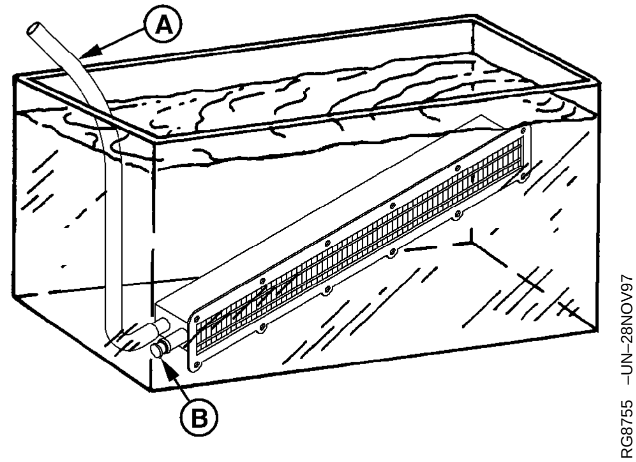
5. Observe water for any air bubbles, indicating a leak in the aftercooler.

   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.

6. Inspect aftercooler cover for cracks or damage. Replace as necessary.

7. Clean cover with solvent and dry with compressed air.



A—Compressed Air Hose
B—Tube Port

RG,CTM8,DX353 –19–13JAN95–1/1

ESSENTIAL TOOLS

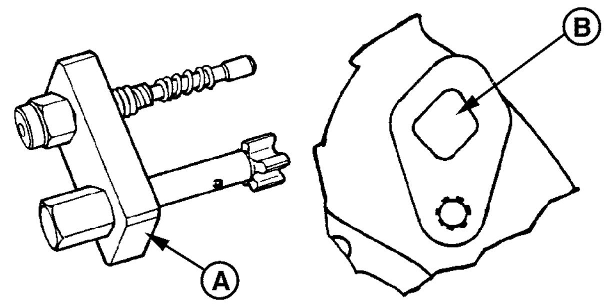
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,374 –19–08OCT98–1/12

Flywheel Turning Tool (A) JD281A

Used on engines with 142 tooth flywheel ring gear and a diamond shaped tool guide bore (B) in flywheel housing. Tool has it's own spring loaded timing pin which threads into flywheel housing.

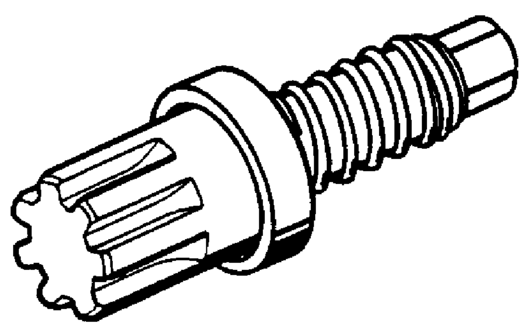


RG6252 –UN–03NOV97

DPSG,OUO1004,374 –19–08OCT98–2/12

Flywheel Turning Tool JDG820

Used on engines with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) ID flywheel housing guide bore. Used to rotate engine to check damper radial runout and time engine. Replace JDE81-1 Flywheel Turning Tool.



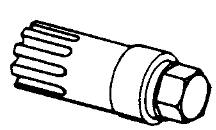
RG7056

RG7056 –UN–05DEC97

DPSG,OUO1004,374 –19–08OCT98–3/12

Flywheel Turning Tool JDE83

Used to rotate flywheel on engines with 142-tooth flywheel ring gear and a 26.5 mm (1.04 in.) ID flywheel housing guide bore diameter. Use with JDE81-4 Timing Pin.



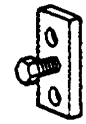
RG6251 –UN–22JUL92

Continued on next page

DPSG,OUO1004,374 –19–08OCT98–4/12

RG5152 –UN–23AUG88

Injection Pump Shaft Removal Tool JD303



Used to remove injection pump drive shaft from drive gear on Stanadyne DB2 injection pumps with non-retained drive shafts.

DPSG,OUO1004,374 –19–08OCT98–5/12

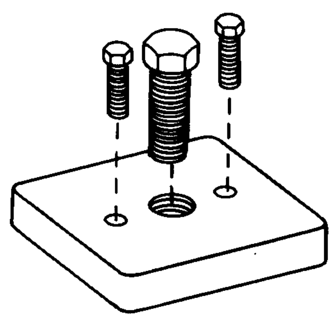
RG5153 –UN–23AUG88

Injection Pump Drive Shaft Seal Installer JD256

Used to install pump shaft seal on Stanadyne DB2 injection pumps with non-retained drive shafts.

DPSG,OUO1004,374 –19–08OCT98–6/12

Injection Pump Drive Gear Puller JDG670A



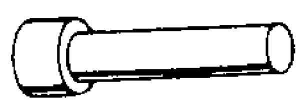
RG6032 –UN–13JAN92

Remove drive gear from tapered shaft on Stanadyne DB4 (with retained drive shafts) and DB4 fuel injection pumps. Also used to remove drive gear on Lucas CAV injection pumps.

DPSG,OUO1004,374 –19–08OCT98–7/12

RG5068 –UN–05DEC97

Timing Pin JDE81-4



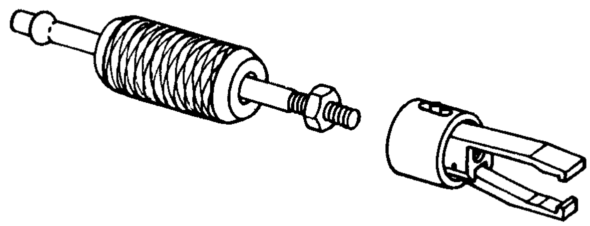
RG5068

Lock engine at TDC when installing injection pump or timing valve train. Used with JDG820, JDE81-1, or JDE83 Flywheel Turning Too.

Continued on next page DPSG,OUO1004,374 –19–08OCT98–8/12

Injection Nozzle Puller JDE38B

Remove injection nozzles.



RG9478 –UN–12NOV98

Nozzle Puller with Adapter

If JDE38B is not available, JDE38A Nozzle Puller with JDG716 Adapter can be used. JDG716 can be used with slide handle adapter from JDE38 or JDE38A to remove 9.5 mm nozzles without removing the rocker arm cover.

Repair Kit

JDG716-1 Repair Kit is available if leg of JDG716 Adapter is damaged.

DPSG,OUO1004,374 –19–08OCT98–9/12

RG5084 –UN–23AUG88

Nozzle Bore Cleaning Tool JDE39

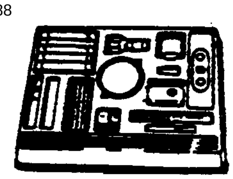
Clean injection nozzle bore in cylinder head.

DPSG,OUO1004,374 –19–08OCT98–10/12

RG5224 –UN–23AUG88

Nozzle Cleaning Kit JDF13

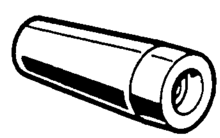
Clean injection nozzles.



DPSG,OUO1004,374 –19–08OCT98–11/12

Nozzle Carbon Stop Seal Installer JD258

Used to install carbon stop seal in injection nozzle groove.



RG6254 –UN–22JUL92

DPSG,OUO1004,374 –19–08OCT98–12/12

SERVICE EQUIPMENT AND TOOLS

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

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,375 –19–08OCT98–1/8

Bosch Bench Mounted Nozzle Tester JT25510

Check nozzle opening pressure.

DPSG,OUO1004,375 –19–08OCT98–2/8

Fuel Line KJD10109

Use with JT25510 Nozzle Tester to check nozzle opening pressure.

DPSG,OUO1004,375 –19–08OCT98–3/8

Fuel Injection Nozzle Tester Adapter Set D01110AA

Check nozzle opening pressure.

DPSG,OUO1004,375 –19–08OCT98–4/8

OTC Portable Nozzle Tester D01109AA

Check nozzle opening pressure.

DPSG,OUO1004,375 –19–08OCT98–5/8

Nozzle Holding Fixture ROS17787

Support fuel injection nozzles for service.

Continued on next page

DPSG,OUO1004,375 –19–08OCT98–6/8

Inspection Magnifier. ROS16487

Inspect injection nozzle tips.

DPSG,OUO1004,375 –19–08OCT98–7/8

Torque Wrench Adapter . . . . ROS18958 (English) or No. 24374 (Metric)

Tighten pressure adjusting screw locknut on injection nozzle.

DPSG,OUO1004,375 –19–08OCT98–8/8

OTHER MATERIAL

Number	Name	Use
T43512 (U.S.) TY9473 (Canadian) 242 (LOCTITE®)	Thread Lock and Sealer (Medium Strength)	Apply to injection pump front access plate cap screws, fuel line fittings and supply pump mounting cap screws, between fuel pump and cylinder block gasket, and timing hole cover cap screws.
ROS16489 (U.S.)	Lapping Compound	Use on nozzle valve for cleaning in the guide area ONLY.

Number	Name	Use
TY15130[1] (U.S.) NA (Canadian)	Form-in-Place Gasket	Use on injection pump cover and pump timing gear cover ONLY when a traditional gasket is not available through service parts.

LOCTITE is a registered trademark of Loctite Corp.

[1]Use DD14928 Sealing Compound Kit when servicing an engine within the European Market/Service Area. Follow manufacturer’s directions on package when using and storing sealant.

DPSG,OUO1004,376 –19–08OCT98–1/1

FUEL SYSTEM SPECIFICATIONS

Item	Measurement	Specification
Fuel Filter Base Mounting Bracket-to-Cylinder Head	Torque	34—54 N•m (25—40 lb-ft)
Primary Fuel Filter/Water Separator Mounting Base-to-Bracket	Torque	34 N•m (25 lb-ft)
Final Fuel Filter Mounting Base-to-Bracket	Torque	34 N•m (25 lb-ft)
Fuel Supply Pump	Pressure	28—41 kPa (0.28—0.41 bar) (4—6 psi)
Fuel Supply Line-to-Injection Pump	Torque	30 N•m (22 lb-ft)
Stanadyne DB2 Pump Drive Gear-to-Pump Shaft Hex-Nut (8 mm Chrome)	Torque	60 N•m (45 lb-ft)
Injection Pump-to-Front Plate Hex-Nuts	Torque	27 N•m (20 lb-ft)
Stanadyne DB2/Non-Retained Drive Shaft Injection Pump Fuel Delivery Lines	Torque	27 N•m (20 lb-ft)
Fuel Injection Pump Supply Line	Torque	30 N•m (22 lb-ft)
Fuel Injection Pump Return Line	Torque	16 N•m (12 lb-ft)
Stanadyne Pump Cover Cap Screw (All Models)	Torque	2 N•m (1.7 lb-ft) (20 lb-in.)
Stanadyne DB4 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut	Torque	195 N•m (145 lb-ft)
Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut (11 mm Black)	Torque	125 N•m (90 lb-ft)
Injection Pump Cover Cap Screws (All Models)	Torque	2 N•m (1.7 lb-ft) (20 lb-in.)

Continued on next page
DPSG,OUO1004,377 –19–08OCT98–1/5

Item	Measurement	Specification
Injection Pump-to-Front Plate Hex-Nuts	Torque	27 N•m (20 lb-ft)
Stanadyne DB2/Retained Drive Shaft and DB4 Injection Pump Fuel Delivery Lines	Torque	34 N•m (25 lb-ft)
Stanadyne DM4 Fuel Injection Pump Drive Gear-to-Pump Shaft Retaining Nut	Torque	195 N•m (145 lb-ft)
Stanadyne DM4 Fuel Injection Pump Delivery Lines	Torque	34 N•m (25 lb-ft)
Lucas Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut	Torque	80 N•m (60 lb-ft)
Lucas Injection Pump Drive Gear Cover Cap Screws	Torque	2 N•m (1.7 lb-ft) (20 lb-in.)
Lucas Injection Pump Fuel Delivery Lines	Torque	30 N•m (22 lb-ft)
Aneroid Bracket to Injection Pump Cover Cap Screws	Torque	5 N•m (3.5 lb-ft)
Aneroid Pressure (Lever Lift-Off)	Pressure	76—102 mm Hg (3—4 in. Hg) 10—14 kPa (1.5—2.0 psi)
Aneroid Pressure (Lever at Full Travel)	Pressure	330—380 mm Hg (13—15 in. Hg) 44—51 kPa (6.4—7.4 psi)
Fuel Injection Nozzles (Naturally Aspirated Engines) (Except 4045D and 6068D) and 4039TLV01 Engines		
Opening Pressure of New or Reconditioned Nozzle With New Internal Parts	Opening Pressure For Setting	22060—22750 kPa (221—228 bar) (3200—3300 psi)
	Opening Pressure For Checking (Minimum)	21800 kPa (218 bar) (3160 psi)

Continued on next page

Item	Measurement	Specification
Minimum Acceptable Opening Pressure of Used Nozzle	Opening Pressure For Checking (Minimum)	19850 kPa (198 bar) (2880 psi)
Maximum Opening Pressure Difference Between Cylinders	Maximum Pressure Difference	700 kPa (7 bar) (100 psi)
Fuel Injection Nozzles (Turbocharged Engines) (Except 4039TLV01, and 4045T and 6068T Marine Engines) and 4045D and 6068D Engines		
Opening Pressure of New or Reconditioned Nozzle With New Internal Parts	Opening Pressure For Setting	25510—26200 kPa (255—262 bar) (3700—3800 psi)
	Opening Pressure For Checking (Minimum)	25200 kPa (252 bar) (3660 psi)
Minimum Acceptable Opening Pressure of Used Nozzle	Opening Pressure For Checking (Minimum)	22950 kPa (230 bar) (3330 psi)
Maximum Opening Pressure Difference Between Cylinders	Maximum Pressure Difference	700 kPa (7 bar) (100 psi)
Fuel Injection RE48786 Nozzles (4045T and 6068T Marine Engines)		
Opening Pressure of New or Reconditioned Nozzle With New Internal Parts	Opening Pressure For Setting	25900—26200 kPa (259—262 bar) (3750—3800 psi)
	Opening Pressure For Checking (Minimum)	25200 kPa (252 bar) (3660 psi)
Minimum Acceptable Opening Pressure of Used Nozzle	Opening Pressure For Checking (Minimum)	22950 kPa (230 bar) (3330psi)
Maximum Opening Pressure Difference Between Cylinders	Maximum Pressure Difference	700 kPa (7 bar) 100 psi)
Fuel Injection Nozzle Tip	Spray Angle	152°

Continued on next page

DPSG,OUO1004,377 –19–08OCT98–3/5

Item	Measurement	Specification
Nozzle Valve/Seat Tightness Condition at Pressure Test of 2800—3500 kPa (28—35 bar) (400—500 psi)	Leakage	Nozzle tip dry after 5 seconds. (Slight dampness permissible on used nozzles.)
Fuel Injection Nozzle Return Leakage at Pressure Test of 10300 kPa (103 bar) (1500psi)	Leakage	3—10 Drops/30 Seconds
Fuel Injection Nozzle Tip Orifice	Number of Orifices Per Nozzle	4
Fuel Injection Nozzle Tip Orifice (Naturally Aspirated Engines) (Except 4045D and 6068D) (Including 4039TLV01)	ID	0.28 mm (0.011 in.)
Fuel Injection Nozzle Tip Orifice (Turbocharged Engines) (Except 4039TLV01 and 4045T and 6068T Marine Engines) (Including 4045D and 6068D Engines)	ID	0.30 mm (0.012 in.)
Fuel Injection Nozzle Tip Orifice (4045T and 6068T Marine Engines)	ID	0.29 mm (0.0116 in.)
Fuel Injection Nozzle Pressure Adjusting Screw Locknut	Torque	10 N•m (7 lb-ft)
Fuel Injection Nozzle Valve Needle Lift (Naturally Aspirated Engines) (Except 4045D and 6068D) (Including 4039TLV01)	Needle Lift (Based on Zero Lift)	1/2 Turn Counterclockwise
Fuel Injection Nozzle Valve Needle Lift (Turbocharged Engines) (Except 4039TLV01) (Including 4045D and 6068D)	Needle Lift (Based on Zero Lift)	3/4 Turn Counterclockwise
Fuel Injection Nozzle Lift Adjusting Screw Lock Nut	Torque	5 N•m (3.5 lb-ft)
Fuel Injection Nozzle Hold-Down Clamp Cap Screws	Torque	37 N•m (27 lb-ft)

Continued on next page DPSG,OUO1004,377 –19–08OCT98–4/5

Item	Measurement	Specification
Fuel Leak-Off Line Hex Nuts	Torque	5 N•m (3.7 lb-ft) (44 lb-in.)
Fuel Injection Nozzle Delivery Line	Torque	34 N•m (25 lb-ft)

DPSG,OUO1004,377 –19–08OCT98–5/5

FUEL SYSTEM—GENERAL INFORMATION

Engines may be equipped with a Stanadyne or Lucas rotary-type injection pump. Rotary pumps are dynamically timed at the factory. See Group 115.

Some injection pumps are equipped with an aneroid.

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

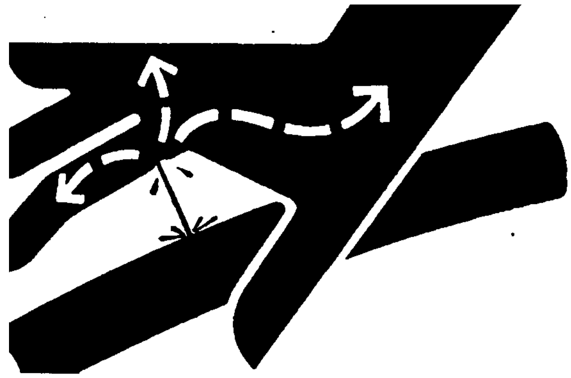
The fuel supply pump is a separate component mounted on the side of engine block and is actuated by a lever that rides on engine camshaft lobe.

Engines are equipped with a round final fuel filter or a rectangular fuel filter. Hand primer on top of round filter element is optional.

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

DPSG,OUO1004,368 –19–13SEP98–1/1

RELIEVE FUEL SYSTEM PRESSURE



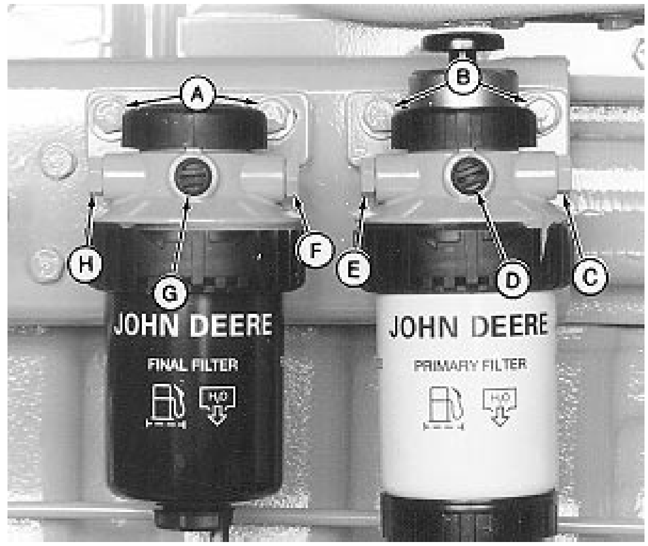
CAUTION: Escaping diesel fuel under pressure can have sufficient force to penetrate the skin, causing serious injury. Before disconnecting lines, be sure to relieve pressure. Before applying pressure to the system, be sure ALL connections are tight and lines, pipes and hoses are not damaged. Keep hands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

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

Any time the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system. (See BLEED FUEL SYSTEM in Group 115.)

RG,CTM8,G35,6 –19–29SEP94–1/1

REPLACE PRIMARY FUEL FILTER/WATER SEPARATOR AND FINAL FUEL FILTER ASSEMBLIES



RG71111 –UN–30SEP94

A—Cap Screw (2 used)
B—Cap Screw (2 used)
C—Water Separator Output Port
D—Vent Screw
E—Water Separator Input Port
F—Final Fuel Filter Input Port
G—Vent Screw
H—Final Fuel Filter Output Port

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

1. Thoroughly clean fuel filter/water separator assembly and surrounding area, if not previously done.
2. Connect a drain line to filter drain adapters and drain all fuel from filters.
3. Disconnect fuel lines from ports (C, E, F, and H).
4. Remove cap screws (A). Remove final fuel filter.
5. Remove cap screws (B). Remove water separator filter.
6. Replace parts as necessary.

NOTE: New primary fuel filter canisters are now keyed differently than the final fuel filters to prevent possible interchanging. The filters must be indexed properly and the key on canister must be oriented in slot of mounting base for correct installation.

7. Install water separator and fuel filters.
8. Connect lines.
9. Loosen vent screw (G) two full turns.
10. Fill filters using hand pump until fuel comes out final filter vent screw. Tighten vent screw. Wait three seconds to allow fuel to fill lines. Push hand pump two more times.

Fuel Filter Base Mounting Bracket-to-Cylinder Head—Specification

Torque .... 34—54 N•m (25—40 lb-ft)

Primary Fuel Filter/Water Separator Mounting Base-to-Bracket—Specification

Torque .... 34 N•m (25 lb-ft)

Continued on next page

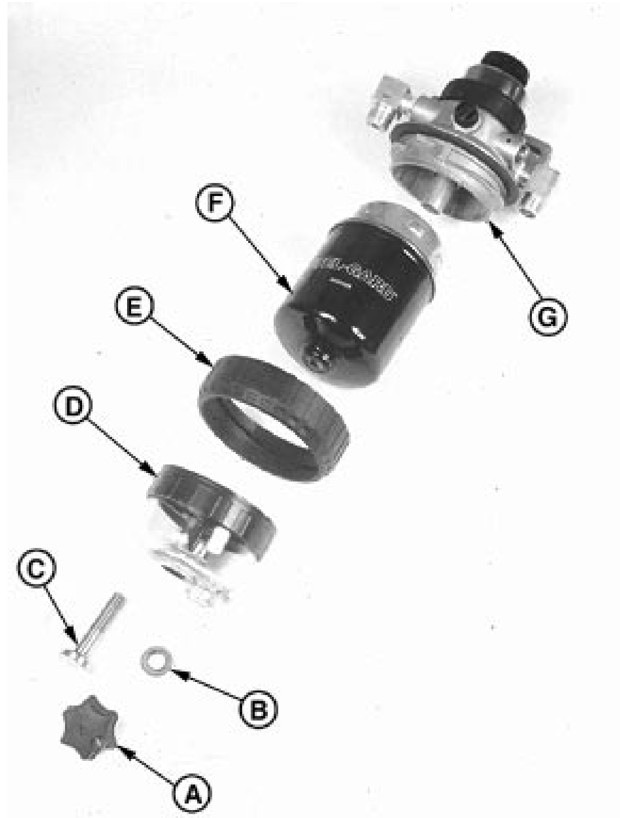
RG,CTM8,DX152 –19–18JAN95–1/2

Final Fuel Filter Mounting Base-to-Bracket—Specification

Torque .... 34 N•m (25 lb-ft)

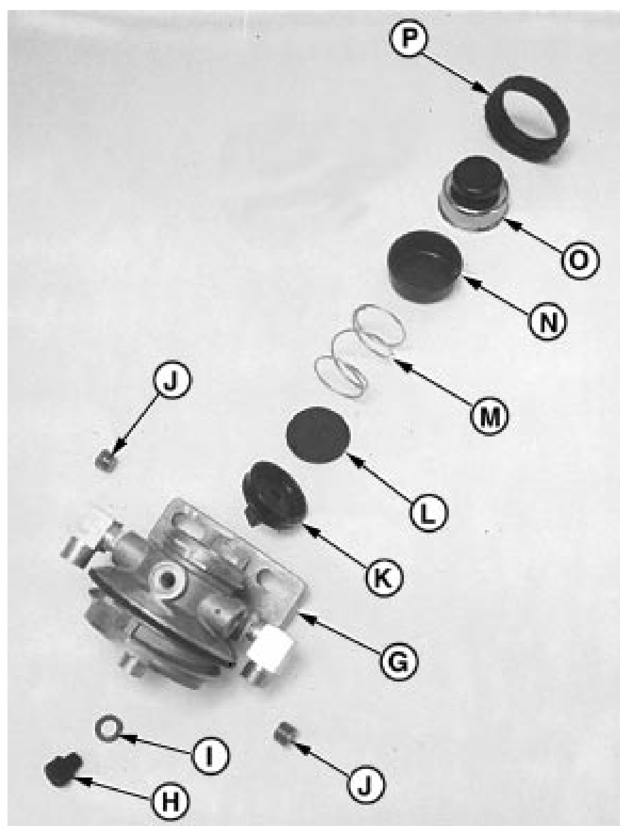
RG,CTM8,DX152 –19–18JAN95–2/2

PRIMARY FUEL FILTER/WATER SEPARATOR ASSEMBLY



RGT7751HR –UN–19NOV97

Primary Filter/Water Separator Assembly



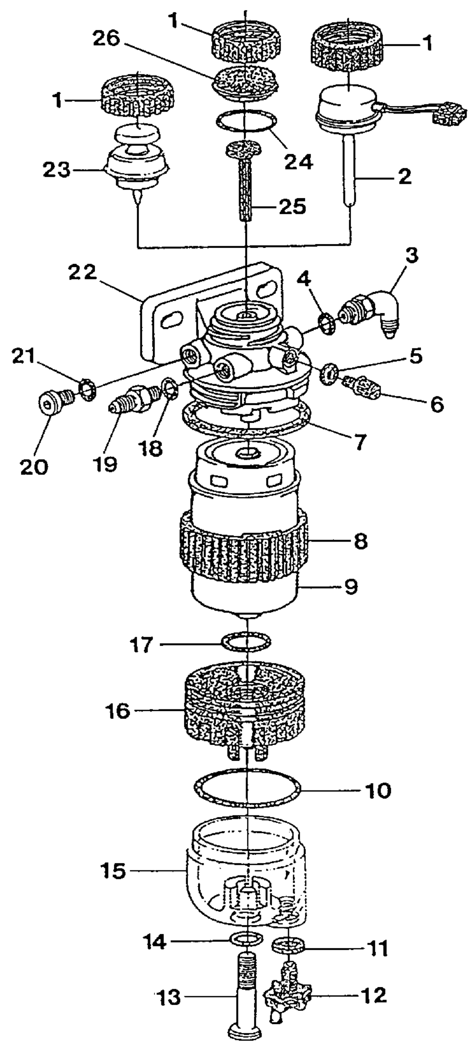
RGT7751HS –UN–19NOV97

Filter Base Assembly

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

DPSG,OUO1004,369 –19–13SEP98–1/1

FINAL FUEL FILTER ASSEMBLY



Final Fuel Filter

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

[1] *Positions and types of fittings vary depending on application.*

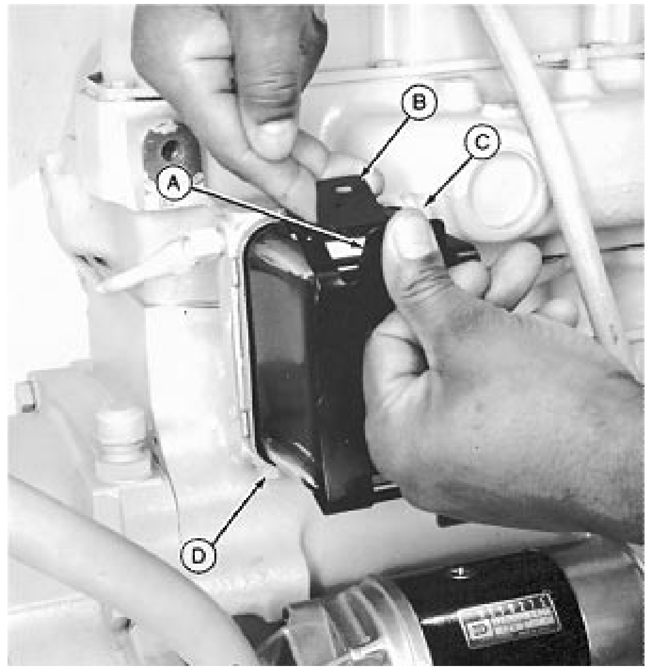
DPSG,OUO1004,370 –19–13SEP98–1/1

REPLACE RECTANGULAR FUEL FILTER ELEMENT

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

1. Loosen bleed plug (C) on side of filter base. Remove drain plug from bottom of filter base and drain fuel from filters.

2. Push inward on tab (A) while lifting upward on tab (B) to release the retaining hook. Remove retaining spring and pull fuel filter off fuel filter body.



RG5668 –UN–12APR90

A—Tab A
B—Tab B
C—Bleed Plug
D—Drain Plug

Continued on next page

RG,CTM8,G35,7A –19–16SEP92–1/2

Before installing a new filter element, inspect the filter element-to-mounting plate contact locations (broken lines) for cleanliness. This location MUST BE completely void of any dirt or other contaminants. Carefully clean as required.

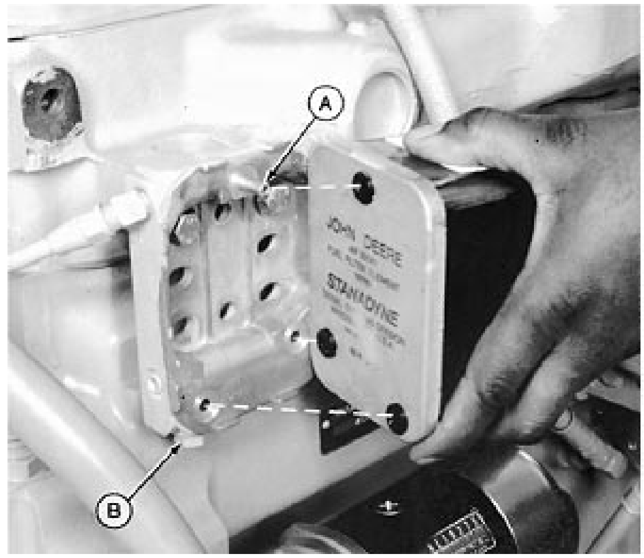
IMPORTANT: Any dirt lodged in the spring pin groove or at the end of the spring pin (A) by cleaning efforts will be washed into the fuel injection system. This may result in severe damage to the fuel injection pump or nozzles.

3. Place filter on filter body with upper seal over spring pin on filter body.

4. Hook bottom end of retaining spring first, then hook the top end.

5. Install drain plug (B) and tighten securely.

6. Bleed air from fuel system. (See BLEED FUEL SYSTEM, in Group 115.)

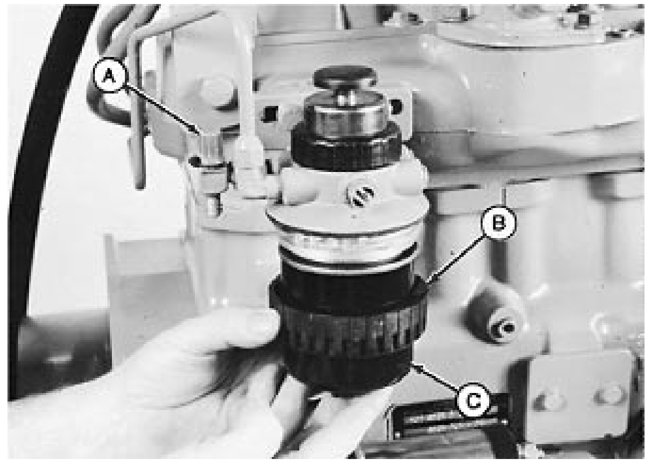


RG5669 –UN–12APR90

A—Spring Pin
B—Drain Plug

RG,CTM8,G35,7A –19–16SEP92–2/2

REPLACE ROUND FUEL FILTER ELEMENT (EARLY MODEL ENGINES)



A—Fuel Inlet Valve
B—Filter Retaining Ring
C—Fuel Filter

1. Rotate the fuel inlet valve (A) to the closed position.

2. Firmly grasp the filter retaining ring (B) and rotate it counterclockwise (left) 1/3 turn. Remove retaining ring and fuel filter (C).

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

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

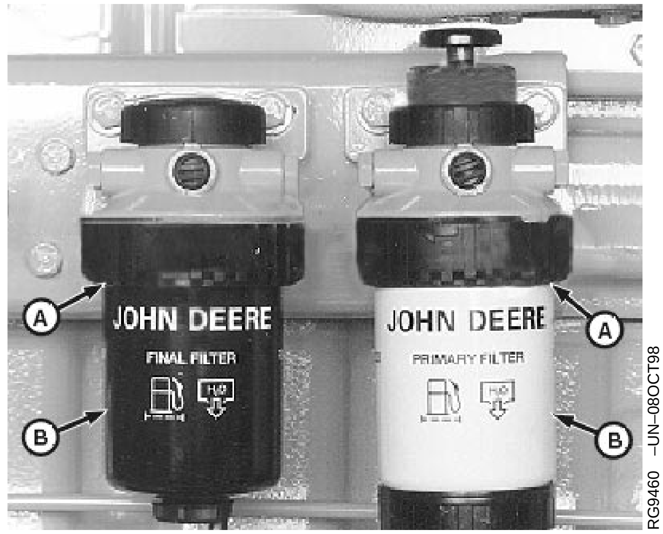
4. Install new filter element onto mounting base and position element using a slight rocking motion. Be sure element is properly indexed on mounting base.

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

6. Rotate fuel inlet valve to the OPEN position and bleed the fuel system. (See BLEED THE FUEL SYSTEM, in Group 115.)

RG,CTM8,G35,R1 –19–29SEP92–1/1

REPLACE FINAL FUEL FILTER AND PRIMARY FUEL FILTER/WATER SEPARATOR ELEMENTS (LATER ENGINES)



A—Retaining Ring
B—Filter Element

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

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

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

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

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

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

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

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

5. Remove water separator bowl, if equipped. Drain and clean separator bowl. Dry with compressed air.

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

7. Thoroughly inspect filter base seal ring. Replace as needed.

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

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

Continued on next page
DPSG,OUO1004,372 –19–19SEP98–1/2

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

10. Bleed fuel system. (See BLEED THE FUEL SYSTEM, in Group 115.)

DPSG,OUO1004,372 –19–19SEP98–2/2

REMOVE FUEL SUPPLY PUMP

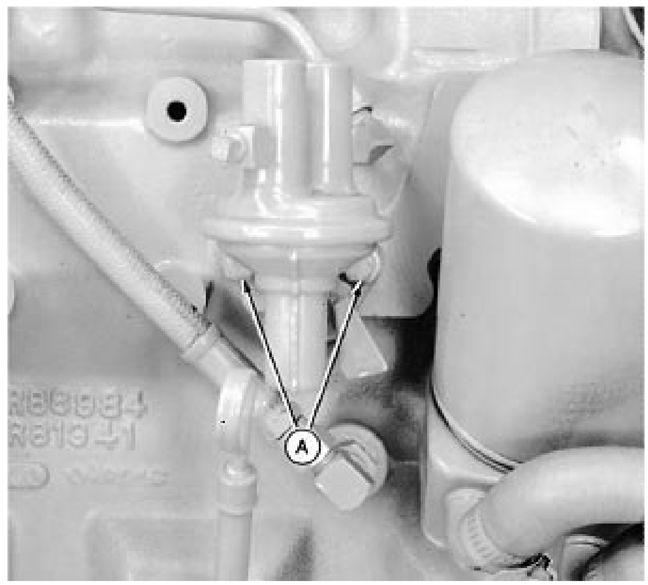
NOTE: 3029 engines do not have a fuel supply pump, fuel is gravity fed to this engine.

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

1. Disconnect fuel lines and cap connections on fuel supply pump and fuel lines to keep debris out of fuel system.

2. Remove cap screws (A) and remove fuel supply pump assembly from cylinder block.

3. Cover opening on cylinder block to prevent dirt from entering the engine.



RG5671 –UN–12APR90

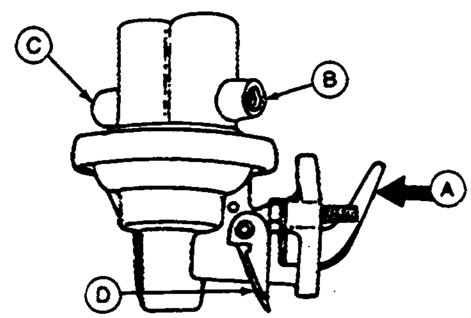
A—Cap Screws

RG,CTM8,G35,14 –19–11SEP92–1/1

BENCH TEST FUEL SUPPLY PUMP

The following bench tests can be performed on a supply pump installed on the engine when the pump is suspected to be defective. See MEASURE FUEL SUPPLY PUMP PRESSURE in Group 115.

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



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

VACUUM/PRESSURE TEST

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

1. Remove inlet and outlet fittings.

2. Install vacuum/pressure gauge to inlet side of pump (B).

3. Move primer lever (D) all the way upward. Release lever and at the same time observe gauge:

   The gauge needle should read the same value each time, and then very slowly return to "0". This indicates that the inlet valve and diaphragm are in good condition. Proceed to next step.

   If the gauge needle does not move at all, or the needle rapidly returns to "0", the pump is defective and must be replaced.

4. Remove vacuum/pressure gauge and install onto outlet side of pump (C).

5. Move priming lever all the way to upward position. Release lever and at same time observe gauge reading:

Continued on next page

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

Fuel Supply Pump—Specification

Pressure .... 28—41 kPa (0.28—0.41 bar) (4—6 psi)

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

RG,CTM8,G35,15 –19–11SEP92–2/3

LEAKAGE TEST

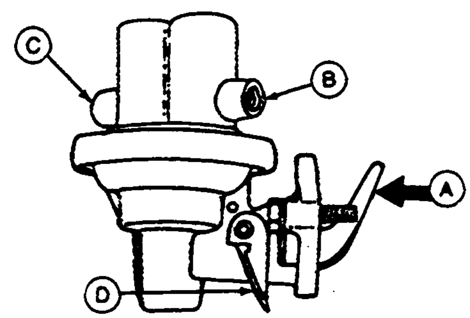
The leakage test should be performed if a supply pump suspected of leaking fuel externally, or internally into the engine crankcase.

1. Install an air line on inlet side of pump (B) and apply 140 kPa (1.4 bar) (20 psi) pressure.

2. Hold finger over outlet side of pump (C) or install a plug. Submerge pump into a container of clean diesel fuel.

   If air bubbles occur around banded connection holding the two halves of pump together (indicating leakage), replace pump.

   If the diaphragm is bad, there will be leakage through vent holes (if equipped) and around the rocker arm. Replace pump as necessary.



RG5167 –UN–14DEC88

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

RG,CTM8,G35,15 –19–11SEP92–3/3

INSTALL FUEL SUPPLY PUMP

IMPORTANT: Apply LOCTITE® 242 Thread Lock and Sealer (TY9370) to threads of supply pump mounting screws and fuel line fittings when reinstalling supply pump. DO NOT allow sealant to get into fuel system.

1. Install the fuel supply pump to cylinder block using a new gasket. Tighten cap screws to specifications.

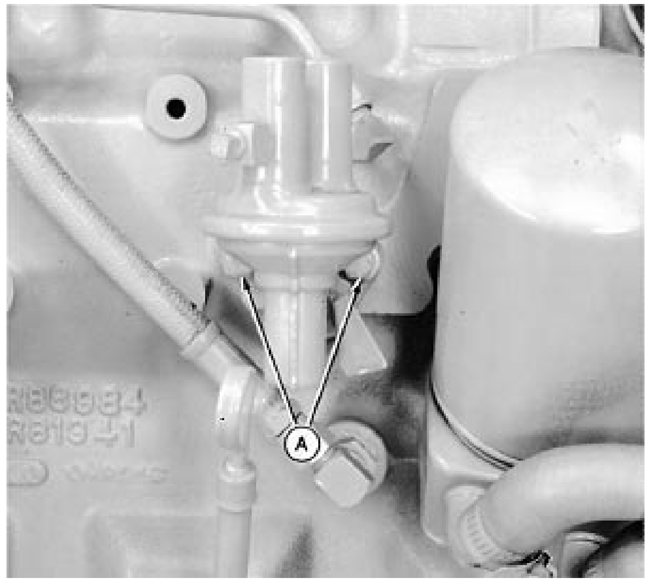
Fuel Supply Line-to-Injection Pump—Specification

Torque .... 30 N•m (22 lb-ft)

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

2. Connect fuel lines and tighten securely.

3. Bleed fuel system. (See BLEED THE FUEL SYSTEM in Group 115.)



RG5671 –UN–12APR90

A—Cap Screws

LOCTITE is a registered trademark of the Loctite Corp.

RG,CTM8,G35,17 –19–18JAN95–1/1

FUEL INJECTION PUMP TIMING

Fuel injection pumps on John Deere Diesel Engines are timed one of two ways at the factory:

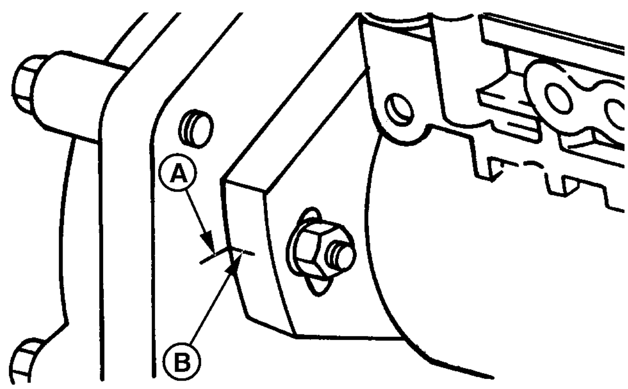
By Static Timing, which is accomplished by the alignment of internal pump timing marks (cam ring-to-governor weight retainer) and/or the alignment of injection pump flange-to-front plate timing marks.

By Dynamic Timing, which involves a sensor installed within the No. 1 fuel line and connected to a pulse-activated timing meter to determine precisely at what point injection occurs. Another form of dynamic timing employs the use of a timing light along with a fixed reference mark on engine block and a timing mark on crankshaft damper or pulley which aligns with fixed reference mark when light flashes.

See Group 115 for dynamic timing procedures.

RG,CTM8,G35,18 –19–18JAN95–1/3

STATIC TIMING WITH EXTERNAL MARKS



A—Mark on Front Plate
B—Mark on Pump

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

2. Tighten the three hex nuts securing pump to front plate to specifications.

Rotary Injection Pump Mounting Nuts—Specification

Torque .... 27 N•m (20 lb-ft)

Also see “Dynamic Timing” in Group115.

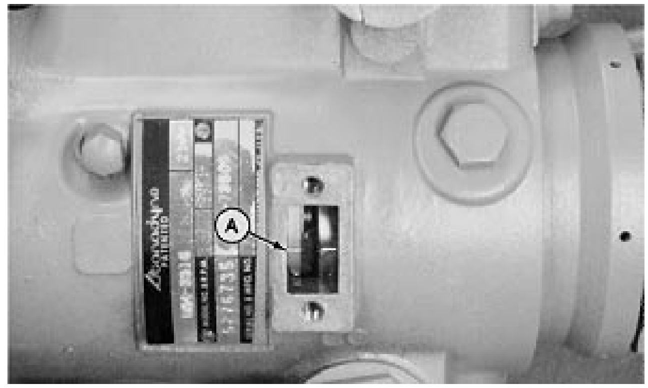
Continued on next page

RG,CTM8,G35,18 –19–18JAN95–2/3

STATIC TIMING WITHOUT TIMING MARKS (STANADYNE PUMPS)

1. Make sure piston no. 1 is at TDC compression stroke and remove timing hole cover from injection pump.

2. With attaching hex nuts finger tight, pivot the pump housing away from the block as far as slots will allow. Then pivot it back until the timing marks (A) on cam ring and governor weight retainer are aligned. Tighten pump attaching nuts to specifications.



T6077AK –UN–28OCT88

Rotary Injection Pump Mounting Nuts—Specification

Torque .... 27 N•m (20 lb-ft)

RG,CTM8,G35,18 –19–18JAN95–3/3

REMOVE STANADYNE MODEL DB2 INJECTION PUMP WITH NON-RETAINED DRIVE SHAFT

Stanadyne DB2 injection pumps will have either a non-retained drive shaft (shaft stays in engine when pump is removed) a retained drive shaft (shaft stays in the pump when pump is removed from engine). Pumps with retained drive shafts are identified with a label on the pump mounting flange that reads "TOOL REQUIRED FOR REMOVAL - SEE OPERATOR'S MANUAL". Refer to REMOVE STANADYNE MODEL DB2 (WITH RETAINED DRIVE SHAFT) AND DB4 INJECTION PUMPS, later in this group.

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

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

NOTE: The injection pump can be removed without engine being positioned at No.1 TDC, however, this aids installation if the pump drive shaft position is not changed.

2. Use either JD281A, JDG820, or JDE83 Flywheel Turning Tool to rotate crankshaft to position No. 1 piston at TDC of it's compression stroke. At this position timing pin should enter hole in flywheel to lock engine at TDC.

Continued on next page

RG,CTM8,G35,R5 –19–18JAN95–1/4

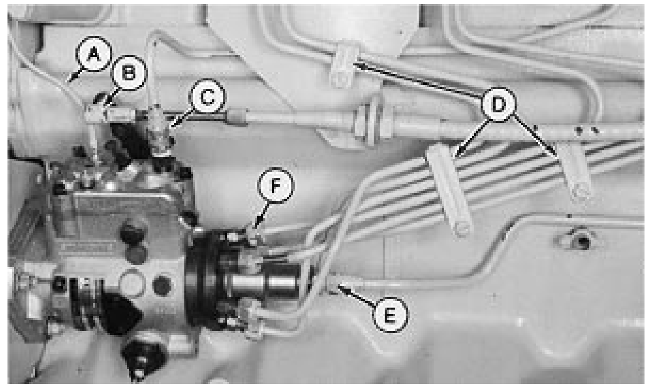
3. Disconnect shut-off cable and speed control linkage (B), if equipped. Disconnect electrical connection to shut-off solenoid (A) or throttle positioning solenoid, if equipped. Tag electrical wires for correct reassembly.

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

4. Disconnect fuel return line (C) and fuel supply line (D).

5. Disconnect all fuel delivery (pressure) lines (E) from injection pump using a suitable 17 mm deep-well crowsfoot socket.

6. Disconnect all fuel delivery (pressure) lines from injection nozzles so that line assembly can be lifted up to allow clearance for injection pump when removed from shaft.



T7263AG –UN–03JUL90

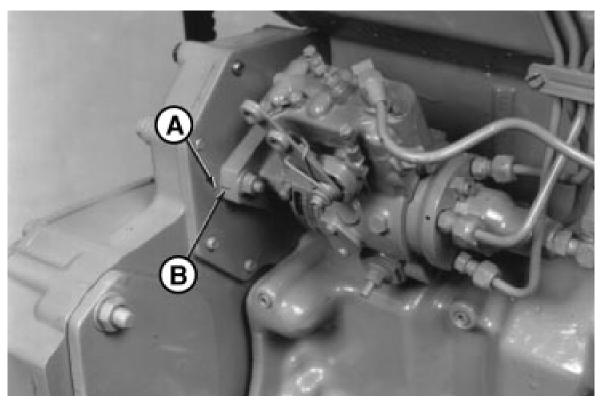
A—Wiring Lead
B—Speed Control Linkage
C—Fuel Return Line
D—Fuel Supply Line
E—Fuel Delivery Lines

RG,CTM8,G35,R5 –19–18JAN95–2/4

7. Check to make sure that timing marks are present on front plate (A) and injection pump flange (B). This provides a reference timing mark when pump is reinstalled on engine.

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

8. Remove three mounting stud hex nuts.



RG6278 –UN–03NOV97

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

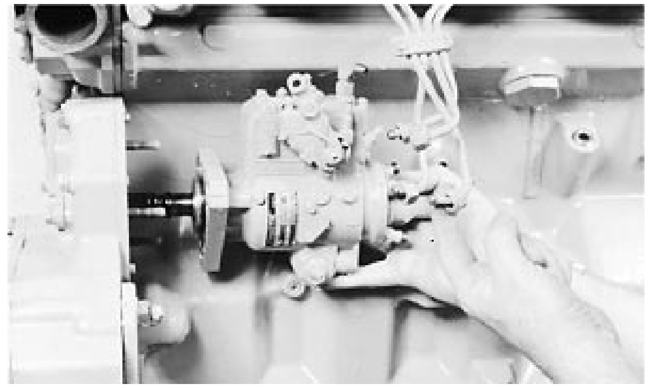
Continued on next page

RG,CTM8,G35,R5 –19–18JAN95–3/4

9. Remove injection pump from mounting studs and pump drive shaft. Shaft will stay with engine (in drive gear).

10. Remove both seals from shaft and discard.

11. If pump repair is needed remove drive shaft from drive gear, take injection pump and drive shaft to an authorized ADS repair station. (See REMOVE STANADYNE DB2 NON-RETAINED INJECTION PUMP DRIVE SHAFT FROM ENGINE, later in this group.)



RG6291 –UN–22JUL92

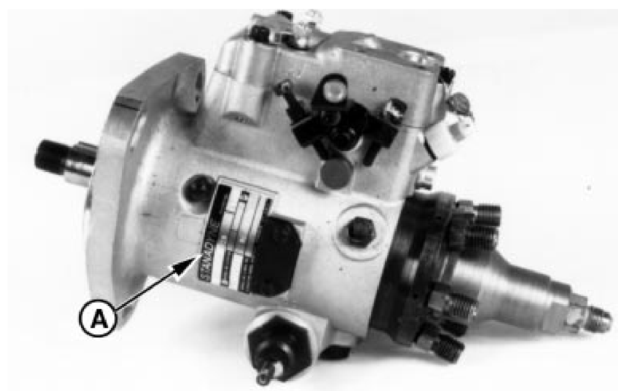
RG,CTM8,G35,R5 –19–18JAN95–4/4

REPAIR STANADYNE FUEL INJECTION PUMP

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

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

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



RG5724 –UN–31OCT97

A—Serial Number Tag

RG,CTM8,G35,25 –19–29SEP94–1/1

REMOVE STANADYNE DB2 NON-RETAINED INJECTION PUMP DRIVE SHAFT FROM ENGINE

Some authorized Stanadyne repair stations require the drive shaft to accompany the injection pump when pump is serviced. Otherwise, it is not necessary to remove the drive shaft, unless shaft is broken, worn, or damaged.

1. Remove injection pump as described earlier in this group.

2. Remove injection pump cover plate from timing gear cover (shown removed).

3. Remove nut (A) and washer securing pump drive gear to shaft. Be careful not to drop nut and/or washer inside timing gear cover.

A—Nut

RG,CTM8,G35,22 –19–16SEP92–1/3

4. Install JD303 Injection Pump Shaft Removal Tool on timing gear cover. Evenly tighten attaching screws securely.

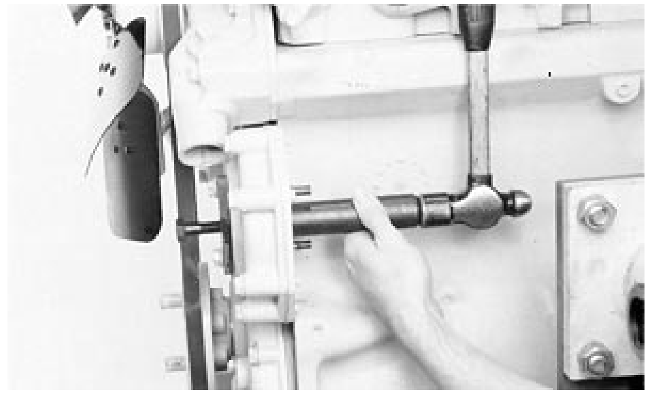
IMPORTANT: DO NOT overtighten center cap screw, damage may occur to timing gear cover.

5. Turn center cap screw clockwise against injection pump drive shaft until drive gear is held firmly against the front plate.

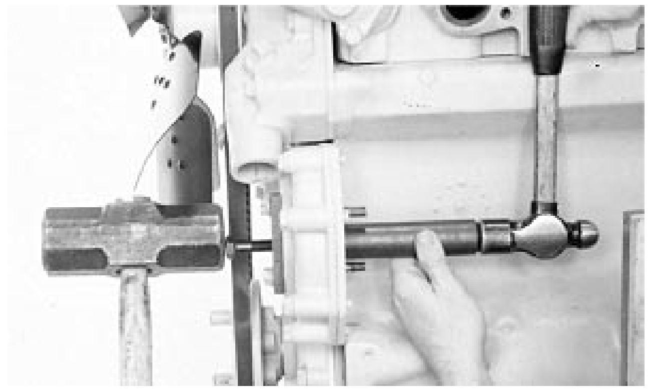
Continued on next page RG,CTM8,G35,22 –19–16SEP92–2/3

6. Using a suitable tubular-type driver (one that will go over shaft and against drive gear) and a hammer, drive gear off shaft. Be careful not to lose Woodruff key in pump shaft.

NOTE: Pump shaft is tapered. It may be necessary to have an assistant hold a heavy hammer against the head of JD303 Shaft Removal Tool's center forcing screw while striking the gear. If shaft still does not come loose from gear, it may be necessary to remove the timing gear cover (Group 16) and press shaft out of gear.



T81894 –UN–01NOV88



T81895 –UN–01NOV88

RG,CTM8,G35,22 –19–16SEP92–3/3

INSTALL NON-RETAINED DRIVE SHAFT IN STANADYNE DB2 INJECTION PUMP (IF REMOVED FROM ENGINE)

1. Apply a light coating of clean engine oil or grease to new seals for pump drive shaft. Install both seals on shaft as shown.

2. Before installing the drive shaft, find the small drilled hole (A) on the drive shaft tang. There is a similar drilled hole in the distributor rotor in the injection pump. The shaft must be installed in the injection pump so the two drilled holes (in pump rotor and in shaft) are aligned.

RG6276 –UN–22JUL92

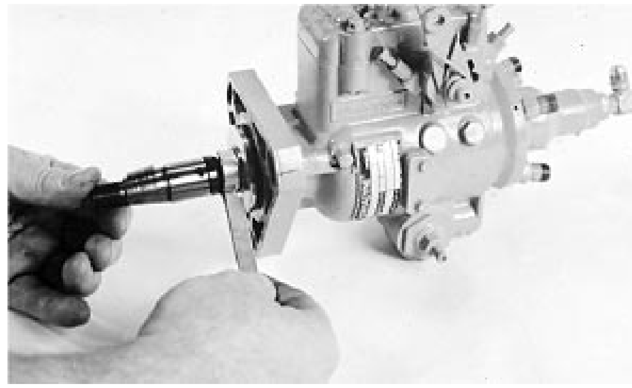
A—Drilled Hole

Continued on next page

RG,CTM8,G35,26 –19–17JUL92–1/2

IMPORTANT: Do not invert drive shaft seal lips. If resistance is felt, stop and inspect position of seal. If seal has been forced back, replace seal.

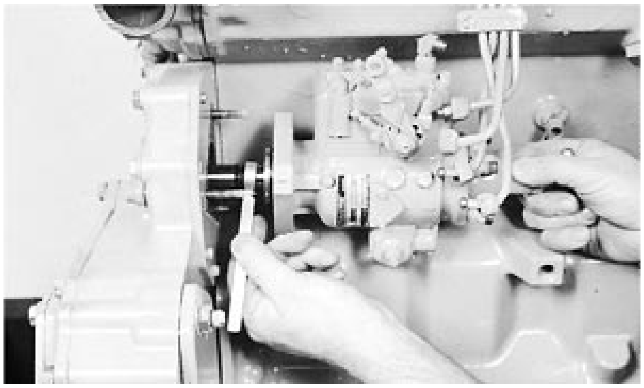
3. Compress seal with JD256 Injection Pump Drive Shaft Seal Installing Tool as the shaft is installed.



RG6275 –UN–22JUL92

RG,CTM8,G35,26 –19–17JUL92–2/2

INSTALL STANADYNE MODEL DB2 INJECTION PUMP WITH NON-RETAINED DRIVE SHAFT



RG6277 –UN–22JUL92

T95246 –UN–01NOV88

A—Gear-to-Shaft Hex Nut

Early Stanadyne DB2 injection pumps are timed by aligning internal marks on cam ring and governor weight retainer. Current DB2 injection pumps are timed by locking No. 1 cylinder at TDC of it’s compression stroke and align timing marks on pump mounting flange with reference mark on front plate. ALWAYS check for reference timing marks on pump mounting flange and front plate first, if no marks are found, pump should be timed by referencing internal marks.

1. On early pumps that are timed using internal timing marks, position engine at TDC of No. 1 piston’s compression stroke and lock at this position with timing pin. Rotate injection pump shaft until timing marks on governor weight retainer and cam ring are aligned.

2. **On pumps where drive shaft has remained in drive gear:**

   Lubricate two new shaft seals with a light coating of clean engine oil or grease and install.

IMPORTANT: Do not invert drive shaft seal lips. If resistance is felt, stop and inspect position of seals. If either seal has been forced back, install a new seal.

NOTE: Lubricate a new O-ring with clean engine oil and install on front face of injection pump mounting flange.

3. Compress seals with JD256 Shaft Seal Installation Tool and install pump over shaft and position hub onto mounting studs.

   On pumps where drive shaft is installed in pump:

   Make sure Woodruff key is installed in pump shaft and that it is not loose in keyway. Replace pump drive shaft and/or keyway as necessary.

IMPORTANT: Do not drop Woodruff key, shaft nut, or washer into timing gear cover while installing injection pump. Retain shaft in gear with nut and washer.

4. Lubricate a new O-ring with clean engine oil, install O-ring onto front face of pump mounting flange. Slide injection pump onto mounting studs while inserting pump shaft and key into drive gear keyway.

Continued on next page

RG,CTM8,G35,28 –19–18FEB95–1/5

5. Install three hex nuts onto pump mounting studs and tighten finger-tight only at this time.

6. Tighten drive gear-to-shaft hex nut (A) to specifications.

Stanadyne DB2 Pump Drive Gear-to-Pump Shaft Hex-Nut (8 mm Chrome)—Specification

Torque.. 60 N•m (45 lb-ft)

Install drive gear access plate using a new gasket, apply LOCTITE® 242 to cap screw threads and tighten to specifications.

Stanadyne Pump Cover Cap Screw (All Models)—Specification

Torque.. 2 N•m (1.7 lb-ft) (20 lb-in.)

LOCTITE is a registered trademark of the Loctite Corp.

RG,CTM8,G35,28 –19–18FEB95–2/5

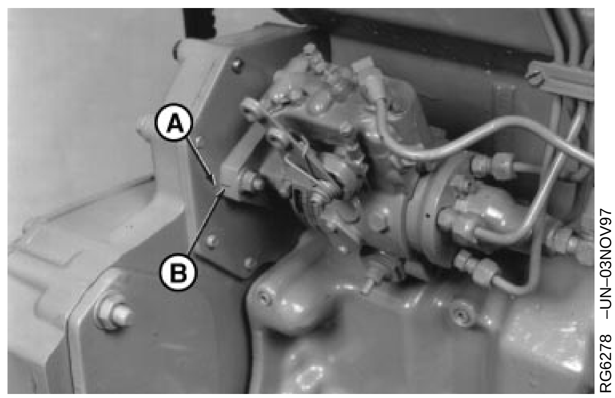
7. **On current pumps that are static timed:**

   Align timing mark on the pump flange (B) exactly with timing mark on the cylinder block front plate (A).

8. Install and tighten three hex nuts securing the pump to the front plate to specifications.

Injection Pump-to-Front Plate Hex-Nuts—Specification

Torque .... 27 N•m (20 lb-ft)



A—Timing Mark on Pump Flange
B—Timing Mark on Block

Continued on next page

RG,CTM8,G35,28 –19–18FEB95–3/5

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

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

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

Stanadyne DB2/Non-Retained Drive Shaft Injection Pump Fuel Delivery Lines—Specification

Torque .... 27 N•m (20 lb-ft)

11. Connect fuel supply line (C) and fuel return line (D) and tighten to specifications.

Fuel Injection Pump Supply Line—Specification

Torque .... 30 N•m (22 lb-ft)

Fuel Injection Pump Return Line—Specification

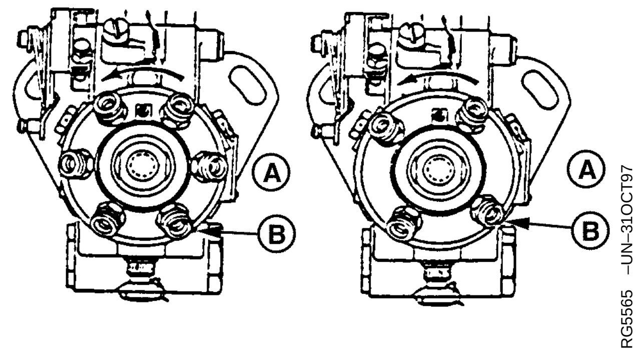
Torque .... 16 N•m (12 lb-ft)

12. Connect fuel shut-off cable and speed control linkage, if equipped. Install and securely tighten electrical connections to shut-off solenoid and throttle positioning solenoid, if equipped.

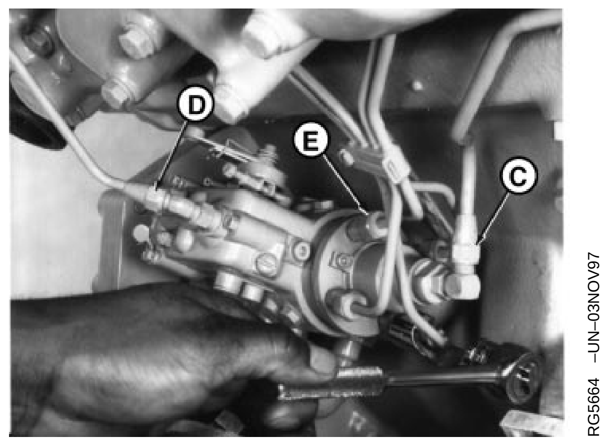
13. Install timing hole cover plate on pump, using a new gasket. Apply LOCTITE® 242 to cap screw threads and tighten to specifications.

Stanadyne Pump Cover Cap Screw (All Models)—Specification

Torque .... 2 N•m (1.7 lb-ft) (20 lb-in.)



6-Cylinder and 4-Cylinder



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

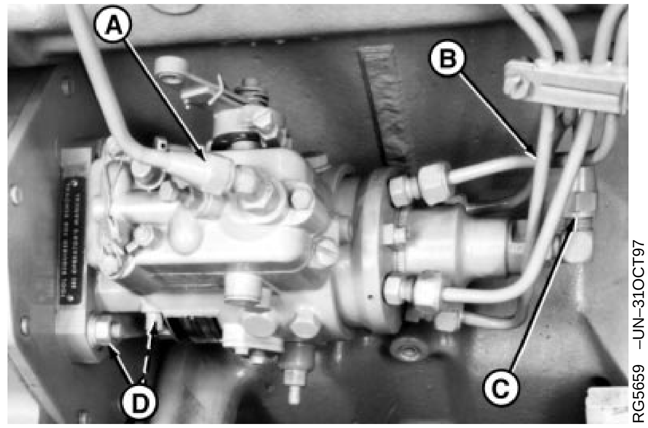
LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

14. Bleed air from fuel system as outlined in Group 115. Start engine, run for several minutes and check for fuel leaks.

RG,CTM8,G35,28 –19–18FEB95–5/5

REMOVE STANADYNE MODEL DB2 (WITH RETAINED DRIVE SHAFT) AND DB4 INJECTION PUMP



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

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

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

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

2. Disconnect shut-off cable and speed control linkage, if equipped. Disconnect electrical connection to shut-off solenoid or throttle positioning solenoid, if equipped. Tag electrical wires for correct reassembly.

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

3. Disconnect fuel return line (A) and fuel supply line (C).

4. Disconnect all fuel delivery (pressure) lines (B) from injection pump using a suitable 17 mm deep-well crowsfoot socket.

Continued on next page

RG,CTM8,G35,R10 –19–29SEP94–1/3

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

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

6. Attach JDG670A Drive Gear Puller (A) to injection pump drive gear as shown.

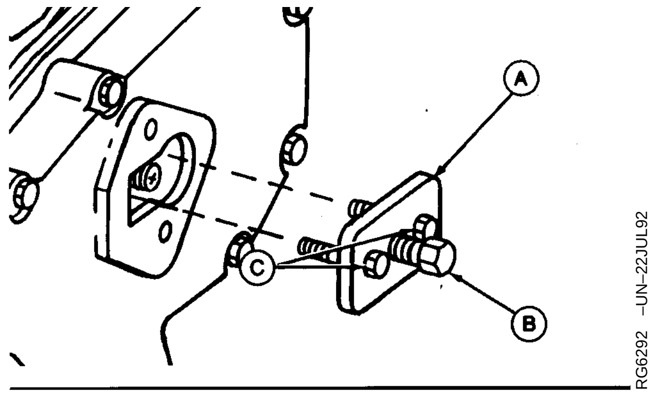
NOTE: Replace 6 mm Grade 12.9 cap screws (C) as needed.

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

IMPORTANT: On engines equipped with crankshaft gear-driven auxiliary drive options, DO NOT remove puller from gear after pump shaft is free from gear. The drive gear will move inside timing gear cover and may become disengaged from camshaft gear causing the gear to be one or more teeth out of time.

Once gear is free from shaft, remove center forcing screw from puller and tighten the two 6 mm screws into gear on puller until gear is pulled against timing gear cover. Leave puller attached until injection pump is reinstalled on engine.

8. Tighten center forcing screw until pump drive gear is free from tapered shaft. Remove JDG670A Puller and screws from drive gear.



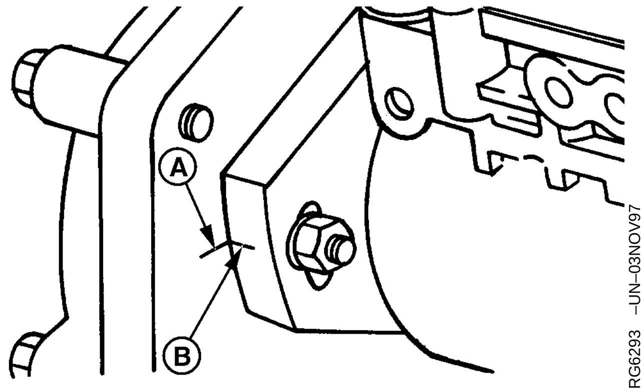
A—Drive Gear Puller
B—Forcing Screw
C—Cap Screws

Continued on next page RG,CTM8,G35,R10 –19–29SEP94–2/3

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

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

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



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

RG,CTM8,G35,R10 –19–29SEP94–3/3

INSPECT INJECTION PUMP DRIVE GEAR I.D. AND SHAFT O.D.

IMPORTANT: Use a good light source to thoroughly inspect gear I.D. and shaft O.D.

1. Inspect injection pump drive gear I.D. full 360° for metal transfer as a result of slippage on shaft.

2. Inspect injection pump drive shaft O.D. full 360° for presence of metal transfer from gear slippage. Also, check to see if index pin in shaft is not damaged, indicating gear slippage.

If there is clear evidence of metal transfer on pump shaft O.D., in drive gear I.D., or if index pin in pump shaft is damaged, injection pump and drive gear MUST BE replaced.

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

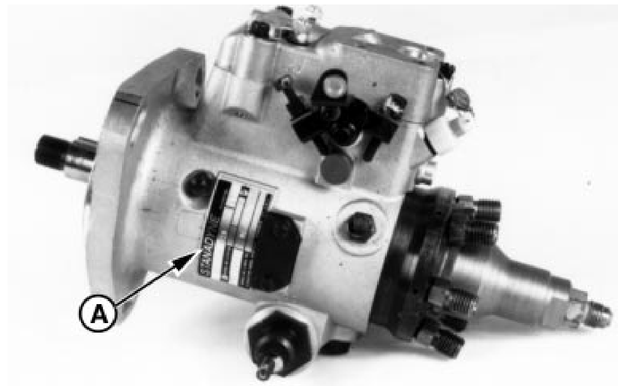
RG,CTM8,G35,R14 –19–21AUG92–1/1

REPAIR STANADYNE FUEL INJECTION PUMP

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

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

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



RG5724 –UN–31OCT97

A—Serial Number Tag

RG,CTM8,G35,25 –19–29SEP94–1/1

INSTALL STANADYNE MODEL DB2 (WITH RETAINED DRIVE SHAFT) AND DB4 INJECTION PUMP

A—Drive Gear Retaining Nut

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

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

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

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

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

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

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

Continued on next page RG,CTM8,G35,R15 –19–18FEB95–1/4

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

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

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

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

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

Stanadyne DB4 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut—Specification

Torque .... 195 N•m (145 lb-ft)

Stanadyne DB2 Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut (11 mm Black)—Specification

Torque .... 125 N•m (90 lb-ft)

8. Install access cover plate using a new gasket, apply LOCTITE® 242 (TY9370) to cap screw threads and tighten to specifications.

Injection Pump Cover Cap Screws (All Models)—Specification

Torque .... 2 N•m (1.7 lb-ft) (20 lb-in.)

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

RG,CTM8,G35,R15 –19–18FEB95–2/4

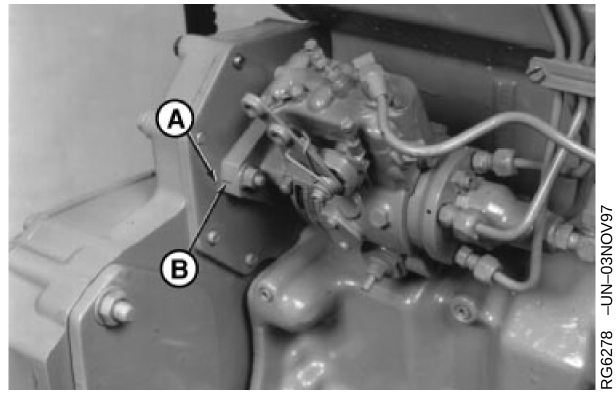
9. **On current pumps that are static timed:**

   Align timing mark on the pump flange (B) with timing mark on the cylinder block front plate (A).

10. Tighten the three hex nuts securing the pump to the front plate to specifications.

Injection Pump-to-Front Plate Hex-Nuts—Specification

Torque .... 27 N•m (20 lb-ft)



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

Continued on next page RG,CTM8,G35,R15 –19–18FEB95–3/4

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

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

12. Tighten fuel delivery (pressure) lines at pump to 34 N•m (25 lb-ft), using a suitable 17 mm deep-well socket.

Stanadyne DB2/Retained Drive Shaft and DB4 Injection Pump Fuel Delivery Lines—Specification

Torque .... 34 N•m (25 lb-ft)

13. Connect fuel supply line (C) and fuel return line (D) and tighten to specifications.

Fuel Injection Pump Supply Line—Specification

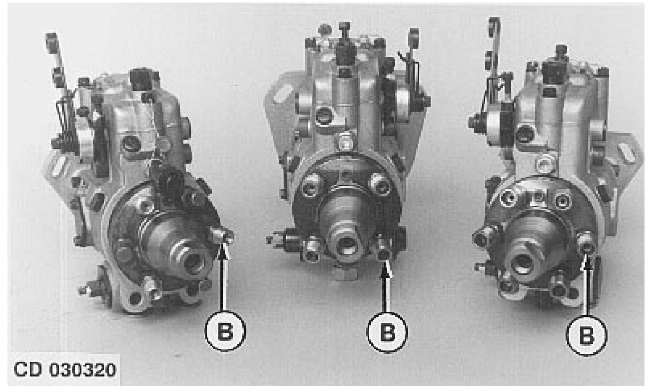
Torque .... 30 N•m (22 lb-ft)

Fuel Injection Pump Return Line—Specification

Torque .... 16 N•m (12 lb-ft)

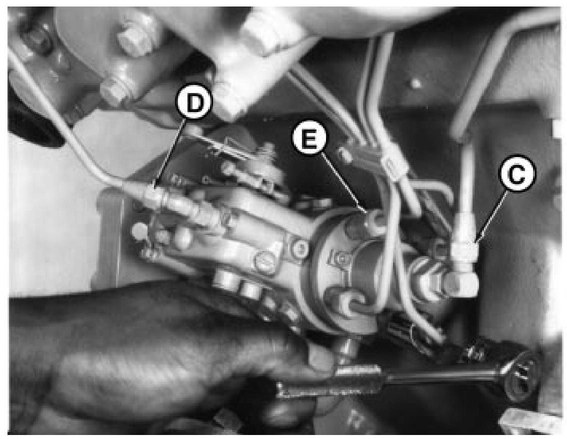
14. Connect fuel shut-off cable and speed control linkage, if equipped. Install and securely tighten electrical connections to shut-off solenoid and throttle positioning solenoid, if equipped.

15. Bleed air from fuel system as outlined in Group 115. Start engine, run for several minutes and check entire fuel system for leaks.



CD30320 –UN–17FEB95

6-Cylinder and 4-Cylinder



RG5664 –UN–03NOV97

B—Outlet Connection to No. 1 Cylinder
C—Fuel Supply Line
D—Fuel Return Line
E—Fuel Delivery (Pressure) Lines

RG,CTM8,G35,R15 –19–18FEB95–4/4

REMOVE STANADYNE MODEL DM4 FUEL INJECTION PUMP

Stanadyne injection pumps are internally timed by aligning governor weight retainer with cam ring.

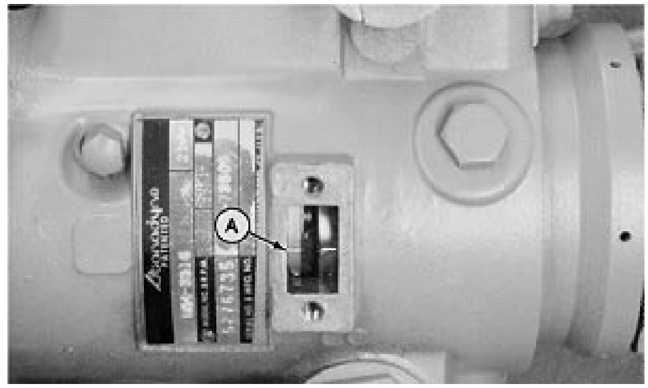
IMPORTANT: Never steam clean or pour cold water on a fuel injection pump while the pump is running or while it is warm. Doing so may cause seizure of internal rotating pump parts.

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

2. Use appropriate flywheel turning tool to rotate flywheel until engine is positioned at 'TDC' of No. 1 cylinder's compression stroke. Install JDE81-4 Timing Pin into hole in flywheel to lock engine at this position.

3. Remove timing hole cover (shown removed) from side of injection pump. Timing marks (A) will be aligned when engine is at No. 1 'TDC'.

   If timing marks are not aligned, remove timing pin from flywheel and rotate engine one full revolution until timing pin once again enters hole in flywheel. Marks should now be aligned and engine should be locked at No.1 'TDC'.



A—Timing Marks

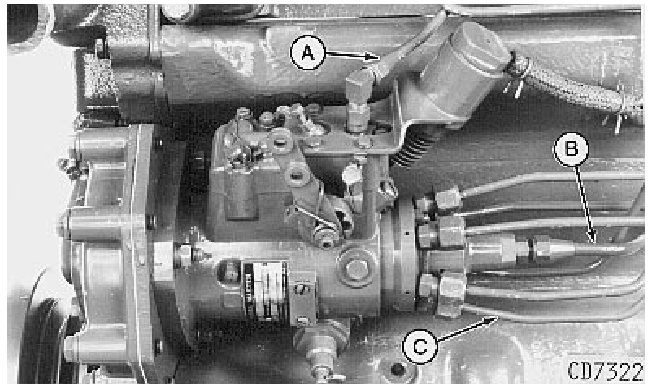
Continued on next page RG,CTM8,G35,R18 –19–18FEB95–1/3

4. Disconnect shut-off cable and speed control linkage, if equipped. Disconnect electrical connection to shut-off solenoid or throttle positioning solenoid if equipped. Tag electrical wires for correct reassembly.

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

5. Disconnect fuel supply line (B) and fuel return line (A).

6. Disconnect all fuel delivery lines (C) from fuel injection pump outlet fittings.



CD7322 –UN–23MAY95

A—Fuel Return Line
B—Fuel Supply Line
C—Fuel Delivery Lines

RG,CTM8,G35,R18 –19–18FEB95–2/3

7. Remove injection pump drive gear cover plate from timing gear cover, (shown removed).

8. Remove hex nut (A) and washer securing injection pump drive gear to pump drive shaft.

NOTE: Be careful pump shaft key does not fall into timing gear cover when pump is removed from engine.

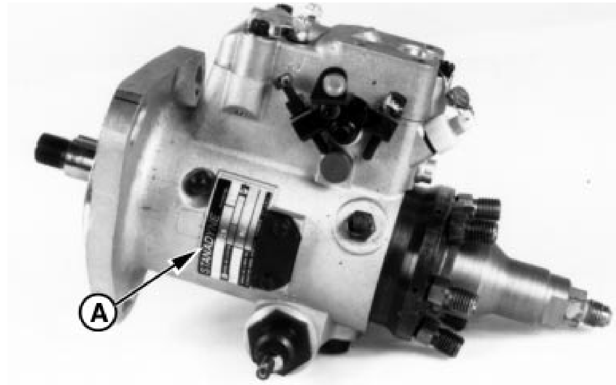
9. Remove three mounting stud nuts and washers and remove remove injection pump from engine. Place pump on a clean flat table.

T95246 –UN–01NOV88

A—Drive Gear Retaining Hex Nut

RG,CTM8,G35,R18 –19–18FEB95–3/3

REPAIR STANADYNE FUEL INJECTION PUMP



RG5724 –UN–31OCT97

A—Serial Number Tag

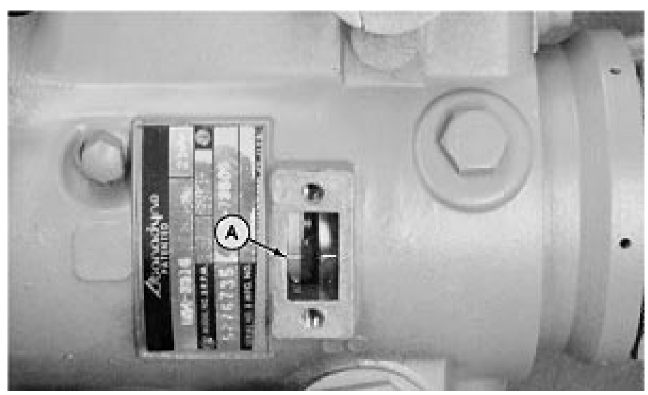
IMPORTANT: Do not disassemble the fuel injection pump further than necessary for installing available repair parts—not even for cleaning.

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

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

RG,CTM8,G35,25 –19–29SEP94–1/1

INSTALL STANADYNE MODEL DM4 FUEL INJECTION PUMP



T6077AK –UN–28OCT88

A—Timing Mark

1. Make sure that engine is locked at 'TDC' of No. 1 cylinder's compression stroke.

2. Remove timing hole cover from side of injection pump, (shown removed). Rotate pump drive shaft and align timing mark (A) on governor weight retainer hub with timing mark on cam ring.

3. Check pump mounting flange packing for damage. Replace packing as necessary. Lubricate packing with clean engine oil an instsall in groove on front face of pump mounting flange.

4. Install injection pump onto mounting studs so that shaft key aligns with keyway in pump drive gear. Install washers and nuts onto mounting studs. Tighten nuts finger tight.

Continued on next page RG,CTM8,G35,R21 –19–16SEP92–1/3

5. Install washer and nut (A) onto end of injection pump shaft. Tighten nut to specifications.

Stanadyne DM4 Fuel Injection Pump Drive Gear-to-Pump Shaft Retaining Nut—Specification

Torque .... 195 N•m (145 lb-ft)

6. Install access cover plate using a new gasket, apply LOCTITE® 242 (TY9370) to cap screw threads and tighten to specifications.

Injection Pump Cover Cap Screws (All Models)—Specification

Torque .... 2 N•m (1.7 lb-ft) (20 lb-in.)

7. Rotate injection pump away from block (counterclockwise, as viewed from flywheel end) as far as it will go. Now rotate pump in opposite direction until timing marks on governor weight retainer and cam ring are aligned. Tighten mounting stud nuts to specifications.

Injection Pump-to-Front Plate Hex-Nuts—Specification

Torque .... 27 N•m (20 lb-ft)

T95246 –UN–01NOV88

A—Drive Gear Retaining Nut

LOCTITE is a registered trademark of the Loctite Corp.

Continued on next page

RG,CTM8,G35,R21 –19–16SEP92–2/3

IMPORTANT: ALWAYS use a backup wrench when tightening fuel lines at injection pump so that fuel discharge fittings are altered to prevent possible internal pump damage.

8. Connect all fuel delivery (pressure) lines (C) at injection pump discharge fittings and tighten to specifications.

Stanadyne DM4 Fuel Injection Pump Delivery Lines—Specification

Torque .... 34 N•m (25 lb-ft)

9. Connect and tighten fuel supply line (B) and fuel return line (A) to specifications.

Fuel Injection Pump Supply Line—Specification

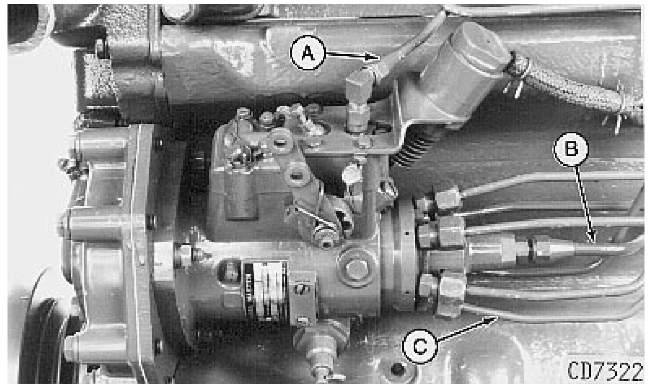
Torque .... 30 N•m (22 lb-ft)

Fuel Injection Pump Return Line—Specification

Torque .... 16 N•m (12 lb-ft)

10. Connect wiring to throttle positioning solenoid or fuel shut-off solenoid, if equipped.

11. Bleed the fuel system as detailed in Group 115. Start engine, run for several minutes, and check entire fuel system for leaks.



CD7322 –UN–23MAY95

A—Fuel Return Line
B—Fuel Supply Line
C—Fuel Delivery Lines

RG,CTM8,G35,R21 –19–16SEP92–3/3

REMOVE LUCAS CAV FUEL INJECTION PUMP

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

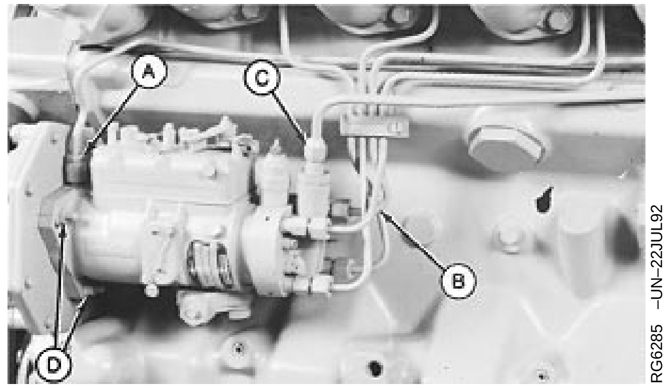
1. Clean the fuel injection pump, lines and area around the pump with cleaning solvent or a steam cleaner.

2. Disconnect shut-off cable and speed control linkage, if equipped. Disconnect electrical connection to shut-off solenoid or throttle positioning solenoid, if equipped. Tag electrical wires for correct reassembly.

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

3. Disconnect fuel return line (A) and fuel supply line (C).

4. Disconnect all fuel delivery (pressure) lines (B) from injection pump using a suitable 17 mm deep-well crowsfoot socket.



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

RG,CTM8,G35,R24 –19–18JAN95–1/4

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

A—Drive Gear Retaining Nut

Continued on next page

RG,CTM8,G35,R24 –19–18JAN95–2/4

NOTE: The injection pump drive gear fits snugly onto a tapered drive shaft and is indexed by a Woodruff key installed in drive shaft. Use JDG670A Drive Gear Puller (A) to remove drive gear from shaft.

6. Attach JDG670A Drive Gear Puller to injection pump drive gear as shown. Follow instructions provided with tool set.

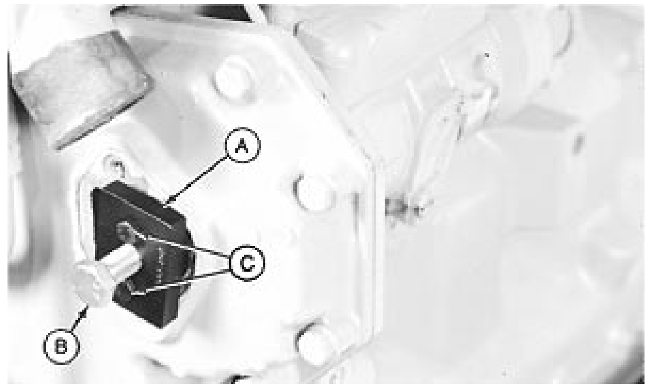
NOTE: Replace 6 mm, Grade 12.9 cap screws (C) as needed.

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

IMPORTANT: On engines equipped with crankshaft gear-driven auxiliary drive options, DO NOT remove puller from gear after pump shaft is free from gear. The drive gear will move inside timing gear cover and may become disengaged from camshaft gear causing the gear to be one or more teeth out of time.

Once gear is free from shaft, remove center forcing screw from puller and tighten the two 6 mm screws into gear on puller until gear is pulled against timing gear cover. Leave puller attached until injection pump is reinstalled on engine.

8. Tighten center forcing screw until pump drive gear is free from tapered shaft. Remove JDG670A Puller and screws from drive gear.



RG6294 –UN–22JUL92

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

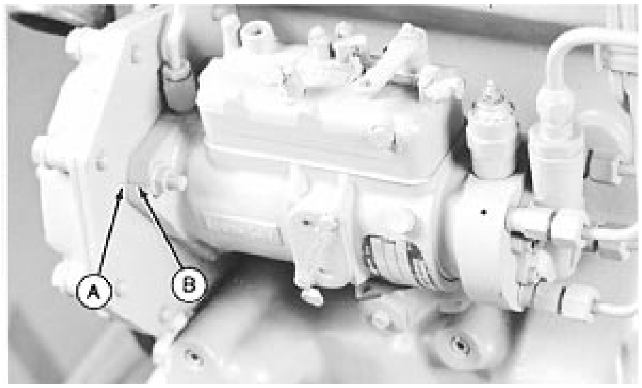
Continued on next page

RG,CTM8,G35,R24 –19–18JAN95–3/4

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

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

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



RG6284 –UN–22JUL92

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

RG,CTM8,G35,R24 –19–18JAN95–4/4

REPAIR LUCAS CAV FUEL INJECTION PUMP

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

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

RG,CTM8,G35,R33 –19–16SEP92–1/1

INSTALL LUCAS CAV FUEL INJECTION PUMP

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

1. Place a new O-ring onto front face of pump mounting flange with mounting slots aligned. Slide injection pump onto mounting studs while inserting pump shaft into drive gear.

2. Check pump shaft Woodruff key for proper alignment with pump drive gear key slot.

3. Install injection pump partially onto mounting studs with engaging pump pilot hub into engine front plate.

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

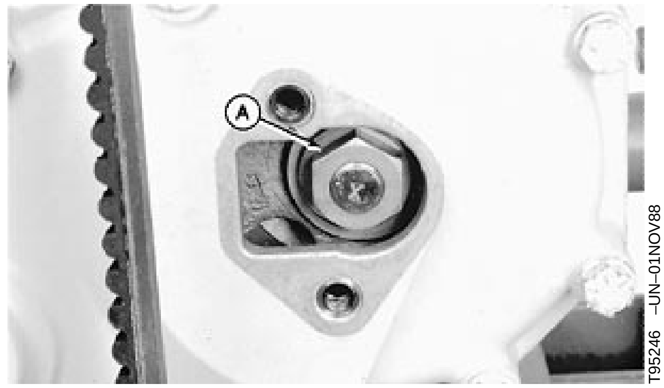
5. Install pump mounting flange flush to engine front plate with drive gear held flush against front side of engine front plate.

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

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

Lucas Fuel Injection Pump Drive Gear-to-Shaft Retaining Nut—Specification

Torque .... 80 N•m (60 lb-ft)



A—Drive Gear Retaining Nut

Continued on next page

8. Install access cover plate using a new gasket, apply LOCTITE® 242 (TY9370) to cap screw threads and tighten to specifications.

Lucas Injection Pump Drive Gear Cover Cap Screws—Specification

Torque .... 2 N•m (1.7 lb-ft) (20 lb-in.)

LOCTITE is a registered trademark of the Loctite Corp.

RG,CTM8,G35,R28 –19–18FEB95–2/4

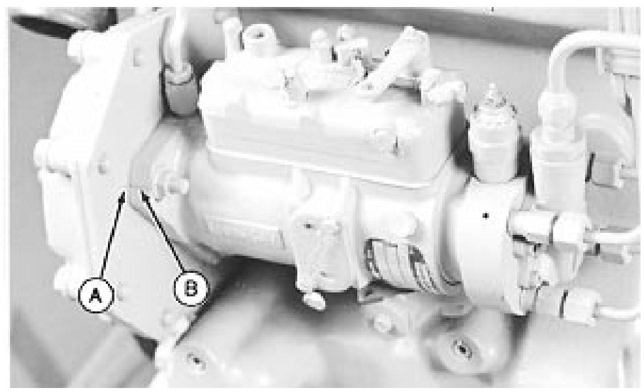
9. **On current pumps that are static timed:**

   Align timing mark on the pump flange (B) with timing mark on the cylinder block front plate (A).

10. Tighten the three hex nuts securing the pump to the front plate to specifications.

Fuel Injection Pump to Front Plate Retaining Nuts—Specification

Torque .... 27 N•m (20 lb-ft)



RG6284 –UN–22JUL92

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

Continued on next page RG,CTM8,G35,R28 –19–18FEB95–3/4

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

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

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

Lucas Injection Pump Fuel Delivery Lines—Specification

Torque .... 30 N•m (22 lb-ft)

13. Connect fuel supply line (C) and fuel return line (D) and tighten to specifications.

Fuel Injection Pump Supply Line—Specification

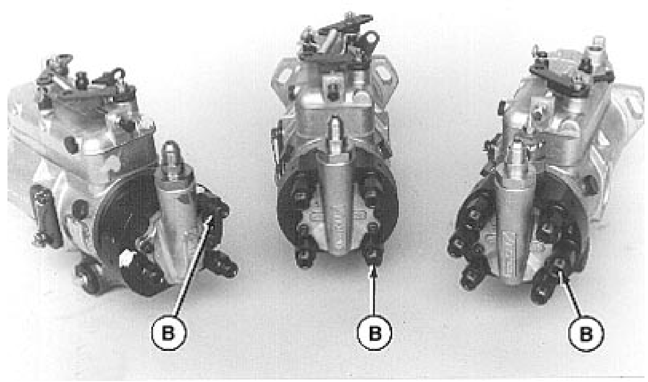
Torque .... 30 N•m (22 lb-ft)

Fuel Injection Pump Return Line—Specification

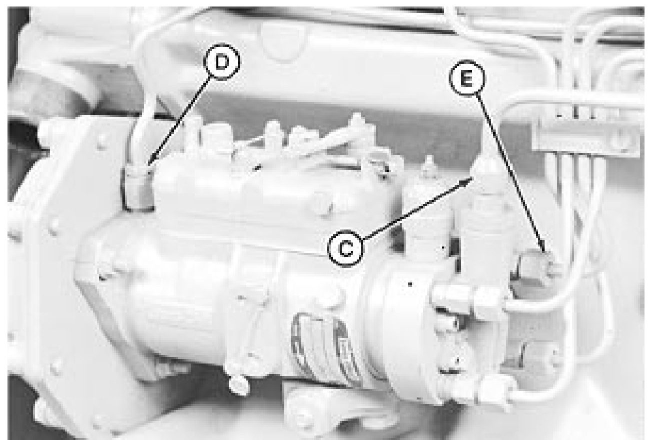
Torque .... 16 N•m (12 lb-ft)

14. Connect fuel shut-off cable and speed control linkage, if equipped. Install and securely tighten electrical connections to shut-off solenoid and throttle positioning solenoid, if equipped.

15. Bleed air from fuel system as outlined in Group 115. Start engine, run for several minutes and check entire fuel system for leaks.



RG9471 –UN–12NOV98



RG6295 –UN–22JUL92

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

RG,CTM8,G35,R28 –19–18FEB95–4/4

ANEROID REPLACEMENT

NOTE: It is not necessary to remove fuel injection pump when replacing an aneroid.

1. Remove clamp (A) and hose (B). Remove retaining ring (C) and attaching screws (D).

2. Remove aneroid and bracket assembly from pump.

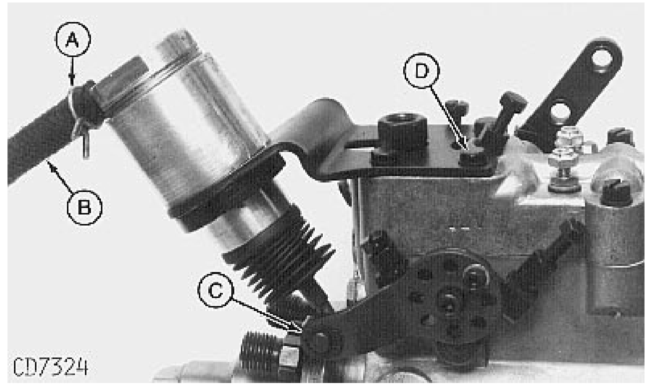
3. Prepare and adjust new aneroid. (See ANEROID ADJUSTMENT in this group.)

4. Attach operating rod to pump lever with retaining ring (C) and fasten bracket to injection pump cover with screws (D). Tighten screws to specifications.

Aneroid Bracket to Injection Pump Cover Cap Screws—Specification

Torque .... 5 N•m (3.5 lb-ft)

5. Connect hose (B) to aneroid inlet with clamp (A).



CD7324 –UN–23MAY95

A—Clamp
B—Hose
C—Retaining Ring
D—Cap Screw

RG,CTM8,DY022 –19–29SEP94–1/1

ANEROID FIELD ADJUSTMENT

1. On an inoperative aneroid, screw in operating rod and count the number of turns until it bottoms.

2. Take the new aneroid, screw in operating rod until it bottoms then back off by the same number of turns as were needed for the previous aneroid.

3. Install adjusted aneroid on injection pump.

RG,CTM8,G35,50 –19–29SEP94–1/1

ANEROID WORKSHOP ADJUSTMENT

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

1. Install a new aneroid on the injection pump.
2. Connect a regulated air pressure source to aneroid inlet and use a mercury manometer in preference to a gauge, as operating pressures are very low.
3. Note the pressure at which shut-off lever lifts off forward screw and the pressure required to obtain full travel until rear screw bottoms.

Aneroid Pressure (Lever Lift-Off)—Specification

Pressure.. 76—102 mm Hg (3—4 in. Hg)
10—14 kPa (1.5—2.0 psi)

Aneroid Pressure (Lever at Full Travel)—Specification

Pressure.. 330—380 mm Hg
(13—15 in. Hg)
44—51 kPa (6.4—7.4 psi)

NOTE: Liff-off pressure can be checked by inserting a shim of 0.05 mm (0.002 in.) thickness between lever and front screw; the shim will slip out as soon as the lever starts to move.

4. If lever travel requires more pressure than specified, lengthen the operating rod; if less pressure is required, shorten operating rod.
5. Once aneroid is set, repeat test to check adjustment.
6. Install injection pump on engine.

IMPORTANT: During aneroid adjustment, do not touch the forward/rear screw, as these devices have been adjusted on the test stand.

RG,CTM8,G35,51 –19–29SEP94–1/1

REPLACE ENGINE FRONT PLATE

1. Refer to Group 16 for front plate removal procedure. Consult your parts catalog for correct replacement front plate for your engine. Installing the wrong front plate will result in an inability to properly time the fuel injection pump.

   Three replacement front plates are available through service parts:

   - One plate is used for all Lucas and Stanadyne DB2 and DB4 injection pumps.
   - A second plate is used for Stanadyne DM4 injection pumps.
   - A third plate is used for engines with camshaft gear driven PTO.

IMPORTANT: Replacement front plates do not have a reference timing mark for the fuel injection pump. Timing mark must be transferred from existing front plate during reassembly.

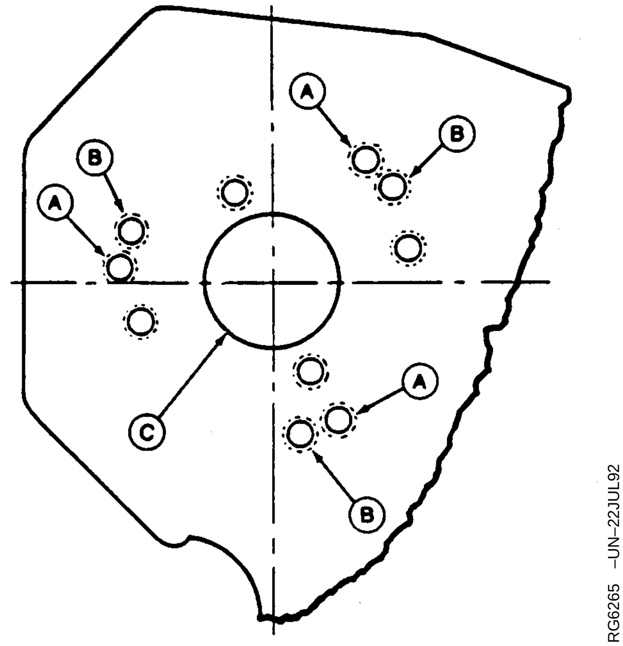
NOTE: Apply LOCTITE® 242 (TY9370) to threads of studs and set screw plugs before installing in front plate.

2. Install three mounting studs in appropriate location on front plate for your pump application.

3. Install set screw plugs in ALL threaded holes not used for mounting studs.

4. Accurately transfer injection pump timing mark from original front plate onto replacement plate as outlined later in this group. (See TRANSFER FUEL INJECTION PUMP TIMING MARK ONTO REPLACEMENT FRONT PLATE.)

5. Refer to Group 16 for front plate installation procedure.



Front Plate-Viewed from Pump Side

A—Stud Holes (All Stanadyne pumps and all 3- and 6-cyl. CAV. Also for CAV 4-cyl. pumps on 6000 Series Tractors.)
B—Stud Holes (All CAV 4-cyl. pumps except 6000 Series Tractors.)
C—50 mm (1.97 in.) Pump Pilot Bore Diameter

LOCTITE is a registered trademark of the Loctite Corp.

RG,CTM8,G35,R32 –19–18JAN95–1/1

TRANSFER FUEL INJECTION PUMP TIMING MARK ONTO REPLACEMENT FRONT PLATE

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

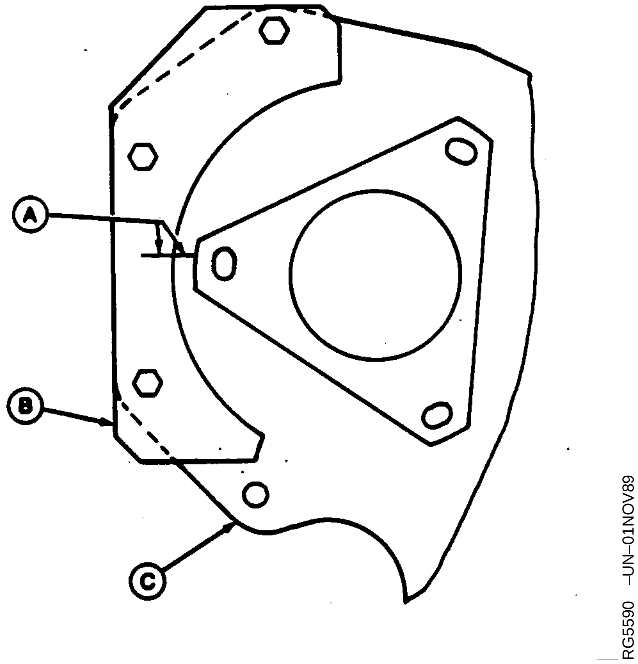
1. Position DFRG2 Aluminum Template (B) onto original front plate (C) as shown. (See Group 199, Dealer Fabricated Tools for manufacturing detail.) Install and tighten three 3/8-16 cap screws securely.

2. Transfer injection pump timing mark (A) from previous front plate onto template using a fine tip marker and straightedge. Remove template from front plate being replaced.

3. Attach template (with timing mark) to new replacement front plate and tighten cap screws securely.

4. Transfer timing mark from the template to the new front plate using a scribe. Scribe deep enough so mark becomes a permanent reference.

5. Remove template from front plate and refer to Group 16 for front plate installation procedure.



Front Plate (Viewed From Pump Side)

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

RG,CTM8,G35,33 –19–29SEP94–1/1

REMOVE FUEL INJECTION NOZZLES

General Nozzle Service Precautions:

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

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

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

RG,CTM8,G35,34 –19–16SEP92–1/4

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

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

RG6296 –UN–22JUL92

RG,CTM8,G35,34 –19–16SEP92–2/4

2. Disconnect fuel injection line from nozzle using a backup wrench on nozzle connection as shown.

3. Remove cap screw securing nozzle in cylinder head nozzle bore.

RG6297 –UN–22JUL92

Continued on next page

RG,CTM8,G35,34 –19–16SEP92–3/4

4. Pull injection nozzle out of cylinder head using JDE38B Injection Nozzle Puller Set or JDG716 Adapter and slide handle from JDE38 or JDE38A Puller Set.

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

RG6298 –UN–22JUL92

RG,CTM8,G35,34 –19–16SEP92–4/4

CLEAN FUEL INJECTION NOZZLE BORE

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

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

RG6299 –UN–22JUL92

RG,CTM8,G35,R37 –19–30SEP94–1/1

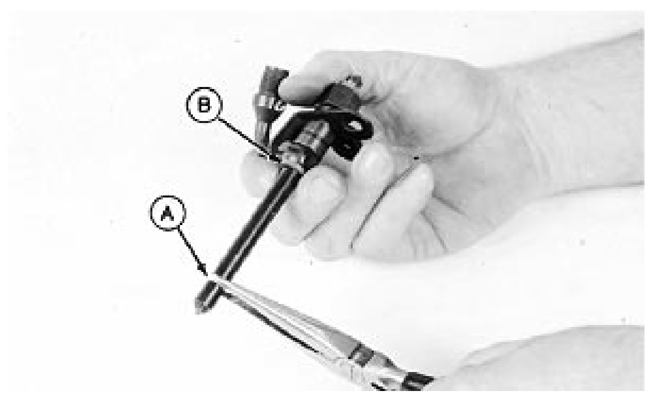
CLEAN INJECTION NOZZLES

1. Remove carbon stop seal (A) from groove in nozzle body using needle nose pliers and remove upper sealing washer (B). Discard seal and washer.

2. Place nozzle in solvent or clean diesel fuel, so carbon stop seal groove is submerged, and soak for a while.

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

3. After soaking, clean nozzle tip with ROS16488 Brass Wire Brush. Never use a steel wire brush or scraper.



RG6300 –UN–22JUL92

A—Carbon Stop Seal
B—Upper Sealing Washer

TEFLON is a registered trademark of Du Pont Co.

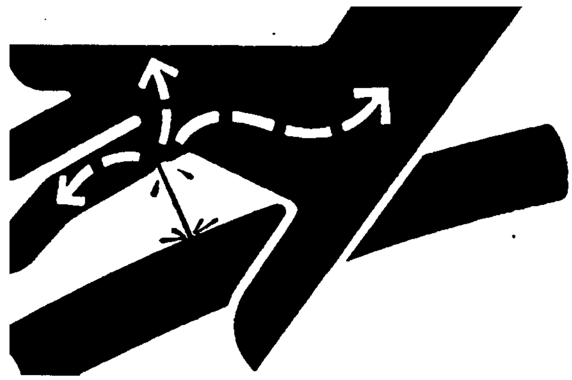
RG,CTM8,G35,R38 –19–16SEP92–1/1

DIAGNOSE FUEL INJECTION NOZZLE MALFUNCTION

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

RG,35,JW7594 –19–20NOV97–1/1

TEST FUEL INJECTION NOZZLES



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

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

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

1. Connect injection nozzle to nozzle tester.

Continued on next page

RG,35,JW7592 –19–20NOV97–1/6

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

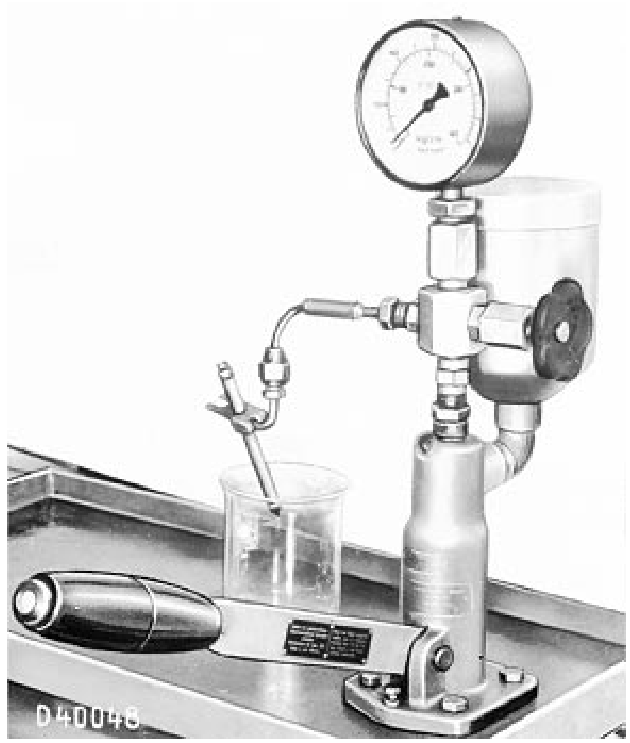
2. Use Y900-3, Y900-5 Adapters (C) and Y900-2 Fuel Line (B) from D01110AA Adapter Set to connect nozzles to D01109AA Nozzle Tester.

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

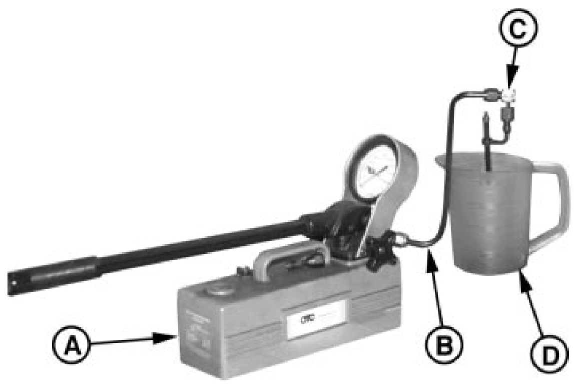
NOTE: Rapid operation of pump handle will result in inaccurate cracking pressure readings and cause undue wear on gauge.

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

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



D40048 –UN–11JUL89



RG7799 –UN–11NOV97

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

OPENING PRESSURE TEST

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

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

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

Continued on next page

RG,35,JW7592 –19–20NOV97–2/6

NOTE: In a some applications, nozzles normally used on aspirated (D) engines may be specified for turbocharged (T or H) engines and vice verrsa. In these cases, use specifications listed below according to engine type (turbocharged or aspirated).

3. Refer to the following specifications for nozzles on naturally aspirated (D) engines (except 4045D and 6068D) and for specifications on 4039TLV01 engines:

Opening Pressure of New or Reconditioned Nozzle With New Internal Parts—Specification

Opening Pressure For Setting .... 22060—22750 kPa (221—228 bar) (3200—3300 psi)
Opening Pressure For Checking............................... 21800 kPa (218 bar) (3160 psi) (Minimum)

Minimum Acceptable Opening Pressure of Used Nozzle—Specification

Opening Pressure For Checking............................... 19850 kPa (198 bar) (2880 psi) (Minimum)

Maximum Opening Pressure Difference Between Cylinders—Specification

Maximum Pressure Difference .... 700 kPa (7 bar) (100 psi)

4. Refer to the following specifications for nozzles on turbocharged engines (except 4039TLV01, and 4045T and 6068T Marine Engines) and for 4045D and 6068D Engines:

Opening Pressure of New or Reconditioned Nozzle With New Internal Parts—Specification

Opening Pressure For Setting .... 25510—26200 kPa (255—262 bar) (3700—3800 psi)
Opening Pressure For Checking............................... 25200 kPa (252 bar) (3660 psi) (Minimum)

Minimum Acceptable Opening Pressure of Used Nozzle—Specification

Opening Pressure For Checking............................... 22950 kPa (230 bar) (3330 psi) (Minimum)

Continued on next page

RG,35,JW7592 –19–20NOV97–3/6

Maximum Opening Pressure Difference Between Cylinders—Specification

Maximum Pressure Difference .... 700 kPa (7 bar) (100 psi)

5. Refer to the following specifications for nozzles on 4045T and 6068T Marine Engines:

Opening Pressure of New or Reconditioned Nozzle With New Internal Parts—Specification

Opening Pressure For Setting .... 25900—26200 kPa (259—262 bar) (3750—3800 psi)
Opening Pressure For Checking .... 25200 kPa (252 bar)
(Minimum) (3660 psi)

Minimum Acceptable Opening Pressure of Used Nozzle—Specification

Opening Pressure For Checking .... 22950 kPa (230 bar)
(Minimum) (3330psi)

Maximum Opening Pressure Difference Between Cylinders—Specification

Maximum Pressure Difference .... 700 kPa (7 bar) 100 psi)

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

CHATTER TEST

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

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

Continued on next page

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

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

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

SPRAY PATTERN TEST

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

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

2. Observe spray pattern and check for plugged orifices.

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

Fuel Injection Nozzle Tip—Specification

Spray Angle.. 152°

LEAKAGE TEST

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

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

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

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

Continued on next page

Nozzle Valve/Seat Tightness Condition at Pressure Test of 2800—3500 kPa (28—35 bar) (400—500 psi)—Specification

Leakage .... Nozzle tip dry after 5 seconds. (Slight dampness permissible on used nozzles.)

VALVE STEM AND GUIDE WEAR TEST

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

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

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

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

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

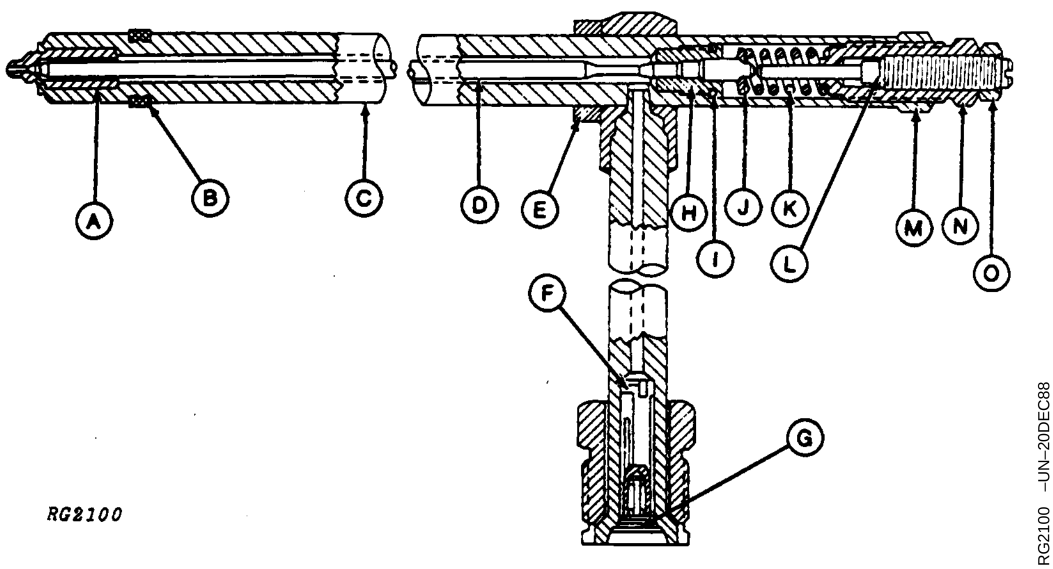
Fuel Injection Nozzle Return Leakage at Pressure Test of 10300 kPa (103 bar) (1500psi)—Specification

Leakage .... 3—10 Drops/30 Seconds

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

RG,35,JW7592 –19–20NOV97–6/6

DISASSEMBLE INJECTION NOZZLES



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

Continued on next page

S11,3010,NU –19–16SEP92–1/4

GENERAL NOZZLE REPAIR NOTES

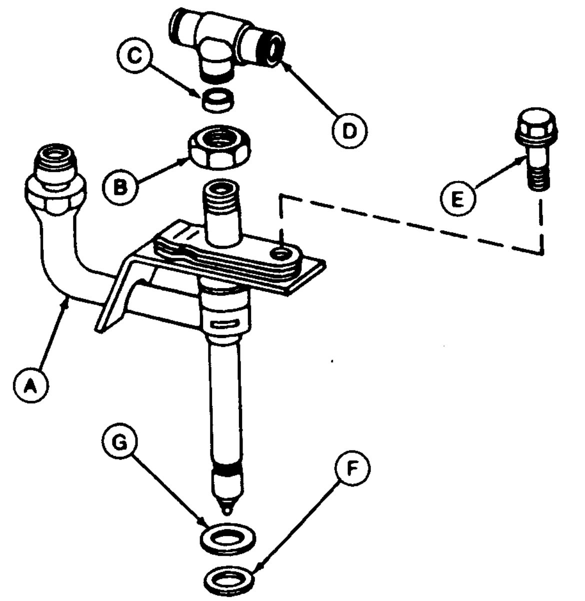
NOTE: Disassembly of nozzles is not recommended unless servicing is indicated by nozzle operation and testing.

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

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

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

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



RG6266 –UN–22JUL92

A—Nozzle Assembly
B—Tube Nut
C—Packing
D—Leak-off T-fitting
E—Cap Screw
F—Carbon Stop Seal
G—Upper Sealing Washer

Continued on next page

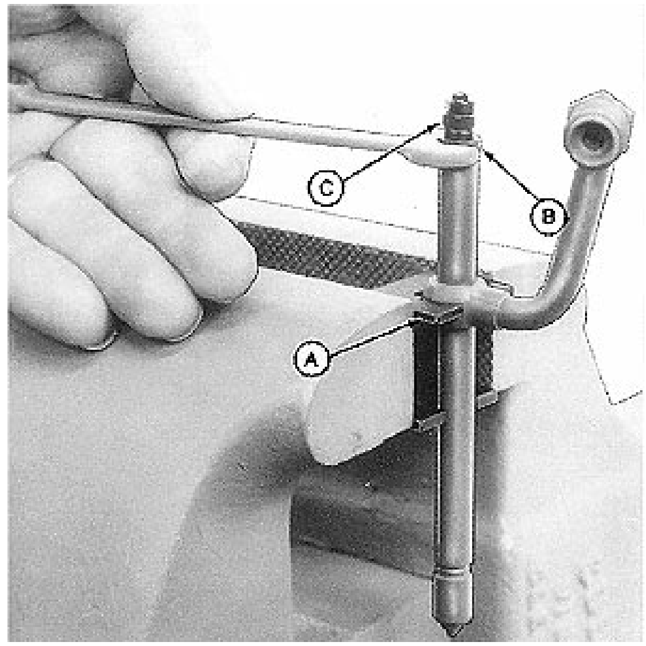
S11,3010,NU –19–16SEP92–2/4

1. Place nozzle in ROS17787 Holding Fixture (A) and secure fixture in a vise.

2. Loosen pressure adjusting screw lock nut (B).

3. Back out pressure adjusting screw (C) and lift assembly.

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



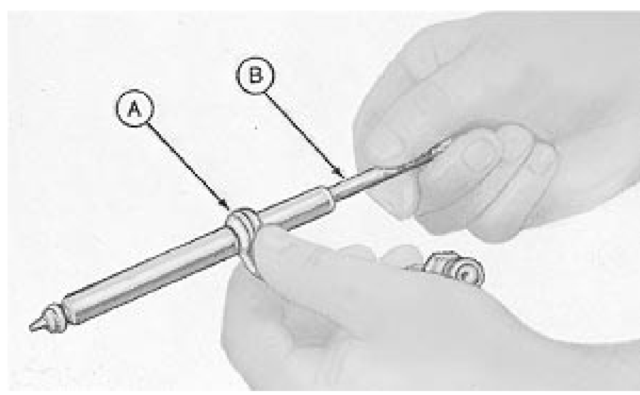
RG1918 –UN–07NOV94

A—Holding Fixture
B—Lock Nut
C—Adjusting Screw

S11,3010,NU –19–16SEP92–3/4

5. If valve does not slide freely from body (A), use No. 1681 Retractor (B) to remove valve.

6. Remove locating clamps and spacer from nozzle body.



RG2092 –UN–20DEC88

A—Valve Body
B—Retractor

S11,3010,NU –19–16SEP92–4/4

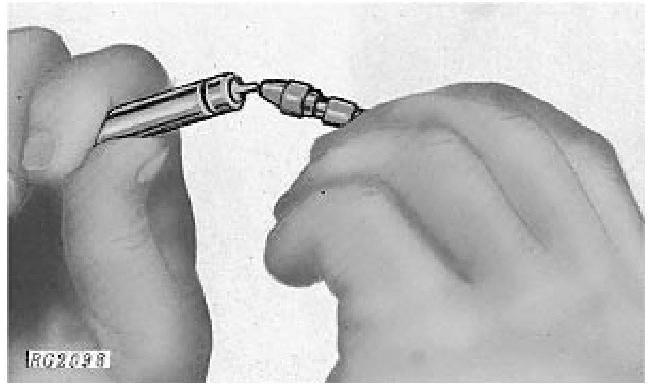
35
70

INSPECT AND CLEAN NOZZLE BODY

NOTE: Unless otherwise indicated, all tools required for nozzle cleaning can be found in the JDF13 Nozzle Cleaning Kit.

Clean carbon stop seal groove and nozzle tip with ROS16488 Brass Wire Brush.

Inspect tip for cracks and spray orifices for chipping and erosion using ROS16487 Inspection Magnifier.



RG2098 –UN–20DEC88

Continued on next page S11,3010,NX –19–11SEP92–1/2

TO CLEAN CARBON FROM NOZZLE ORIFICES:

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

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

Fuel Injection Nozzle Tip Orifice—Specification

Number of Orifices Per Nozzle 4

Fuel Injection Nozzle Tip Orifice (Naturally Aspirated Engines) (Except 4045D and 6068D) (Including 4039TLV01)—Specification

ID .... 0.28 mm (0.011 in.)

Fuel Injection Nozzle Tip Orifice (Turbocharged Engines) (Except 4039TLV01 and 4045T and 6068T Marine Engines) (Including 4045D and 6068D Engines)—Specification

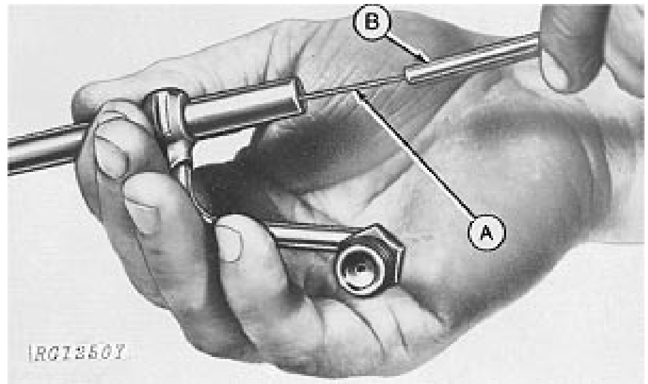
ID .... 0.30 mm (0.012 in.)

Fuel Injection Nozzle Tip Orifice (4045T and 6068T Marine Engines)—Specification

ID .... 0.29 mm (0.0116 in.)

.

2. Clamp the wire in ROS16483 Pin Vise. Wire should not protrude from the vise more than 0.8 mm (1/32 in.).
3. Insert wire in orifice and rotate.
4. Use ROS17712 Scraper to clean deposits from valve seating area.
5. Grasp ROS16476 Sac Hole Drill (A) with No. 16481 Valve Retractor (B).
6. For final cleaning, use a cleaning wire 0.03 mm (0.001 in.) smaller than the nominal orifice size and repeat Steps 2 and 3.



RG1250 –UN–20DEC88

A—Sac Hole Drill
B—Valve Retractor

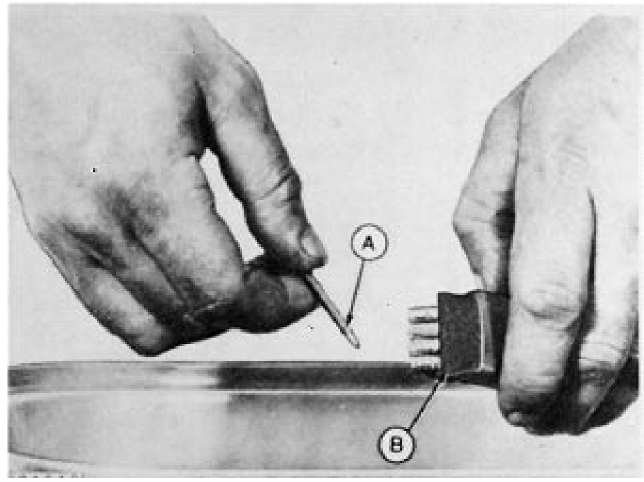
S11,3010,NX –19–11SEP92–2/2

INSPECT AND CLEAN VALVE AND VALVE SEAT

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

Use ROS16488 Brass Wire Brush (B) to remove deposits from seating area on tip of nozzle valve (A). Use a ROS16544 Felt Pad to remove varnish deposits.

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



RG1919 –UN–20DEC88

A—Nozzle Valve Tip
B—Brass Wire Brush

Continued on next page

S11,3010,NZ –19–16SEP92–1/2

INCONSISTENT CHATTER OR NO CHATTER

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

1. Place a small amount of ROS16489 Lapping Compound on the valve in guide area only. DO NOT use any other compound for this purpose.

2. Slide valve into body.

3. Grip top of the valve with No. 16481 Retractor (A) and rotate valve (B) in the guide by turning retractor. The amount of lapping required can be accomplished in 10—20 turns by hand. The valve should be raised and lowered in the guide every 3—4 revolutions and direction of rotation changed for best results.

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

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

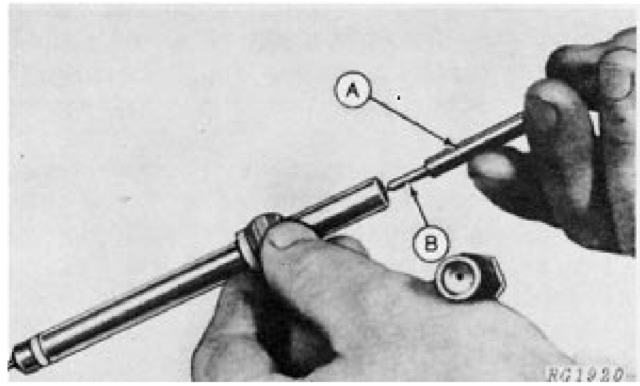
SEAT LEAKAGE

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

1. Apply a small amount of ROS16489 Lapping Compound to valve tip and insert valve in nozzle body.

2. Gripping valve with No. 16481 Retractor, rotate valve 3 to 5 turns to clean up seat.

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



RG1920 –UN–20DEC88

A—Retractor
B—Valve

S11,3010,NZ –19–16SEP92–2/2

INSPECT VALVE ADJUSTING MECHANISM

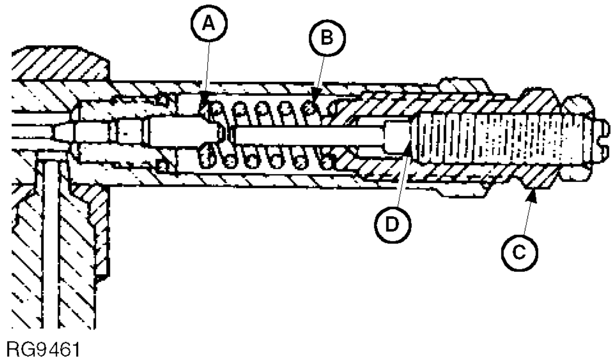
1. Inspect lift adjusting screw (D). Replace if bent or otherwise damaged.

2. Inspect pressure adjusting screw (C). Replace if worn or damaged.

3. Inspect pressure adjusting spring (B). Replace if broken or distorted.

4. Inspect spring seat (A) for wear. Replace as necessary.

5. Replace nozzle clamp if bent.

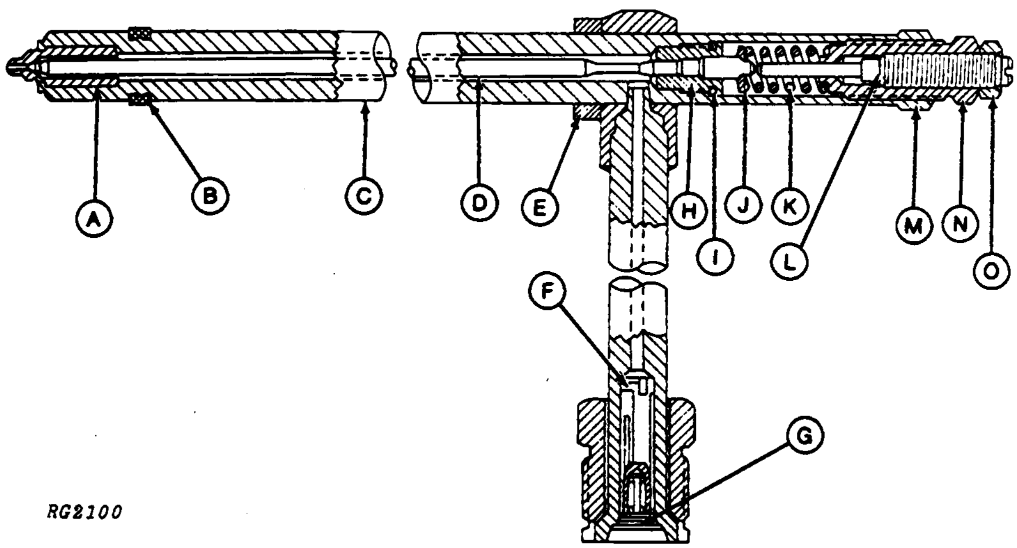


RG9461 –UN–01OCT98

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

S11,3010,OC –19–30SEP94–1/1

ASSEMBLE INJECTION NOZZLES



RG2100 –UN–20DEC88

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

1. Install nozzle spacer onto upper nozzle body. Position nozzle locating clamp over upper nozzle body with flanges pointing downward. Install three remaining clamps onto nozzle body.

IMPORTANT: Wear rubber gloves when assembling nozzles.

2. Dip valve (D) in clean fuel and insert into nozzle body (C).

3. Thread lift adjusting screw (L) into pressure adjusting screw (N) until top just enters screw.

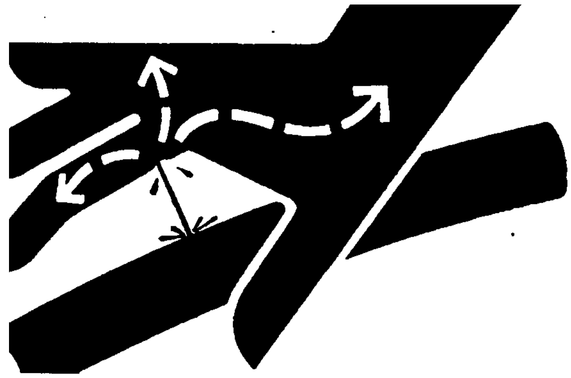
4. Invert adjusting screw assembly and assemble spring seat (J) and spring (K) to adjusting screw.

5. Tilt body, DO NOT allow valve to fall out, and install spring adjusting screw assembly to body. Be careful not to dislodge spring or seat during initial assembly.

6. Turn pressure adjusting screw (N) down as far as possible by hand; usually about ten full turns. Adjust nozzle as detailed later in this group.

RG,CTM8,G35,R41 –19–16SEP92–1/1

ADJUST FUEL INJECTION NOZZLES


X9811 –UN–23AUG88

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

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

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

Connect nozzle to nozzle tester. (See TEST INJECTION NOZZLES earlier in this group.)

ADJUST NOZZLE OPENING PRESSURE

1. Close pressure gauge valve and flush nozzle by operating pump rapidly.

2. Raise pressure on pump until nozzle opens (gauge drops sharply).

3. Refer to nozzle opening pressure specifications on following pages.

NOTE: In a some applications, nozzles normally used on aspirated (D) engines may be specified for turbocharged (T or H) engines and vice verrsa. In these cases, use specifications listed below according to engine type (turbocharged or aspirated).

4. Refer to the following specifications for nozzles on naturally aspirated (D) engines (except 4045D and 6068D) (including 4039TLV01):

Continued on next page

Opening Pressure of New or Reconditioned Nozzle With New Internal Parts—Specification

Opening Pressure For Setting .... 22060—22750 kPa (221—228 bar) (3200—3300 psi)
Opening Pressure For Checking............................... 21800 kPa (218 bar) (3160 psi) (Minimum)

Minimum Acceptable Opening Pressure of Used Nozzle—Specification

Opening Pressure For Checking............................... 19850 kPa (198 bar) (2880 psi) (Minimum)

Maximum Opening Pressure Difference Between Cylinders—Specification

Maximum Pressure Difference .... 700 kPa (7 bar) (100 psi)

5. Refer to the following specifications for nozzles on turbocharged engines (except 4039TLV01, and 4045T and 6068T Marine Engines) (Including 4045D and 6068D Engines):

Opening Pressure of New or Reconditioned Nozzle With New Internal Parts—Specification

Opening Pressure For Setting .... 25510—26200 kPa (255—262 bar) (3700—3800 psi)
Opening Pressure For Checking............................... 25200 kPa (252 bar) (3660 psi) (Minimum)

Minimum Acceptable Opening Pressure of Used Nozzle—Specification

Opening Pressure For Checking............................... 22950 kPa (230 bar) (3330 psi) (Minimum)

Maximum Opening Pressure Difference Between Cylinders—Specification

Maximum Pressure Difference .... 700 kPa (7 bar) (100 psi)

6. Refer to the following specifications for nozzles on 4045T and 6068T Marine Engines:

Continued on next page

RG,CTM8,DY047 –19–18JAN95–2/7

Opening Pressure of New or Reconditioned Nozzle With New Internal Parts—Specification

Opening Pressure For Setting .... 25900—26200 kPa (259—262 bar) (3750—3800 psi)
Opening Pressure For Checking............................... 25200 kPa (252 bar) (3660 psi) (Minimum)

Minimum Acceptable Opening Pressure of Used Nozzle—Specification

Opening Pressure For Checking............................... 22950 kPa (230 bar) (3330psi) (Minimum)

Maximum Opening Pressure Difference Between Cylinders—Specification

Maximum Pressure Difference .... 700 kPa (7 bar) 100 psi)

Continued on next page

RG,CTM8,DY047 –19–18JAN95–3/7

If opening pressure is incorrect:

1. Remove nozzle from tester and install in ROS17787 Holding Fixture (A).

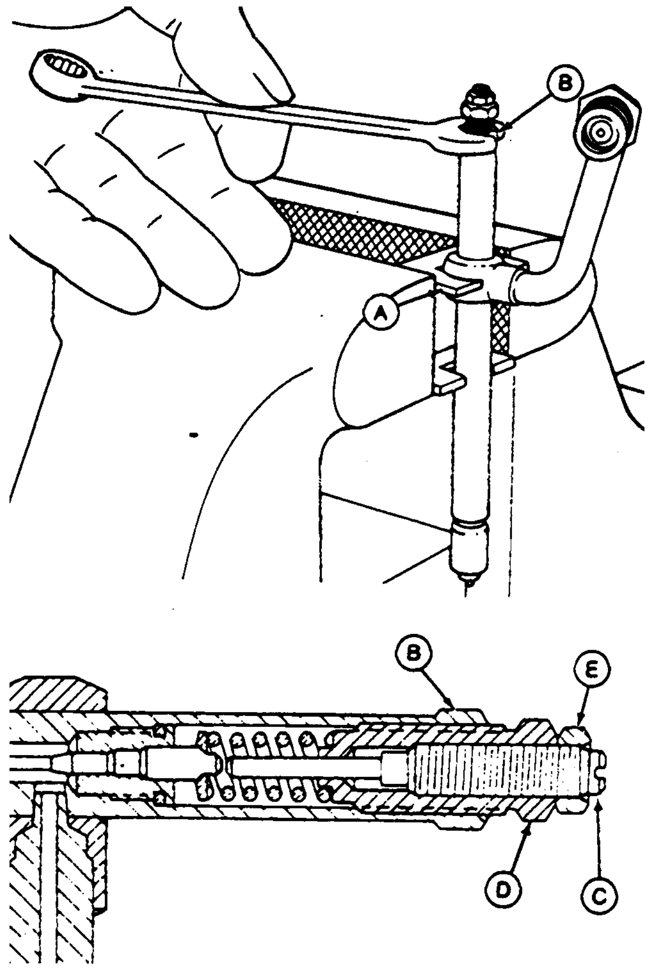
2. Loosen pressure adjusting screw lock nut (B).

3. Reconnect nozzle to tester with tip pointing downward.

4. Back out lift adjusting screw (C) far enough (two or three turns) to prevent bottoming when pressure adjusting screw (D) is turned.

5. Turn pressure adjusting screw in (clockwise) to increase opening pressure, or out (counterclockwise) to decrease opening pressure.

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



RG4825 –UN–14DEC88

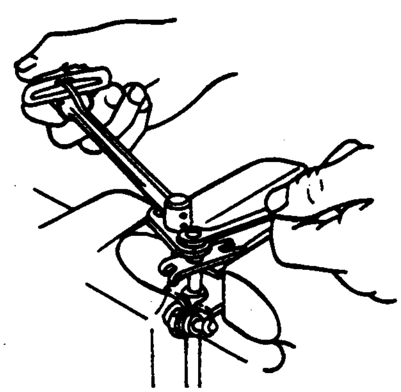
A—ROS17787 Holding Fixture
B—Pressure Adjusting Screw Locknut
C—Lift Adjusting Screw
D—Pressure Adjusting Screw
E—Lift Adjusting Screw Locknut

RG,CTM8,DY047 –19–18JAN95–4/7

6. Remove nozzle from tester and secure in holding fixture. While holding pressure adjusting screw, tighten pressure adjusting screw lock nut to specifications using the ROS18958 (English size) or No. 24374 (metric size) Torque Wrench Adapter.

Fuel Injection Nozzle Pressure Adjusting Screw Locknut—Specification

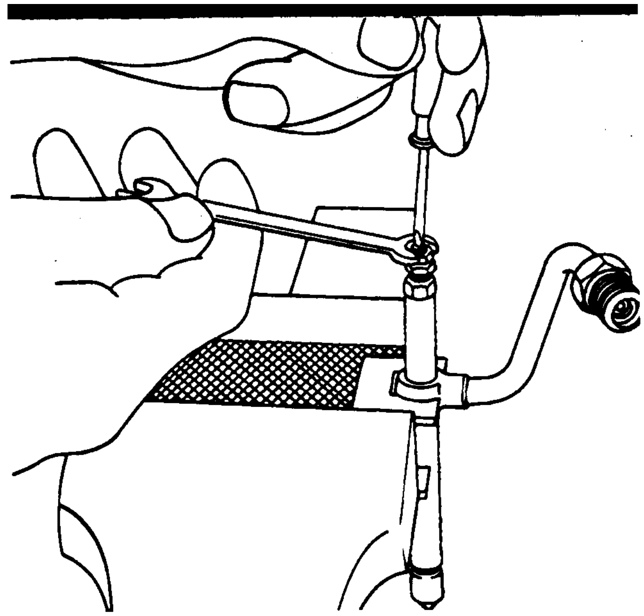
Torque .... 10 N•m (7 lb-ft)



RG4826 –UN–14DEC88

Continued on next page RG,CTM8,DY047 –19–18JAN95–5/7

ADJUST NOZZLE VALVE LIFT



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

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

2. Check for valve bottoming by raising pressure to 1380—3450 kPa (14—34 bar) (200—500 psi) above nozzle opening pressure.

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

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

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

Fuel Injection Nozzle Valve Needle Lift (Naturally Aspirated Engines) (Except 4045D and 6068D) (Including 4039TLV01)—Specification

Needle Lift (Based on Zero Lift)...................... 1/2 Turn Counterclockwise

Fuel Injection Nozzle Valve Needle Lift (Turbocharged Engines) (Except 4039TLV01) (Including 4045D and 6068D)—Specification

Needle Lift (Based on Zero Lift)...................... 3/4 Turn Counterclockwise

5. Hold pressure adjusting screw stationary while tightening lock nut. Use ROS18958 Torque Wrench Adapter on English-type lock nuts; No. 24374 on metric-type lock nuts.

   Tighten lift adjusting screw lock nut to specifications.

Fuel Injection Nozzle Lift Adjusting Screw Lock Nut—Specification

Torque .... 5 N•m (3.5 lb-ft)

6. Recheck nozzle opening pressure.

Continued on next page

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

7. Clean nozzle with ROS16488 Brass Wire Brush.

RG,CTM8,DY047 –19–18JAN95–7/7

INSTALL SEALS ON INJECTION NOZZLE

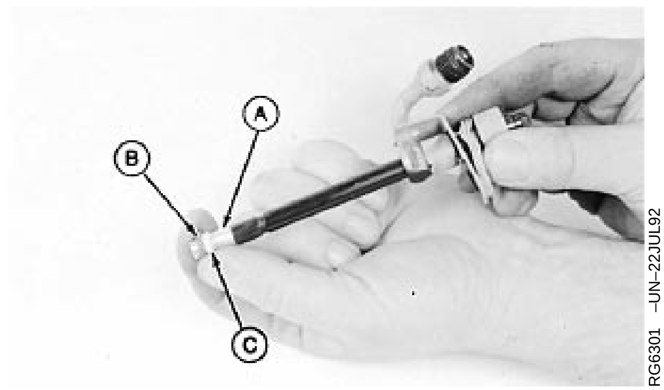
IMPORTANT: Each time an injection nozzle is removed from the cylinder head, replace carbon stop seal (C) with a new one.

1. Position JD258 (ROS16477) Pilot Tool (A) over nozzle tip.

2. Position a new carbon stop seal (C) on pilot tool. Use a new seal washer (B) to help slide the carbon seal into place until it seats in it’s groove on nozzle body.

3. Continue to slide upper sealing washer onto nozzle body until it seats against inlet fitting.

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



A—Pilot Tool
B—Seal Washer
C—Carbon Stop Seal

RG,CTM8,G35,R42 –19–16SEP92–1/1

INSTALL INJECTION NOZZLES

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

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

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

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

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

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

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

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

Fuel Injection Nozzle Hold-Down Clamp Cap Screws—Specification

Torque .... 37 N•m (27 lb-ft)

6. Install leak-off line assembly. Tighten hex nuts to specifications.

Fuel Leak-Off Line Hex Nuts—Specification

Torque .... 5 N•m (3.7 lb-ft) (44 lb-in.)

RG6302 –UN–22JUL92

RG6297 –UN–22JUL92

Continued on next page

RG,CTM8,G35,R43 –19–18JAN95–1/2

7. Bleed air from loose injection line connection. Tighten connection using two wrenches to specifications.

Fuel Injection Nozzle Delivery Line—Specification

Torque .... 34 N•m (25 lb-ft)

(See BLEED THE FUEL SYSTEM in Group 115.)

RG,CTM8,G35,R43 –19–18JAN95–2/2

ESSENTIAL TOOLS

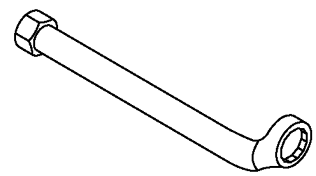
NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC).

SERVICEGARD is a trademark of Deere & Company

DPSG,OUO1004,471 –19–25OCT98–1/2

Starting Motor Removal Tool KJD10213

Remove starting motor on 6000 Series Tractors.



DPSG,OUO1004,471 –19–25OCT98–2/2

REMOVE AND INSTALL STARTER

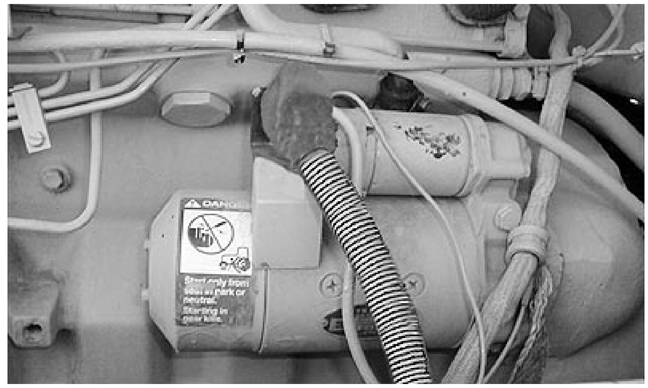
NOTE: Refer to CTM77 for repair and testing of starter motor.

CAUTION: Disconnect battery ground strap or serious injury could result if tools ground electrical system.

1. Disconnect ground strap from battery.
2. Disconnect wiring to starter motor.
3. If equipped with RH dipstick tube, remove tube.

NOTE: On Model 6000 Series Tractors, use KJD10213 Starting Motor Removal Tool as necessary to remove cap screws.

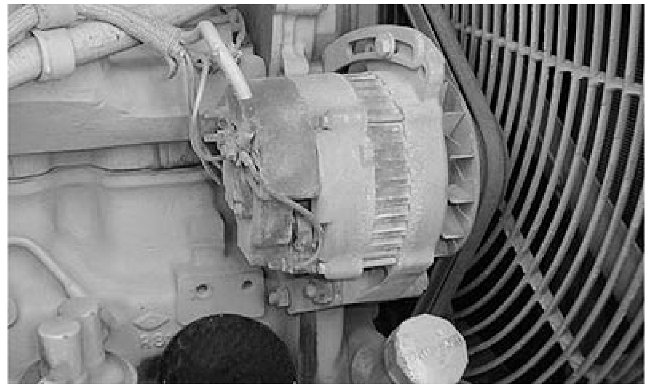
4. Remove three mounting cap screws and/or nuts.
5. Remove starting motor.
6. Install starting motor and tighten cap screws and/or nuts.
7. Connect starter wiring and ground strap.
8. Install dipstick tube if removed.



RG9463 –UN–29OCT98

DPSG,OUO1004,472 –19–25OCT98–1/1

REMOVE AND INSTALL ALTERNATOR



RG9462 –UN–29OCT98

NOTE: Refer to CTM77 for repair and testing of alternator.

IMPORTANT: Always disconnect battery negative (—) cables before removing alternator or a short circuit could result.

1. Disconnect battery ground (—) cable.

2. Disconnect positive (+) red wire and regulator connector.

3. Remove belt guard.

4. Remove alternator.

NOTE: If mounting plate for alternator and tensioner was removed, tighten plate-to-timing gear cover hardware first, then plate-to-engine hardware.

5. Install alternator. Tighten all mounting hardware.

6. If removed, install alternator pulley and tighten pulley nut to specifications.

Delco-Remy Model 12SI and 21SI Alternator Pulley Nut—Specification

Torque .... 100 N•m (75 lb-ft)

Delco-Remy Model 10SI and 15SI Alternator Pulley Nut—Specification

Torque .... 80 N•m (60 lb-ft)

Motorola Model 8E Alternator Pulley Nut—Specification

Torque .... 60 N•m (45 lb-ft)

Motorola (All Other Models) Alternator Pulley Nut—Specification

Torque .... 68 N•m (50 lb-ft)

Niehoff Alternator Pulley Nut—Specification

Torque .... 95 N•m (70 lb-ft)

Continued on next page

DPSG,OUO1004,473 –19–25OCT98–1/2

Nippondenso Alternator Pulley Nut (W/Add-On Regulator)—Specification

Torque .... 77 N•m (57 lb-ft)

Nippondenso Alternator Pulley Nut (W/Built-In Regulator)—Specification

Torque .... 106 N•m (78 lb-ft)

Robert Bosch Alternator Pulley Nut—Specification

Torque .... 40 N•m (30 lb-ft)

Valeo Alternator Pulley Nut—Specification

Torque .... 47 N•m (35 lb-ft)

Valeo A13N Series Alternator Pulley Nut—Specification

Torque .... 55 N•m (41 lb-ft)

Magneton Alternator Pulley Nut—Specification

Torque .... 40 N•m (30 lb-ft)

7. Install alternator belt using 1/2 in. drive ratchet on belt tensioner.

8. Install belt guard.

9. Connect positive (+) red wire and regulator connector.

10. Connect battery ground (—) cable.

DPSG,OUO1004,473 –19–25OCT98–2/2

EFFECTS OF ALTITUDE AND TEMPERATURE ON ENGINE PERFORMANCE

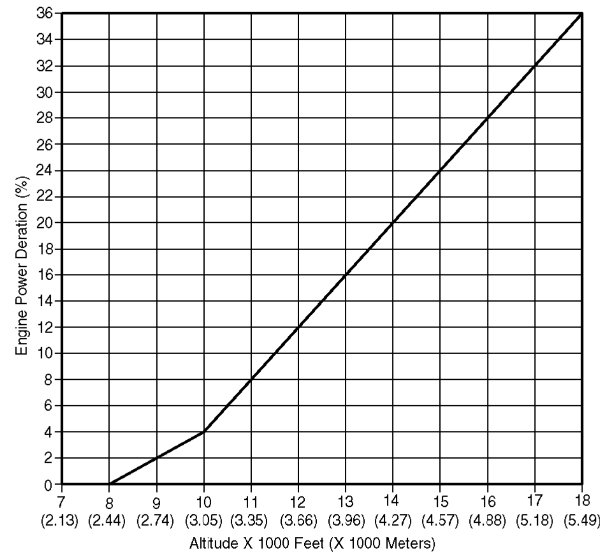
Altitude, fuel temperature, air temperature, and humidity may affect engine performance. As a general rule, atmospheric changes will usually cause a decrease in engine power by the percentages shown below.

NATURALLY ASPIRATED ENGINES

ATMOSPHERIC CHANGE	% POWER DECREASE
Fuel Temperature Rise of 1° C (1.8° F) above 40° C (104° F)	0.17
Air Temperature Rise of 5.5° C (10° F) above 25° C (77° F)	1.50
Altitude Rise of 300 m (1000 ft) above 180 m (600 ft)	3.00
Relative Humidity Rise of 10% above 0%	0.10

TURBOCHARGED ENGINES

ATMOSPHERIC CHANGE	% POWER DECREASE
Fuel Temperature Rise of 1° C (1.8° F) above 40° C (104° F)	0.19
Air Temperature Rise of 5.5° C (10° F) above 25° C (77° F)	0.50
Altitude rise	See figure above.
Relative Humidity Rise of 10% above 0%	0.07



RG9094 –UN–27MAR98

Turbocharged Engines

DPSG,OUO1004,451 –19–24OCT98–1/1

PRELIMINARY ENGINE TESTING

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 Group 105).

S11,22010,BW –19–08APR94–1/1

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.

Operation	Detailed Reference
Change engine oil and filter.	Operator's Manual
Lubricate PTO clutch internal levers and linkage, if equipped.	Operator's Manual
Replace fuel filter and water separator, if equipped.	Group 35/Operator's Manual
Clean crankcase vent tube.	Group 35/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. Replace if necessary.	Group 25/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 110
Check fuel injection system: Check engine/injection pump timing: check and adjust speed advance; clean injection nozzles, and adjust opening pressure.	Group 35 and 115
Check engine oil pressure. Correct as necessary.	Group 105
Check engine valve clearance. Adjust if necessary.	Group 05
Check engine speeds. Correct as necessary.	Group 115
Check engine performance on dynamometer.	This Group

RG,100,JW7643 –19–21NOV97–1/1

DYNAMOMETER TEST

IMPORTANT: Dynamometers should be periodically checked for accuracy and calibrated as necessary.

NOTE: High elevations may affect engine performance. (See EFFECTS OF ALTITUDE AND TEMPERATURE ON ENGINE PERFORMANCE earlier 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 operating range.

3. Run engine at fast idle, and gradually increase load on engine until speed is reduced to rated speed rpm.

NOTE: Refer to appropriate machine technical manual for average power ratings of specific application. Allow ±5% for minimum and maximum power.

4. Read horsepower on dynamometer and record reading over a period of several minutes after engine stabilizes.

5. Compare readings taken with power rating level for your engine application listed on the following chart.

CTM8,GR105,6 –19–03FEB95–1/1

DYNAMOMETER TEST SPECIFICATIONS

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES[a]

Engine Model	Injection Pump Option Code	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Governor Regulation	Rated Speed (rpm)	Fast Idle (rpm)	Power Rating Kw (BHP)
CD3029DF	1602	RE53785		STD	2500	2710	43 (57)
	1603	RE53786		3—5%	1800	1865	35 (47)
	1620	RE53787	RE64241	3—5%	1500	1580	31 (41)
	1620	RE64241		3—5%	1500	1580	31 (41)
	1632	RE59140		STD	2200	2390	31 (41)
	1641	RE53787	RE64241	3—5%	1500	1575	31 (41)
	1641	RE64241		3—5%	1500	1575	31 (41)
	1642	RE67271		STD	2500	2710	43 (57)
	1643	RE67271		STD	2500	2710	43 (57)
	1644	RE41939	RE58298	3—5%	1800	1890	34 (46)
	1644	RE58298		3—5%	1800	1890	34 (46)
	1645	RE67003		STD	2500	2710	36.5 (49)
	1648	RE41941	RE58929	3—5%	1500	1575	30 (40)
	1648	RE58929		3—5%	1500	1550	30 (40)
	1650	RE41938	RE58930	STD	2500	2750	43 (57)
	1650	RE58930		STD	2500	2710	43 (57)
	1654	RE63523		STD	2400	2640	42 (56)
CD3029TF	1602	RE53785		STD	2500	2710	59 (79)
	1632	RE58903[b]		STD	2500	2710	59 (79)
	1633	RE51979		STD	2200	2450	46 (62)
	1634	RE53783		STD	2500	2710	59 (79)
	1640	RE53958		STD	2500	2710	59 (79)
	1645	RE58413		STD	2100	2310	48 (64)
T04039DF	1602	RE20510	RE44483	STD	2500	2750	43 (57)
	1602	RE44483	RE47133	STD	2500	2750	60 (80)
	1602	RE47133	RE49360	STD	2500	2750	60 (80)
	1602	RE49360		STD	2500	2750	60 (80)
	1603	RE46360[b]	RE20511	STD	2500	2750	49 (66)
	1603	RE20511	RE47134	3—5%	1800	1890	49 (66)
	1603	RE47134		3—5%	1800	1890	49 (66)
T04039DF (Continued on next page)	1604	RE48354	RE57105	STD	2500	2750	57 (76)

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Governor Regulation**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Power Rating Kw (BHP)**
T04039DF (Continued)	1604	RE57105		STD	2500	2750	57 (76)
	1610	RE20511	RE47134	3—5%	1800	1890	49 (66)
	1610	RE47134		3—5%	1800	1890	49 (66)
	1611	RE65033		3—5%	1800	1890	43 (58)
	1615	RE46360[b]		STD	2500	2750	60 (80)
	1620	RE47176[b]		3—5%	1800	1890	49 (66)
	1621	RE58577[b]		3—5%	1800	1890	49 (66)
	1624	RE28451	CANCELLED	3—5%	1800	1890	49 (66)
CD4039DF	1602	RE37927	RE42348	STD	2500	2750	60 (80)
	1602	RE42348	RE47133	STD	2500	2750	60 (80)
	1602	RE47133	RE49360	STD	2500	2750	60 (80)
	1602	RE49360		STD	2500	2750	60 (80)
	1603	RE42351	RE47134	3—5%	1800	1890	49 (66)
	1603	RE47134		3—5%	1800	1890	49 (66)
	1606	RE37924	CANCELLED	STD	2500	2750	58 (78)
	1609	RE52749		STD	2300	2530	58 (78)
	1614	RE52822		STD	2900	3190	60 (80)
	1618	RE47134		3—5%	1800	1890	49 (66)
	1620	RE47176[b]		3—5%	1800	1890	49 (66)
	1623	RE37927	RE42349	STD	2500	2750	60 (80)
	1623	RE42349	RE47798	STD	2500	2750	60 (80)
	1623	RE47798	RE49495	STD	2500	2750	60 (80)
	1623	RE49495	RE50778	STD	2500	2750	60 (80)
	1623	RE50778[b]		STD	2500	2750	60 (80)
	1624	RE49360	CANCELLED	STD	2500	2750	60 (80)
	1641	RE42353	RE50828	3—5%	1500	1575	40 (54)
	1641	RE50828	RE64243	3—5%	1500	1575	40 (54)
	1641	RE64243		3—5%	1500	1575	40 (54)
CD4039DF (Continued on next page)	1643	RE45358	CANCELLED	STD	2500	2750	60 (80)

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP4/JP8 Jet "A" Fuel.

Continued on next page

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Governor Regulation**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Power Rating Kw (BHP)**
CD4039DF (Continued)	1645	RE42354	RE50829	3—5%	1500	1575	40 (54)
	1645	RE50829[b]	RE64244	3—5%	1500	1575	40 (54)
	1645	RE64244		3—5%	1500	1575	40 (54)
	1646	RE42352		3—5%	1800	1890	49 (66)
	1664	RE49360		STD	2500	2750	60 (80)
T04039DFM	1602	RE44483	RE47133	STD	2500	2750	60 (80)
	1602	RE47133		STD	2500	2750	60 (80)
	1606	RE49361		STD	2500	2750	60 (80)
	1612	RE65034		STD	2500	2750	60 (80)
T04039TF	1602	RE41956	RE47135	STD	2500	2750	82 (110)
	1602	RE47135	RE54151	STD	2500	2750	82 (110)
	1602	RE54151		STD	2500	2750	82 (110)
	1603	RE42077	RE48154	3—5%	1800	1890	76 (102)
	1603	RE48154		3—5%	1800	1890	76 (102)
	1604	RE40408		3—5%	1800	1890	76 (102)
	1613	RE65016		STD	2500	2750	82 (110)
	1615	RE36939[b]	RE47494	STD	2500	2750	82 (110)
	1615	RE47494[b]		STD	2500	2750	82 (110)
	1619	RE42837	RE47177	STD	2500	2750	82 (110)
	1619	RE47177[b]		STD	2500	2750	82 (110)
	1620	RE42833	RE48155	3—5%	1800	1890	76 (102)
	1620	RE48155		3—5%	1800	1890	76 (102)
CD4039TF	1601	RE48484		STD	1800	1865	76 (102)
	1602	RE26858	RE47135	STD	2500	2710	82 (110)
	1602	RE47135		STD	2500	2710	82 (110)
	1603	RE21515	RE48154	3—5%	1800	1865	76 (102)
	1603	RE48154		3—5%	1800	1865	76 (102)
	1605	RE47909		STD	2900	3190	82 (110)
	1610	RE52750		STD	2300	2495	71 (95)
	1611	RE55565		STD	2200	2420	78 (105)
CD4039TF (Continued on next page)	1619	RE47177[b]		STD	2500	2710	82 (110)

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Governor Regulation**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Power Rating Kw (BHP)**
CD4039TF (Continued)	1620	RE48155[b]		3—5%	1800	1865	76 (102)
	1623	RE31765	CANCELLED	STD	2500	2710	82 (110)
	1625	RE47135	CANCELLED	STD	2500	2710	82 (110)
	1625	RE31765		STD	2500	2710	82 (110)
	1635	RE31759	RE50808	3—5%	1500	1575	63 (85)
	1635	RE50808[b]		3—5%	1500	1575	63 (85)
	1636	RE31766	CANCELLED	3—5%	1800	1865	63 (85)
	1641	RE29471	RE50809	3—5%	1500	1575	63 (85)
	1641	RE50809		3—5%	1500	1575	63 (85)
	1642	RE69326		3—5%	2200	2420	78 (105)
	1643	RE45356	CANCELLED	STD	2500	2710	82 (110)
	1650	RE38946	RE50866	STD	2500	2710	82 (110)
	1650	RE50866[b]		STD	2500	2710	82 (110)
	1651	RE38947	RE50867	STD	2500	2710	82 (110)
	1651	RE50867[b]		STD	2500	2710	82 (110)
T04045DF	1602	RE32288	RE42089	STD	2400	2640	63 (85)
	1602	RE42089	RE47179	STD	2400	2640	63 (85)
	1602	RE47179		STD	2400	2640	63 (85)
	1623	RE57113		STD	2100	2310	55 (74)
CD4045DF	1602	RE47179		STD	2400	2605	63 (85)
	1626	RE55079		STD	2200	2390	61 (82)
	1635	RE68444		STD	2400	2605	63 (85)
	1636	RE68444		STD	2400	2605	63 (85)
T04045TF	1601	RE52015		STD	2400	2640	90 (120)
	1602	RE32292	RE41774	STD	2400	2640	86 (115)
	1602	RE41774	RE47180	STD	2400	2640	86 (115)
	1602	RE47180		STD	2400	2640	86 (115)
	1609	RE42058	RE48156	3—5%	1800	1890	84 (113)
T04045TF (Continued on next page)	1609	RE48156		3—5%	1800	1890	84 (113)
[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.							
[b]Can be used with JP5/JP8 Jet "A" fuel.							

Continued on next page

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Governor Regulation**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Power Rating Kw (BHP)**
T04045TF (Continued)	1619	RE42839[b]	RE47181	STD	2400	2640	86 (115)
	1619	RE47181[b]		STD	2400	2640	86 (115)
CD4045TF	1602	RE47180		STD	2400	2650	86 (115)
	1603	RE64298		STD	2400	2650	86 (115)
	1620	RE57647		3—5%	1500	1550	70 (94)
	1625	RE58882		STD	2200	2390	84 (113)
	1627	RE55080		STD	2200	2420	84 (113)
	1628	RE48156		3—5%	1800	1890	84 (113)
	1629	RE52015		STD	2400	2640	90 (120)
	1630	RE57717		STD	2400	2640	90 (120)
	1631	RE52015		STD	2400	2640	90 (120)
	1632	RE57717		STD	2400	2640	90 (120)
	1637	RE68454		STD	2400	2640	86 (115)
	1638	RE68455		STD	2400	2640	86 (115)
	1639	RE68456		3—5%	1500	1550	70 (94)
	1640	RE68457		3—5%	1800	1890	84 (113)
	1641	RE68458		STD	2400	2640	90 (120)
	1642	RE68459		STD	2400	2640	90 (120)
	1643	RE64298		STD	2400	2640	86 (115)
	1644	RE68454		STD	2400	2640	86 (115)
	1645	RE68458		STD	2400	2640	90 (120)
	1646	RE68459		STD	2400	2640	90 (120)
T04045TFM	1605	RE41774	RE49362	STD	2400	2640	86 (115)
	1605	RE49362		STD	2400	2640	86 (115)
	1609	RE42058	RE48156	3—5%	1800	1890	71 (95)
	1609	RE48156	CANCELLED	3—5%	1800	1890	71 (95)
	1610	RE48156		3—5%	1800	1890	71 (95)
	1615	RE60917		STD	2400	2640	97 (130)
	1620	RE65035		3—5%	1800	1890	71 (95)
	1621	RE65036		STD	2400	2640	86 (115)
(Continued on next page)	1622	RE65037		STD	2400	2640	97 (130)

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES (Continued)[a]							
Engine Model	Injection Pump Option Code	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Governor Regulation	Rated Speed (rpm)	Fast Idle (rpm)	Power Rating Kw (BHP)
T06059DF	1602	RE24182	RE47058	STD	2500	2750	90 (120)
	1602	RE47058		STD	2500	2750	90 (120)
	1615	RE47059[b]		STD	2500	2750	90 (120)
CD6059DF	1602	RE37935	RE52159	STD	2500	2750	89 (119)
	1602	RE52159		STD	2500	2750	89 (119)
	1603	RE37933	CANCELLED	3—5%	1800	1890	74 (99)
	1604	RE38863	CANCELLED	STD	2100	2310	80 (107)
	1623	RE37935	RE52160	STD	2500	2750	89 (119)
	1623	RE52160[b]		STD	2500	2750	89 (119)
	1635	RE37936	CANCELLED	STD	2500	2750	81 (109)
	1636	RE37933	CANCELLED	3—5%	1800	1890	74 (99)
	1638	RE37934	CANCELLED	3—5%	1500	1575	62 (83)
	1641	RE37934	CANCELLED	3—5%	1500	1575	62 (83)
	1648	RE52159		STD	2500	2750	89 (119)
	1650	RE52160		STD	2500	2750	89 (119)
	16BZ	RE52160		STD	2500	2750	89 (119)
T06059TF	1602	RE42091	RE47137	STD	2500	2750	124 (166)
	1602	RE47137		STD	2500	2750	124 (166)
	1603	RE40243	RE44463	3—5%	1800	1890	124 (166)
	1603	RE44463	RE48159	3—5%	1800	1890	124 (166)
	1603	RE58159		3—5%	1800	1890	112 (150)
	1604	RE40409[b]		3—5%	1800	1890	124 (166)
	1615	RE47057[b]		STD	2500	2750	124 (166)
	1619	RE47178[b]		STD	2500	2750	124 (166)
	1621	RE42290[b]		STD	2500	2750	124 (166)
	1624	RE42841	RE44479	3—5%	1800	1890	124 (166)
	1624	RE44479	RE48160	3—5%	1800	1890	112 (150)
	1624	RE48160		3—5%	1800	1890	112 (150)
	1644	RE40243	RE48157	3—5%	1800	1890	124 (166)
T06059TF (Continued on next page)	1644	RE48157		3—5%	1800	1890	124 (166)

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Governor Regulation**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Power Rating Kw (BHP)**
T06059TF (Continued)	1645	RE42841	RE48158	3—5%	1800	1890	124 (166)
	1645	RE48158		3—5%	1800	1890	124 (166)
CD6059TF	1602	RE19914	RE47137	STD	2500	2710	123 (165)
	1602	RE47137		STD	2500	2710	123 (165)
	1603	RE19981	RE48159	3—5%	1800	1890	112 (150)
	1603	RE48159		3—5%	1800	1890	112 (150)
	1604	RE38864	CANCELLED	3—5%	1800	1890	112 (150)
	1611	RE37937	CANCELLED	STD	2500	2750	100 (134)
	1619	RE47178[b]		STD	2500	2710	123 (165)
	1623	RE31767	CANCELLED	STD	2500	2750	123 (165)
	1624	RE48160[b]		3—5%	1800	1890	111 (149)
	1632	RE31768	CANCELLED	3—5%	1800	1890	111 (149)
	1636	RE31760	RE50886	3—5%	1500	1575	94 (126)
	1636	RE50886		3—5%	1500	1575	94 (126)
	1641	RE29472	RE50885	3—5%	1500	1575	94 (126)
	1641	RE50885[b]		3—5%	1500	1575	94 (126)
	1641	RE50892		3—5%	1500	1575	104 (139)
	1644	RE48157		3—5%	1800	1890	124 (166)
	1645	RE48158[b]		3—5%	1800	1890	123 (165)
	1646	RE50892		3—5%	1500	1575	104 (139)
	1647	RE50893		3—5%	1500	1575	104 (139)
	1649	RE47137	CANCELLED	STD	2500	2750	123 (165)
	1651	RE47178	CANCELLED	STD	2500	2750	123 (165)
	1652	RE56483		STD	2500	2750	123 (165)
(Continued next page)	1653	RE56484		STD	2500	2750	123 (165)

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page DPSG,OUO1004,498 –19–27NOV98–7/8

POWER RATINGS ON DYNAMOMETER FOR OEM ENGINES (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Governor Regulation**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Power Rating Kw (BHP)**
T06068DF	1602	RE42092	RE47182	STD	2400	2640	97 (130)
	1602	RE47182		STD	2400	2640	97 (130)
	1619	RE42842	RE47183	STD	2400	2640	97 (150)
	1619	RE47183		STD	2400	2640	97 (130)
CD6068DF	1622	RE47182		STD	2400	2640	97 (130)
	1623	RE47183		STD	2400	2640	97 (130)
T06068DFM	1623	RE65038		STD	2400	2640	97 (130)
	1630	RE52008		STD	2400	2640	97 (130)
T06068TF	1602	RE42094	RE49427	STD	2400	2640	130 (174)
	1602	RE49427	RE47184	STD	2400	2640	130 (174)
	1602	RE47184	RE41815	STD	2400	2640	130 (174)
	1602	RE41815		STD	2400	2640	130 (174)
	1610	RE42920		STD	2200	2420	94 (126)
	1612	RE65015[b]		STD	2400	2640	130 (174)
	1619	RE42843	RE47185	STD	2400	2640	130 (174)
	1619	RE47185[b]		STD	2400	2640	130 (174)
CD6068TF	1605	RE65342		3—5%	1500	1580	116 (156)
	1642	RE47184		STD	2400	2640	130 (174)
	1643	RE47185		STD	2400	2640	130 (174)
	1646	RE67761		3—5%	1500	1580	116 (156)
T06068TFM	1624	RE65039		3—5%	1800	1890	114 (153)
	1625	RE65040		STD	2400	2640	130 (175)
	1626	RE65041		STD	2600	2860	164 (220)
	1630	RE52010		STD	2400	2640	130 (175)
	1631	RE52012		3—5%	1800	1890	114 (153)
	1632	RE56421		STD	2600	2860	164 (220)
[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.							
[b]Can be used with JP5/JP8 Jet "A" fuel.							

DPSG,OUO1004,498 –19–27NOV98–8/8

ENGINE BREAK-IN GUIDELINES

Engine break-in should be performed when the following repair 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. Check and reset valve clearance.
- Injection pump has been removed or critical adjustments have been made while it is on the engine. (Primary objective is to check power).

RG,CTM61,G105,2 –19–29SEP94–1/1

PERFORM ENGINE BREAK-IN

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. This oil is specifically formulated to enhance break-in of John Deere diesel engines.

   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[a]
1 minute	No load	850 rpm
2 minutes	No load	Fast Idle
15 minutes	1/2—3/4 load	2000 rpm to rated speed
10 Minutes	Full load	Rated speed

[a]Engine speeds listed are as preset to factory specification. In most cases, slow idle speed will be reset depending upon specific vehicle application requirements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

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.

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.

RG,100,JW7645 –19–21NOV97–1/1

ENGINE OIL CONSUMPTION

All engines consume some oil. The consumption rate depends on loading, design of key parts and engine condition. Since fuel consumption is an indicator of operating power levels, fuel used versus oil consumed is a critical factor in analyzing oil consumption. Oil consumption should be measured over a 100 hour period.

Long term oil consumption (3 oil drain intervals after the engine is broken in) with consumption rates poorer than 400:1 (100 gallons of fuel and 1 quart of oil) indicates a need to monitor/investigate. Suggested steps would be:

- Check for signs of ingested dust or perform an OILSCAN Test to check for silicon.
- Check for proper crankcase oil fill level.
- Perform compression test to find low compression cylinders.
- Remove head and inspect for glazed or worn liners.
- Inspect pistons for carbon deposits in the ring land grooves.
- Measure valve stem OD and valve guide ID to determine clearance.

NOTE: Ring gap alignment does not identify the leak source.

Intake valves do not have valve stem seals and some oil deposits on the valve stem tulip is normal.

When changing to a premium oil such as TORQ-GARD SUPREME® PLUS-50®, little oil consumption change is expected although a small percentage of engines may experience a noticeable change in consumption rates. This may be due to the following:

- The previous oil may have left deposits on internal components. Use of PLUS-50® oil will cause different chemical reactions in those deposits. The time required for the engine to regain the previous oil consumption rate will vary from one to three normal drain intervals.
- TORQ-GARD SUPREME® PLUS-50® contains a high performance anti-oxidant along with other additives resulting in the oil remaining in the specified viscosity grade throughout the recommended drain interval. API oil grades CD, CE, and CF-4 universal engine oils do not provide this oxidation resistance which results in more rapid thickening. Increased oil viscosity can reduce oil consumption.

DPSG,OUO1004,114 –19–07MAY98–1/1

CHECK CRANKCASE VENTILATION SYSTEM

1. Inspect crankcase ventilation system for restrictions and bent or damaged condition. Lack of ventilation causes excessive oil consumption or 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 or hose with solvent and compressed air if restricted. Replace hose if necessary.

A—Crankcase Vent Hose

CTM8,GR100,2 –19–16SEP92–1/1

CHECK AIR INTAKE SYSTEM

1. Replace air cleaner primary filter element. Replace secondary element if primary element has holes in it.

2. Check condition of air intake hose(s). Replace hoses that are cracked, split, or otherwise in poor condition.

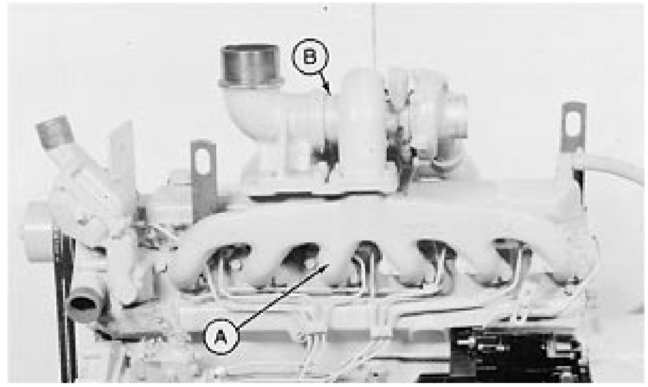
3. Check hose clamps for tightness. Replace clamps that cannot be properly tightened. This will help prevent dust from entering the air intake system which could cause serious engine damage.

S11,22010,BY –19–03FEB95–1/1

CHECK EXHAUST SYSTEM

1. Inspect exhaust system for leaks or restrictions. Check manifold (A) for cracks. Repair or replace as necessary.

2. On turbocharged engines, check exhaust adapter (B) to make sure it has end play and rotates freely. Correct as necessary.



RG4834 –UN–30NOV88

A—Exhaust Manifold
B—Exhaust Adapter

S11,22010,BZ –19–01JUL92–1/1

CHECK AND SERVICE COOLING SYSTEM

TS281 –UN–23AUG88

1. Remove trash that has accumulated on or near radiator.

2. Visually inspect entire cooling system for leaks or damage. Repair or replace as necessary.

3. Inspect radiator hoses for signs of leakage or rot. Replace hoses as necessary.

CAUTION: Do not drain coolant until it has cooled below operating temperature. Always loosen block drain valve slowly to relieve any excess pressure.

4. Remove and check thermostats. (See REMOVE, TEST, AND INSTALL THERMOSTATS in Group 25.)

5. Drain and flush cooling system. (See FLUSHING AND SERVICING 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 or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled.

6. Fill cooling system with recommended concentration of coolant, clean soft water, and inhibitors. (See ENGINE COOLANT RECOMMENDATIONS/SPECIFICATIONS in Group 02.)

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

8. After engine cools, check coolant level.

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

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

RG,CTM8,DX126 –19–03FEB95–1/1

CHECK ELECTRICAL SYSTEM

TS204 –UN–23AUG88

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

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

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

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. Follow diagnosis and testing procedures outlined in CTM77.

6. Check tension of fan belts. (See Engine Operator's Manual.)

7. Check operation of starting motor and gauges.

RG,CTM8,DX123 –19–06FEB95–1/1

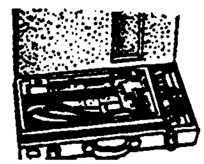
ESSENTIAL TOOLS

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,OUO1004,379 –19–17OCT98–1/5

RG5161 –UN–23AUG88

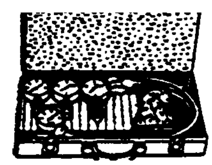


Compression Test Set . . JT01674 (formerly D14546BA or FKM10021)

Used to check cylinder compression pressure. Use adapter and gauge/hose assembly from set.

DPSG,OUO1004,379 –19–17OCT98–2/5

RG5162 –UN–23AUG88



Universal Pressure Test Kit . . . . . JT05470 (D15027NU or FKM10002)

Used to check engine oil pressure.

Continued on next page

DPSG,OUO1004,379 –19–17OCT98–3/5

Cooling System Pressure Pump D05104ST

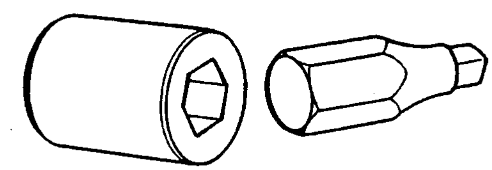
Used to pressure test radiator cap and cooling system.

R26406N –UN–29NOV88

DPSG,OUO1004,379 –19–17OCT98–4/5

Oil Gallery Plug Tool JDG782

Used to remove and install oil gallery plug.



RG6612 –UN–29JAN93

DPSG,OUO1004,379 –19–17OCT98–5/5

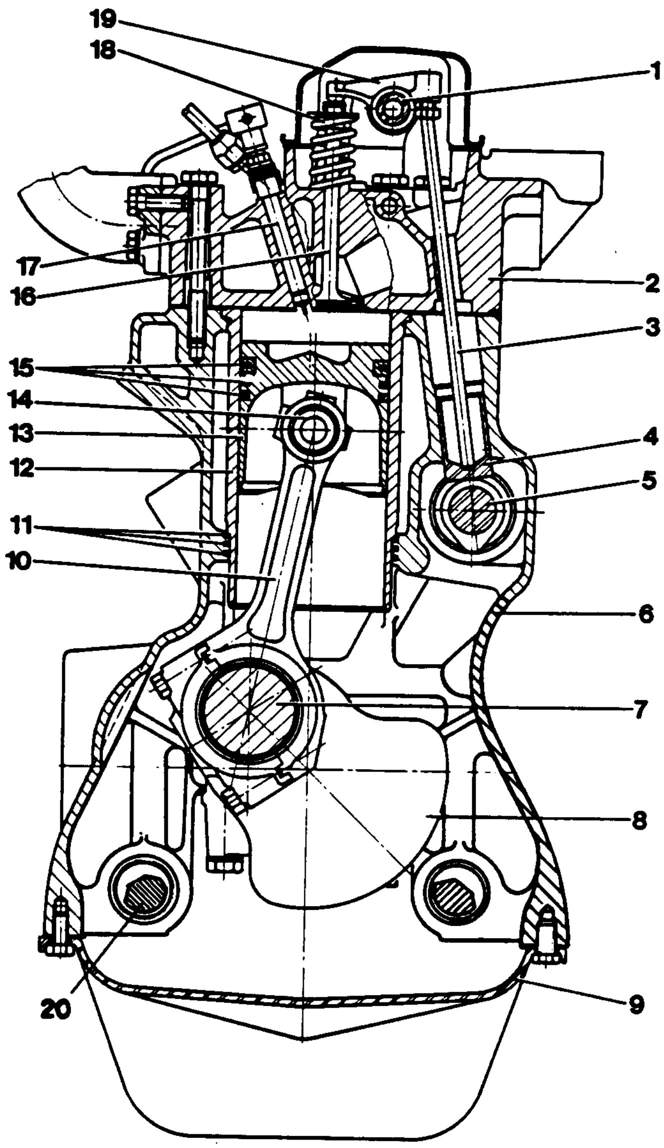
ENGINE TEST SPECIFICATIONS

Item	Measurement	Specification
Engine Compression Pressure Test	Minimum Pressure Maximum Difference Between Cylinders	2400 kPa (24 bar) (350 psi) 350 kPa (3.5 bar) (50 psi)
Oil Pressure-No Load at 850 rpm and 93°C (200°F) Oil Temperature (4- and 6-cylinder)	Minimum Pressure	100 kPa (1.0 bar) (15 psi)
Oil Pressure-Full Load at 850 rpm and 105°C (220°F) Oil Temperature (3-cylinder)	Minimum Pressure	140 kPa (1.4 bar) (20 psi)
Oil Pressure-Full Load at Rated Speed and 105°C (220°F) Oil Temperature[1]	Maximum Pressure	380 ± 103 kPa (3.80 ± 1.03 bar) (55 ± 15 psi)
Crankcase Pressure (Blow-By) at Crankcase Vent Tube		
3 and 4-Cylinder "D" Engines	Crankcase Pressure (Blow-By)	4.0 m^3/h (141 cu ft/h)
6-Cylinder "D" Engines	Crankcase Pressure (Blow-By)	6.0 m^3/h (225 cu ft/h)
3 and 4-Cylinder "T" and "A" Engines	Crankcase Pressure (Blow-By)	6.0 m^3/h (225 cu ft/h)
6-Cylinder "T" and "A" Engines	Crankcase Pressure (Blow-By)	8.0 m^3/h (282 cu ft/h)
Cooling System	Test Pressure	50 kPa (0.5 bar) (7 psi)

[1]Gauge fluctuations and tolerance extremes can result in readings up to 586 kPa (5.86 bar) (85 psi).

DPSG,OUO1004,382 –19–17OCT98–1/1

ENGINE—SECTIONAL VIEW



1—Rocker Arm Shaft
2—Cylinder Head
3—Push Rod
4—Cam Follower
5—Camshaft
6—Cylinder Block
7—Crankshaft
8—Crankshaft Counterweight
9—Oil Pan
10—Connecting Rod
11—Liner Packing Rings
12—Cylinder Liner
13—Piston
14—Piston Pin
15—Piston Rings
16—Valve
17—Fuel Injection Nozzle
18—Valve Spring
19—Rocker Arm
20—Balancer Shafts (some 4-cylinder engines only)

S11,2000,EH –19–03FEB95–1/1

GENERAL ENGINE DESCRIPTION

Model 3029, 4039, 4045, 6059, and 6068 engines are vertical, in-line, valve-in-head, 4-cycle (stroke) diesel engines.

Direct fuel injection is provided by a distributor-type injection pump and 9.5 mm injection nozzles (17) mounted in cylinder head (2). The gear driven injection pump is timed to the crankshaft by the timing gear train.

Some engines are equipped with a turbocharger. The turbocharger uses energy from exhaust gases to compress intake air and force it into the combustion chamber.

The cylinder block (6) is a one-piece casting. The block is available in structural and non-structural configurations.

The camshaft (5) is timed to the crankshaft through the timing gear train. The camshaft rotates in honed bores in the cylinder block. Camshaft gear-driven auxiliary drive engines and all 3029 engines use a bushing in No. 1 camshaft bore. The camshaft lobes determine the duration and lift of each valve, and operate the fuel transfer pump.

Balancer shafts (20) are used on some four-cylinder engines to reduce vibration. The two shafts rotate on bushings in cylinder block and are counter-rotating at twice engine speed.

Intake and exhaust valves (16) are operated by camshaft followers (4), push rods (3) and rocker arm assembly (19). Valve seat inserts in cylinder head are used for intake and exhaust valves.

The crankshaft (7) is a one-piece, heat treated, steel or nodular-iron forging which operates in replaceable two-piece main bearings. Steel crankshafts may have either ground-fillets, or undercut and rolled fillets. All nodular-iron crankshafts are machined with undercut and rolled fillets.

Two different types of main thrust bearing inserts are used to control end-play, depending on the producing factory. Normally, a two-piece thrust bearing insert is used on Dubuque engines, and a 5/6-piece bearing insert is used on Saran engines. The 5/6-piece bearing has high thrust load capability, and may be retro-fitted to Dubuque engines[1] at service repair if so desired.

IMPORTANT: Service thrust bearing kits are now supplied with a six-piece thrust bearing assembly. It is acceptable to use a six-piece bearing where five-piece was previously used. Follow instructions provided.

If a crankshaft has excessive end play, thrust washer sets are available in standard size or 0.007 in. oversize.

Cylinder liners (12) are "wet" (surrounded by coolant) and are individually replaceable. O-rings seals (11) are used at the lower connection between cylinder block and liners.

Pistons (13) are made of high-grade cast aluminum alloy with internal ribbing. The skirt is cam ground to allow for expansion during operation. The piston crown has a cut-out combustion bowl with a truncated cone center. All piston rings (15) are located above the piston pin. Two compression rings and one oil control ring are used. The top compression ring is a keystone shaped ring located close to the top of the piston for improved engine performance.

[1] *Main (thrust) bearing web undercut in block and or bearing cap MUST be 113.8 mm (4.48 in.) in order to accept five piece thrust bearings.*

Continued on next page

The hardened, fully-floating piston pins (14) are held in place by snap rings. Spray jets (piston cooling orifices) in cylinder block spray pressurized oil on the underside of the piston to lubricate piston pins and cool pistons.

The forged steel connecting rods (10) have replaceable pin bushing and bearing inserts. 3029 connecting rods have a tapered pin-end.

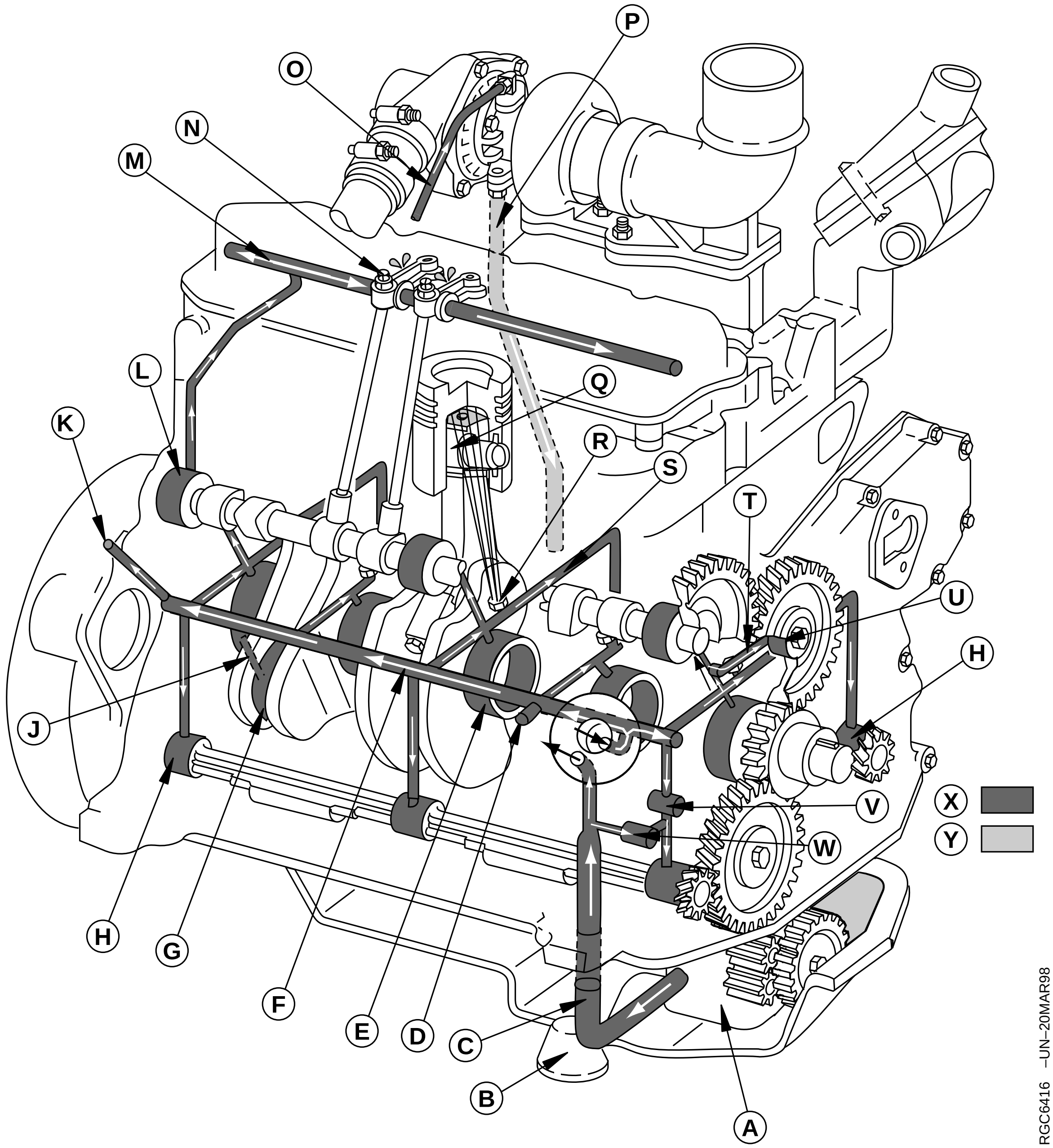
Piston stroke is different for various 300 Series engines. 3029, 4039 and 6059 eingines have a short stroke of 110 mm (4.33 inches). The 4045 and 6068 engines have a long stroke of 127 mm (5.00 inches).

The engine is equipped with a gear-driven oil pump and full-flow oil filter. The oil filter has an internal bypass valve which opens if the filter element becomes restricted. Most engines are equipped with an oil cooler mounted externally on the cylinder block. The engine is equipped with a pressure regulator valve to relieve excessive pressure build-up in the main oil gallery, and a bypass valve to prevent oil starvation if the oil cooler and filter become plugged.

The engine has a pressurized cooling system, consisting of radiator, water pump, multi-blade fan, and one or two thermostats.

CTM8,GR01,11 –19–18FEB95–2/2

HOW THE ENGINE LUBRICATION SYSTEM WORKS



A—Oil Pump
B—Oil Suction Line
C—Oil Outlet Tube
D—Turbo Oil Supply (Camshaft Side of Block)
E—Main Bearing
F—Main Oil Gallery
G—Connecting Rod Bearing
H—Balancer Shaft Bushings
J—Main-to-Rod Cross Drilling
K—Turbo Oil Supply (Oil Gallery in Flywheel Housing)
L—Rear Camshaft Bearing
M—Rocker Arm Shaft
N—Rocker Arm
O—Turbocharger Oil Supply Line
P—Turbocharger Oil Drain Line
Q—Piston Pin Bushing
R—Piston Cooling Orifice
S—Cross-Drilling
T—Oil Passage to Upper Idler Bushing
U—Upper Idler Gear Bushing
V—Pressure Regulator Valve
W—Pressure Bypass Valve
X—Pressurized Oil
Y—Pressure-Free Oil

Continued on next page

The engine lubrication system consists of a positive displacement gear-driven oil pump (A), full flow oil filter, oil cooler, oil pressure regulating valve, and an oil by-pass valve.

The oil pump pulls oil from the oil pan sump through a strainer and a suction line (B). The pump forces oil through the outlet tube (C) into a vertical drilling in the cylinder block, and up to the oil cooler and filter. After flowing through the cooler and filter, oil flows into the main oil gallery.

The main oil gallery (F) runs the length of the cylinder block and delivers oil to cross drillings in each of the main bearing webs. The cross-drillings (S) intersect with oil passages that feed oil to the crankshaft main bearings (E), to piston cooling orifices (R), to camshaft bearings (L), and to balancer shaft bushings (H).

From the main bearings, oil flows to the connecting rod bearings (G) through drilled cross-passages (J) in the crankshaft between the main journals and connecting rod journals.

Oil from the piston cooling orifices (R) sprays on the underside of the piston to keep the piston crown cool. The oil spray also provides splash lubrication for the piston pin and bushing (Q) by splashing oil into a hole drilled in the top end of the connecting rod.

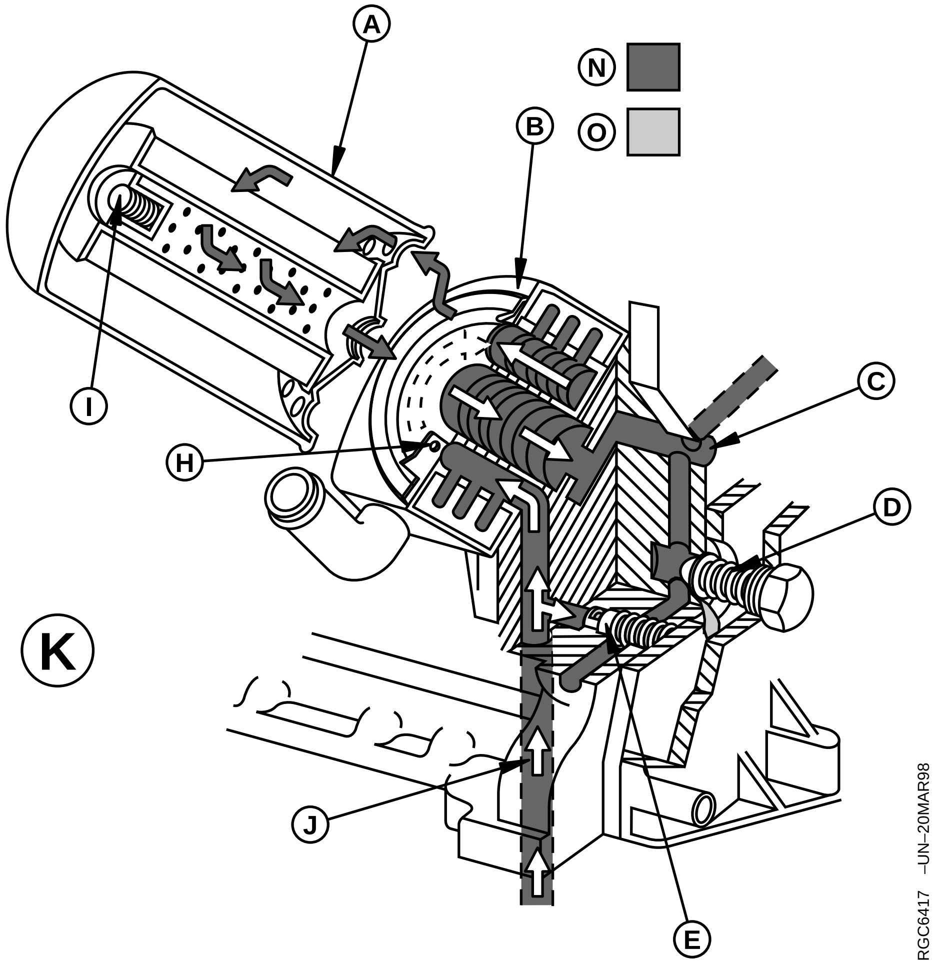
At the rear of the cylinder block, oil flows from the rear camshaft bore (L), up through the cylinder head, and into the rocker arm shaft (M). Oil flows through the rocker arm shaft and lubricates each of the rocker arms (N). Oil drips from the rocker arms to lubricate the adjusting screws, push rods, and camshaft followers.

At the front of the cylinder block, oil flows from the cross-drilling into a passage (T) in the front face of the block. This oil passage intersects with the upper idler gear shaft to provide oil to the idler gear bushing (U). The lower idler gear bushing is splash lubricated.

The turbocharger oil supply line (O) supplies oil to the turbocharger from one of the following locations:

- filtered side of oil filter adapter (long stroke engines);
- rear end of main oil gallery in the flywheel housing (K), or main oil gallery (F) on camshaft side of engine (4- and 6-cylinder short stroke engines);
- cross-drilling on fuel injection pump side of engine (3-cylinder engines). Oil returns from the turbocharger through the drain line (P).

Continued on next page RG,CTM8,G105,1 –19–18FEB95–2/4



A—Oil Filter
B—Turbocharger Oil Supply
C—Main Oil Gallery
D—Pressure Regulator Valve
E—Pressure Bypass Valve
F—Oil Cooler (High Flow)
G—Oil Cooler (Standard Flow)
H—Oil Cooler Bypass Valve
I—Filter Bypass Valve
J—From Oil Pump
K—Short Stroke System
L—Common Lube Long Stroke System
M—Pre-Common Lube Long Stroke System
N—Pressurized Oil
O—Pressure-Free Oil

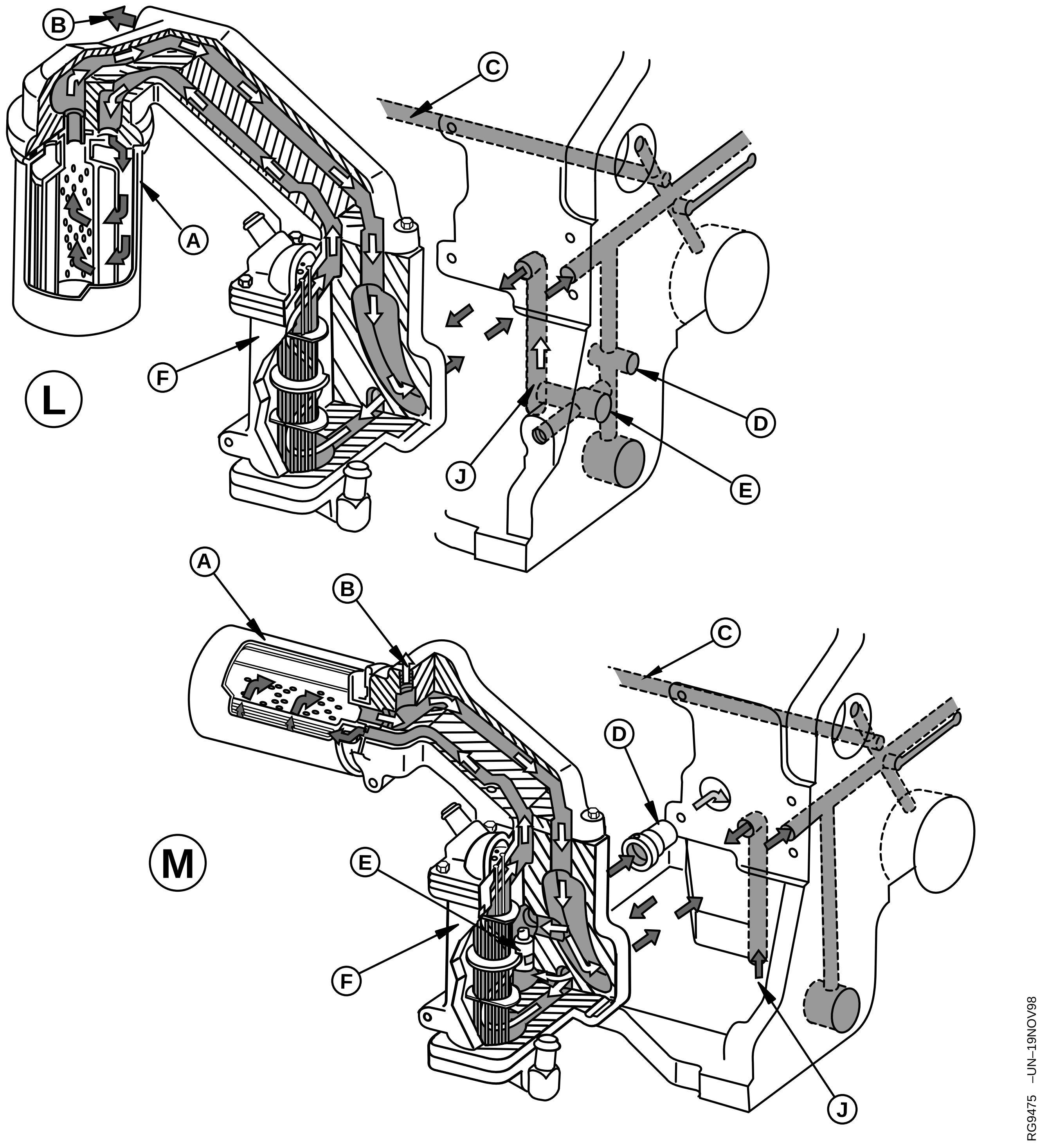
Oil flows through oil cooler and into oil filter. Oil flows through filter element from outside-to-inside, and then returns through oil cooler housing into main oil gallery.

If oil pressure from pump (J) exceeds oil pressure in main oil gallery (C) by more than 340 ± 34 kPa (3.38 ± 0.34 bar) (49 ± 5 psi), oil bypass valve (E) opens. This allows oil to bypass oil cooler and filter, and flow directly from pump to main oil gallery to prevent oil starvation.

Also, oil filter (A) and standard flow oil cooler (G) each have their own bypass valve (I and H, respectively) that opens if oil flow becomes restricted.

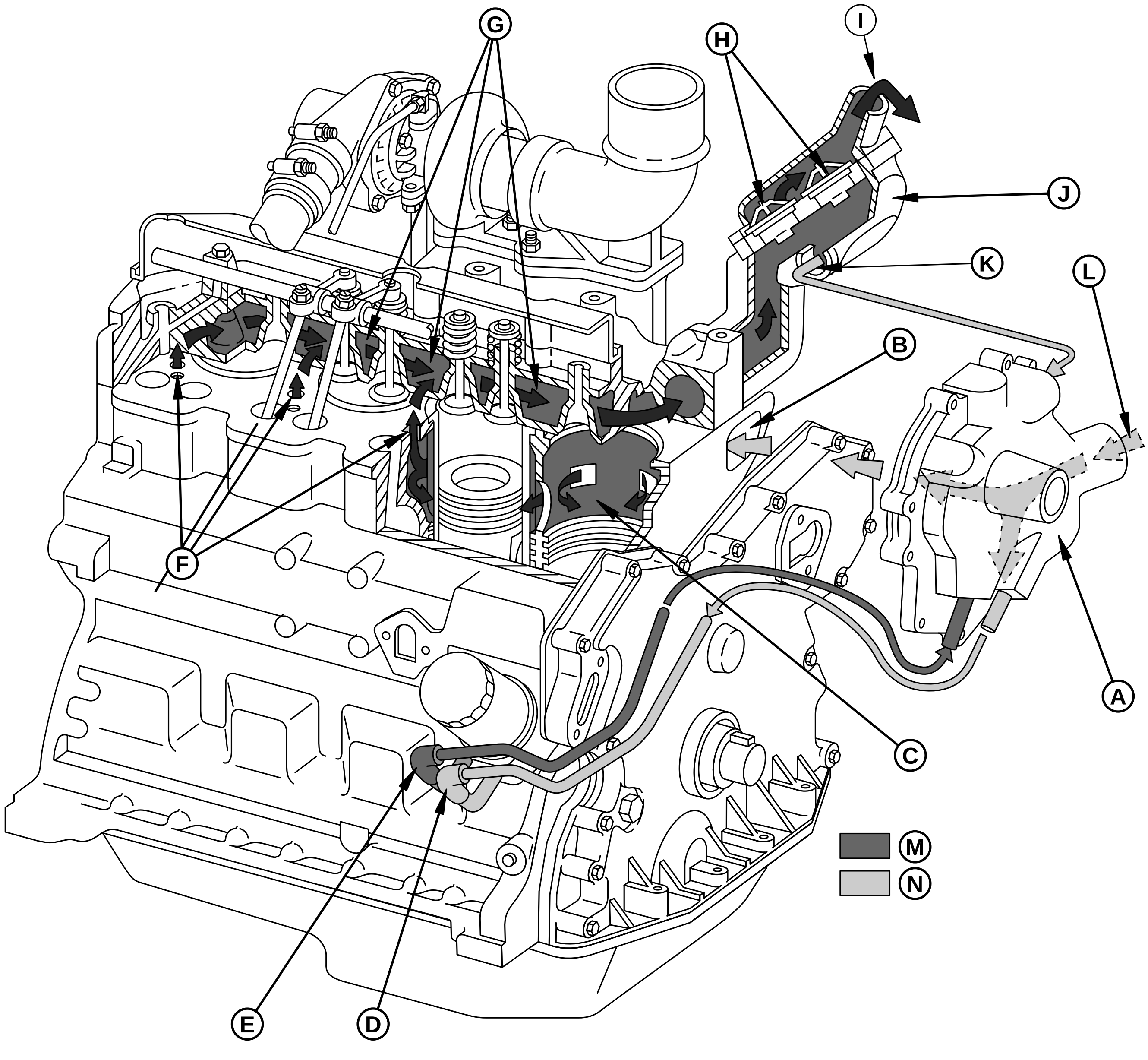
If oil pressure in main oil gallery exceeds a predetermined factory safety pressure, the pressure regulator valve (D) opens and relieves excess pressure back to oil pan.

Continued on next page



RG,CTM8,G105,1 –19–18FEB95–4/4

HOW THE COOLING SYSTEM WORKS



A—Water Pump
B—Main Coolant Gallery
C—Coolant Jacket
D—Oil Cooler Supply
E—Oil Cooler Return
F—Block Deck Passages
G—Cylinder Head Coolant Passages
H—Thermostats
I—Upper Radiator Hose
J—Thermostat Housing
K—Bypass Circuit
L—Suction Side of Water Pump
M—High Temperature Coolant
N—Low Temperature Coolant
O—Oil Cooler Return (Upper End of Block)

The cooling system includes the radiator, water pump (A), and thermostats (H).

Continued on next page

RG,CTM8,G105,5 –19–18SEP92–1/3

Coolant is circulated from the water pump into the main coolant gallery (B). From the gallery, coolant flows into the coolant jacket (C), around the cylinder liners, up through the block deck passages (F), and into the cylinder head. In the cylinder head, the coolant flows through passages (G) around the intake and exhaust ports, valve seats, and injection nozzles. Coolant flows toward the front end of the cylinder head and exits through the water manifold and thermostat housing (J).

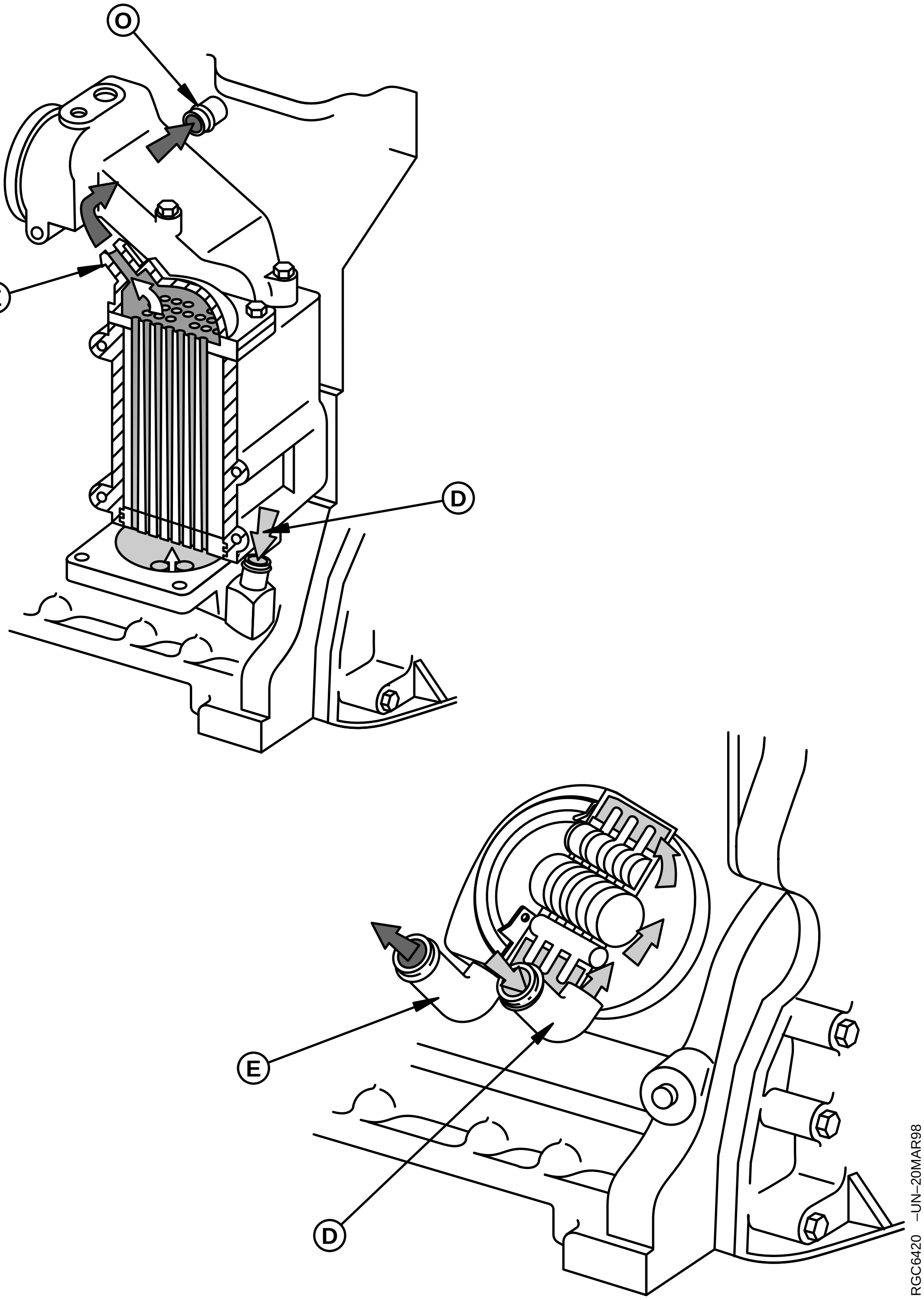
During the warm-up period, thermostats are closed and coolant is directed through a bypass circuit (K) into suction side of water pump. The coolant continues circulating through the cylinder block, cylinder head, and water pump to provide a uniform and fast warm-up period.

Once the engine has reached operating temperature, the thermostats open and allow coolant to flow through the upper radiator hose (I) to the radiator top tank. Coolant circulates through the radiator, dissipates heat, and then flows out of the radiator through the lower hose and into the suction side (L) of the water pump. Coolant continues flowing through the engine and radiator circuit until the coolant temperature drops below the thermostat opening temperature.

Coolant is supplied to the oil cooler by a supply line (D) from the pressure side of the water pump. After the water flows through the oil cooler, it returns (E) to either the suction side of the water pump or to the upper end of the cylinder block (O).

Diagram on next page shows high-flow oil cooler (top) and standard oil cooler (bottom).

Continued on next page RG,CTM8,G105,5 –19–18SEP92–2/3

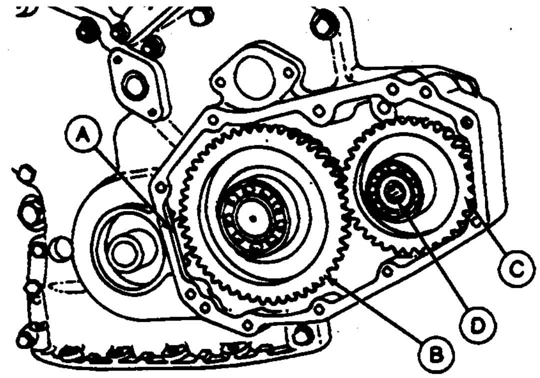


A—Water Pump
B—Main Coolant Gallery
C—Coolant Jacket
D—Oil Cooler Supply
E—Oil Cooler Return
F—Block Deck Passages
G—Cylinder Head Coolant Passages
H—Thermostats
I—Upper Radiator Hose
J—Thermostat Housing
K—Bypass Circuit
L—Suction Side of Water Pump
M—High Temperature Coolant
N—Low Temperature Coolant
O—Oil Cooler Return (Upper End of Block)

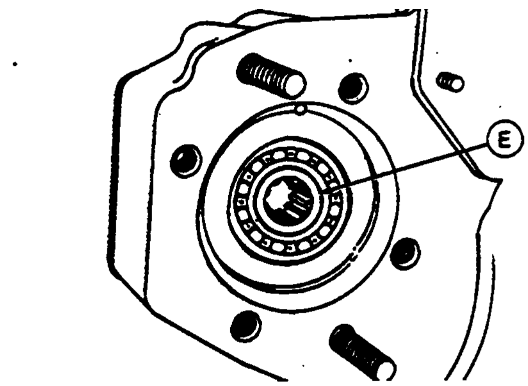
RG,CTM8,G105,5 –19–18SEP92–3/3

HOW THE CRANKSHAFT GEAR-DRIVEN AUXILIARY DRIVE WORKS

A drive gear (A) on the engine crankshaft transmits power through an idler gear (B) to the auxiliary (output) drive gear (C) for driving engine accessories. The output shaft at front (D) is equipped with a 5/8—9 tooth SAE type "A" spline and 2-bolt mounting. Output shaft at rear (E) is equipped with a 7/8—13 tooth SAE type "B" spline which can have either a 2-bolt or 4-bolt mounting.



RG5173 –UN–30NOV88



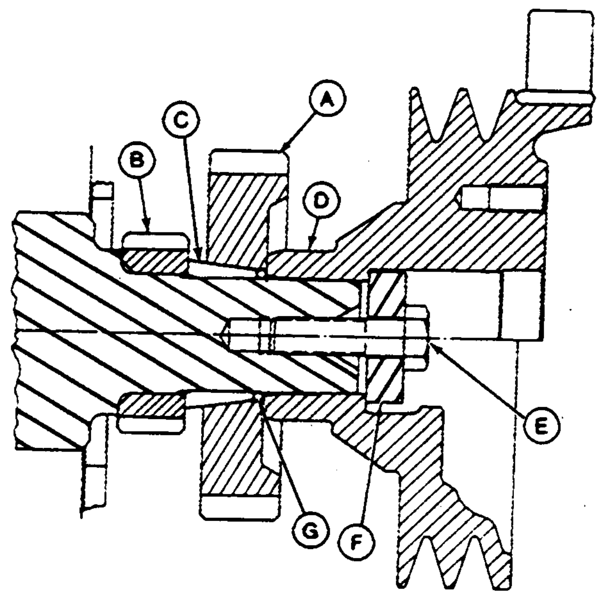
RG5174 –UN–30NOV88

A—Drive Gear
B—Idler Gear
C—Auxiliary (Output) Drive Gear
D—Output Shaft (at front)
E—Output Shaft (at rear)

Continued on next page

S11,22010,DL –19–03FEB95–1/4

The auxiliary drive gear (A) is positioned in front of the regular crankshaft gear (B) and mounts on a tapered collet (C). When damper pulley (D) and cap screw (E) are installed, the auxiliary drive gear is forced onto the collet causing the collet to clamp onto the crankshaft nose. This allows power to be transmitted through the collet and drive gear. One O-ring (G) is used to prevent external seepage of engine oil.

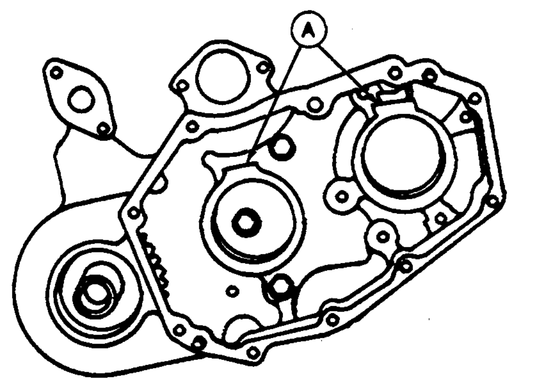


RG5175 –UN–30NOV88

A—Auxiliary Crankshaft Drive Gear
B—Regular Crankshaft Gear
C—Tapered Collet
D—Pulley
E—Cap Screw
F—Washer
G—O-Ring

Continued on next page S11,22010,DL –19–03FEB95–2/4

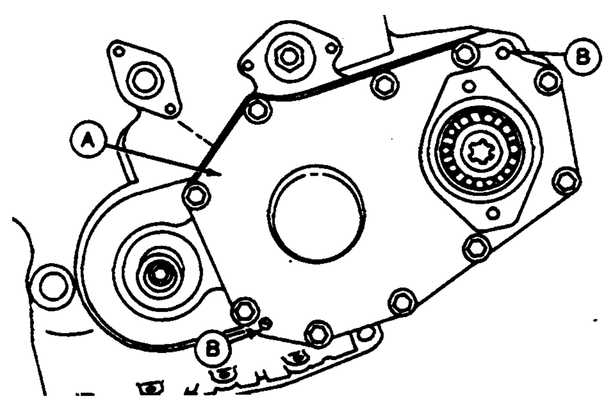
The idler and output gears are supported by ball bearings. Gears and bearings are splash lubricated. Splash oil collecting on top of bearing bosses (A) is directed down through a hole in each boss to lubricate the bearings.



A—Bearing Bosses

S11,22010,DL −19−03FEB95−3/4

The auxiliary gear cover (A) supports the outer bearing race for the idler and output gear assemblies. Two dowel pins (B) are used to properly align auxiliary gear cover to timing gear cover.



A—Auxiliary Gear Cover
B—Dowel Pins

S11,22010,DL −19−03FEB95−4/4

HEAD GASKET JOINT CONSTRUCTION AND OPERATION

The head gasket joint consists of the following components:

- Cylinder head gasket
- Cylinder head (A)
- Cylinder block (E)
- Cylinder liners (C)
- Cylinder head cap screws (B)

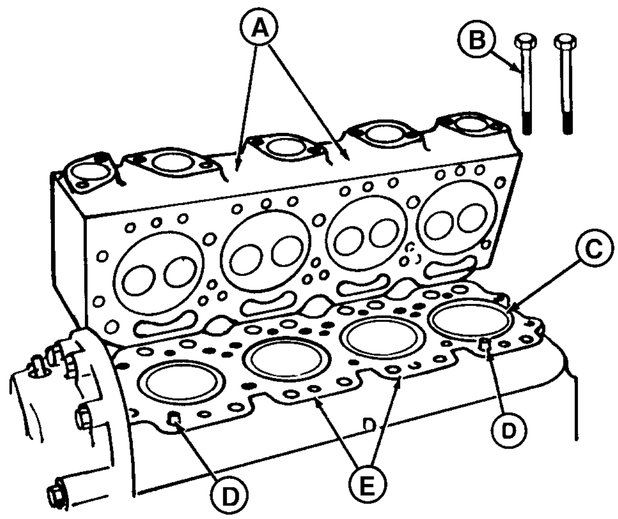
The head gasket must form an air-tight seal between cylinder liners and cylinder head that can withstand the temperatures and pressures of the combustion process. The gasket must also form a liquid-tight seal between the cylinder head and cylinder block to retain coolant and oil in their respective passages. The gasket is constructed of thin, formed sheets of steel-inserted, non-asbestos material (F). 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 from moving in the joint. Dowels (D) are used to properly locate head gasket on block.

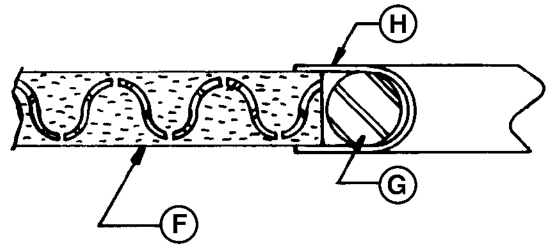
The cylinder liners must protrude evenly from top of cylinder block the specified amount to provide adequate clamping force on fire ring of each cylinder.

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 specifications, gasket joint may fail resulting in combustion leaks, coolant leaks, or oil leaks.



RG6433 –UN–03NOV97



RG6430 –UN–03NOV97

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

Continued on next page

RG,CTM8,G105,9 –19–16SEP92–1/2

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 pressures persist.

RG,CTM8,G105,9 –19–16SEP92–2/2

DIAGNOSING HEAD GASKET JOINT FAILURES

NOTE: DB1119 'CYLINDER HEAD GASKET FAILURES' for 400 Series engines can be used as a guide for diagnosing head gasket failures on 300 Series engines. Use 300 Series specifications from this manual (CTM8).

Head gasket failures generally fall into three categories:

- Combustion seal failures.
- Coolant seal failures.
- Oil seal failures.

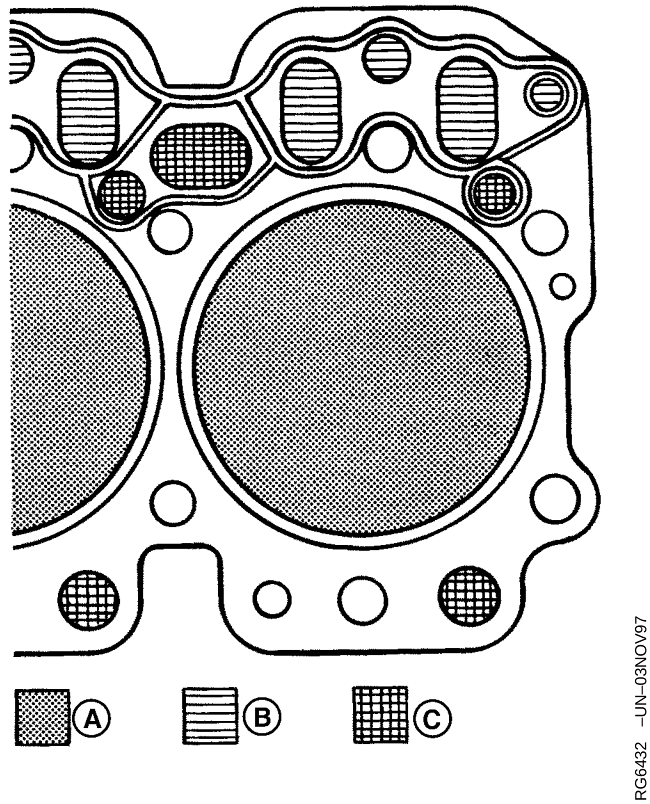
Combustion seal failures occur when combustion gases escape between cylinder head and head gasket combustion flange, or between combustion flange and cylinder liner. Leaking combustion gases may vent to an adjacent cylinder, to a coolant or oil passage, or externally.

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. Since oil and coolant passages are primarily on right hand (camshaft) side of engine, fluid leaks are most likely to occur in that area.

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.



A—Combustion Sealing Areas
B—Oil Sealing Areas
C—Coolant Sealing Areas

Continued on next page

- Damaged or incorrect pressure cap.
- Presence of oil in coolant.
- Low coolant levels.
- Improper coolant.
- Unusually high or low oil levels.
- Oil degradation, dilution, or contamination.
- Correctly specified injection pump.
- Indications of fuel or timing adjustments.
- 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.

COMBUSTION SEAL LEAKAGE

Symptoms:

- Exhaust from head gasket crevice
- Air bubbles in radiator/overflow tank
- Coolant discharge from overflow tube

Continued on next page

RG,CTM8,G105,10 –19–16SEP92–2/4

- Engine overheating
- Power loss
- Engine runs rough
- White exhaust smoke
- Loss of cab heat
- Gasket section dislodged, missing (blown)
- Coolant in cylinder
- Coolant in crankcase oil
- Low coolant level

Possible Causes:

- Insufficient liner standout
- Excessive liner standout differential between cylinders
- Low head bolt clamping loads
- Rough/damaged liner flange surface
- Cracked/deformed gasket combustion flange
- Out-of-flat/damaged/rough cylinder head surface
- Missing/mislocated gasket fire ring
- Block cracked in liner support area
- Excessive fuel delivery
- Advanced injection pump timing
- Hydraulic or mechanical disturbance of combustion seal

NOTE: Cracked cylinder head or liners may also allow combustion gas leakage into coolant.

COOLANT SEAL LEAKAGE

Symptoms:

- Coolant discharge from head gasket crevice
- Coolant in crankcase oil
- Low coolant level
- High oil level
- Coolant discharge from crankcase vent

Possible Causes:

- Excessive liner standout
- Excessive liner standout differential between cylinders
- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces

Continued on next page
RG,CTM8,G105,10 –19–16SEP92–3/4

- Damage/voids in elastomer beading

NOTE: Cracked cylinder head, liners, liner packings, defective oil cooler or aftercooler may also allow coolant leakage into crankcase.

OIL SEAL LEAKAGE

Symptoms:

- Oil discharge from head gasket crevice
- Oil in coolant
- Low crankcase oil level
- Reduced oil to rocker arms (noisy)

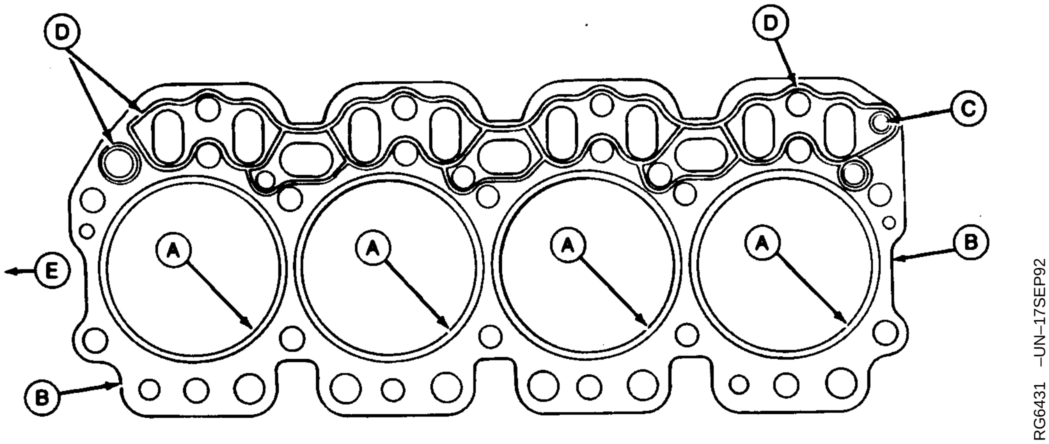
Possible Causes:

- Excessive liner standout
- Excessive liner standout differential between cylinders
- Low head bolt clamping loads
- Out-of-flat/damaged/rough block surface
- Out-of-flat/damaged/rough cylinder head surface
- Oil or coolant overheating
- Cracks/creases in gasket body surfaces
- Damage/voids in elastomer beading
- Damaged/missing O-ring seal at oil port to rocker arms

NOTE: Defective oil cooler may also allow oil leakage into coolant.

RG,CTM8,G105,10 –19–16SEP92–4/4

HEAD GASKET INSPECTION AND REPAIR SEQUENCE



A—Combustion Seals (Flanges)
B—Gasket Body
C—Rocker Arm Oil Port
D—Elastomer Beading Strips
E—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.
   - O-ring seal missing/damaged in port area (C).
   - Elastomer missing/damaged in port areas (D).
   - 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 block, head, liners, and cap screws. (See Groups 05 and 10.)

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

   Cylinder Head (See Group 05.)

   - Check surface flatness/finish.

Continued on next page

RG,CTM8,G105,15 –19–16SEP92–1/2

- Inspect for surface damage.
- Check cylinder head thickness, if resurfacing.

Cylinder Block and Liners (assembled and clamped) (See Group 05 or 10.)

- Check liner standout at four places on each liner.
- Check liner standout difference between cylinders.

Cylinder Block (See 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 (See Group 10.)

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

Cylinder Head Cap Screws (See Group 05.)

- Inspect for corrosion damage.
- Inspect condition of threads.
- Inspect for straightness.
- 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.

RG,CTM8,G105,15 –19–16SEP92–2/2

DIAGNOSING ENGINE MALFUNCTIONS

Engine Will Not Crank

Electrical System Malfunction

- Weak battery
- Corroded or loose battery connections
- Defective main switch or start safety switch
- Starter solenoid defective
- Starter defective

Engine Hard to Start or Will Not Start

Electrical System Malfunction

- Loose or corroded battery connections
- Weak battery
- Excessive resistance in starter circuit

Fuel System Malfunction - See Group 115

- Empty fuel tank
- Improper fuel
- Water, dirt or air in fuel system
- Plugged fuel filter
- Stuck shut-off control
- Dirty or faulty fuel injection nozzles
- Defective fuel injection pump
- Defective fuel transfer pump
- Fuel injection pump incorrectly timed

Service Problem

- Too high viscosity crankcase oil

Engine Runs Irregularly or Stalls Frequently

Basic Engine Problem

- Coolant temperature too low
- Improper valve clearance
- Cylinder head gasket leaking
- Worn or broken compression rings
- Valves sticking or burned
- Exhaust system restricted
- Engine compression too low
- Engine overheating
- Worn camshaft lobes

Fuel System Malfunction - See Group 115

- Defective fuel injection pump
- Low fuel supply
- Fuel injection nozzles defective or leaking
- Fuel filter or fuel lines restricted
- Defective fuel transfer pump
- Fuel injection pump incorrectly timed

Engine Misfiring

Service Problem

- Water in fuel
- Mixture of gasoline and diesel fuel

Fuel System Malfunction - See Group 115

- Air in fuel system
- Defective fuel injection nozzles
- Defective fuel injection pump
- Fuel injection nozzles improperly installed
- Leaking fuel injection nozzle seals
- Worn or defective fuel transfer pump
- Fuel injection pump incorrectly timed

Basic Engine Problem

- Engine overheated
- Lobes of camshaft worn
- Weak valve springs
- Pre-ignition
- Engine compression too low
- Improper valve clearance
- Burnt, damaged or stuck valves

Lack of Engine Power

Service Problem

Continued on next page
RG,105,JW7655 –19–21NOV97–1/4

- Air cleaner restricted or dirty
- Excessive resistance in air intake system
- Improper crankcase oil

Fuel System Malfunction - See Group 115

- Fuel filter restricted
- Defective fuel transfer pump
- Defective fuel injection pump
- Fuel injection pump incorrectly timed

Basic Engine Problem

- Engine overheated
- Engine clutch slipping
- Defective cylinder head gasket
- Lobes of camshaft worn
- Improper valve clearance
- Improper valve timing
- Burnt, damaged or stuck valves
- Weak valve springs
- Piston rings and cylinder liners excessively worn
- Engine compression too low
- Improper coolant temperature

Engine Overheats

Service Problem

- Lack of coolant in cooling system
- Radiator core and/or side screens dirty
- Cooling system limed up
- Engine overloaded
- Too low crankcase oil level

Basic Engine Problem

- Loose or defective fan belt
- Defective thermostat(s)
- Damaged cylinder head gasket
- Defective water pump
- Defective radiator cap

Fuel System Malfunction - See Group 115

- Fuel injection pump delivers too much fuel
- Fuel injection pump incorrectly timed

Excessive Oil Consumption

Basic Engine Problem

- Oil control rings worn or broken
- Scored cylinder liners or pistons
- Excessive resistance in air intake system
- Oil flow through oil passages restricted
- Worn valve guides or stems
- Excessive oil pressure
- Piston ring grooves excessively worn
- Piston rings sticking in ring grooves
- Insufficient piston ring tension
- Piston ring gaps not staggered
- Excessive main or connecting rod bearing clearance
- Front and/or rear crankshaft oil seal faulty
- Glazed cylinder liners (insufficient load during engine break-in)

Service Problem

- Too low viscosity crankcase oil
- Crankcase oil level too high
- External oil leaks

Low Oil Pressure

Service Problem

- Low crankcase oil level
- Clogged cooler or filter
- Improper crankcase oil
- Excessive oil temperature
- Oil pressure regulating valve failure
- Defective oil pressure warning switch or engine oil pressure indicator light

Basic Engine Problem

- Leakage at internal oil passages
- Defective oil pump

Continued on next page

- Excessive clearance between oil pump gears and cover
- Clogged oil pump screen
- Excessive main and connecting rod bearing clearance
- Improper regulating valve adjustment
- Piston cooling orifice missing

Low Oil Pressure at Slow Idle

Basic Engine Problem

- Bypass oil check valve failure

High Oil Pressure

Basic Engine Problem

- Clogged oil lines
- Improper oil classification
- Oil pressure regulating valve bushing loose (wanders)
- Improperly operating regulating valve
- Stuck or damaged filter bypass valve

Oil Sludge and Dilution

Basic Engine Problem

- Coolant leakage into lubrication system
- Incomplete combustion
- Excessive oil consumption
- Defective injection pump (failed internal O-ring seals)

Excessive Fuel Consumption

Service Problem

- Engine overloaded
- Air cleaner restricted or dirty

Basic Engine Problem

- Compression too low

Fuel System Malfunction - See Group 115

- Leaks in fuel system
- Fuel injection nozzles dirty or faulty
- Fuel injection pump defective (delivers too much fuel)
- Fuel injection pump incorrectly timed

Black or Grey Exhaust Smoke

Service Problem

- Excess fuel
- Engine overloaded
- Air cleaner restricted or dirty
- Defective muffler (causing back-pressure)

Fuel System Malfunction - See Group 115

- Fuel injection nozzles dirty or faulty
- Incorrect engine timing

White Exhaust Smoke

Basic Engine Problem

- Engine compression too low
- Defective thermostat(s) (does not close)

Fuel System Malfunction - See Group 115

- Defective fuel injection nozzles
- Fuel injection pump incorrectly timed

Coolant in Crankcase

Basic Engine Problem

- Cylinder head gasket defective
- Cylinder head or block cracked
- Cylinder liner seals leaking

Abnormal Engine Noise

Basic Engine Problem

Continued on next page

RG,105,JW7655 –19–21NOV97–3/4

- Worn main or connecting rod bearings
- Excessive crankshaft end play
- Loose main bearing caps
- Foreign material in combustion chamber
- Worn connecting rod bushings and piston pins
- Scored pistons
- Worn timing gears
- Excessive valve clearance
- Worn cam followers
- Bent push rods
- Worn camshaft
- Worn rocker arm shaft
- Insufficient engine lubrication
- Worn turbocharger bearings

Fuel System Malfunction - See Group 115

- Fuel injection pump incorrectly timed

Detonation or Pre-Ignition

Basic Engine Problem

- Oil picked up by intake air stream (intake manifold)

Fuel System Malfunction - See Group 115

- Dirty or faulty fuel injection nozzles
- Incorrect fuel injection pump timing
- Fuel injection nozzle tip holes enlarged
- Fuel injection nozzle tips broken
- Carbon build-up in compression chamber

Water Pump Leaking

Seal ring or pump shaft worn

Coolant Temperature Below Normal

Defective thermostat(s)

Coolant temperature gauge defective

Engine Vibrating

Fan blades bent or broken

Water pump shaft worn

Balancer shaft/gear broke (4-cylinder)

RG,105,JW7655 –19–21NOV97–4/4

TEST ENGINE COMPRESSION PRESSURE

RG5646 –UN–02APR90

IMPORTANT: Compression pressures are affected by the cranking speed of the engine. Before beginning test, insure that batteries are fully charged and injection nozzle area is thoroughly cleaned.

1. Start engine and run at rated speed until it warms up to normal operating temperature. (From a cold start, operate engine 10—15 minutes at slow idle.)

   Shut off fuel supply and remove fuel injection nozzles. (See Group 35.)

2. Install JT01679 Adapter[1] with O-ring (or D14550BA Adapter[2]) in injection nozzle bore. Use JT02017 Holding Clamp[2] to hold JT01679 Adapter in position. Install hold down screw in clamp and tighten screw to 37 N•m (27 lb-ft). Attach JT01682 Test Gauge[2] (or D14547BA[2]) to adapter.

3. Push throttle lever to "STOP" position. Turn crankshaft for 10—15 seconds with starting motor (minimum cranking speed — 150 rpm cold/200 rpm hot).

4. Compare readings from all cylinders.

   Compression pressure must be within specification.

Engine Compression Pressure Test—Specification

Minimum Pressure	2400 kPa (24 bar) (350 psi)
Maximum Difference Between Cylinders	350 kPa (3.5 bar) (50 psi)

[1]Part of JT01674 Compression Test Set

[2]Part of D14546BA Compression Test Set

Continued on next page RG,CTM8,DX125 –19–03FEB95–1/2

NOTE: Pressure given was taken at 183 m (600 ft) above sea level. A 3.6 percent reduction in gauge pressure will result for each additional 300 m (1000 ft) rise in altitude.

5. If pressure is much lower than shown, remove gauge and apply oil to ring area of piston through injection nozzle bore. Do not use too much oil. Do not get oil on the valves.

6. Test compression again.

   If pressure is high, worn, or stuck rings are indicated, replace piston rings or install new piston and liner set as needed. (See Group 10.)

   If pressure is low, valves could be worn or sticking. Recondition cylinder head as required. (See Group 05.)

7. Measure compression pressure in all remaining cylinders and compare readings. Recondition cylinders and valves as required.

RG,CTM8,DX125 –19–03FEB95–2/2

CHECK ENGINE OIL PRESSURE

RG6414 –UN–21AUG92

RG6415 –UN–21AUG92

1. Remove main oil gallery plug using JDG782 Oil Gallery Plug Tool.

2. Attach pressure gauge from JT05470 Universal Pressure Test Kit as shown.

IMPORTANT: To achieve an accurate oil pressure reading, warm up engine crankcase oil to 105°C (220°F) or high oil pressure readings will occur.

3. Measure oil pressure at slow idle (no load) and rated speed (full load) as specified below.

Oil Pressure-No Load at 850 rpm and 93°C (200°F) Oil Temperature (4- and 6-cylinder)—Specification

Minimum Pressure... 100 kPa (1.0 bar) (15 psi)

Oil Pressure-Full Load at 850 rpm and 105°C (220°F) Oil Temperature (3-cylinder)—Specification

Minimum Pressure... 140 kPa (1.4 bar) (20 psi)

Oil Pressure-Full Load at Rated Speed and 105°C (220°F) Oil Temperature[1]—Specification

Maximum Pressure................................ 380 ± 103 kPa (3.80 ± 1.03 bar) (55 ± 15 psi)

NOTE: Tolerance extremes and gauge fluctuations can result in the gauge reading up to 586 kPa (5.86 bar) 85 psi. This is not detrimental to the engine.

The oil pressure regulating valve is designed so that adjustment of oil pressure should not be required.

[1]*Gauge fluctuations and tolerance extremes can result in readings up to 586 kPa (5.86 bar) (85 psi).*

CTM8,GR105,15 –19–03FEB95–1/1

MEASURE ENGINE CRANKCASE PRESSURE (BLOW-BY)

Excessive blow-by coming out of the crankcase breather tube indicates that either the turbocharger (if equipped) seals are faulty or the piston rings and cylinder liners are not adequately sealing off the combustion chamber. This is a comparative check that requires some experience to determine when blow-by is excessive.

Run engine at high idle and check crankcase breather tube. Look for significant fumes and/or dripping oil coming out of the breather tube at fast idle, with no load.

If excessive blow-by is observed, perform the following to determine if the turbocharger (if equipped) is causing the blow-by:

1. Remove the turbocharger oil drain line where it connects to the engine block and run line into a bucket.

2. Run engine at high idle, slightly loaded and determine if boost pressure is forcing oil through the drain line, and check crankcase breather tube to determine if blow-by has decreased.

3. If it appears that boost pressure is forcing oil through the drain line, and/or blow-by decreases with the drain line disconnected from block, replace the turbocharger, and retest.

MEASURING CRANKCASE PRESSURE USING A STANDARD GAS GAUGE

1. Place a hose with a standard gas gauge in end of crankcase vent tube.

2. Run engine at rated speed and load. Engine should be at operating temperature and run-in (with at least 100 operating hours).

3. Measure blow-by over a period of 5 minutes. Multiply figure obtained by 12 (hourly rate) and compare to the following specifications.

3 and 4-Cylinder “D” Engines—Specification

Crankcase Pressure (Blow-By) .... 4.0 m^3/h (141 cu ft/h)

6-Cylinder “D” Engines—Specification

Crankcase Pressure (Blow-By) .... 6.0 m^3/h (225 cu ft/h)

3 and 4-Cylinder “T” and “A” Engines—Specification

Crankcase Pressure (Blow-By) .... 6.0 m^3/h (225 cu ft/h)

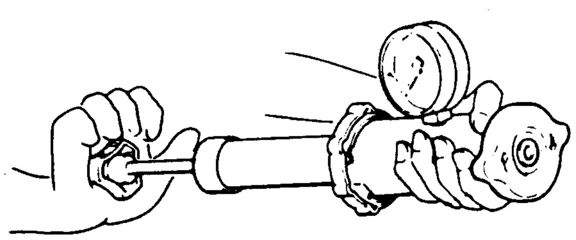
6-Cylinder “T” and “A” Engines—Specification

Crankcase Pressure (Blow-By) .... 8.0 m^3/h (282 cu ft/h)

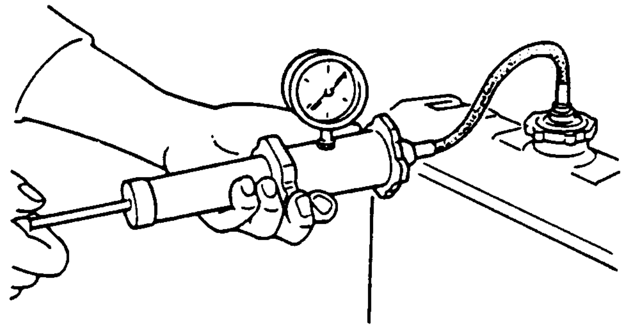
4. If blow-by is lower, there probably is no undue wear between piston rings and liners. If blow-by is higher, there could be excessive wear between piston rings and liners, resulting in loss of engine power. An overhaul of the engine should be considered only after other possible repair options (if any) are evaluated.

CTM8,GR105,16 –19–06FEB95–1/1

PRESSURE TEST COOLING SYSTEM AND RADIATOR CAP



RG6557 –UN–20JAN93



RG6558 –UN–20JAN93

CAUTION: Explosive released fluids from pressurized cooling system can cause serious burns.

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

TEST RADIATOR CAP

1. Remove radiator cap and attach to D05104ST Pressure Pump as shown.

2. Pressurize cap to the following specification:[1].

Cooling System—Specification

Test Pressure .... 50 kPa (0.5 bar) (7 psi)

Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable.If gauge does not hold pressure, replace radiator cap.

3. Remove the cap from gauge, turn it 180°, and retest cap. This will verify that the first measurement was accurate.

TEST COOLING SYSTEM

NOTE: Engine should be warmed up to test overall cooling system.

1. Allow engine to cool, then carefully remove radiator cap.

2. Fill radiator with coolant to the normal operating level.

IMPORTANT: DO NOT apply excessive pressure to cooling system, doing so may damage radiator and hoses.

3. Connect gauge and adapter to radiator filler neck. Pressurize cooling system to 50 kPa (0.5 bar) (7 psi)[1], using D05104ST Pressure Pump.

4. With pressure applied, check all cooling system hose connections, radiator, and overall engine for leaks.

   If leakage is detected, correct as necessary and pressure test system again.

[1]Test pressures recommended are for all Deere OEM cooling systems. On specific vehicle applications, test cooling system and pressure cap according to the recommended pressure for that vehicle.

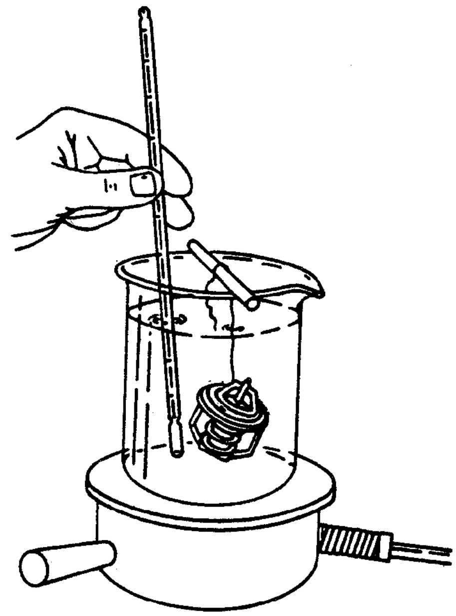
Continued on next page

DPSG,OUO1004,378 –19–17OCT98–1/2

If no leakage is detected, but the gauge indicated a drop in pressure, coolant may be leaking internally within the system or at the block-to-head gasket.

DPSG,OUO1004,378 –19–17OCT98–2/2

INSPECT THERMOSTAT AND TEST OPENING TEMPERATURE



RG5971 –UN–23NOV97

Visually inspect thermostat for corrosion or damage. Replace as necessary.

Test thermostat as follows:

CAUTION: DO NOT allow thermostat or thermometer to rest against the side or bottom of container when heating water. Either may rupture if overheated.

1. Remove thermostats.

2. Suspend thermostat and a thermometer in a container of water.

3. Stir the water as it heats. Observe opening action of thermometer and compare temperatures with specification given in chart below.

NOTE: Due to varying tolerances of different suppliers, initial opening and full open temperatures may vary slightly from specified temperatures.

THERMOSTAT TEST SPECIFICATIONS

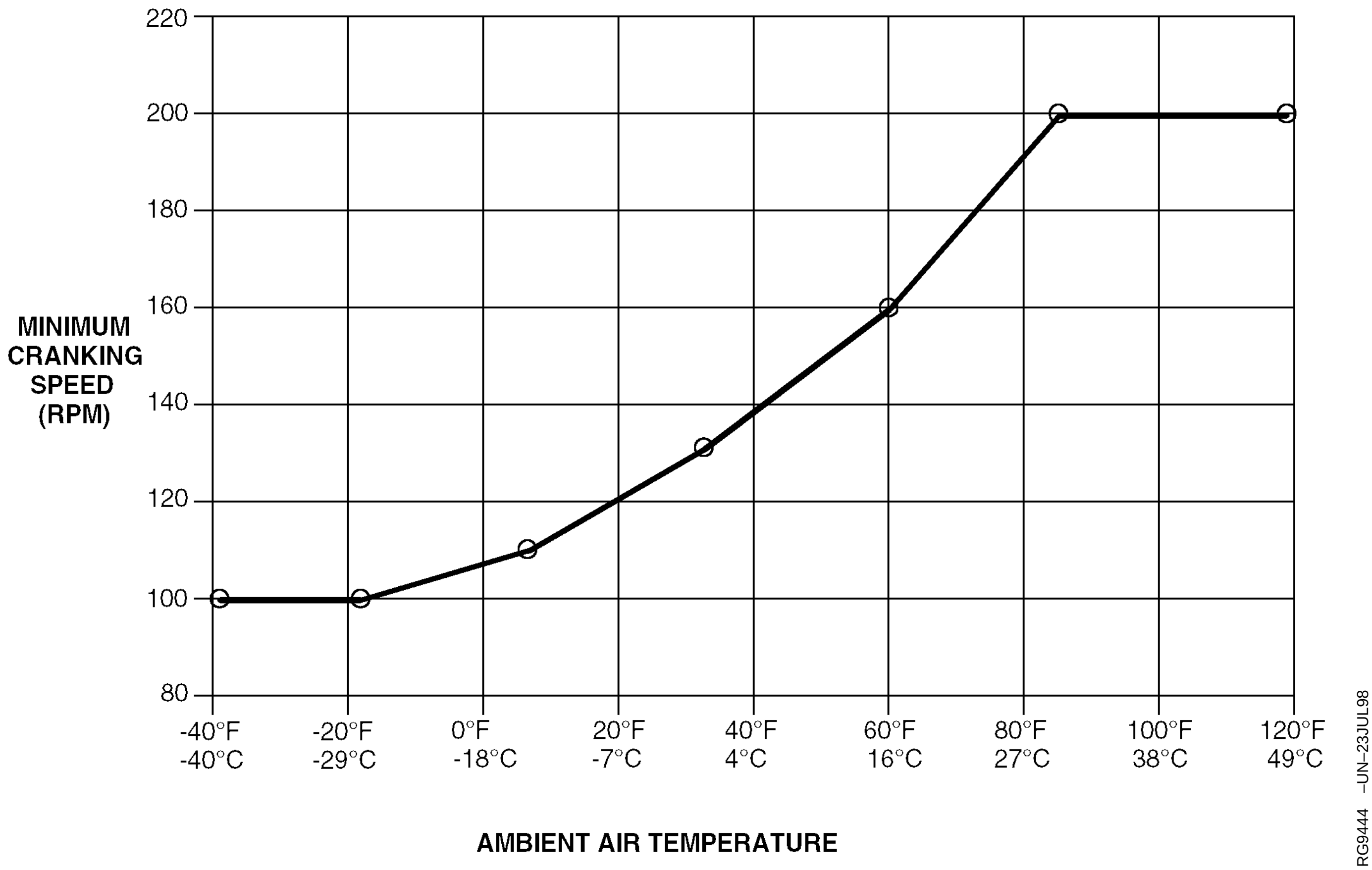
Rating	Initial Opening (Range)	Full Open (Nominal)
71°C (160°F)	69—72°C (156—162°F)	84°C (182°F)
77°C (170°F)	74—78°C (166—172°F)	89°C (192°F)
82°C (180°F)	80—84°C (175—182°F)	94°C (202°F)
89°C (192°F)	86—90°C (187—194°F)	101°C (214°F)
90°C (195°F)	89—93°C (192—199°F)	103°C (218°F)
92°C (197°F)	89—93°C (193—200°F)	105°C (221°F)
96°C (205°F)	94—97°C (201—207°F)	100°C (213°F)
99°C (210°F)	96—100°C (205—212°F)	111°C (232°F)

4. 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.

5. If any thermostat is defective on a multiple thermostat engine, replace all thermostats.

RG,105,JW7648 –19–21NOV97–1/1

ENGINE CRANKING SPEED TEST



IMPORTANT: Make sure that batteries are fully charged before performing this test.

1. Disable the fuel supply system at the injection pump so fuel delivery is in the OFF position.

2. If not using the machine tachometer, install a photo tach or TIME TRAC®.

3. Crank the engine for 15 seconds and record engine speed.

4. Compare recorded engine speed to chart above.

Cranking speed should meet or exceed specified engine rpm for a given ambient air temperature. For example, at 85°F (29°C) ambient air temperature, cranking speed should be at least 200 rpm.

If cranking speed is below specifications, check the following:

- Starting system problems (low battery, loose or defective wiring, defective starter, etc.).
- Excessive engine loads (hydraulic pumps/thick oil, thick engine oil, etc.).

TIME TRAC is a registered trademark of Stanadyne Automative Corp.

DPSG,OUO1004,452 –19–24OCT98–1/1

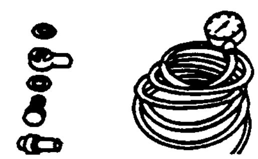
ESSENTIAL TOOLS

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,OUO1004,389 –19–18OCT98–1/3

RG5163 –UN–23AUG88



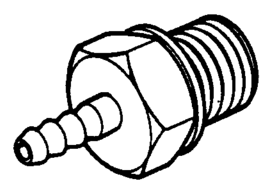
Manifold Pressure Tester . . . . JDE147 or FKM10002

Used to test intake manifold pressure on turbocharged engines.

DPSG,OUO1004,389 –19–18OCT98–2/3

Barbed Fitting. JT03470

Use with JDE147 Manifold Pressure Tester for measuring manifold pressure on 3029T (turbocharged) engines.



RG6357 –UN–20AUG92

DPSG,OUO1004,389 –19–18OCT98–3/3

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

Continued on next page

DPSG,OUO1004,390 –19–18OCT98–1/3

Water Vacuum Gauge Kit D05022ST

Used to test air filter restriction indicator switch.

DPSG,OUO1004,390 –19–18OCT98–2/3

Turbocharger Shield JDG576

Used to cover inlet on turbine on all turbocharged engines to protect blower when test running the engine with the air filter system disconnected.

DPSG,OUO1004,390 –19–18OCT98–3/3

AIR INTAKE SYSTEM TEST SPECIFICATIONS

Item	Measurement	Specification
4039TF Engine Intake Manifold Pressure (Turbocharger Boost) at Engine Rated Speed and Full Load Power		
Intake Manifold Pressure Standard Governor (2500 rpm)	Pressure	103—131 kPa (1.03—1.31 bar) (15—19 psi)
Intake Manifold Pressure 3—5% Governor (1800 rpm)	Pressure	62—76 kPa (0.62—0.76 bar) (9—11 psi)
Intake Manifold Pressure 3—5% Governor (1500 rpm)	Pressure	60—69 kPa (0.60—0.69 bar) (9—10 psi)
4045TF Engine Intake Manifold Pressure (Turbocharger Boost) at Engine Rated Speed and Full Load Power		
Intake Manifold Pressure Standard Governor (2200 rpm)	Pressure	103—131 kPa (1.03—1.31 bar) (15—19 psi)
Intake Manifold Pressure 3—5% Governor (1800 rpm)	Pressure	70—80 kPa (0.70—0.80 bar) (10—12 psi)
Intake Manifold Pressure 3—5% Governor (1500 rpm)	Pressure	50—60 kPa (0.50—0.60 bar) (8—10 psi)
6059TF Engine Intake Manifold Pressure (Turbocharger Boost) at Engine Rated Speed and Full Load Power		
Intake Manifold Pressure Standard Governor (2500 rpm)	Pressure	90—117 kPa (0.90—1.17 bar) (13—17 psi)
Intake Manifold Pressure 3—5% Governor (1800 rpm)	Pressure	62—76 kPa (0.62—0.76 bar) (9—11 psi)
Intake Manifold Pressure 3—5% Governor (1500 rpm)	Pressure	48—62 kPa (0.48—0.62 bar) (8—10 psi)

Continued on next page

DPSG,OUO1004,453 –19–24OCT98–1/2

Item	Measurement	Specification
6068TF Engine Intake Manifold Pressure (Turbocharger Boost) at Engine Rated Speed and Full Load Power		
Intake Manifold Pressure Standard Governor (2400 rpm)	Pressure	70—98 kPa (0.70—0.98 bar) (10—14 psi)
Intake Manifold Pressure 3—5% Governor (1800 rpm)	Pressure	55—65 kPa (0.55—0.65 bar) (8—10 psi)

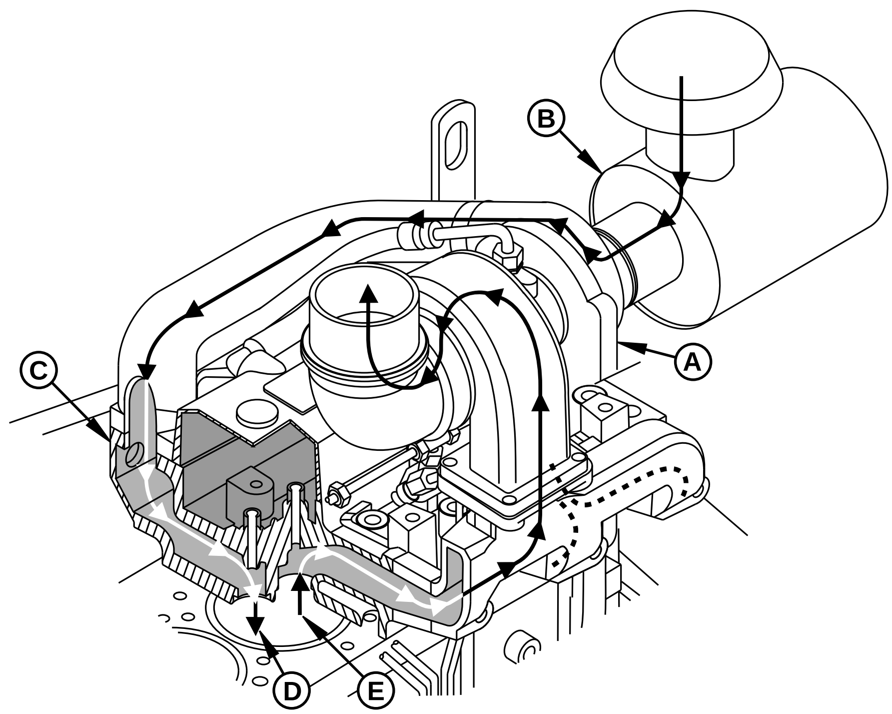
DPSG,OUO1004,453 –19–24OCT98–2/2

DIAGNOSING AIR INTAKE MALFUNCTIONS

Symptom	Problem	Solution
Engine Starts Hard or Won't Start	Air leak on suction side of system.	Check hose and pipe connections for tightness; repair as required. (See Group 30.)
Erratic Engine Operation	Air leak on suction side of system.	Check hose and pipe connections for tightness; repair as required. (See Group 30.)
Engine Emits Excessive Black Smoke	Air cleaner element restricted.	Clean or replace elements. (See operator's manual.)
	Turbocharger defective.	Repair or replace. (See Group 30.)
	Air leak in manifold.	Check hose and pipe connections for tightness; repair as required. (See Group 30.)
Engine Idles Poorly	Air leak on suction side of system.	Check hose and pipe connections for tightness; repair as required. (See Group 30.)
Engine Does Not Develop Full Power	Air cleaner restricted.	Clean or replace elements. (See operator's manual.)
	Air leak on suction side of system.	Check hose and pipe connections for tightness; repair as required. (See Group 30.)
	Turbocharger defective.	Repair or replace. (See Group 30.)
	Manifold pressure pipe to aneroid loose or broken.	Check hose and pipe connections for tightness; repair as required. (See Group 30.)
Turbocharger "Screams"	Air leak in manifold.	Check intake manifold gasket and manifold; repair as required. (See Group 30.)

RG,110,JW7674 –19–24NOV97–1/1

HOW THE AIR INTAKE AND EXHAUST SYSTEM WORKS



RG9473 –UN–19NOV98

A—Turbocharger
B—Air Cleaner
C—Intake Side of Cylinder Head
D—Outside Intake Air
E—Exhaust Air

Engine suction draws dust-laden outside air (D) through an air inlet stack into the air cleaner (B). Air is filtered through dry type primary and secondary (safety) filter elements in the air cleaner canister. Clean air travels through the air intake hose to the turbocharger (A) and into the intake side of the cylinder head (C).

Exhaust (E), drives the turbocharger to deliver a larger quantity of air to meet the engine requirements than what could be delivered under naturally aspirated (non-turbocharged) conditions.

On some engines, an air-to-air aftercooler cools the turbocharger compressor discharge air by routing it through a heat exchanger before it enters the engine. The heat exchanger uses no liquid coolant but relies on air flow to cool the charge air.

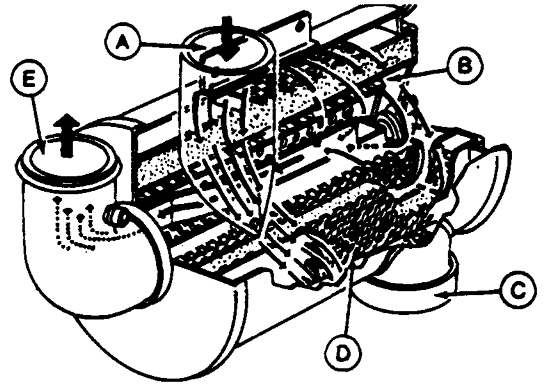
RG,110,JW7673 –19–24NOV97–1/1

AIR CLEANER OPERATION

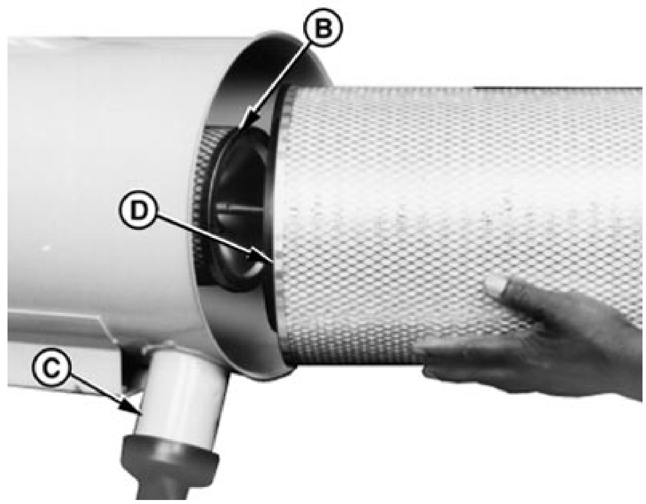
Under suction generated by the engine, unfiltered air flows through air inlet tube (A) and is forced into a high-speed centrifugal motion by tilted fins in the element. By this circulating action most of the dust and dirt particles are separated from the air and collected in the dust unloading valve (C).

The remaining dirt is removed as the air flows through the primary element (D) and the secondary (safety) filter (B) before being drawn into the engine.

The secondary (safety) filter ensures that should primary element fail, no unfiltered air is drawn into the engine.



E25999 –UN–20SEP88



RG9477 –UN–13NOV98

A—Air Inlet Tube
B—Secondary (Safety) Filter
C—Dust Unloading Valve
D—Primary Element
E—Air Outlet

DPSG,OUO1004,387 –19–18OCT98–1/1

AIR FILTER RESTRICTION INDICATOR SWITCH TEST

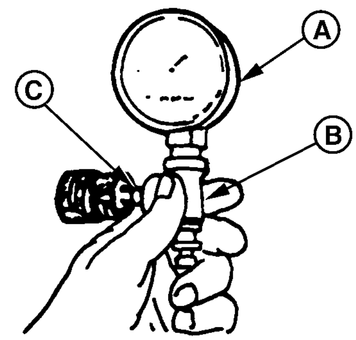
1. Remove air filter restriction indicator switch from air intake piping.

2. Install pipe nipple (C), tee fitting (B), and gauge (A) from D05022ST Water Vacuum Gauge Kit into air filter restriction indicator hole. Install air filter restriction indicator into tee fitting.

3. Start engine and slowly cover the air cleaner inlet with a piece of paper or cardboard.

4. Air restriction indicator must show red at 5.6—6.8 kPa (56—68 bar) (22.7—27.3 in. water) (1.6—2.0 in. hg) vacuum.

   If air restriction indicator shows red at any other value than listed above, install a new indicator.



RGT6188AQ –UN–19NOV97

A—Gauge
B—Tee Fitting
C—Pipe Nipple

RG,110,JW7671 –19–24NOV97–1/1

INTAKE AIR LEAK TEST


T5906AP –UN–23FEB89

RG6356 –UN–20AUG92

A—Adapter

Loose connections or cracks in the suction side of the air intake pipe can allow debris to be ingested into the engine causing rapid wear in the cylinders. Additionally, on turbocharged engines, compressor damage may occur and cause an imbalance resulting in bearing failure.

Air leaking from loose connections or cracks on the pressure side of the turbocharger can cause excessive smoke and low power.

NOTE: The following test procedure requires that the air intake be sealed off to pressurize the system. Using a plastic bag to seal the air intake filter is used as an example..

CAUTION: Do not start engine during this test procedure. Plastic bag (or whatever material/object used to seal intake) can be sucked into the engine.

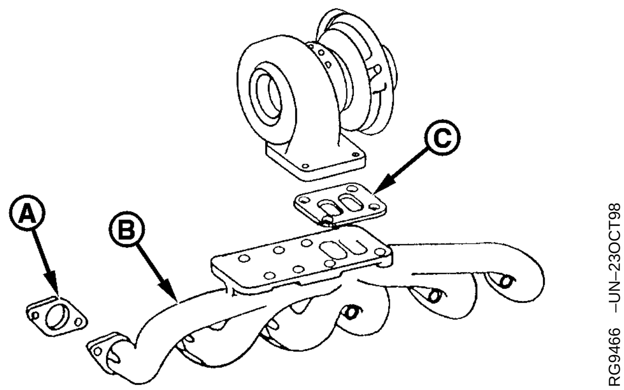
1. Remove air cleaner cover and main filter element
2. Put a plastic bag over secondary filter element and install main element and cover.
3. Remove plug from manifold and using suitable adapter (A), connect a regulated air source.
4. Pressurize air intake system to 13.8—20.7 kPa (0.13-0.21 bar) (2—3 psi).
5. Spray soap and water solution over all connections from the air cleaner to the turbocharger or air inlet to check for leaks. Repair all leaks.
6. Remove plastic bag from filter element and reinstall element and cover.

DPSG,OUO1004,383 –19–18OCT98–1/1

EXHAUST LEAK CHECK (TURBOCHARGED ENGINES)

Exhaust leaks, upstream of the turbocharger, will cause the turbocharger turbine to rotate at a reduced speed resulting in low boost pressure, low power, and excessive black smoke.

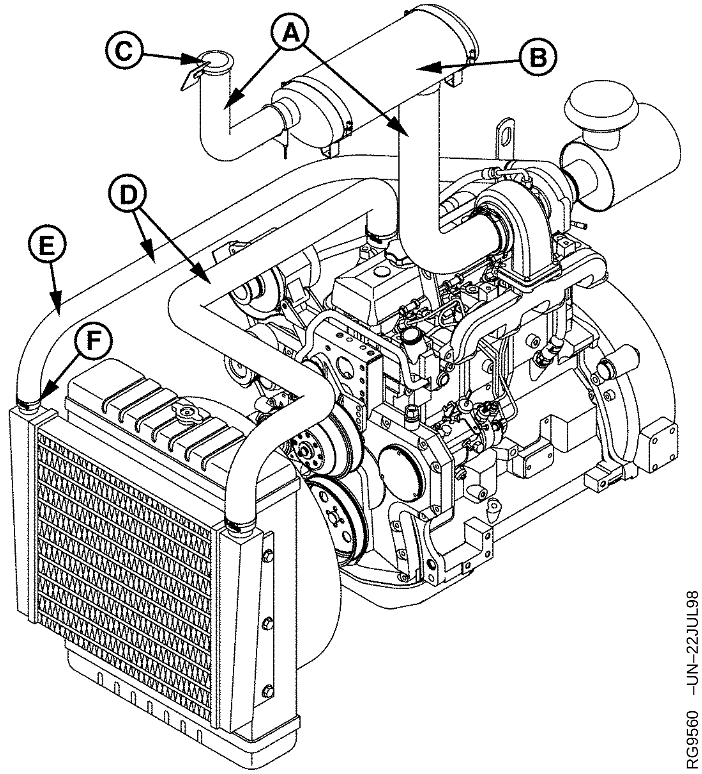
Inspect the exhaust manifold gasket (A), the exhaust manifold (B), and the turbocharger gasket (C) for damage and any signs of leakage. Replace components as needed.



A—Exhaust Manifold Gasket
B—Exhaust Manifold
C—Turbocharger Gasket

DPSG,OUO1004,384 –19–18OCT98–1/1

INTAKE AND EXHAUST RESTRICTION CHECK



A—Exhaust Piping
B—Muffler
C—Rain Cap
D—Intake Piping
E—Elbows
F—Connections

Low power, low boost pressure, and excessive black exhaust smoke can be caused by an intake air or exhaust restriction.

1. Inspect the exhaust piping (A), the muffler (B), and the rain cap (C) for damage or any possible restrictions.

2. Inspect the intake piping (D), any elbows (E), and any connections (F). Look for collapsed pipes, dented pipes and loose connections. Replace components as needed.

DPSG,OUO1004,385 –19–18OCT98–1/1

DIAGNOSING TURBOCHARGER MALFUNCTIONS

Before replacing the turbocharger, determine what caused the failure of the defective unit, and correct the condition. This will prevent an immediate repeat failure of the replacement unit. Refer to Air Intake and Exhaust System Group 30 for repair information.

Noise Or Vibration[1] **:**

- Bearings not lubricated (insufficient oil pressure).
- Air leak in engine intake or exhaust manifold.
- Improper clearance between turbine wheel and turbine housing.
- Broken blades (or other wheel failures).

Engine Will Not Deliver Rated Power:

- Clogged manifold system.
- Foreign material lodged in compressor, impeller, or turbine.
- Excessive dirt build-up in compressor.
- Leak in engine intake or exhaust manifold.
- Leak in intake manifold-to-aneroid pipe.
- Rotating assembly bearing failure.
- Damaged compressor or turbine blades.

Oil On Compressor Wheel Or In Compressor Housing (Oil Being Pushed or Pulled Through Center Housing):

- Excessive crankcase pressure.
- Air intake restriction.
- Drain tube restriction.

Oil In Manifold Or Dripping From Housing:

- Excessive crankcase pressure.
- Air intake restriction.
- Drain tube restriction.
- Damaged or worn journal bearings.
- Unbalanced rotating assembly:
  - Damage to turbine or compressor wheel or blade.
  - Dirt or carbon build-up on wheel or blade.

- Bearing wear:
  - Oil starvation or insufficient lubrication.
  - Shaft seals worn.

Turbine Wheel Drag:

- Carbon build-up behind turbine wheel caused by coked oil or combustion deposits.
- Dirt build-up behind compressor wheel caused by air intake leaks.
- Bearing seizure or dirty, worn bearings caused by excessive temperatures, unbalanced wheel, dirty oil, oil starvation, or insufficient lubrication.

[1] Do not confuse the whine heard during run down with noise which indicates a bearing failure.

RG,110,JW7670 –19–24NOV97–1/1

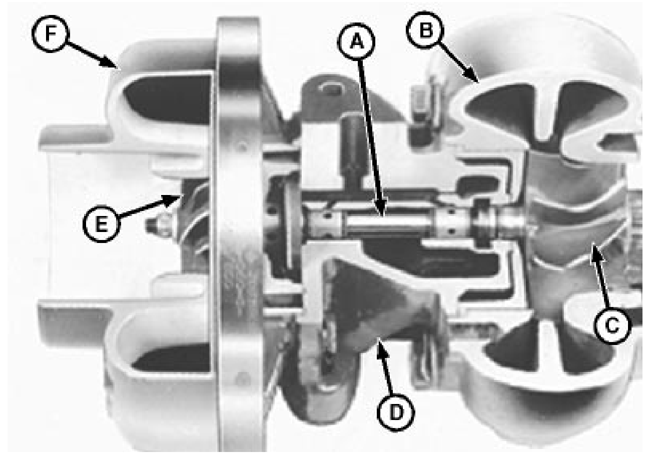
TURBOCHARGER OPERATION

The turbocharger, which is basically an air pump that is driven by exhaust gases, allows the engine to produce added power without increasing displacement. Turbochargers are specially matched for the power ratio requirements of each specific application.

The turbine wheel (C) is driven by the hot engine exhaust gases. These gases flowing through the turbine housing (B) act on the turbine wheel causing shaft (A) to turn.

Compressor wheel (E) brings in filtered air and discharges the compressed air into the intake manifold where it is then delivered to engine cylinders.

Engine oil under pressure from the engine lubrication system is forced through passages in center housing (D) to bearings.



RG9098 –UN–27MAR98

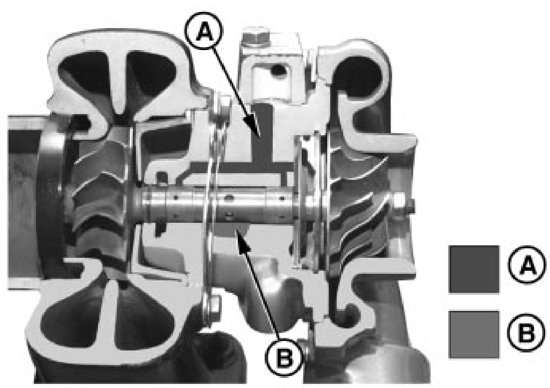
A—Shaft
B—Turbine Housing
C—Turbine Wheel
D—Center Housing
E—Compressor Wheel
F—Compressor Housing

RG,110,JW7669 –19–24NOV97–1/1

HOW THE TURBOCHARGER IS LUBRICATED

Engine oil under pressure from the engine lubrication system is pumped through a passage in the bearing housing and directed to the bearings, thrust plate, and thrust sleeve. Oil is sealed from the compressor and turbine by a piston ring at both ends of the bearing housing.

The turbocharger contains two floating bearings. These bearings have clearance between the bearing OD and the housing bore as well as clearance between the bearing ID and the shaft OD. These clearances are lubricated by the oil supply (A) and the bearings are protected by a cushion of oil. Discharge oil (B) drains by gravity from the bearing housing to the engine crankcase.



RG8099 –UN–18NOV97

A—Pressure Oil
B—Discharge Oil

RG,110,JW7668 –19–24NOV97–1/1

CHECK INTAKE MANIFOLD PRESSURE (TURBOCHARGER BOOST)

NOTE: See AIR INTAKE AND EXHAUST SYSTEM TEST SPECIFICATIONS at the beginning of this group for all OEM (TF) engine specifications. Refer to the appropriate machine technical manual for specific machine applications.

1. Remove plug from intake manifold and install the appropriate fitting (A) from JDE147 Manifold Pressure Test Kit or FKM10002 Universal Pressure Test Kit.

   On 3029T engines, remove plug and install JT03470 Barbed Fitting (A) into intake manifold. Use with JDE147 kit.

   Connect gauge and hose assembly to fitting as shown. Be sure all connections are tight.

2. Before checking boost pressure, warm up engine to allow the lubricating oil to reach operating temperature.

IMPORTANT: Engine speed and load should be stabilized before taking a gauge reading. Be sure that gauge works properly and familiarize yourself with the use of the gauge.

Turbo-boost pressure checks are only a guide to determine if there is an engine problem (valve leakage, faulty nozzles, etc.). Low pressure readings are not a conclusive reason for increasing injection pump fuel delivery. Pump adjustment should be within specifications as established by an authorized diesel repair station.

3. Observe pressure reading on gauge. Reading should be at least 60 kPa (0.6 bar) (9 psi) when engine is developing rated power at full load rated speed.

4. Refer to the following specifications for 4039TF Engines:

A—Barbed Fitting

Continued on next page

Intake Manifold Pressure Standard Governor (2500 rpm)—Specification

Pressure .... 103—131 kPa (1.03—1.31 bar)
(15—19 psi)

Intake Manifold Pressure 3—5% Governor (1800 rpm)—Specification

Pressure .... 62—76 kPa (0.62—0.76 bar)
(9—11 psi)

Intake Manifold Pressure 3—5% Governor (1500 rpm)—Specification

Pressure .... 60—69 kPa (0.60—0.69 bar)
(9—10 psi)

Refer to the following specifications for 4045TF Engines:

Intake Manifold Pressure Standard Governor (2200 rpm)—Specification

Pressure .... 103—131 kPa (1.03—1.31 bar)
(15—19 psi)

Intake Manifold Pressure 3—5% Governor (1800 rpm)—Specification

Pressure .... 70—80 kPa (0.70—0.80 bar)
(10—12 psi)

Intake Manifold Pressure 3—5% Governor (1500 rpm)—Specification

Pressure .... 50—60 kPa (0.50—0.60 bar)
(8—10 psi)

Refer to the following specifications for 6059TF Engines:

Intake Manifold Pressure Standard Governor (2500 rpm)—Specification

Pressure .... 90—117 kPa (0.90—1.17 bar)
(13—17 psi)

Intake Manifold Pressure 3—5% Governor (1800 rpm)—Specification

Pressure .... 62—76 kPa (0.62—0.76 bar)
(9—11 psi)

Intake Manifold Pressure 3—5% Governor (1500 rpm)—Specification

Pressure .... 48—62 kPa (0.48—0.62 bar)
(8—10 psi)

Refer to the following specifications for 6068TF Engines:

Continued on next page

DPSG,OUO1004,388 –19–18OCT98–2/3

Intake Manifold Pressure Standard Governor (2400 rpm)—Specification

Pressure .... 70—98 kPa (0.70—0.98 bar)
(10—14 psi)

Intake Manifold Pressure 3—5% Governor (1800 rpm)—Specification

Pressure .... 55—65 kPa (0.55—0.65 bar)
(8—10 psi)

5. If boost pressure is too high, remove fuel injection pump and have it checked for high fuel delivery by an authorized diesel repair station.

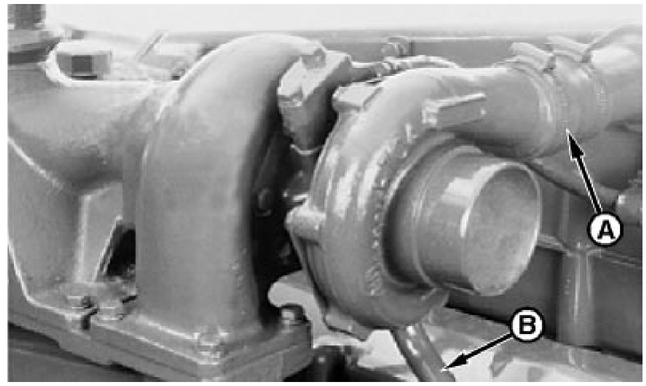
   If boost pressure is too low, check the following:

   - Restricted air filter elements.
   - Restricted fuel filter elements.
   - Incorrect fast idle adjustment.
   - Incorrect injection pump timing.
   - Exhaust manifold leaks.
   - Intake manifold leaks.
   - Faulty fuel transfer pump.
   - Low compression pressure.
   - Faulty fuel injection nozzles.
   - Carbon build-up in turbocharger.
   - Turbocharger compressor or turbine wheel rubbing housing.
   - Low fuel injection pump fuel delivery.
   - Restricted exhaust.

6. After completing test, remove test equipment and reinstall nozzle adapter and plug. Tighten securely.

DPSG,OUO1004,388 –19–18OCT98–3/3

TURBOCHARGER OIL SEAL LEAK TEST



A—Crossover Tube
B—Oil Return Line

Seals are used on both sides of the turbocharger rotor assembly. The seals are used to prevent exhaust gasses and air from entering the turbocharger housing. Oil leakage past the seals is uncommon but can occur.

A restricted or damaged turbocharger oil return line can cause the housing to pressurize causing oil to leak by the seals. Additionally, intake or exhaust restrictions can cause a vacuum between the compressor and turbocharger housing causing oil to leak by the seals.

1. Remove exhaust pipe (shown removed) and crossover tube (A).

2. Inspect the turbine casing and crossover tube for evidence of oil leakage.

   If oil leakage is present, perform the following:

   - Inspect turbocharger oil return line (B) for kinks or damage. Replace if necessary.
   - Check the air intake filter, hoses, and crossover tube for restrictions.
   - Check the exhaust system for restrictions to include position of exhaust outlet.

3. Perform necessary repairs and repeat test.

DPSG,OUO1004,386 –19–18OCT98–1/1

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,OUO1004,478 –19–01NOV98–1/6

TIME TRAC® Kit JT07158 (FKM10429A)

Used to perform the dynamic timing of engines with rotary injection pumps.

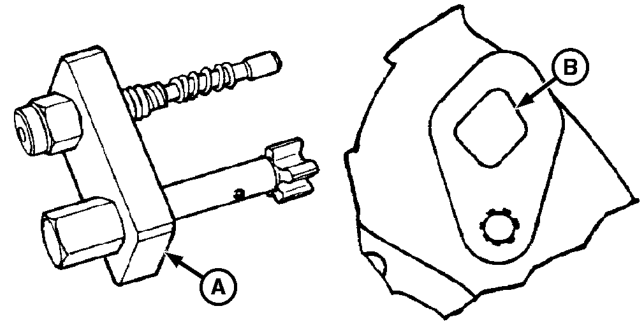
RG7246 –UN–23NOV97

TIME TRAC is a registered trademark of Stanadyne Automotive Corp.

DPSG,OUO1004,478 –19–01NOV98–2/6

Flywheel Turning Tool JD281A

Used on engines with 142 tooth flywheel ring gear and a diamond shaped tool guide bore (B) in flywheel housing. Tool (A) has it's own spring loaded timing pin which threads into flywheel housing.



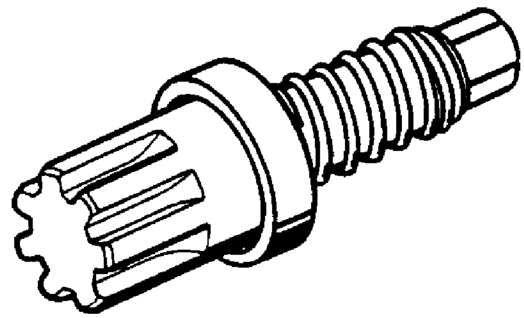
RG9455 –UN–02SEP98

Continued on next page

DPSG,OUO1004,478 –19–01NOV98–3/6

Flywheel Turning Tool JDG820

Used to rotate flywheel on engines with 129-tooth flywheel ring gear and a 29.9 mm (1.18 in.) ID flywheel housing guide bore diameter.



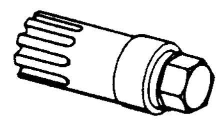
RG7056 –UN–05DEC97

RG7056

DPSG,OUO1004,478 –19–01NOV98–4/6

Flywheel Turning Tool JDE83

Used to rotate flywheel on engines with 142-tooth flywheel ring gear and a 26.5 mm (1.04 in.) ID flywheel housing guide bore diameter.



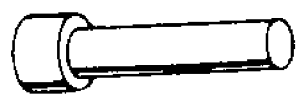
RG6251 –UN–22JUL92

DPSG,OUO1004,478 –19–01NOV98–5/6

RG5068 –UN–05DEC97

Timing Pin JDE81-4

Used to lock engine at TDC.



RG5068

DPSG,OUO1004,478 –19–01NOV98–6/6

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

Continued on next page

DPSG,OUO1004,466 –19–24OCT98–1/4

Clamp-On Transducer JT07177

Use with TIME-TRAC® meter to measure engine speed.

DPSG,OUO1004,466 –19–24OCT98–2/4

Cable JT07172

Use with TIME-TRAC® meter to measure engine speed.

DPSG,OUO1004,466 –19–24OCT98–3/4

Pressure Gauge 0—200 kPa (0—2 bar) (0—30 psi), hose and fittings.

Measure transfer pump pressure in rotary injection pump systems. Assemble test equipment from JT05470 Universal Pressure Test Kit or any other suitable equipment.

DPSG,OUO1004,466 –19–24OCT98–4/4

FUEL SYSTEM TEST SPECIFICATIONS

Item	Measurement	Specification
Rotary Injection Pump Mounting Nuts	Torque	27 N•m (20 lb-ft)
Fuel Supply Pump	Nominal Pressure	25—30 kPa (0.25—0.30 bar) (3.5—4.5 psi)
Fuel Supply Pump	Minimum Pressure	15 kPa (0.15 bar) (2.0 psi)

DPSG,OUO1004,479 –19–01NOV98–1/1

FUEL INJECTION PUMP SPECIFICATIONS

Injection pump timing specifications are provided for OEM applications. For industrial applications refer to SP458 Specifications Handbook. For agricultural applications, refer to DB1216 Specifications Handbook.

Continued on next page

DPSG,OUO1004,499 –19–27NOV98–1/9

FUEL INJECTION PUMP SPECIFICATIONS[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Slow Idle (rpm)**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Dynamic Timing (DBTDC)**
CD3029DF	1602	RE53785		800	2500	2710	17
	1603	RE53786			1800	1865	15
	1620	RE53787	RE64241		1500	1580	15
	1620	RE64241			1500	1580	15
	1632	RE59140		800	2200	2390	17
	1641	RE53787	RE64241		1500	1575	15
	1641	RE64241			1500	1575	15
	1642	RE67271		800	2500	2710	17
	1643	RE67271		800	2500	2710	17
	1644	RE41939	RE58298		1800	1890	15
	1644	RE58298			1800	1890	15
	1645	RE67003		800	2500	2710	15
	1648	RE41941	RE58929		1500	1575	13
	1648	RE58929			1500	1550	15
	1650	RE41938	RE58930	800	2500	2750	17
	1650	RE58930		800	2500	2710	17
	1654	RE62523		800	2400	2640	17
CD3029TF	1602	RE53785		800	2500	2710	11
	1632	RE58903[b]		800	2500	2710	11
	1633	RE51979		800	2200	2450	17
	1634	RE53783		800	2500	2710	11
	1640	RE53958		800	2500	2710	11
	1645	RE58413		800	2100	2310	15
T04039DF	1602	RE20510	RE44483	850	2500	2750	20.1
	1602	RE44483	RE47133	850	2500	2750	15
	1602	RE47133	RE49360	850	2500	2750	17
	1602	RE49360		850	2500	2750	15
	1603	RE46360[b]	RE20511	850	2500	2750	15
	1603	RE20511	RE47134		1800	1890	15
	1603	RE47134			1800	1890	15
T04039DF (Continued on next page)	1604	RE48354	RE57105	850	2500	2750	15

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

FUEL INJECTION PUMP SPECIFICATIONS (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Slow Idle (rpm)**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Dynamic Timing (DBTDC)**
T04039DF (Continued)	1604	RE57105		850	2500	2750	15.5
	1610	RE20511	RE47134		1800	1890	15
	1610	RE47134			1800	1890	15
	1611	RE65033			1800	1890	15
	1615	RE46360[b]		850	2500	2750	15
	1620	RE47176[b]			1800	1890	15
	1621	RE58577[b]			1800	1890	15
	1624	RE28451	CANCELLED		1800	1890	15
CD4039DF	1602	RE37927	RE42348	800	2500	2750	17
	1602	RE42348	RE47133	800	2500	2750	17
	1602	RE47133	RE49360	800	2500	2750	17
	1602	RE49360		800	2500	2750	15
	1603	RE42351	RE47134		1800	1890	15
	1603	RE47134			1800	1890	14
	1606	RE37924	CANCELLED	800	2500	2750	15
	1609	RE52749		800	2300	2530	15
	1614	RE52822		800	2900	3190	13
	1618	RE47134			1800	1890	14
	1620	RE47176[b]			1800	1890	14
	1623	RE37927	RE42349	800	2500	2750	15
	1623	RE42349	RE47798	800	2500	2750	15
	1623	RE47798	RE49495	800	2500	2750	15
	1623	RE49495	RE50778	800	2500	2750	15
	1623	RE50778[b]		800	2500	2750	15
	1624	RE49360	CANCELLED	800	2500	2750	15
	1641	RE42353	RE50828		1500	1575	15
	1641	RE50828	RE64243		1500	1575	15
	1641	RE64243			1500	1575	15
CD4039DF (Continued on next page)	1643	RE45358	CANCELLED	800	2500	2750	17

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP4/JP8 Jet "A" Fuel.

Continued on next page

FUEL INJECTION PUMP SPECIFICATIONS (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Slow Idle (rpm)**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Dynamic Timing (DBTDC)**
CD4039DF (Continued)	1645	RE42354	RE50829		1500	1575	15
	1645	RE50829[b]	RE64244		1500	1575	15
	1645	RE64244			1500	1575	15
	1646	RE42352			1800	1890	15
	1664	RE49360		800	2500	2750	15
T04039DFM	1602	RE44483	RE47133	850	2500	2750	15
	1602	RE47133		850	2500	2750	15
	1606	RE49361		850	2500	2750	15
	1612	RE65034		850	2500	2750	15
T04039TF	1602	RE41956	RE47135	850	2500	2750	12
	1602	RE47135	RE54151	850	2500	2750	13
	1602	RE54151		850	2500	2750	13
	1603	RE42077	RE48154		1800	1890	14
	1603	RE48154			1800	1890	13
	1604	RE40408			1800	1890	14.5
	1613	RE65016		850	2500	2750	13
	1615	RE36939[b]	RE47494	850	2500	2750	12
	1615	RE47494[b]		850	2500	2750	12
	1619	RE42837	RE47177	850	2500	2750	12
	1619	RE47177[b]		850	2500	2750	13
	1620	RE42833	RE48155		1800	1890	14
	1620	RE48155			1800	1890	13
CD4039TF	1601	RE48484		800	1800	1865	13
	1602	RE26858	RE47135	800	2500	2710	13
	1602	RE47135		800	2500	2710	13
	1603	RE21515	RE48154		1800	1865	13
	1603	RE48154			1800	1865	13
	1605	RE47909		800	2900	3190	11
	1610	RE52750		800	2300	2495	13
	1611	RE55565		800	2200	2420	13
CD4039TF (Continued on next page)	1619	RE47177[b]		800	2500	2710	13

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

FUEL INJECTION PUMP SPECIFICATIONS (Continued)[a]							
Engine Model	Injection Pump Option Code	Original Injection Pump (Part No.)	Replaced By Injection Pump (Part No.)	Slow Idle (rpm)	Rated Speed (rpm)	Fast Idle (rpm)	Dynamic Timing (DBTDC)
CD4039TF (Continued)	1620	RE48155[b]			1800	1865	13
	1623	RE31765	CANCELLED	800	2500	2710	13
	1625	RE47135	CANCELLED	800	2500	2710	13
	1625	RE31765		800	2500	2710	13
	1635	RE31759	RE50808		1500	1575	14
	1635	RE50808[b]			1500	1575	14
	1636	RE31766	CANCELLED		1800	1865	13
	1641	RE29471	RE50809		1500	1575	14
	1641	RE50809			1500	1575	14
	1642	RE69326			2200	2420	13
	1643	RE45356	CANCELLED	800	2500	2710	13
	1650	RE38946	RE50866	800	2500	2710	13
	1650	RE50866[b]		800	2500	2710	13
	1651	RE38947	RE50867	800	2500	2710	13
	1651	RE50867[b]		800	2500	2710	13
T04045DF	1602	RE32288	RE42089	850	2400	2640	13.5
	1602	RE42089	RE47179	850	2400	2640	13.5
	1602	RE47179		850	2400	2640	13.5
	1623	RE57113		850	2100	2310	15.5
CD4045DF	1602	RE47179		800	2400	2605	13.5
	1626	RE55079		800	2200	2390	15
	1635	RE68444		800	2400	2605	13.5
	1636	RE68444		800	2400	2605	13.5
T04045TF	1601	RE52015		850	2400	2640	15
	1602	RE32292	RE41774	850	2400	2640	11.5
	1602	RE41774	RE47180	850	2400	2640	11.5
	1602	RE47180		850	2400	2640	11.5
	1609	RE42058	RE48156		1800	1890	12
T04045TF (Continued on next page)	1609	RE48156			1800	1890	12

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

DPSG,OUO1004,499 –19–27NOV98–5/9

FUEL INJECTION PUMP SPECIFICATIONS (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Slow Idle (rpm)**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Dynamic Timing (DBTDC)**
T04045TF (Continued)	1619	RE42839[b]	RE47181	850	2400	2640	11.5
	1619	RE47181[b]		850	2400	2640	11.5
CD4045TF	1602	RE47180		800	2400	2650	11
	1603	RE64298		800	2400	2650	11
	1620	RE57647			1500	1550	14
	1625	RE58882		800	2200	2390	15
	1627	RE55080		800	2200	2420	15
	1628	RE48156			1800	1890	14
	1629	RE52015		800	2400	2640	15
	1630	RE57717		800	2400	2640	15
	1631	RE52015		800	2400	2640	15
	1632	RE57717		800	2400	2640	15
	1637	RE68454		800	2400	2640	11
	1638	RE68455		800	2400	2640	11
	1639	RE68456			1500	1550	14
	1640	RE68457			1800	1890	14
	1641	RE68458		800	2400	2640	15
	1642	RE68459		800	2400	2640	15
	1643	RE64298		800	2400	2640	11.5
	1644	RE68454		800	2400	2640	11.5
	1645	RE68458		800	2400	2640	15
	1646	RE68459		800	2400	2640	15
T04045TFM	1605	RE41774	RE49362	850	2400	2640	12.5
	1605	RE49362		850	2400	2640	12.5
	1609	RE42058	RE48156		1800	1890	12
	1609	RE48156	CANCELLED		1800	1890	15
	1610	RE48156			1800	1890	15
	1615	RE60917		850	2400	2640	16
	1620	RE65035			1800	1890	15
	1621	RE65036		850	2400	2640	12.5
(Continued on next page)	1622	RE65037		850	2400	2640	16

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

FUEL INJECTION PUMP SPECIFICATIONS (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Slow Idle (rpm)**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Dynamic Timing (DBTDC**
T06059DF	1602	RE24182	RE47058	850	2500	2750	17
	1602	RE47058		850	2500	2750	17
	1615	RE47059[b]		850	2500	2750	17
CD6059DF	1602	RE37935	RE52159	800	2500	2750	15
	1602	RE52159		800	2500	2750	17
	1603	RE37933	CANCELLED		1800	1890	14
	1604	RE38863	CANCELLED	800	2100	2310	15
	1623	RE37935	RE52160	800	2500	2750	15
	1623	RE52160[b]		800	2500	2750	17
	1635	RE37936	CANCELLED	800	2500	2750	15
	1636	RE37933	CANCELLED		1800	1890	14
	1638	RE37934	CANCELLED		1500	1575	13
	1641	RE37934	CANCELLED		1500	1575	13
	1648	RE52159		800	2500	2750	17
	1650	RE52160		800	2500	2750	17
	16BZ	RE52160		800	2500	2750	17
T06059TF	1602	RE42091	RE47137	850	2500	2750	13
	1602	RE47137		850	2500	2750	13
	1603	RE40243	RE44463		1800	1890	12
	1603	RE44463	RE48159		1800	1890	12
	1603	RE58159			1800	1890	14
	1604	RE40409[b]			1800	1890	14
	1615	RE47057[b]		850	2500	2750	13
	1619	RE47178[b]		850	2500	2750	13
	1621	RE42290[b]		850	2500	2750	14
	1624	RE42841	RE44479		1800	1890	12
	1624	RE44479	RE48160		1800	1890	14
	1624	RE48160			1800	1890	14
	1644	RE40243	RE48157		1800	1890	12
T06059TF (Continued on next page)	1644	RE48157			1800	1890	12

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page DPSG,OUO1004,499 –19–27NOV98–7/9

FUEL INJECTION PUMP SPECIFICATIONS (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Slow Idle (rpm)**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Dynamic Timing (DBTDC)**
T06059TF (Continued)	1645	RE42841	RE48158		1800	1890	12
	1645	RE48158			1800	1890	12
CD6059TF	1602	RE19914	RE47137	800	2500	2710	13
	1602	RE47137		800	2500	2710	13
	1603	RE19981	RE48159		1800	1890	14
	1603	RE48159			1800	1890	16
	1604	RE38864	CANCELLED		1800	1890	15
	1611	RE37937	CANCELLED	800	2500	2750	15
	1619	RE47178[b]		800	2500	2710	13
	1623	RE31767	CANCELLED	800	2500	2750	13
	1624	RE48160[b]			1800	1890	14
	1632	RE31768	CANCELLED		1800	1890	14
	1636	RE31760	RE50886		1500	1575	17
	1636	RE50886			1500	1575	15
	1641	RE29472	RE50885		1500	1575	17
	1641	RE50885[b]			1500	1575	15
	1641	RE50892			1500	1575	15
	1644	RE48157			1800	1890	14
	1645	RE48158[b]			1800	1890	14
	1646	RE50892			1500	1575	13
	1647	RE50893			1500	1575	13
	1649	RE47137	CANCELLED	800	2500	2750	13
	1651	RE47178	CANCELLED	800	2500	2750	13
	1652	RE56483		800	2500	2750	13
(Continued next page)	1653	RE56484		800	2500	2750	13

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

Continued on next page

DPSG,OUO1004,499 –19–27NOV98–8/9

FUEL INJECTION PUMP SPECIFICATIONS (Continued)[a]							
Engine Model	**Injection Pump Option Code**	**Original Injection Pump (Part No.)**	**Replaced By Injection Pump (Part No.)**	**Slow Idle (rpm)**	**Rated Speed (rpm)**	**Fast Idle (rpm)**	**Dynamic Timing (DBTDC)**
T06068DF	1602	RE42092	RE47182	850	2400	2640	17.2
	1602	RE47182		850	2400	2640	17.2
	1619	RE42842	RE47183	850	2400	2640	15
	1619	RE47183		850	2400	2640	17.2
CD6068DF	1622	RE47182		800	2400	2640	18
	1623	RE47183		800	2400	2640	18
T06068DFM	1623	RE65038		850	2400	2640	17.2
	1630	RE52008		850	2400	2640	17.2
T06068TF	1602	RE42094	RE49427	850	2400	2640	14
	1602	RE49427	RE47184	850	2400	2640	14
	1602	RE47184	RE41815	850	2400	2640	14
	1602	RE41815		850	2400	2640	14
	1610	RE42920		850	2200	2420	14
	1612	RE65015[b]		850	2400	2640	14
	1619	RE42843	RE47185	850	2400	2640	14
	1619	RE47185[b]		850	2400	2640	14
CD6068TF	1605	RE65342			1500	1580	15
	1642	RE47184		800	2400	2640	14
	1643	RE47185		800	2400	2640	14
	1646	RE67761			1500	1580	15
T06068TFM	1624	RE65039			1800	1890	12.5
	1625	RE65040		850	2400	2640	13.5
	1626	RE65041		850	2600	2860	12.4
	1630	RE52010		850	2400	2640	13.5
	1631	RE52012			1800	1890	12.5
	1632	RE56421		850	2600	2860	12.4

[a]Engine speeds listed are as preset to factory specifications. In most cases, slow idle speed will be reset depending upon specific vehicle application requriements. Refer to your machine technical manual for engine speeds that are different from those preset at the factory.

[b]Can be used with JP5/JP8 Jet "A" fuel.

DPSG,OUO1004,499 –19–27NOV98–9/9

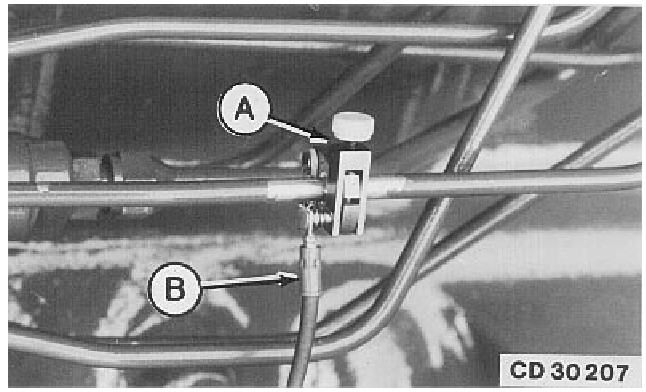
USING TIME TRAC® AS A TACHOMETER

The TIME-TRAC® meter can be used as a tachometer by using clamp on transducer JT07177 (A) at nozzle end of any high pressure fuel injection line.

1. Remove paint and thoroughly clean the area of the high-pressure line to which the clamp-on transducer is to be attached.

2. Install transducer (A) and connect JT07172 cable (B) between transducer and JT07170 meter port marked "SR".

3. Switch on meter and start the engine to measure and record engine speed.



CD30207 –UN–07MAR95

A—Transducer
B—Cable

TIME TRAC is a registered trademark of Stanadyne Automotive Corp.

DPSG,OUO1004,115 –19–11MAY98–1/1

CHECK AND ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING

NOTE: If using FKM10429 Kit, JDG821 Magnetic Pickup Adapter (tapered) and JT07173 SOI Clamp Assembly are not included in the kit and must be ordered separately. There is also an adapter kit available to convert FKM10429 to FKM10429A under the FKM10465 part number.

The JT07158 (or FKM10429A) TIME TRAC® Kit electronically indicates start of injection with respect to piston top dead center (TDC), and allows accurate setting of injection pump timing to provide optimum power, smoke, and exhaust emissions.

Timing engines with this timing kit improves consistency between engines and helps to control cylinder firing pressures which can be a factor in head gasket failures as well as improve overall engine performance efficiencies.

RG7246 –UN–23NOV97

TIME TRAC is a registered trademark of Stanadyne Automotive Corp.

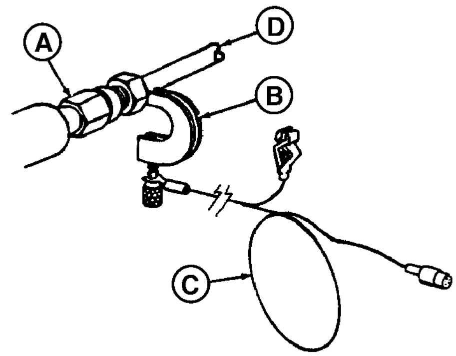
Continued on next page

DPSG,OUO1004,454 –19–24OCT98–1/9

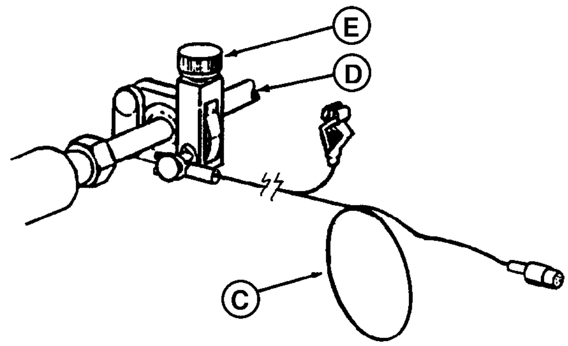
INSTALL JT07158 (OR FKM10429A) TIME TRAC® KIT:

IMPORTANT: All transducers and sensors must be installed at nozzle end of No. 1 fuel injection line. If access to No. 1 line is restricted, sensor can be installed on No. 4 injection line (4-cylinder engines) and No. 6 injection line (6-cylinder engines).

Remove all paint from injection line where clamp-on transducer will be installed and be sure this location is thoroughly clean.



RG7285 –UN–03NOV97



RG7286 –UN–03NOV97

A—JT07155 In-Line SOI Sensor
B—JT07173 SOI Clamp Assembly
C—JT07172 Transducer Cable
D—Fuel Injection (Delivery) Line
E—JT07177 6 mm (Green) Clamp-On Transducer

1. On engines with optional JT07155 In-Line SOI Sensor (A) installed between injection nozzle and fuel delivery line, install JT07173 SOI Clamp Assembly (B) onto clean sensor and tighten securely.

2. On engines without optional JT07155 In-Line Sensor, install JT07177 6 mm (green) Clamp-on Transducer (E) onto clean, paint-free injection line and tighten securely.

3. Assemble red lead of JT07172 Transducer Cable (C) onto in-line sensor or transducer, however equipped.

4. Attach spring clip to a solid ground. Plug connector into JT07170 meter port marked SR.

TIME TRAC is a registered trademark of Stanadyne Automative Corp.

Continued on next page

DPSG,OUO1004,454 –19–24OCT98–2/9

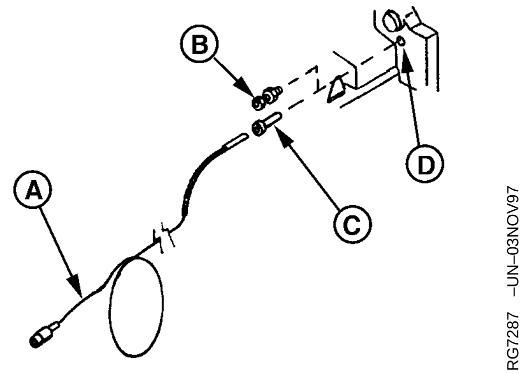
5. Rotate engine using JDG820, JDE83 or JD281A and install JDE81-4 Timing Pin in flywheel timing hole (D) to ensure engine is NOT stopped at TDC. Magnetic pick-up probe will enter TDC timing hole in flywheel and be damaged when engine is started. An air gap of 0.64 mm (0.025 in.) is recommended between tip of probe and flywheel face.

6. Install JDG793 Threaded Magnetic Pick-up Adapter (B) into flywheel housings with tapped hole until it bottoms. Insert probe of magnetic pickup (A) into adapter until it contacts flywheel. Back out hex head of adapter two flats and tighten lock nut; this will provide recommended air gap.

7. Install JDG821 Tapered Magnetic Pick-up Adapter[1] (C) into flywheel housings without tapped hole. Lightly tap adapter to lock into position. Insert probe into adapter until it contacts the flywheel. Pull probe back out to provide 0.64 mm (0.025 in.) gap.

NOTE: In some cases, it may be necessary to shorten JDG821 Adapter by approximately 8 mm to prevent contact with flywheel.

8. Plug magnetic pick-up connector into JT07170 meter port marked MP.



A—Magnetic Pick-Up
B—JDG793 Threaded Magnetic Pick-Up Adapter
C—JDG821 Tapered Magnetic Pick-Up Adapter
D—Flywheel Timing Hole

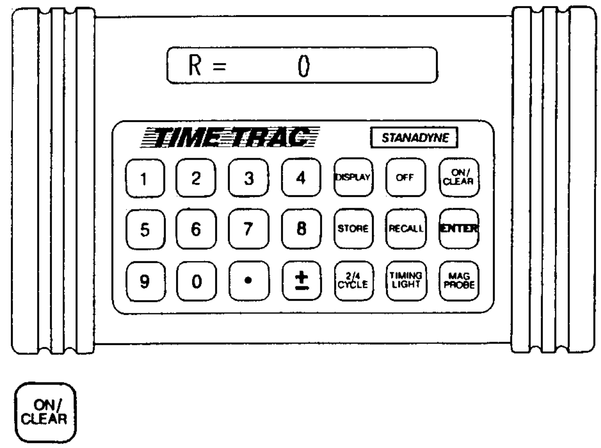
[1]*Order JDG821 Adapter separately. Not part of JT07158 TIME TRAC Kit.*

Continued on next page DPSG,OUO1004,454 –19–24OCT98–3/9

CHECK ROTARY INJECTION PUMP RATED LOAD DYNAMIC TIMING:

1. Engine OFF. Push ON/CLEAR button.

   Display shows: R=0



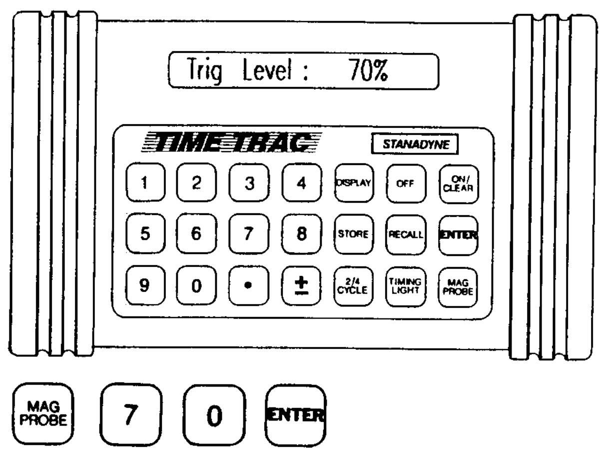
RG7031 –UN–27SEP94

DPSG,OUO1004,454 –19–24OCT98–4/9

2. Push MAG PROBE button.

   Display shows: Trig Level: 30%

3. Change to 70% and push ENTER.

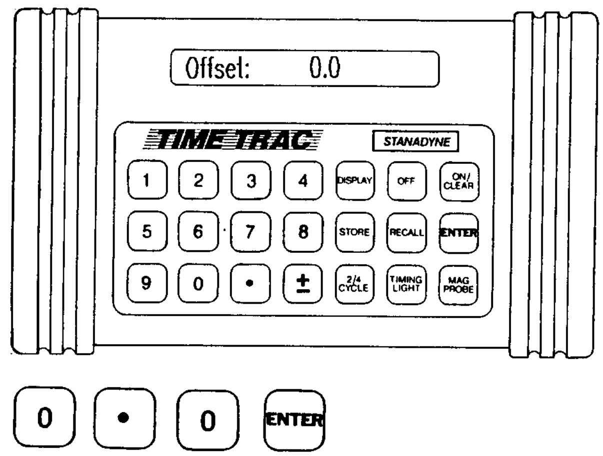


RG7032 –UN–27SEP94

Continued on next page DPSG,OUO1004,454 –19–24OCT98–5/9

4. Display shows: Offset: 20.0°

   Change to offset 0° and push ENTER.



RG7033 –UN–27SEP94

DPSG,OUO1004,454 –19–24OCT98–6/9

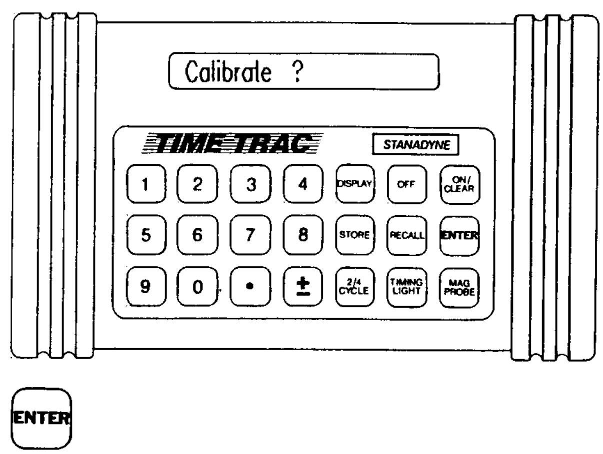
5. Display shows: Calibrate?

   Start engine and push ENTER.

6. Run engine at 1300 rpm. Push ENTER. Display shows: Calibrating then Engine RPM and timing.

NOTE: If display shows NO PROBE, the magnetic pick-up probe has not been installed properly [air gap exceeds 0.64 mm (0.025 in.)] or there is debris on the back of the flywheel. Check for proper air gap or clean the back side of the flywheel by inserting a soft wooden dowel into the engine timing pin hole with the engine running at low idle speed.

7. Warm engine to normal operating temperature, check slow and fast idle rpm. (See FUEL INJECTION PUMP SPECIFICATIONS earlier in this group.) Adjust speeds as necessary.



RG7129 –UN–06OCT94

Continued on next page

DPSG,OUO1004,454 –19–24OCT98–7/9

IMPORTANT: Many machines have hydraulic pumps that have adequate flow to load engine well below rated load rpm. Some equipment may need to be driven in high gear or pull a load to bring engine speed to rated load rpm.

8. Run engine at wide open throttle (WOT) and load engine down gradually to rated speed rpm.

9. Record engine speed (rpm) and timing degrees.

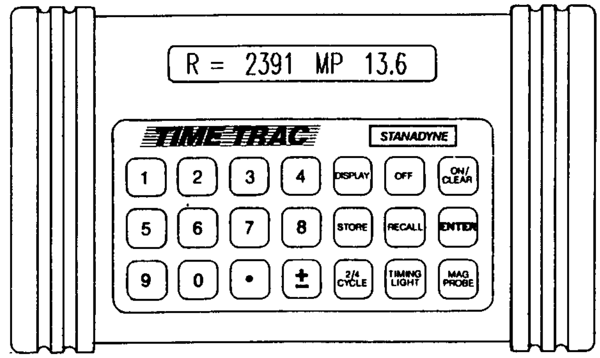
10. Compare recorded speeds and timing degrees to charts earlier in this group for OEM applications or refer to machine technical manual.

IMPORTANT: Stop engine prior to making timing adjustments. Injection pump can seize if adjustment is made with engine running.

11. Stop engine.

If dynamic timing reading is more than 8 degrees retarded with pump flange and front plate timing marks at original location as shipped from factory, this may indicate the pump advance is not functioning. Check the following:

- Change fuel filter(s).
- Check transfer pump for positive fuel pressure to injection pump.
- Check camshaft movement on injection pumps with rectangular timing window.
- Check pump drive shaft-to-gear key or pin to ensure key or pin has not sheared.
- If none of the above checks are conclusive, remove pump and have necessary repairs made at an authorized diesel repair station.



RG7037 –UN–27SEP94

Continued on next page

DPSG,OUO1004,454 –19–24OCT98–8/9

ADJUST ROTARY INJECTION PUMP DYNAMIC TIMING:

1. Loosen injection pump mounting flange nuts and adjust pump timing.

   To advance pump timing, rotate top of pump clockwise view from rear (flywheel end) of engine. To retard timing, rotate top of pump counterclockwise. Pump flange movement of 1.524 mm (0.060 in.) is equivalent to 2 degrees of engine timing.

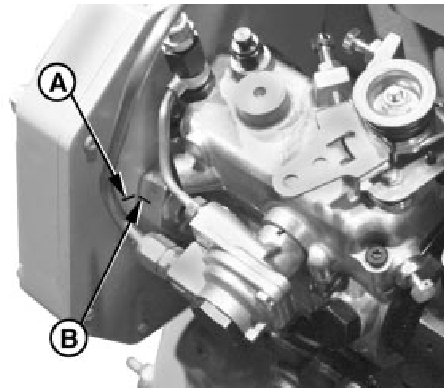
2. Tighten injection pump mounting flange nuts to specifications.

Rotary Injection Pump Mounting Nuts—Specification

Torque .... 27 N•m (20 lb-ft)

Start engine and check injection pump dynamic timing again. Adjust timing as needed.

3. Grind away original timing mark and stamp new timing mark (B) onto injection pump flange to align with timing mark (A) on front plate after all final adjustments have been made and satisfactory engine performance is achieved.

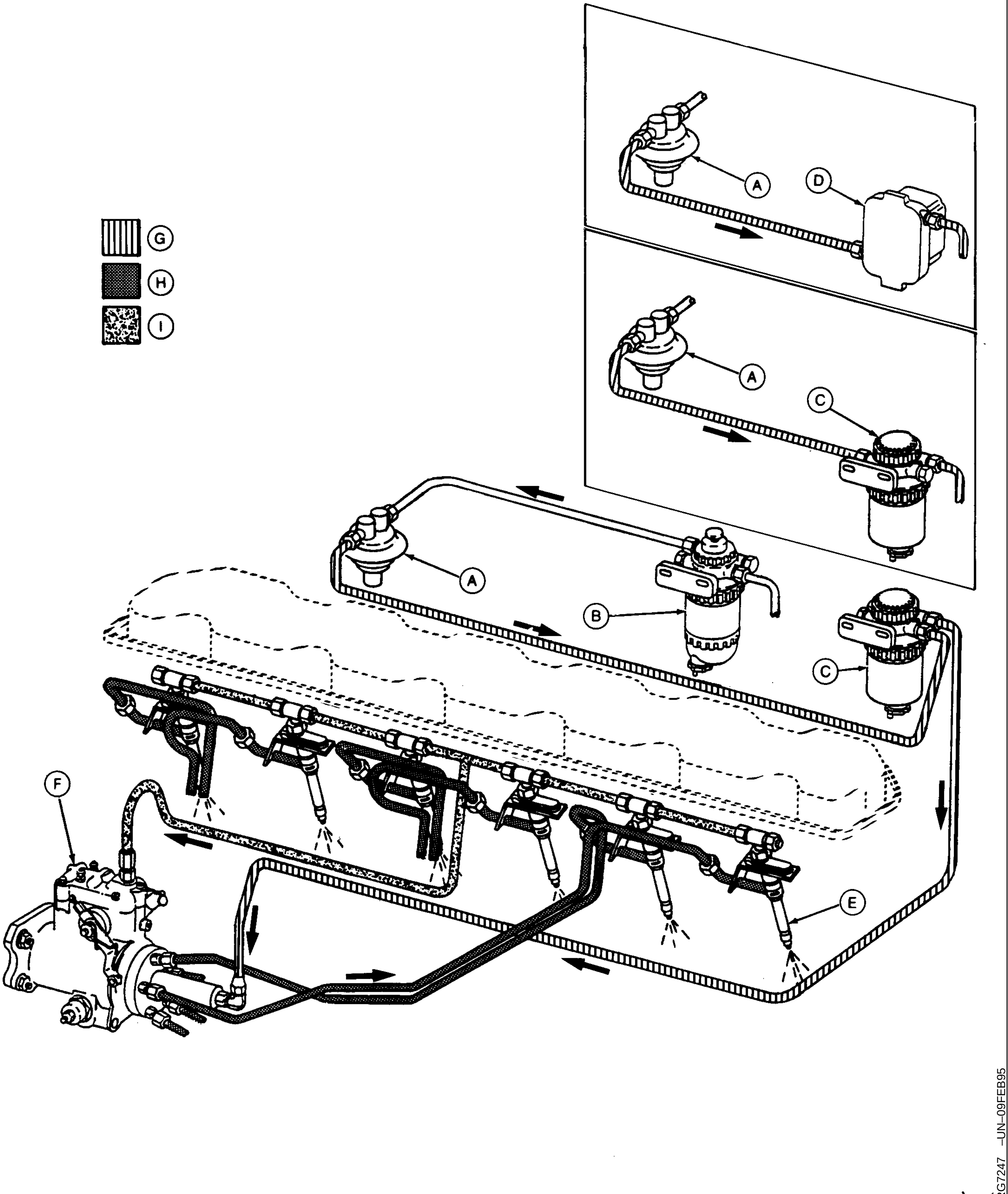


RG7723A –UN–07NOV97

A—Front Plate Timing Mark
B—Pump Timing Mark

DPSG,OUO1004,454 –19–24OCT98–9/9

FUEL SYSTEM OPERATION



Continued on next page

RG,CTM8,DT522 –19–18FEB95–1/2

A—Fuel Supply (Transfer) Pump
B—Round Primary Fuel Filter/Water Separator
C—Round Final Fuel Filter
D—Rectangular Fuel Filter
E—Fuel Injection Nozzles
F—Fuel Injection Pump
G—Supply Pump Pressure Fuel
H—Injection Pressure Fuel
I—Fuel Return (Leak-off)

The fuel supply pump (A) draws fuel from the tank and pressurizes it. This pressure permits the fuel to flow through the filter (B) and charge the transfer pump of the rotary-type injection pump (F).

NOTE: Some 3029 engines may not utilize a fuel supply pump. Fuel is gravity fed from the fuel tank and drawn into the injection pump.

With the fuel injection pump charged with fuel by the fuel supply pump, the injection pump plungers pressurize the fuel to approximately 50 000 kPa (500 bar) (7255 psi). Delivery (pressure) lines are used to route this high pressure fuel to the fuel injection nozzles (E).

Fuel enters the injection nozzle at a pressure which easily overcomes the pressure required to open the nozzle valve. When the nozzle valve opens, fuel is forced out through the orifices in the nozzle tip and atomizes as it enters the combustion chamber.

Incorporated into the fuel system is a means of returning excess (or unused) fuel (I) back to the fuel tank. Excess fuel comes from two sources:

1. Fuel Injection Pump: A quantity of fuel greater than that required by the engine is supplied to the fuel injection pump.
2. Fuel Injection Nozzles: A small amount of fuel seeps past the nozzle valve for lubrication purposes.

To get the excess fuel back to the tank, a return line from the injection pump is connected to the middle of the nozzle leak-off line. Fuel from both sources is then returned to the tank by a return pipe connected to the front end of the leak-off pipe.

RG,CTM8,DT522 –19–18FEB95–2/2

DIAGNOSE FUEL SYSTEM MALFUNCTIONS

Symptom	Problem	Solution
Fuel Not Reaching Injection Nozzles	Fuel filter restricted.	Replace fuel filter. (See Group 35.)
	Fuel line restricted.	Clean lines as required.
	Fuel too heavy at low temperatures.	Use correct grade of fuel.
	Air in system.	Correct problem and bleed fuel system (this group).
	Fuel tank valve shut off.	Open fuel tank valve.
	Low supply pump pressure.	Check fuel lines for restrictions; check pump output pressure (this group).
Engine Starts Hard or Won't Start	Fuel too heavy at low temperature.	Use correct grade of fuel. (See Fuels, Group 02.)
	Injection nozzles faulty or sticking.	Repair or replace as required. (See Group 35.)
	Incorrect timing.	Adjust timing (this group).
	Faulty injection pump.	Repair or replace.
	Water in fuel.	Drain water from filter (or separator if equipped).
	Fuel filter restricted.	Install new filter. See Group 35.
	Low supply pump pressure.	Check pump output pressure (this group).
	Injection pump return fuel line or fittings restricted.	Clean lines as required.
	Low cetane fuel.	Use correct grade of fuel. (See Group 02.)
Engine Starts and Stops	Air in system.	Correct problem and bleed fuel system. (See this group.)

Continued on next page

Symptom	Problem	Solution
	Fuel filter restricted.	Replace fuel filter.
	Fuel lines restricted.	Clean lines as required.
	Water in fuel.	Drain water from filter, (or separator if equipped). Install new filter. (See Group 35.)
	Injection pump return fuel line or fittings restricted.	Clean lines as required.
Erratic Engine Operations	Fuel filter restricted.	Replace fuel filter. (See Group 35.)
	Fuel too heavy at low temperatures.	Use correct grade of fuel. (See Group 02.)
	Injection nozzles faulty or sticking.	Repair or replace nozzles. (See Group 35.)
	Fuel lines restricted.	Clean as required.
	Incorrect timing.	Adjust timing (this group).
	Governor faulty.	Repair. (See Group 35.)
	Water in fuel.	Drain water from filter (or separator, if equipped). Install new filter.
	Injection pump return fuel line or fittings restricted.	Clean lines as required.
	Low cetane fuel.	Use correct grade of fuel. (See Group 02.)
	Injection nozzle return lines restricted.	Clean lines as required.
Engine Emits Excessive Black Smoke	Injection nozzles faulty or sticking.	Repair. (See Group 35.)
	Injection pump timing incorrect.	Adjust timing (this group).
	Low cetane fuel.	Use correct grade of fuel. (See Group 02.)

Continued on next page DPSG,OUO1004,455 –19–24OCT98–2/4

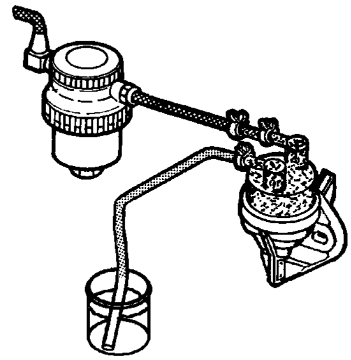
Symptom	Problem	Solution
	Over-fueling.	Repair injection pump. (See Group 35.)
Engine Emits Excessive Blue or White Smoke	Cranking speed too slow.	Check batteries and electrical system.
	Injection pump timing incorrect.	Adjust timing (this group).
	Injection nozzles faulty or sticking.	Repair. (See Group 35.)
	Excessive wear in liners and/or piston rings stuck.	See Group 10.
	Incorrect cetane fuel for ambient temperature.	Use correct grade of fuel. (See Group 02.)
	Engine running too “cold”.	Check thermostat. (See Group 25.)
Engine Idles Poorly	Injection nozzles faulty or sticking.	Repair. (See Group 35.)
	Incorrect timing.	Adjust timing (this group).
	Pump slow idle speed not correctly adjusted.	Adjust slow idle speed (this group).
	Fuel lines restricted.	Clean as required.
	Water in fuel.	Drain water from filter, (or separator, if equipped). Install new filter. (See Group 35.)
	Injection pump return lines or fittings restricted.	Clean as required.
	Injection nozzle return lines clogged.	Clean as required.
	Low cetane fuel.	Use correct grade of fuel. (See Group 02.)
Engine Does Not Develop Full Power	Low cetane fuel.	Use correct grade of fuel. (See Group 02.)
	Incorrect timing.	Adjust timing (this group).

Continued on next page DPSG,OUO1004,455 –19–24OCT98–3/4

Symptom	Problem	Solution
	Injection pump or governor faulty.	Repair. (See Group 35.)
	Fuel filter clogged.	Replace fuel filter. (See Group 35.)
	Injection nozzles faulty or sticking.	Repair. (See Group 35.)
	Defective supply pump.	Test (this group).
	Injection pump return fuel line or fittings restricted.	Clean as required.
	Water or gasoline in diesel fuel.	Drain water or replace with clean fuel. Install new filters (this group).
	Incorrect fast idle speed.	Adjust speed (this group).
	Speed control linkage incorrectly adjusted.	Adjust (this group).

DPSG,OUO1004,455 –19–24OCT98–4/4

FUEL SUPPLY QUALITY CHECK


RG9481 –UN–17NOV98

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

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

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

1. Check primary (if equipped) and final fuel filters for servicability. If filter is equipped with with a water separator, empty and clean separator bowl.

2. Start engine and operate under load, observing engine performance.

3. Disconnect fuel line from inlet side of primary fuel filter (if equipped) or inlet side of supply pump on engines without primary filter.

4. Connect a hose to inlet port.

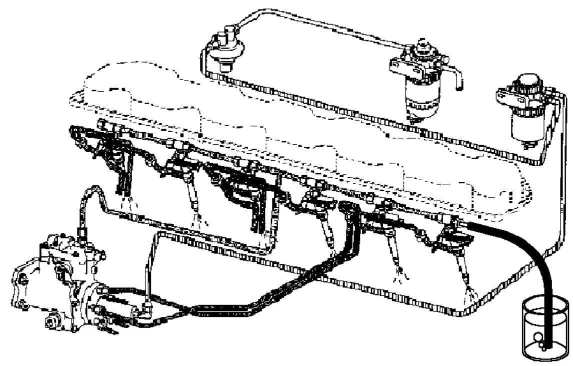
5. Submerge hose in a container of clean, good quality fuel meeting engine specifications.

6. Operate engine under load and observe performance.

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

DPSG,OUO1004,456 –19–24OCT98–1/1

AIR IN FUEL TEST



RG9485 –UN–30NOV98

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

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

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

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

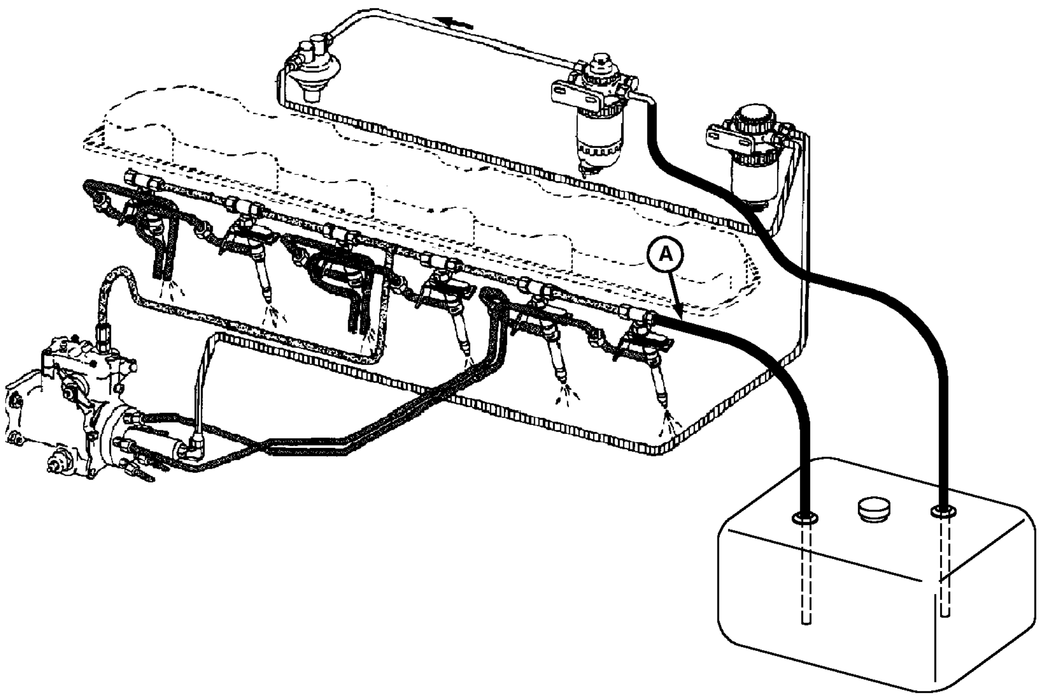
3. If bubbles are still present, check the following:

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

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

DPSG,OUO1004,457 –19–24OCT98–1/1

RESTRICTED FUEL RETURN LINE CHECK



A—Fuel Leak-Off Line

This check will help determine if the fuel return line is restricted.

1. Disconnect fuel leak-off line at the engine (A).

2. Remove fuel tank cap.

3. Force compressed air through the fuel return line while listening at the fuel tank filler neck

4. If the return line isn't restricted, the compressed air bubbling into the fuel tank should be audible through the tank filler neck.

5. If no air bubbling through the tank is audible, completely check the fuel return line for any possible restrictions.

DPSG,OUO1004,458 –19–24OCT98–1/1

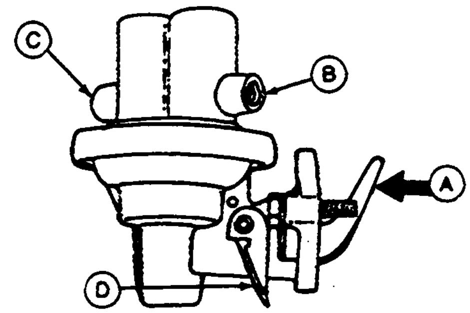
FUEL SUPPLY PUMP OPERATION—IF EQUIPPED

NOTE: Some vehicle applications which use the 3029 engine may not utilize the fuel supply pump. Fuel is gravity fed from the fuel tank and drawn in by the fuel injection pump.

An eccentric lobe on the engine camshaft operates the lever (A) on the supply pump to pressurize the fuel system.

Fuel flows from the fuel tank at gravity pressure to the inlet side (B) of the diaphragm-type pump. The pump increases the fuel pressure to 25—30 kPa (0.25—0.3 bar) (3.5—4.5 psi) at slow idle speed and forces fuel through the outlet side (C) to the filter and fuel injection pump. Minimum output pressure is 15 kPa (0.15 bar) (2 psi).

A hand primer lever (D) is provided for manually forcing fuel through the system to bleed fuel filter, etc.



RG5167 –UN–14DEC88

A—Lever
B—Inlet Side
C—Outlet Side
D—Hand Primer Lever

DPSG,OUO1004,459 –19–24OCT98–1/1

DIAGNOSE FUEL SUPPLY PUMP MALFUNCTIONS

Symptom	Problem	Solution
Low Supply Pump Pressure or Pump Not Functioning Correctly	Out of fuel.	Add fuel to tank.
	Fuel shut off at tank.	Open shut-off valve.
	Restricted fuel line.	Clean as required.
	Air leak in fuel line between pump and tank.	Repair as required.
	Loose or damaged fuel line connections.	Repair as required.
	Hand primer lever left in upward position.	Move lever toward engine block as far as it will go.
	Punctured or leaking diaphragm.	Replace pump. (See Group 35.)
	Worn or damaged valve assemblies.	Replace pump. (See Group 35.)
	Broken valve spring(s).	Replace pump. (See Group 35.)
	Foreign material under diaphragm (from vent holes).	Replace pump. (See Group 35.)
	Wear or damage to hand primer linkage.	Replace pump. (See Group 35.)

DPSG,OUO1004,460 –19–24OCT98–1/1

MEASURE FUEL SUPPLY PUMP PRESSURE

NOTE: Some 3029 engine may not utilize a fuel supply pump. Fuel is gravity fed from the fuel tank and drawn in by the injection pump.

1. Remove plug on fuel filter base.

2. Install test equipment in port (A) as shown.

3. Start engine. Fuel pump should maintain minimum positive pressure listed below. If pressure is low, replace filter element and recheck pressure.

Fuel Supply Pump—Specification

Nominal Pressure... 25—30 kPa (0.25—0.30 bar) (3.5—4.5 psi)

Fuel Supply Pump—Specification

Minimum Pressure.. 15 kPa (0.15 bar) (2.0 psi)

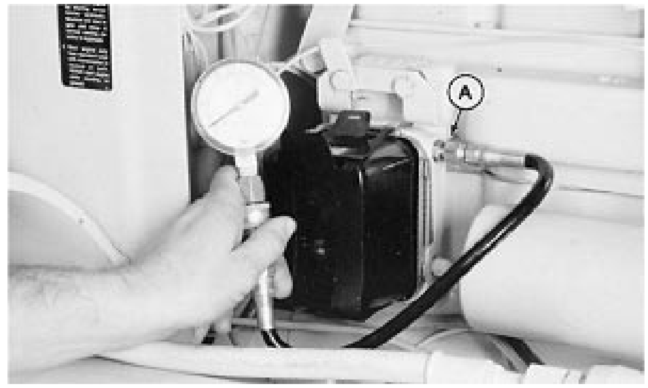
If pressure is still low, perform the following:

1. Disconnect pump-to-filter fuel line at the filter.

2. With throttle set at no-fuel position (or injection pump shut-off solenoid wire disconnected) so engine will not start, turn engine over several times with starting motor.

3. If fuel spurts from the line, the pump is operating properly.

NOTE: Look for a possible restriction in filter/filter base. Make sure pressure gauge/hose assembly is not at fault.



T6006AL –UN–25OCT88

A—Port

DPSG,OUO1004,461 –19–24OCT98–1/1

FUEL SHUT-OFF SOLENOID RESISTANCE TEST (LUCAS PUMP)

1. Disconnect wire to solenoid.

2. Remove solenoid noting if plunger is binding in bore.

3. Check coil resistance with ohmmeter. Resistance should be 9 ohms.

4. Check plunger retraction using a 12 volt source.

   Connect positive cable to connector terminal and negative cable to solenoid body. From the relaxed position, plunger should retract into the solenoid body when voltage is applied.

   If resistance specification is not met and/or plunger does not retract, replace solenoid.

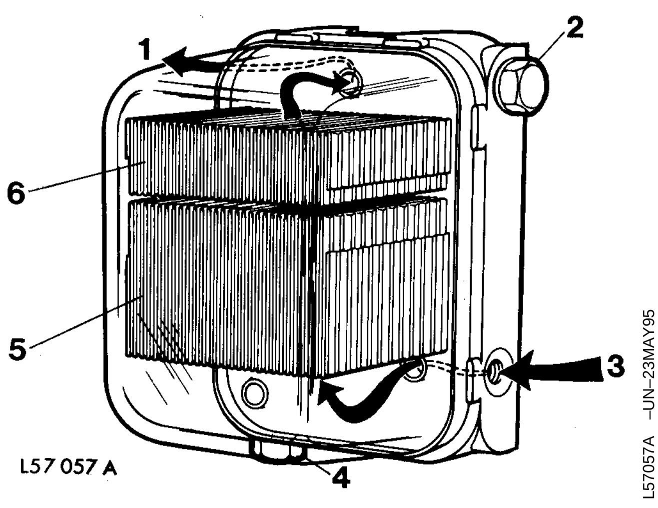
DPSG,OUO1004,462 –19–24OCT98–1/1

RECTANGULAR FINAL FUEL FILTER OPERATION

Fuel enters the filter at inlet (3) and flows through a first stage filtering media (5) then through a second stage filtering media (6) before flowing through outlet (1) to the fuel injection pump. The filtering media is housed in a metal sediment bowl and is glued to the bowl as an assembly.

Since water and other contaminants may settle at the bottom of the sediment bowl, a drain plug (4) is provided to permit removal of these contaminants.

An air vent/bleed plug (2) enables air in the system to be expelled to the outside through the filters when the bleed plug is loosened.



1—Fuel Outlet
2—Bleed Plug
3—Fuel Inlet
4—Drain Plug
5—First Stage Filter
6—Second Stage Filter

S11,23010,GS –19–03OCT94–1/1

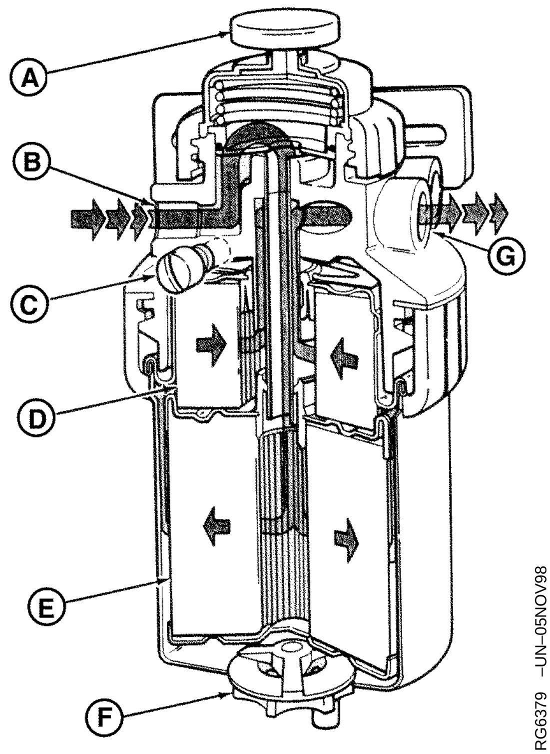
ROUND (PRIMARY) FUEL FILTER/WATER SEPARATOR OPERATION

Fuel enters the filter at inlet (B), then flows through a primary filter (E) and a secondary filter (D) before exiting filter through outlet (G) to the fuel injection pump. The filter elements are housed in a sediment bowl attached to the base with a threaded (detent) ring.

Since water and contaminants settle at the bottom of the sediment bowl, a drain plug (F) is provided.

Air in the system can be expelled through the air vent when bleed screw (C) is loosened.

Priming pump (A) draws fuel from the fuel tank to fill the filter bowl when primary filter element is changed. Priming pump also supplies fuel from the filter to the injection pump.



A—Priming Pump
B—Fuel Inlet
C—Bleed Screw
D—Secondary Filter
E—Primary Filter
F—Plug
G—Fuel Outlet

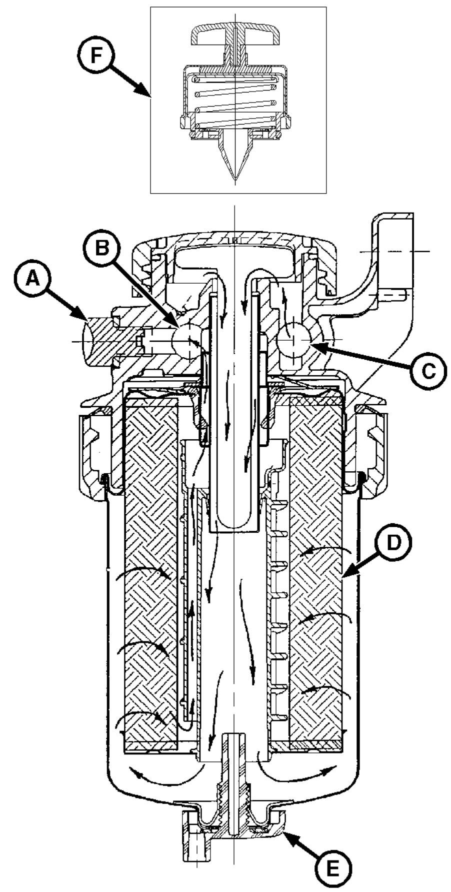
RG,CTM8,G115,13 –19–06FEB95–1/1

FINAL FUEL FILTER/WATER SEPARATOR OPERATION

Fuel enters the filter at inlet (C), then flows through filter element (D) and exits through outlet (B) to the fuel injection pump. The filter element is housed in a sediment bowl attached to the base with a threaded retaining ring.

Since water and contaminants settle at the bottom of the sediment bowl, a drain plug (E) is provided.

Air in the system can be expelled through the air vent when bleed screw (A) is loosened. Optional priming pump (F) draws fuel from the fuel tank to fill the filter bowl when the filter element is changed. The priming pump also supplies fuel from the filter to the injection pump.

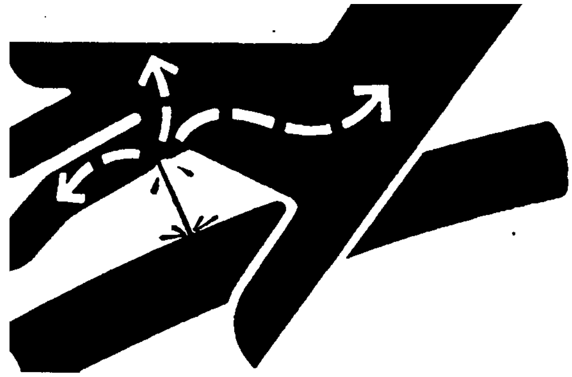


RG9090 –UN–27MAR98

A—Bleed Screw
B—Fuel Outlet
C—Fuel Inlet
D—Filter Element
E—Drain Plug
F—Primer Assembly

RG,115,JW7696 –19–24NOV97–1/1

BLEED THE FUEL SYSTEM



CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid hazards by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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

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

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

RG,CTM8,G35,9 –19–03OCT94–1/6

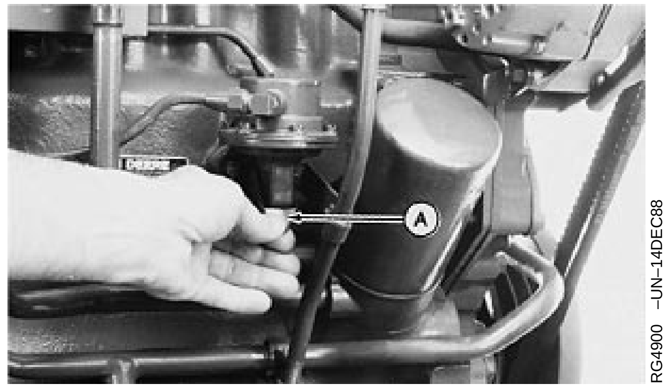
AT RECTANGULAR FINAL FUEL FILTER

A—Bleed Screw

1. Loosen air bleed screw (A) on filter base.

Continued on next page RG,CTM8,G35,9 –19–03OCT94–2/6

2. Operate primer lever (A) of fuel supply pump or turn ignition switch to "ON" position (if your vehicle has an electric supply pump) until fuel flow is free from air bubbles. Tighten bleed screw securely, continue operating hand primer until pumping action is not felt. Push hand primer inward (toward block) as far as it will go or turn ignition switch to "OFF".



A—Primer Lever

RG,CTM8,G35,9 –19–03OCT94–3/6

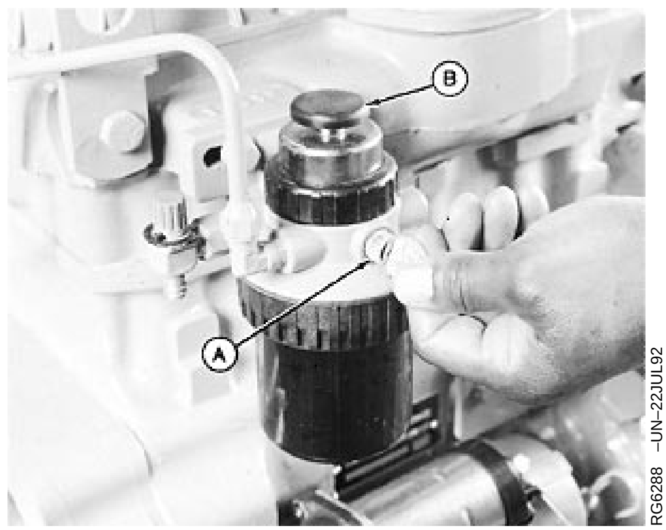
AT ROUND PRIMARY OR FINAL FUEL FILTER

1. Open air bleed vent screw (A) two full turns by hand.

2. Pump the hand primer (B, if equipped) on filter mounting base or turn ignition switch to "ON" position (if your vehicle has an electric supply pump) until a noticeable amount of fuel and air comes out of vent opening. Close vent screw when fuel starts to flow.

3. Pump the hand primer several times until resistance is felt. Continue pumping and open air bleed vent screw.

4. Close air bleed vent screw and pump the hand primer several times until resistance is felt again.



A—Bleed Vent Screw
B—Hand Primer

Continued on next page

RG,CTM8,G35,9 –19–03OCT94–4/6

AT FUEL INJECTION PUMP

On Stanadyne pumps:

1. Loosen fuel return line (A) at fuel injection pump.
2. Operate fuel supply pump primer lever (if equipped) or turn the ignition switch to "ON" if equipped with electric supply pump.
3. As soon as fuel flow is free from air bubbles, tighten fuel return line to 16 N•m (12 lb-ft). Push hand primer inward (toward block) as far as it will go or turn ignition "OFF".

On Lucas CAV pumps:

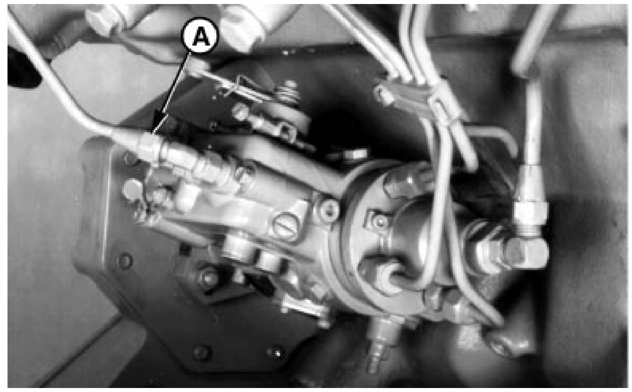
1. Loosen bleed screw (B) on pump cover.

NOTE: On Models DP200/201 Injection Pumps, bleed screw is located on top of cover near the fuel return line.

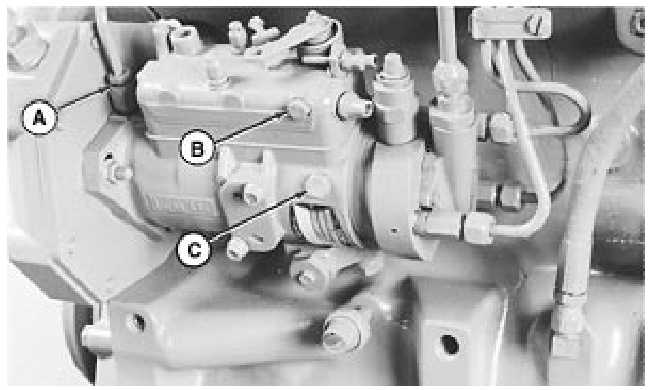
2. Operate supply pump primer lever or turn ignition switch to "ON".

CAUTION: NEVER loosen screw (C) securing pump head, otherwise pump damage may occur.

3. Wait until fuel flow is free from air bubbles. Retighten bleed screw.



RG6264 –UN–03NOV97



RG9482 –UN–17NOV98

A—Fuel Return Line
B—Bleed Screw
C—Pump Head Screw

Continued on next page RG,CTM8,G35,9 –19–03OCT94–5/6

AT FUEL INJECTION NOZZLES

1. Place throttle lever in fast idle position.

   On engines equipped with electronic fuel shut-off solenoid, energize solenoid.

IMPORTANT: Always use a backup wrench when loosening or tightening fuel lines at nozzles and/or injection pump to avoid damage.

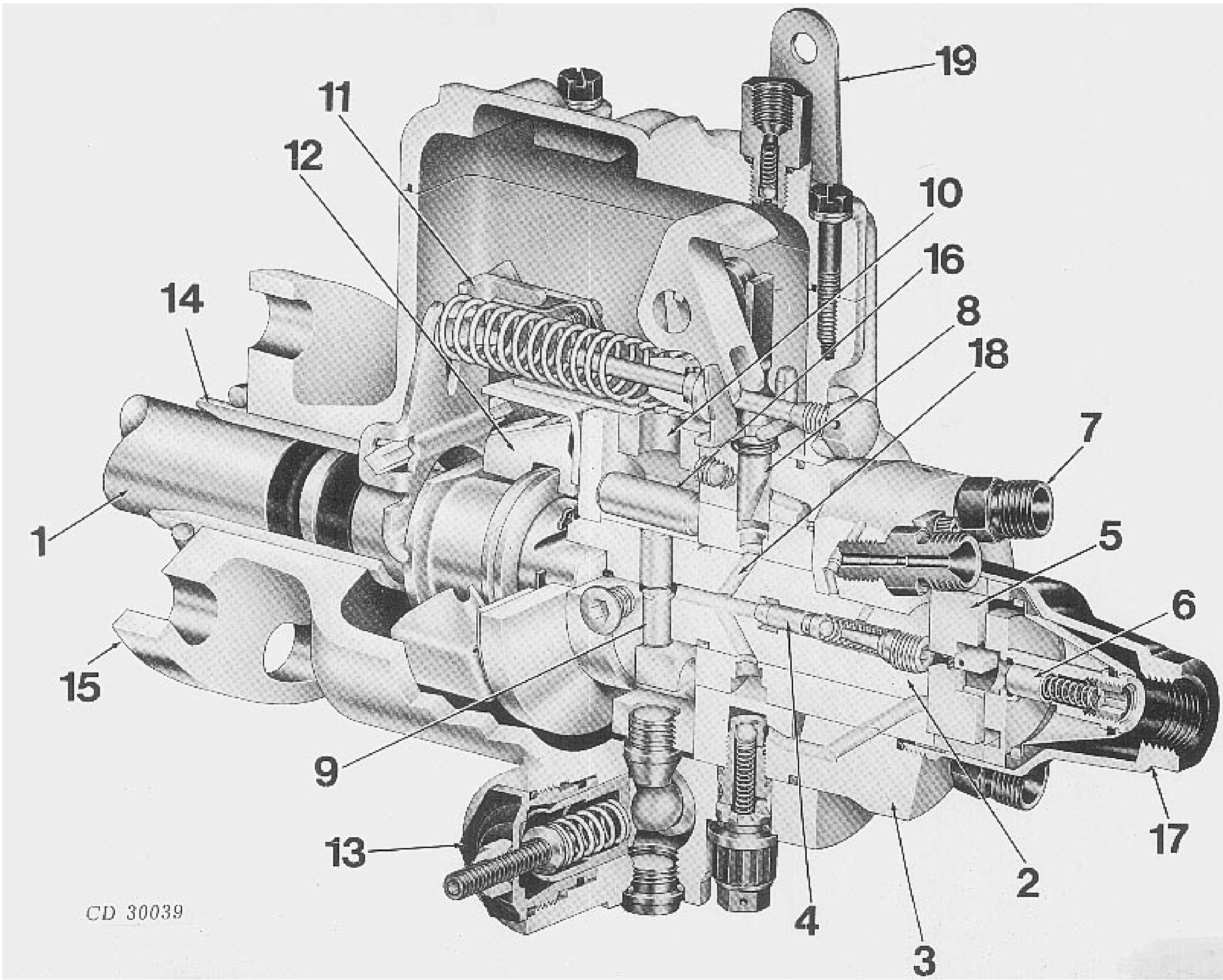
2. Using two open-end wrenches, loosen fuel line connection at injection nozzle.

3. Crank engine over with starting motor, (but do not start engine), until fuel free from bubbles flows out of loosened connection. Retighten connection to 34 N•m (25 lb-ft).

4. Repeat procedure for remaining injection nozzles (if necessary) until all air has been removed from fuel system.

RG,CTM8,G35,9 –19–03OCT94–6/6

STANADYNE FUEL INJECTION PUMP OPERATION



CD30039 –UN–08MAR95

DB2 Pump shown, DB4 Pump similar

1—Drive Shaft
2—Distributor Rotor
3—Hydraulic Head
4—Delivery Valve
5—Supply Pump
6—Pressure Regulator
7—Discharge Fitting
8—Metering Valve
9—Pumping Plungers
10—Internal Cam Ring
11—Governor
12—Governor Weights
13—Advance
14—Drive Shaft Bushing
15—Housing
16—Rollers
17—Supply Pump Inlet
18—Charging Ports
19—Throttle Lever

The main rotating components are the drive shaft (1), distributor rotor (2), supply pump (5) and governor (11).

The drive shaft engages the distributor rotor in hydraulic head (3). The drive end of rotor incorporates two pumping plungers (9).

The plungers are actuated toward each other simultaneously by an internal cam ring (10) through rollers (16) and shoes which are carried in slots at drive end of the rotor. The number of cam lobes normally equal the number of engine cylinders.

Continued on next page

RG,CTM8,G115,2 –19–16SEP92–1/2

The supply pump at rear of rotor is a positive displacement vane-type pump enclosed in the end cap. The end cap also houses supply pump inlet (17), fuel strainer and pressure regulator (6). Supply pump pressure is automatically compensated for viscosity effects due to temperature changes and fuel grade variations.

The distributor rotor incorporates two charging ports (18) and a single axial bore (passage) with one discharge port to serve all head outlets (7) to the injection lines. The rotor rotates in bore of hydraulic head. Metering valve (8) bore, charging ports and discharge fittings are located in the head.

This pump contains its own mechanical governor. The centrifugal force of the weights (12) in their retainer is transmitted through a sleeve to a governor arm and through a positive linkage to the metering valve. The metering valve can be closed to shut off fuel through a solid linkage by an independently operated shut-off lever.

The automatic speed advance (13), advances or retards (hydraulically) the beginning of fuel delivery from the pump. The advance responds to changes in speed only, or to a combination of speed and load changes.

Fuel is drawn from the supply tank through filters into the pump inlet through the inlet filter screen by the vane type fuel transfer pump. Some fuel is bypassed through the pressure regulator assembly to the suction side.

Fuel under transfer pump pressure flows through the center of the transfer pump rotor, past the rotor retainer into a circular groove on the rotor. It then flows through a connecting passage in the head to the automatic advance and up through a radial passage and then through a connecting passage to the metering valve. The radial position of the metering valve, controlled by the governor, regulates flow of the fuel into the radial charging passages which incorporates the head charging ports.

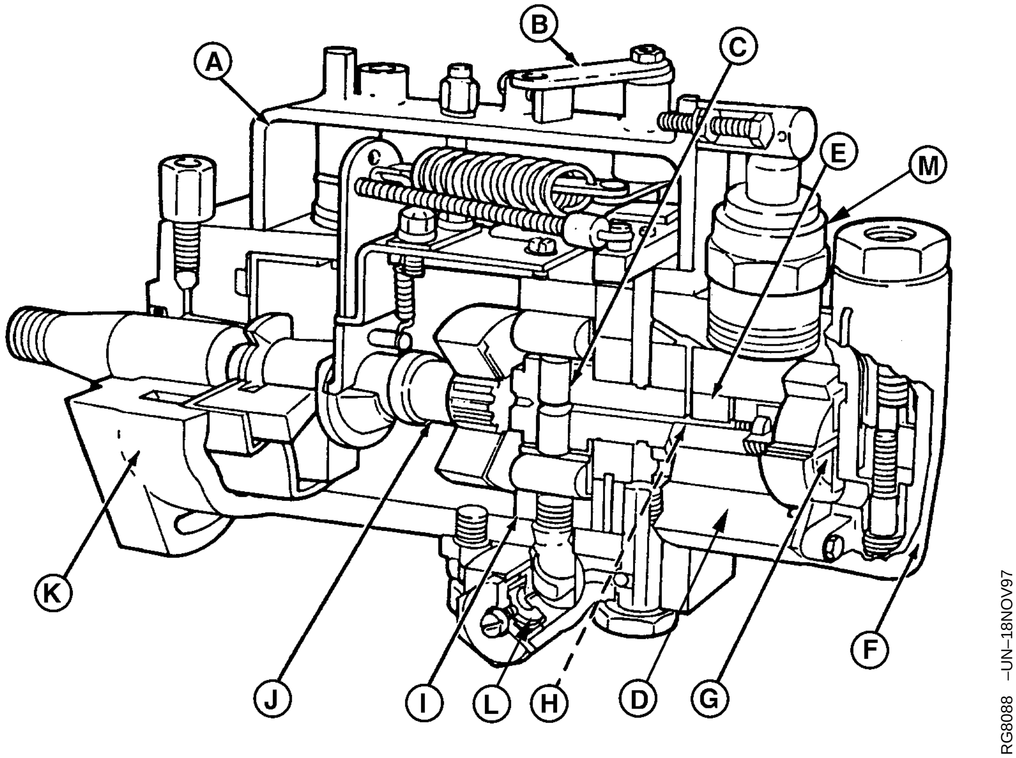
As the rotor revolves, the two rotor inlet passages register with the charging ports in the hydraulic head, allowing fuel to flow into the pumping chamber. With further rotation, the inlet passages move out of registry and the discharge port of the rotor registers with one of the head outlets. While the discharge port is opened, the rollers contact the cam lobes forcing the plungers together. Fuel trapped between the plungers is then pressurized and delivered by the nozzle to the combustion chamber.

Self-lubrication is an inherent feature of the pump’s design. As fuel at transfer pump pressure reaches the charging ports, slots on the rotor shank allow fuel and any entrapped air to flow into the pump housing cavity.

Additionally, an air vent passage in the hydraulic head connects the outlet side of the transfer pump with the pump housing. This allows air and some fuel to be bled back to the fuel tank via the return line. The fuel thus bypassed fills the housing, lubricates the internal components, cools and carries off any small air bubbles. The pump operates with the housing completely full of fuel; there are no dead air spaces anywhere within the pump.

RG,CTM8,G115,2 –19–16SEP92–2/2

LUCAS CAV FUEL INJECTION PUMP OPERATION



A—Governor Housing
B—Throttle Lever
C—Pumping Plungers
D—Hydraulic Head
E—Distributor Rotor
F—End Plate
G—Supply Pump
H—Delivery Valve
I—Internal Cam Ring
J—Drive Shaft
K—Pump Housing
L—Automatic Advance
M—Electric Shutoff

The Lucas CAV fuel injection pump is a horizontally mounted distributor pump with mechanical governor and automatic hydraulic speed advance. The moving parts of the pump are simultaneously lubricated and cooled by diesel fuel flowing through the pump, no additional lubricant is required.

Diesel fuel for injection is fed to the cylinders by a single unit. The pumping plungers (C) and distributor rotor (E) is fitted with two opposed plungers controlled by an internal cam ring (I).

On the other end of the rotor, there is a supply pump (G) which delivers the fuel, drawn from the fuel filter, through the metering valve into the inlet bore in the pump hydraulic head (D), at a pressure that varies with engine speed.

As the rotor rotates, the inlet bore in pump head aligns with inlet bore in the rotor. Fuel coming from the transfer pump reaches the pump plunger chamber's through bore, regulated by the metering valve and forces the two plungers apart.

During further rotation of the distributor rotor, inlet bore in the pump head is closed and distributor channel in the rotor eventually aligns with one of the outlet bores in the pump head. Meanwhile the two pump plungers have reached the cam so that they move toward each other. The trapped, metered fuel is forced, (under high pressure) through a channel in the rotor and outlet opening in the pump head. Then, through pressurizing valve and pressure line, to the injection nozzle and into the appropriate cylinder.

Continued on next page

DPSG,OUO1004,475 –19–31OCT98–1/2

A pressurizing valve is located at each outlet in the pump head where the pressure line leading to the fuel injection nozzle is connected. After injection, the pressure valve closes again, and with it’s small relief piston, draws in a quantity of fuel from the pressure line.

The resulting relief in the pressure line causes a quick and firm closing of the nozzle valve. This prevents fuel from leaking into the combustion chamber.

The quantity of fuel which is needed at any given moment for each cylinder and combustion cycle is regulated by a metering valve. The metering valve is controlled by the speed control rod and throttle lever (B), and by the governor inside the governor housing (A). In the "NO-FUEL" ("OFF") position, the metering valve completely cuts the supply of fuel from supply pump to the rotor.

At slow idle speed or under full load, the supply pump feeds more fuel to the metering valve than is needed for injection. The excessive fuel flows through the pressure regulating valve back to the suction side of the transfer pump. A very small amount of this surplus fuel escapes through the top of the governor housing.

To obtain the best possible performance over the entire speed range, the fuel injection pump is fitted with an automatic, hydraulically operated speed advance (L). This speed advance is preset at the factory. The speed advance adjusts timing of the fuel injection pump in relation to engine speed and load.

DPSG,OUO1004,475 –19–31OCT98–2/2

DIAGNOSE ROTARY FUEL INJECTION PUMP MALFUNCTIONS

Symptom	Problem	Solution
Engine Starts Hard or Won't Start	Shut-off solenoid not functioning properly; or wiring lead loose or broken.	Repair.
	Injection pump not correctly timed.	Check pump timing (refer to this group).
	Defective injection pump.	Remove pump from engine and repair.
	Automatic advance faulty or not operating.	Adjust or repair.
Slow Idle Speed Irregular	Nozzle faulty or sticking.	Repair (See Group 35.)
	Automatic advance faulty or not operating.	Inspect and adjust or repair.
	Injection pump not properly timed.	Check pump timing (refer to this group).
	Defective injection pump.	Remove pump and repair.
Engine Horsepower Low	Pump not properly timed.	Check timing (refer to this group).
	Insufficient throttle arm travel.	Inspect and adjust.
	Automatic advance faulty or not operating.	Adjust or repair.
	Nozzle faulty or sticking.	Repair. (See Group 35.)
	Defective injection pump.	Remove pump and repair.

DPSG,OUO1004,463 –19–24OCT98–1/1

CHECK AND ADJUST ENGINE SPEEDS ON LUCAS CAV PUMP

NOTE: Before checking and adjusting engine speed, make sure engine has reached its normal operating temperature.

CHECK SLOW AND FAST IDLE SPEEDS

1. Start engine and run at 50% load and rated speed until engine reaches normal operating temperature.

2. Stop engine and disconnect speed control rod from fuel injection pump throttle lever.

NOTE: Refer to FUEL INJECTION PUMP SPECIFICATIONS, earlier in this group, for slow and fast idle speeds.

3. Start engine and move injection pump lever to slow idle position against slow idle adjusting screw (1). Using a tachometer, read and record engine speed. Compare reading with specifications. Adjust slow idle as necessary as detailed below.

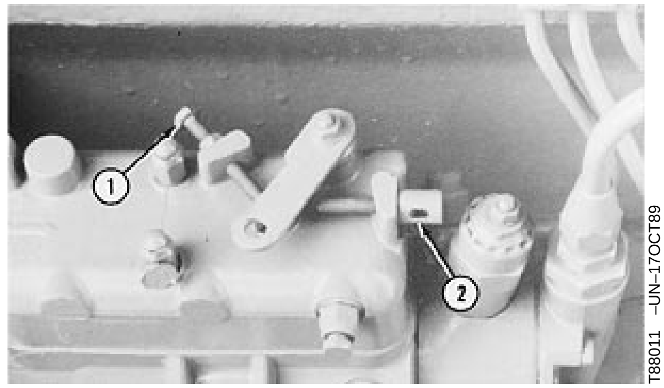
IMPORTANT: If fast idle is not within specification, have an authorized diesel repair station, servicing dealer, or engine distributor adjust as necessary.

4. Move injection pump lever to fast idle position against fast idle adjusting screw (2). Using a tachometer, read and record engine speed. Compare reading with specifications.

ADJUST SLOW IDLE SPEED

1. Move pump throttle lever to slow idle position against slow idle adjusting screw (1). See specifications for specified engine speeds.

2. Loosen slow idle screw lock nut. Turn adjusting screw clockwise to increase speed and counterclockwise to decrease engine speed.



1—Slow Idle Adjusting Screw
2—Fast Idle Adjusting Screw

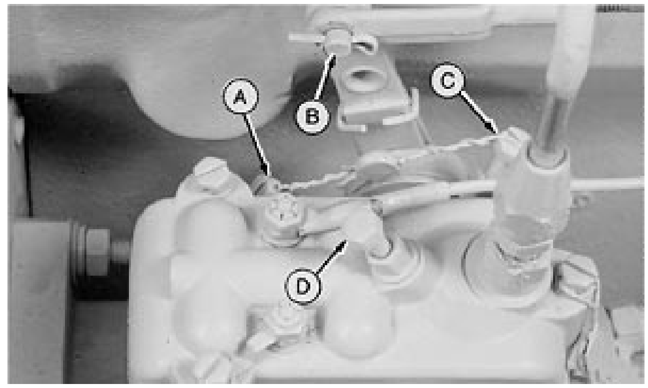
S11,23010,HM –19–18FEB95–1/1

ADJUST VARIABLE SPEED ON GENERATOR SET ENGINES (LUCAS CAV PUMPS ONLY)

See your authorized Lucas CAV Repair Station for speed droop adjustment. This service requires that an internal pump adjustment be made.

S11,OMLM,FI –19–06FEB95–1/1

CHECK AND ADJUST ENGINE SPEEDS ON STANADYNE PUMP



A—Slow Idle Adjusting Screw[1]
B—Control Rod Pin
C—Fast Idle Adjusting Screw
D—Slow Idle Adjusting Screw[1]

NOTE: Before checking and adjusting engine speed, make sure engine has reached its normal operating temperature.

CHECK SLOW AND FAST IDLE SPEEDS

1. Start engine and run at 50% load and rated speed until engine reaches normal operating temperature.

2. Stop engine and remove control rod pin (B, if used). Disconnect speed control rod (or control cable) from fuel injection pump throttle lever.

NOTE: Refer to FUEL INJECTION PUMP SPECIFICATIONS, earlier in this group, for slow and fast idle speeds.

3. Start engine and move injection pump lever to slow idle position against slow idle adjusting screw (A or D). Using a tachometer, read and record engine speed. Compare reading with specifications. Adjust as necessary as detailed below.

IMPORTANT: If fast idle is not within specification, have an authorized diesel repair station, servicing dealer, or engine distributor adjust as necessary.

4. Move injection pump lever to fast idle position against fast idle adjusting screw (C). Using a tachometer, read and record engine speed. Compare reading with specifications.

ADJUST SLOW IDLE SPEED

1. Move pump throttle lever in slow idle position against slow idle adjusting screw (A or D). See specifications for specified engine speeds.

2. Loosen slow idle screw lock. Turn adjusting screw clockwise to increase speed and counterclockwise to decrease engine speed.

[1] Slow idle adjusting screw location varies by injection pump application. Will either be at location A or D.

S11,23010,HN –19–18FEB95–1/1

ADJUST VARIABLE SPEED (DROOP) ON GENERATOR SET ENGINES (3—5% GOVENOR REGULATION)—STANADYNE DB2, DB4, DM4 INJECTION PUMPS

An external speed droop adjusting cap (A) at the rear of the injection pump housing provides precise control of governor sensitivity by decreasing or increasing the effective length (and thereby the rate) of the governor control spring. Fine adjustments can be made while the engine is operating.

1. Start engine and run at rated speed with 50% load applied until it reaches normal operating temperature.

NOTE: If serious surging occurs during the warm-up period, turn the speed droop adjusting cap clockwise until surging stops.

2. When engine has warmed to normal operating temperature, position throttle lever (D or E) to attain full load rated speed (e.g., 1500, 1800 RPM) and apply 100% (full) load.

   Adjust the throttle if necessary to obtain satisfactory full load performance.

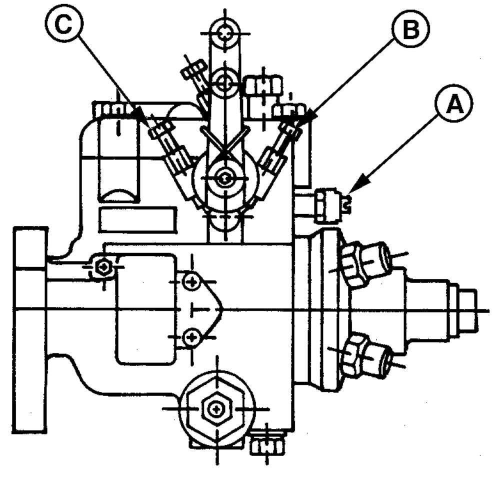
NOTE: Whenever speed droop adjustments are made, throttle position adjustments will also be necessary.

3. Remove load and check for specified no-load speed or frequency.

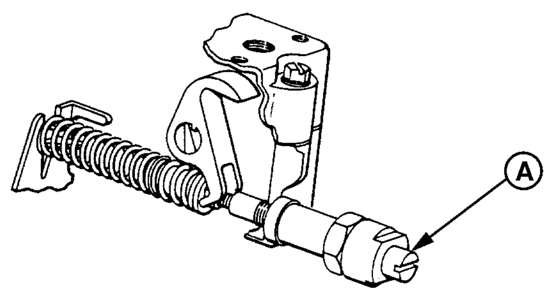
   If incorrect, adjust speed droop adjusting cap slightly (clockwise for increased droop or counterclockwise for less droop).

   If surging exists upon removing the load, turn the adjusting cap clockwise to eliminate.

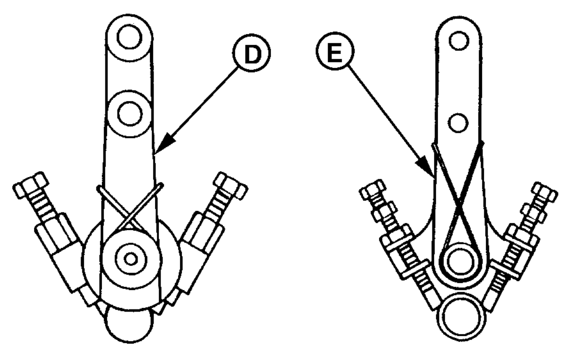
4. Recheck full load and no-load performance and readjust as necessary.



RG5754 –UN–03NOV97



RG6395 –UN–03NOV97



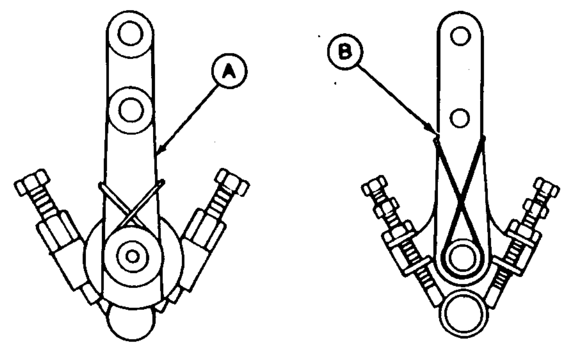
RG6397 –UN–03NOV97

A—Speed Droop Adjusting Cap
B—Fast Idle Screw
C—Slow Idle Screw
D—Early Throttle Lever
E—Current Throttle Lever
F—Throttle Stop

RG,CTM8,G115,18 –19–16SEP92–1/1

CHANGING GEN SET ENGINE RATED SPEED FROM 1800 RPM TO 1500 RPM—STANADYNE DB2, DB4, DM4 INJECTION PUMPS

This instruction covers step-by-step adjustment procedures for changing gen set engine rated speed from 1800 RPM (60 Hz) to 1500 RPM (50 Hz) while maintaining a 3—5% governor regulation.



A—Early Throttle Lever
B—Current Throttle Lever

Continued on next page

RG,GENSET3,1 –19–06FEB95–1/3

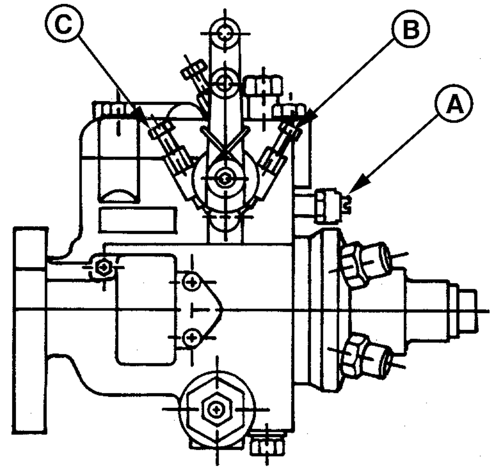
IMPORTANT: Only qualified technicians should attempt the adjustments covered in this instruction. If qualifications are in doubt, have your nearest ADS repair shop perform these adjustments.

Before proceeding with the adjustment covered in this instruction, verify that maximum power is correct for the unit which is being modified.

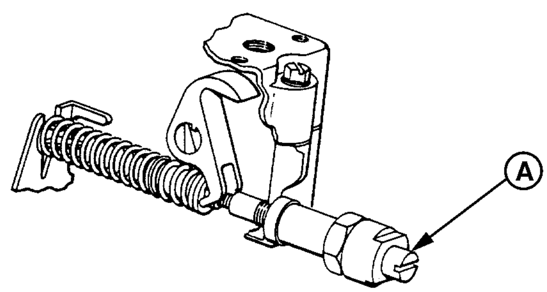
To assure specified power and governing during engine operation on pumps with early type throttle levers (A), the throttle lever must be fixed against the fast idle screw stop by means of an external linkage or spring. If linkage is used, adjust so that the upper throttle lever is pushed 1/8" to 1/4" out of alignment with the lower lever. On pumps with current type throttle levers (B), you can adjust and lock the fast idle using the injection pump fast and slow idle adjusting screws.

To assure specified governing, the fast idle speed must be readjusted any time the droop adjusting cap is adjusted.

1. Start engine and apply 50% load at rated speed until it reaches normal operating temperature.



RG5754 –UN–03NOV97



RG6395 –UN–03NOV97

A—Droop Adjusting Cap
B—Fast Idle Screw
C—Slow Idle Screw

Continued on next page RG,GENSET3,1 –19–06FEB95–2/3

NOTE: If serious surging occurs during the warm-up period, turn in the speed droop adjusting cap (A) clockwise (CW, as viewed from rear of pump) until surging stops.

IMPORTANT: DO NOT back out slow idle screw (C) more than is necessary or internal pump damage may result.

2. When engine has warmed to normal operating temperature, load engine at 100% (full) load and adjust fast idle adjusting screw (B) CW until engine speed is 1500 RPM (50 Hz). Slow idle screw may need to be backed out slightly to obtain this speed setting.

3. Remove load and check for specified no-load speed (frequency). If governor regulation is within 3—5% range, proceed to Step 6.

4. If governor regulation is above the 5% range, back out droop adjusting cap one full turn counterclockwise (CCW, as viewed from rear of pump). If engine surges when load is removed, turn the speed droop adjusting cap CW to eliminate surging.

5. Readjust high idle adjusting screw until 1500 rpm (50 Hz) is obtained at specified power.

   Repeat steps 4—5 until governor regulation is within the 3—5 % range.

6. Tighten fast and slow idle screw lock nuts, remove load, and stop engine.

RG,GENSET3,1 –19–06FEB95–3/3

DIAGNOSE ANEROID MALFUNCTIONS

Symptom	Problem	Solution
Slow Engine Acceleration	Loose pipe or broken connection at inlet fitting.	Repair as required. (See Group 35.)
	Aneroid cover cracked around inlet fitting.	Repair as required. (See Group 35.)
	Defective diaphragm.	Repair as required. (See Group 35)
	Aneroid not correctly adjusted.	Remove injection pump (see Group 35) and adjust on test stand.
Excessive Smoke When Accelerating Engine	Aneroid not correctly adjusted	Remove injection pump (see Group 35) and adjust on test stand.

Use information contained in the chart above to help diagnose aneroid malfunctions.

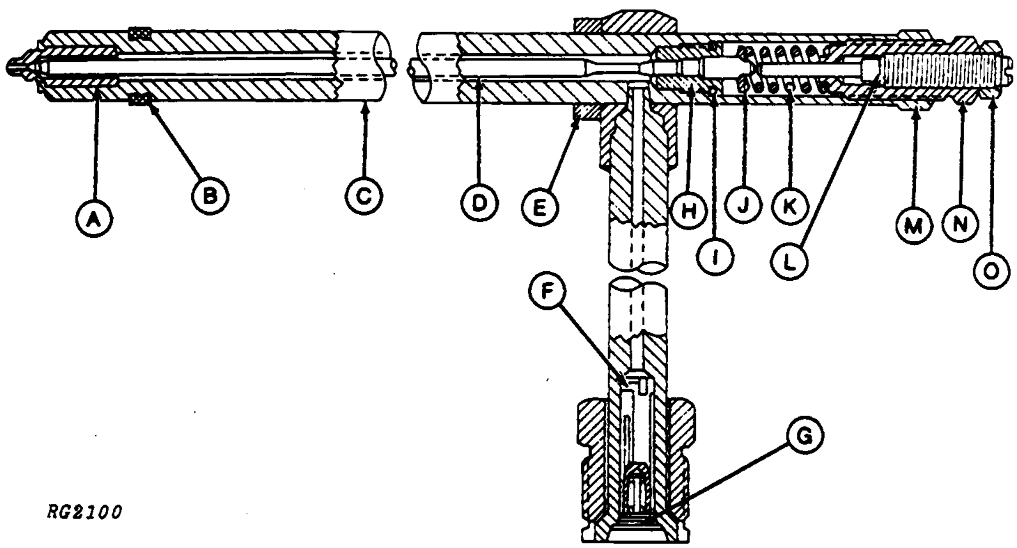
See Group 35 for instructions on how to repair and adjust the aneroid.

The aneroid controls fuel delivery when intake manifold pressure is about 100 kPa (1 bar) (15 psi) or less. Therefore, all final adjustments are to be made on the test stand with aneroid mounted on injection pump.

IMPORTANT: Correct aneroid adjustments are essential for satisfactory engine performance. Whenever the aneroid adjustments have been altered, the injection pump (including aneroid) must be calibrated on the test stand by an authorized diesel injection repair station before releasing the pump for service.

DPSG,OUO1004,477 –19–31OCT98–1/1

FUEL INJECTION NOZZLES—GENERAL INFORMATION AND OPERATION



RG2100 –UN–20DEC88

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

The injection nozzles are located in the engine cylinder head and are of the spring and valve type, hydraulically operated by fuel delivered from the injection pump.

A locating clamp positions the nozzle assembly in the cylinder head. The nozzle is sealed at the top end by a seal washer (E). A carbon stop seal (B), located on the lower end of the nozzle body (C), prevents carbon from collecting around the nozzle in the cylinder head.

Enclosed in the nozzle body are the valve (D), valve spring (K), and spring seat (J). The nozzle operating pressure is controlled by the pressure adjusting screw (N) in the upper end of the nozzle body. Valve lift is adjusted by the lift adjusting screw (L) located in the pressure adjusting screw. The nozzle tip (A) is pressed into the nozzle body and cannot be separated.

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

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

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

A small amount of fuel leaks past the valve into the spring area. This provides lubrication for the nozzle working parts. This excess fuel is then removed from the nozzle at the top by means of a leak-off line routed to the fuel source.

RG,CTM8,G115,9 –19–11SEP92–1/1

DIAGNOSE FUEL INJECTION NOZZLE MALFUNCTIONS

Fuel injection nozzles are usually removed and tested or replaced when there is a noticeable loss of power or excessive smoking.

Listed in the following chart are various malfunctions which may occur on the 9.5 mm nozzles. Only possible defects related to these nozzles are listed. Failures in other components of the fuel injection system are listed under their respective headings in this group.

Refer to Group 35 for repair information.

Symptom	Problem	Solution
Engine Has Low Horsepower	Nozzle orifices plugged.	Repair. (See Group 35.)
	Incorrect nozzle valve opening pressure.	Adjust. (See Group 35.)
	Broken, worn or damaged parts:	Repair as required. (See Group 35.)
	Broken nozzle valve spring	
	Cracked or split nozzle tip	
	Cracked or split nozzle body	
	Internal leak	
	Wrong nozzle assembly installed.	Install correct nozzle assembly. (See Group 35.)
	Nozzle loose in cylinder head.	Make sure nozzle assembly is correctly installed. Tighten clamp cap screw to specified torque. (See Group 35.)
Engine Emits Too Much Smoke	Nozzle orifices plugged.	Repair. (See Group 35.)

Continued on next page

DPSG,OUO1004,464 –19–24OCT98–1/2

Symptom	Problem	Solution
	Broken, worn or damaged parts:	Repair as required. (See Group 35.)
	Broken nozzle valve spring	
	Cracked or split nozzle tip	
	Cracked or split nozzle body	
	Internal leak	
	Wrong nozzle assembly installed.	Install correct nozzle assembly. (See Group 35.)

DPSG,OUO1004,464 –19–24OCT98–2/2

TEST FUEL INJECTION NOZZLES (ENGINE RUNNING)

1. Operate engine at intermediate speed and no load.

2. Slowly loosen the fuel pressure line at one of the nozzles until fuel escapes at the connection (fuel not opening nozzle valve).

NOTE: The injection nozzle before and/or after nozzle being checked could be the faulty nozzle.

- If engine speed changes, the injection nozzle is probably working satisfactory.
- If engine speed does not change, a nozzle is faulty and must be checked and repaired (or replaced).

3. Repeat test for each remaining nozzle assembly.

4. Remove faulty injection nozzles and repair as required. See Group 35.

S11,23010,HR –19–18APR94–1/1

FUEL DRAIN BACK TEST PROCEDURE

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

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

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

2. Drain all fuel from the system, including the fuel transfer pump, fuel injection pump, fuel filters, and water separator (if equipped).
3. Securely plug off the end of the fuel return pipe.
4. Using a low pressure air source, pressurize the fuel system at the fuel supply line.

CAUTION: Maximum air pressure should be 100 kPa (1 bar) (15 psi) when performing this test.

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

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

6. If any leaks are found, take necessary steps to repair.
7. Reconnect supply and return lines and prime system.
8. Start engine and run for approximately 10 minutes.
9. Allow engine to sit overnight and try starting the following morning.

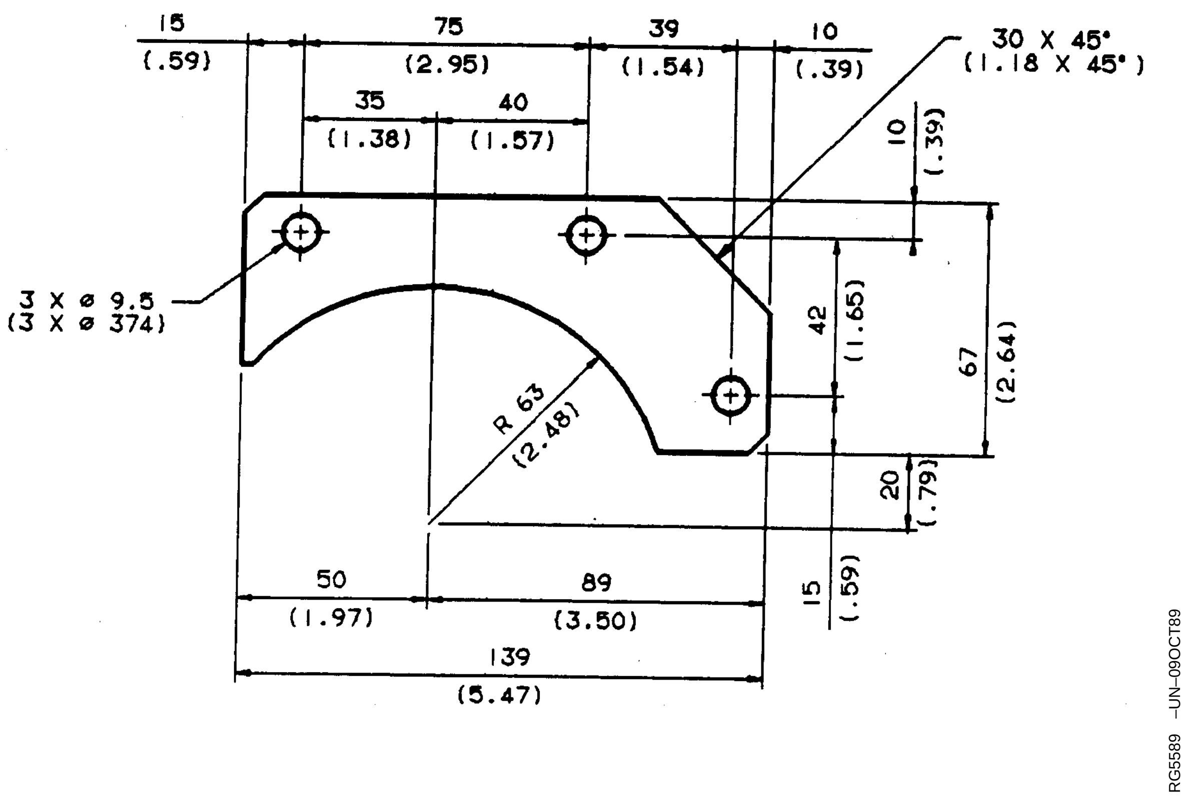
S11,23010,JA –19–28OCT92–1/1

HOW TO MAKE TOOLS

These tools can be made in a service shop using common shop tools and locally obtained materials.

S55,DFRG –19–01DEC89–1/1

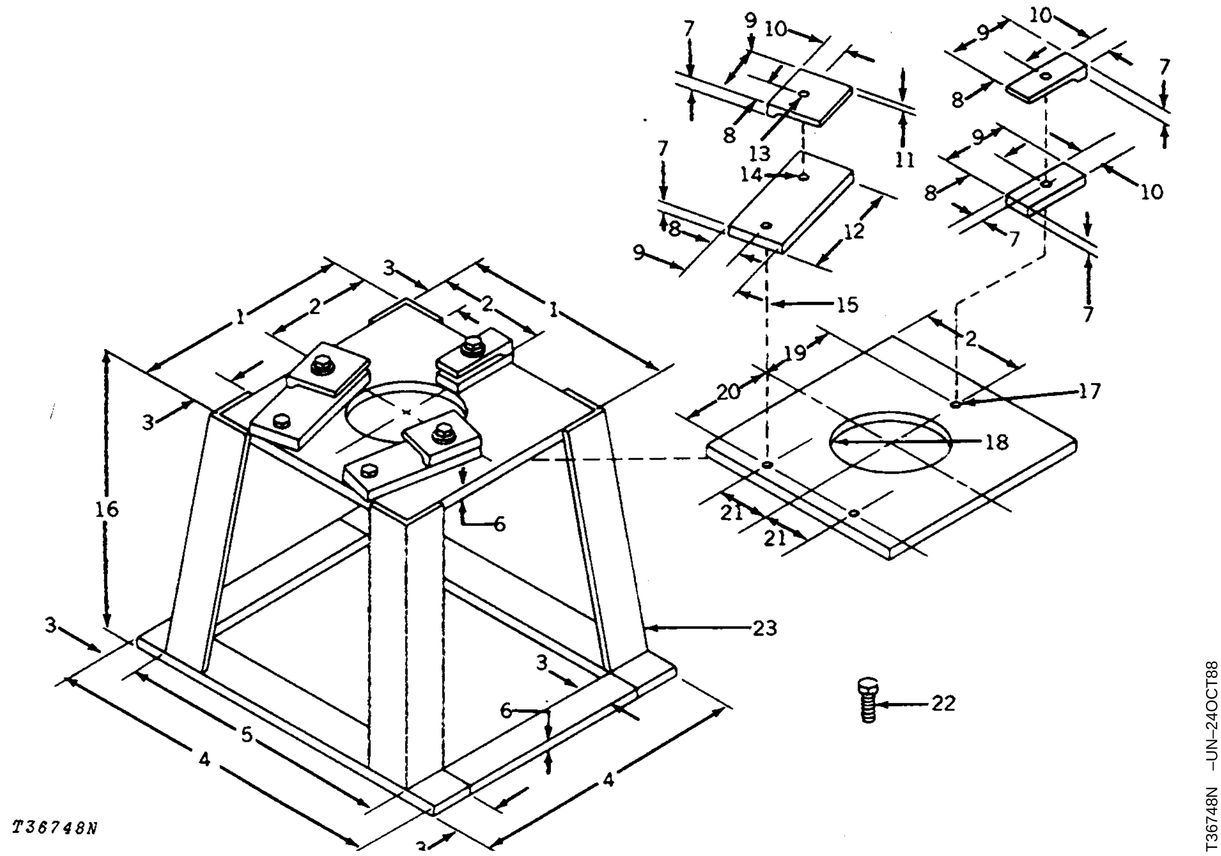
DFRG2—INJECTION PUMP FRONT PLATE TIMING MARK TRANSFER TOOL



Material—Aluminum

S55,DFRG2 –19–01DEC89–1/1

DFRG3—CYLINDER 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 (2.5 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. x 1 in. Cap Screw
23—38.1 mm (1.5 in.) Angle Iron

S55,DFRG3 –19–23FEB87–1/1

Index

SAFETY

live with it