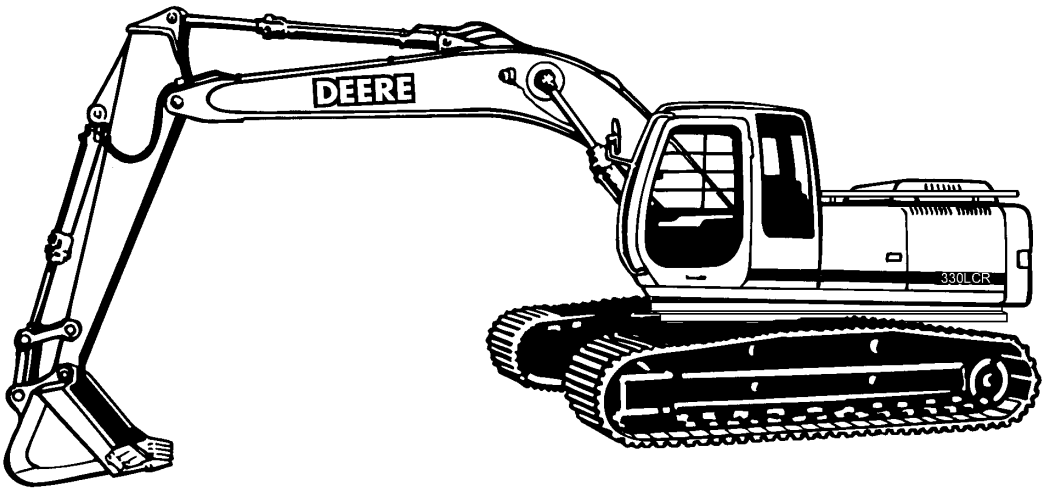
# TECHNICAL MANUAL

# UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

## HYDRAULIC EXCAVATOR
## JOHN DEERE
## MODEL 330LCR
## NSN 3805-01-463-0805

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15 FEBRUARY 2000

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**Technical Manual**
No. 5-3805-281-24-2

**HEADQUARTERS,
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Washington, DC, *15 February 2000***

# UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

## HYDRAULIC EXCAVATOR JOHN DEERE MODEL 330LCR NSN 3805-01-463-0805

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028-2 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is http://aeps.ria.army.mil. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or email your letter, DA Form 2028, or DA Form 2028-2 direct to: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-CI, Rock Island, IL 61299-7630. The email address is AMSTA-LC-CI@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.



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# CHAPTER 11

# SECTION 04

# ENGINE REPAIR

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# Group 0400
# Removal and Installation

## ESSENTIAL TOOLS

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

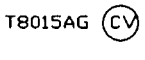
*SERVICEGARD is a trademark of Deere & Company.*

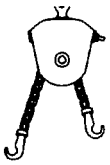
CED,OUOE003,1129 –19–07JUL98–1/5

T8015AG –UN–01JUN93

Load Positioning Sling . . . . . D01043AA

To remove engine.



CED,OUOE003,1129 –19–07JUL98–2/5



Flywheel Turning Tool . . . . . .JDE81-1

To rotate crankshaft to position number one piston at "TDC" on compression stroke.

CED,OUOE003,1129 –19–07JUL98–3/5

T6585NO –UN–18OCT88

Flywheel Turning Tool . . . . . JDG820

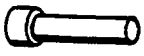
To rotate crankshaft to position number one piston at "TDC" on compression stroke.

CED,OUOE003,1129 –19–07JUL98–4/5

T6585NP –UN–18OCT88

Timing Pin . . . . . JDE-81-4

To lock engine at TDC.



CED,OUOE003,1129 –19–07JUL98–5/5

*Removal and Installation*

## SERVICE EQUIPMENT AND TOOLS

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

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CED,OUOE003,1130 –19–07JUL98–1/8

M12 x 1.75 Metric Lifting Eyebolt . . . . . JT05550

04 0400 2

To support main hydraulic pump and splitter drive.

CED,OUOE003,1130 –19–07JUL98–2/8

Pump Support . . . . . DFT1119[1]

To support hydraulic pump and gearbox.

[1]*Fabricated tool, dealer made. (See Section 99 for instructions to make tool.*

CED,OUOE003,1130 –19–07JUL98–3/8

Crowsfoot Wrench. . . . . JDF22

To remove and install fuel injection lines and to tighten line nuts at delivery valves.

**Continued on next page**

CED,OUOE003,1130 –19–07JUL98–4/8

*Removal and Installation*

3/4 in. Line Wrench

To remove and install fuel injection lines and to tighten line nuts at delivery valves.

CED,OUOE003,1130 –19–07JUL98–5/8

Serrated Wrench. . . . . JDE90

To remove and install fuel injection lines and to tighten line nuts at delivery valves.

CED,OUOE003,1130 –19–07JUL98–6/8

Nozzle Wrench. . . . . JDE92

To remove and install nozzles from cylinder head.

CED,OUOE003,1130 –19–07JUL98–7/8

24 mm (15/16 in.) Deep Socket

Used to remove nozzles.

CED,OUOE003,1130 –19–07JUL98–8/8

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| TY6299 (U.S.) | PERMATEX Aviation (Form-A-Gasket No. 3) | Apply to timing gear cover-to-cylinder block and rear oil seal housing-to-cylinder block mating surfaces. |
| PT569 (U.S.)<br>TY6332 (Canadian) | NEVER-SEEZ® Anti-Seize Lubricant | Apply to fuel injection gland nut threads and nozzle barrel and to inside bore of gland nut. |

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

CED,OUOE003,1131 –19–07JUL98–1/1

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Engine: | | |
| Hydraulic Pump | Weight | 111 kg (245 lb) approximate |
| Engine | Weight | 816 kg (1800 lb) approximate |
| Front Engine Mount Bracket-to-Frame Cap Screw | Torque | 390 N•m (290 lb-ft) |
| Rear Engine Mount Bracket-to-Frame Cap Screw | Torque | 300 N•m (225 lb-ft) |
| Front Engine Mount Bracket-to-Engine Cap Screw | Torque | 300 N•m (225 lb-ft) |
| Rear Engine Mount Bracket-to-Engine Cap Screw | Torque | 300 N•m (225 lb-ft) |
| Main Hydraulic Pump and Splitter Drive-to-Flywheel Housing Cap Screw | Torque | 88 N•m (65 lb-ft) |
| Alternator (B+, WHT) Wire Nut | Torque | 4 N•m (32 lb-in.) |
| Alternator (D+, BLU/YEL) Wire Nut | Torque | 2 N•m (20 lb-in.) |
| Alternator (Ground, BLK) Wire Nut | Torque | 2 N•m (20 lb-in.) |
| Engine Oil Pan: | | |
| Oil Pan-to-Cylinder Block Cap Screw (1/2 in.) | Torque | 156 N•m (117 lb-ft) |
| Oil Pan-to-Cylinder Block Cap Screw (3/8 in.) | Torque | 68 N•m (50 lb-ft) |
| Water Pump: | | |
| Water Pump Cap Screw (3/8-in.) | Torque | 47 N•m (35 lb-ft) |
| Water Pump Cap Screw (5/16-in.) | Torque | 27 N•m (20 lb-ft) |

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5

**Continued on next page**

CED,OUOE003,1128 –19–07JUL98–1/2

*Removal and Installation*

| Item | Measurement | Specification |
|---|---|---|
| Thermostat: | | |
| Thermostat | Opening Temperature | 89—100°C (192—212°F) |
| Thermostat Cover Cap Screw | Torque | 47 N•m (35 lb-ft) |
| Fuel Injection Pump: | | |
| Fuel Supply Pump Mounting Stud Nut | Torque | 5—7 N•m (4—5 lb-ft) (45—60 lb-in.) |
| Fuel Injection Nozzle Gland Nut | Torque | 88 N•m (65 lb-ft) |
| Fuel Injection Nozzle Line Nut | Torque | 27 N•m (20 lb-ft) |
| Engine Valve: | | |
| Intake Valve | Clearance | 0.331—0.431 mm (0.013—0.017 in.) |
| Exhaust Valve | Clearance | 0.661—0.761 mm (0.026—0.030 in.) |
| Valve Adjusting Screw Locknut | Torque | 27 N•m (20 lb-ft) |
| Starter: | | |
| Starter | Weight | 23 kg (50 lb) approximate |
| Starter Cap Screw | Torque | 47 N•m (35 lb-ft) |

CED,OUOE003,1128 –19–07JUL98–2/2

04 0400 6

## REMOVE ENGINE

TS281 –UN–23AUG88

**CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns**

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

1. Disconnect negative (-) battery cable.
2. Drain coolant. Cooling capacity is approximately 30 L (8 gal).

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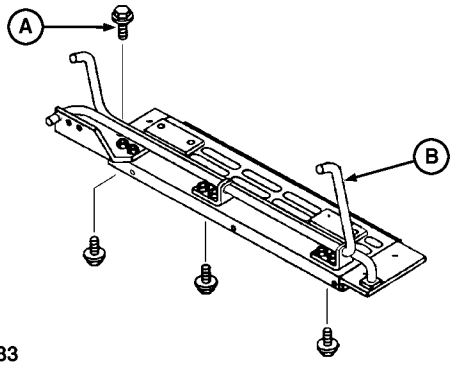
TX,0400,DH5392 –19–15FEB97–1/8

3. Remove cap screws (A). Remove spring assembly (B).




T115283 –UN–17JUN98

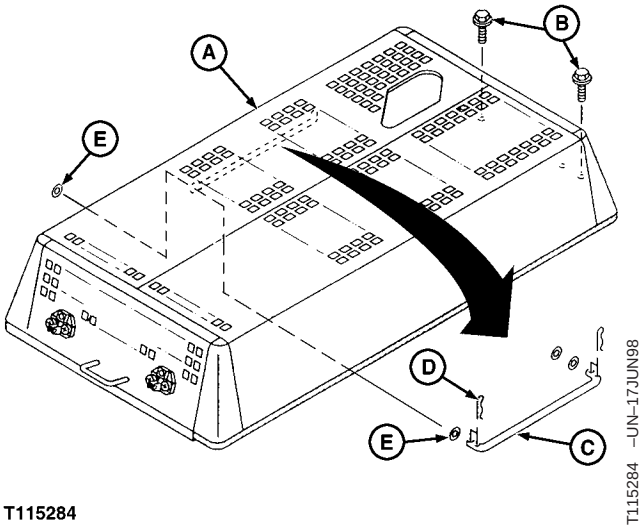
T115283

**A—Cap Screw (7 used)**
**B—Spring Assembly**

**Continued on next page**

TX,0400,DH5392 –19–15FEB97–2/8

4. Remove cotter pin (D) and washer (E).
5. Remove support (C).
6. Remove cap screws (B). Remove engine cover (A).



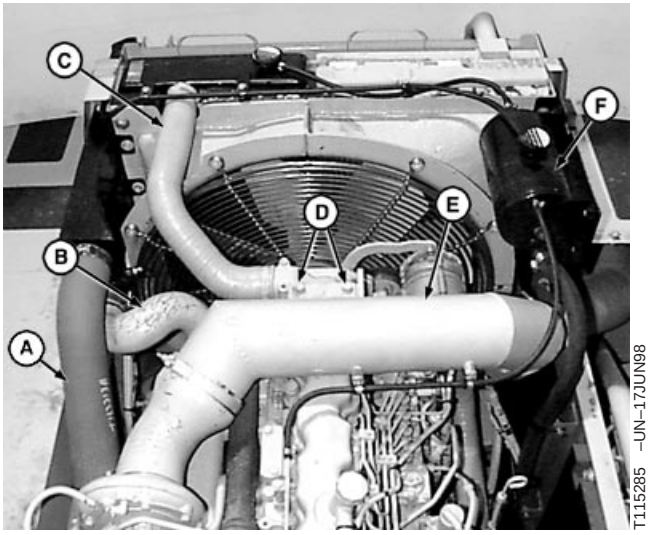

**T115284**

**A—Engine Cover**
**B—Cap Screw (4 used)**
**C—Support**
**D—Cotter Pin**
**E—Washer (2 used)**

04 0400 8

TX,0400,DH5392 –19–15FEB97–3/8

7. Remove clamps. Remove hoses (A—C).
8. Remove clamps. Remove cap screws (D). Remove air intake tube (E).
9. Remove coolant expansion tank (F). (See procedure in Group 0510.)

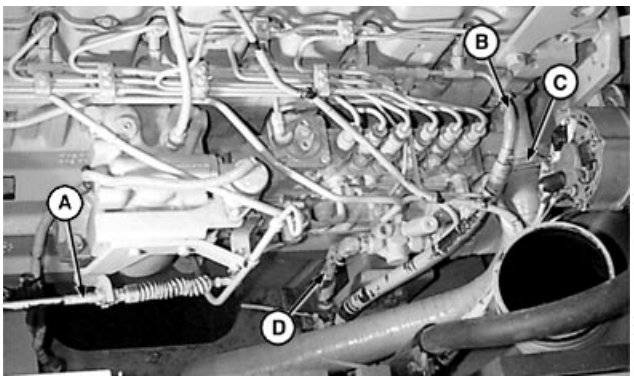



**A—Charge Air Cooler-to-Turbocharger Hose**
**B—Charge Air Cooler-to-Intake Manifold Hose**
**C—Upper Radiator Hose**
**D—Cap Screw (2 used)**
**E—Air Intake Tube**
**F—Coolant Expansion Tank**

**Continued on next page**

TX,0400,DH5392 –19–15FEB97–4/8

10. Remove speed control cable (A). (See procedure in Group 0515.)
11. Remove clamp. Remove lower radiator hose (C).
12. Remove water pump heater hose and engine block heater hose.
13. Remove clamps. Remove fuel supply line (D) and fuel return line (B).
14. Remove muffler. (See procedure in Group 0530.)
15. Remove air conditioning compressor belt. (See procedure in Group 0510.)
16. Remove air conditioning compressor. (See procedure in Group 1830.)




T115286 –UN–17JUN98

**A—Speed Control Cable**
**B—Fuel Return Line**
**C—Lower Radiator Hose**
**D—Fuel Supply Line**

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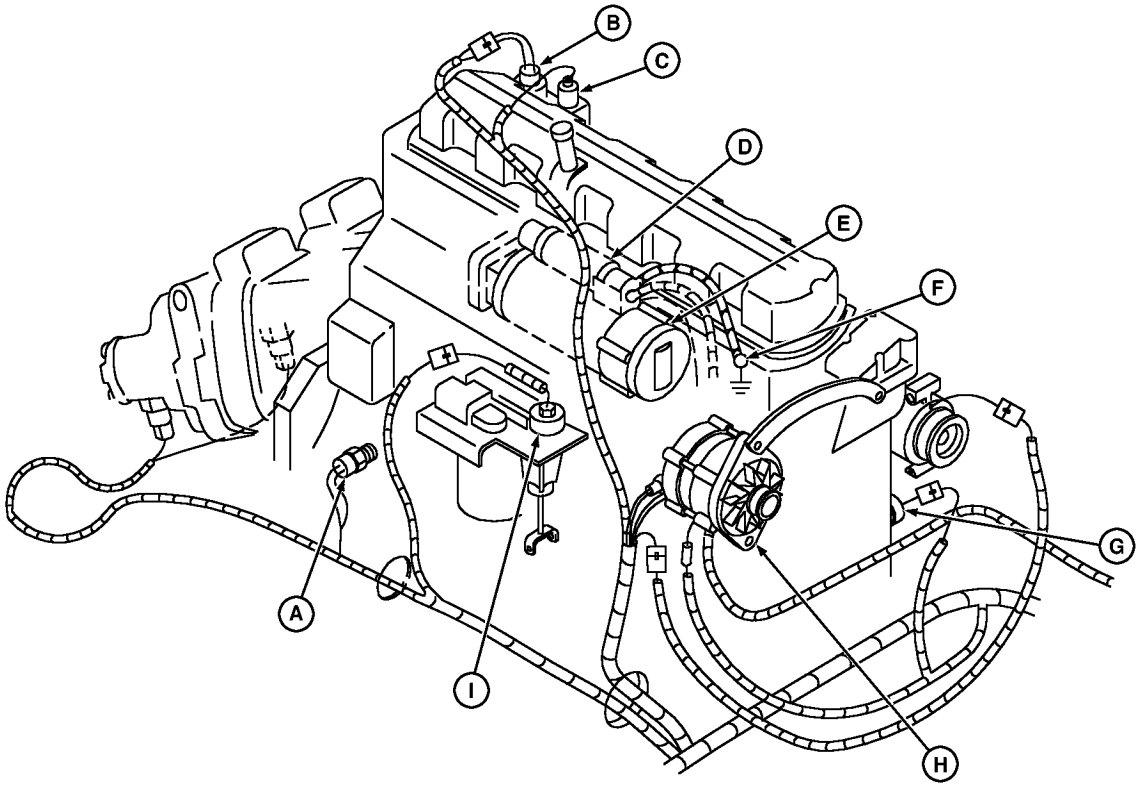



T115653

T115653 –UN–17JUN98

**A—Oil Pressure Switch Connector**
**B—Engine Temperature Switch Connector**
**C—Engine Coolant Temperature Sender**
**D—Start Solenoid Connector**
**E—Starter Motor (RED + Battery Cable)**
**F—Starter-to-Frame Ground Strap**
**G—Oil Level Switch Connector**
**H—Alternator (B+, WHT) (D+, BLU/YEL) (Ground, BLK)**
**I—Fuel Shutoff Solenoid Connector**

17. Disconnect connectors (A, B, D, G, and I).
18. Remove nut. Remove engine coolant temperature sender (C).
19. Remove nut. Remove starter motor RED positive battery cable (E).
20. Remove nut. Remove starter-to-frame ground strap (F).
21. Remove nuts. Remove alternator wires (H).

**Continued on next page**

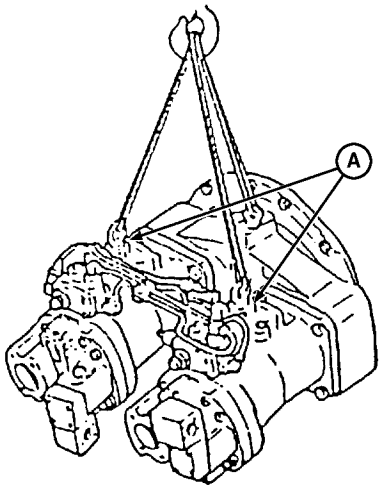
TX,0400,DH5392 –19–15FEB97–6/8

**CAUTION: Hydraulic pump weighs approximately 111 kg (245 lb).**

**Hydraulic Pump—Specification**

Weight..... 111 kg (245 lb) approximate

22. Install JT05550 Metric Lifting Eyebolts (A) into pump controller top plugs.
23. Support main hydraulic pump and splitter drive as shown using DFT1119 Pump Support and a small winch hoist.




T115287

T115287 –UN–17JUN98

**A—Metric Eyebolts (2 used)**

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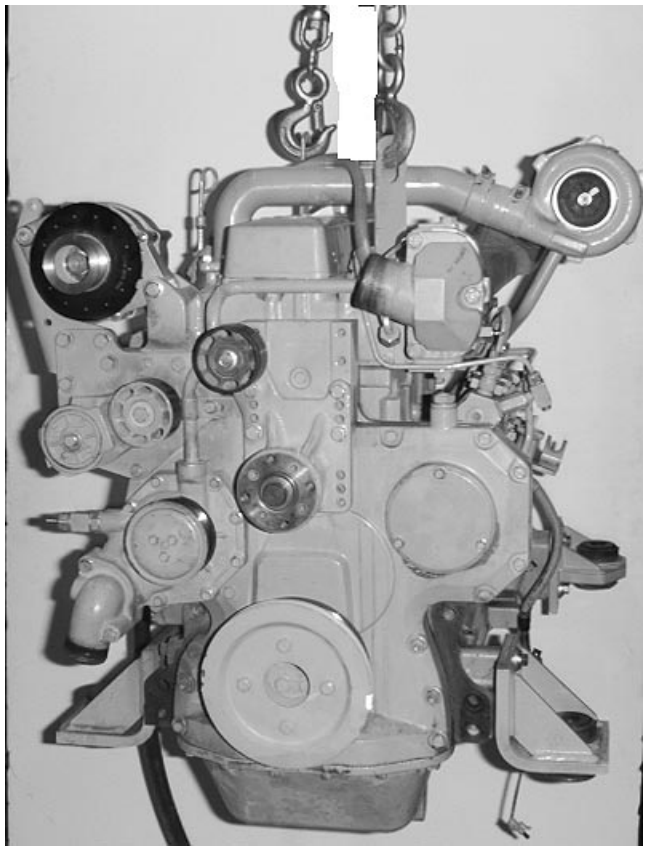
TX,0400,DH5392 –19–15FEB97–7/8

**CAUTION: The approximate weight of engine is 816 kg (1800 lb).**

**Engine—Specification**

Weight..... 816 kg (1800 lb) approximate

24. Attach D01043AA Load Positioning Sling to engine as shown.
25. Remove main hydraulic pump and splitter drive-to-flywheel housing cap screws.
26. Remove engine mount cap screws and nuts.
27. Raise engine slightly and push engine away from hydraulic pump. Lift engine when engine is disengaged from pump drive coupling.



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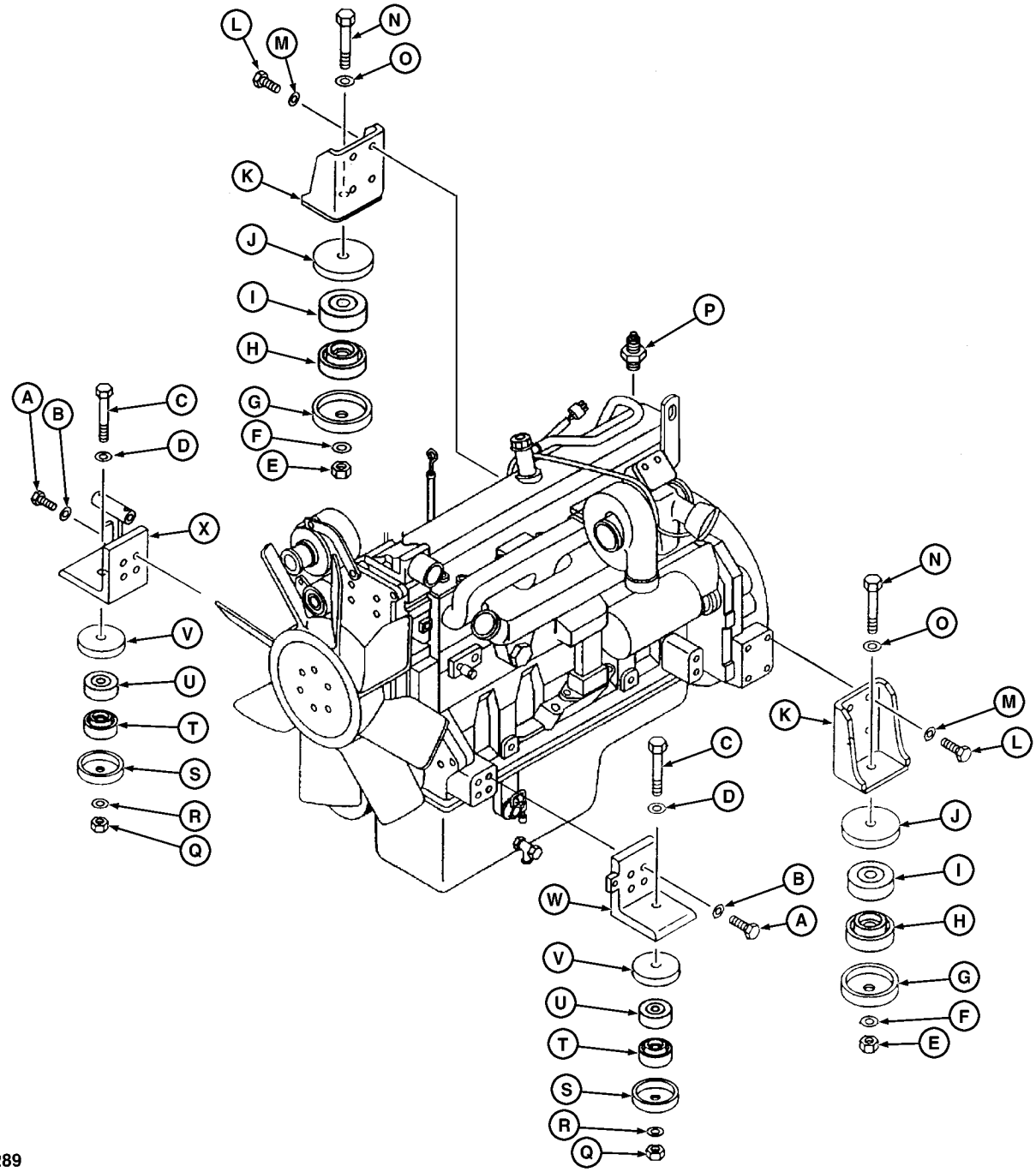
TX,0400,DH5392 –19–15FEB97–8/8

## INSTALL ENGINE




T115289

T115289 –UN–17JUN98

| | | | |
|---|---|---|---|
| A—Cap Screw (8 used) | G—Stopper (2 used) | M—Washer (8 used) | S—Stopper (2 used) |
| B—Washer (8 used) | H—Rubber (2 used) | N—Cap Screw (2 used) | T—Rubber (2 used) |
| C—Cap Screw (2 used) | I—Rubber (2 used) | O—Washer (2 used) | U—Rubber (2 used) |
| D—Washer (2 used) | J—Stopper (2 used) | P—Unit | V—Stopper (2 used) |
| E—Nut (2 used) | K—Bracket | Q—Nut (2 used) | W—Bracket |
| F—Washer (2 used) | L—Cap Screw (8 used) | R—Washer (2 used) | X—Bracket |

1. Lower engine into excavator.

Continued on next page

TX,0400,DH5397 –19–11NOV96–1/7

2. Slide engine toward hydraulic pump to engage pump coupler.

3. Install parts (C, D, Q—T, W). Tighten cap screws (C).

**Front Engine Mount Bracket-to-Frame Cap Screw—Specification**

Torque..... 390 N•m (290 lb-ft)

4. Install parts (K, N, O, E—H). Tighten cap screws (N).

**Rear Engine Mount Bracket-to-Frame Cap Screw—Specification**

Torque..... 300 N•m (225 lb-ft)

**Front Engine Mount Bracket-to-Engine Cap Screw—Specification**

Torque..... 300 N•m (225 lb-ft)

**Rear Engine Mount Bracket-to-Engine Cap Screw—Specification**

Torque..... 300 N•m (225 lb-ft)

5. Install main hydraulic pump and splitter drive-to-flywheel housing cap screws. Tighten to specification.

**Main Hydraulic Pump and Splitter Drive-to-Flywheel Housing Cap Screw—Specification**

Torque..... 88 N•m (65 lb-ft)

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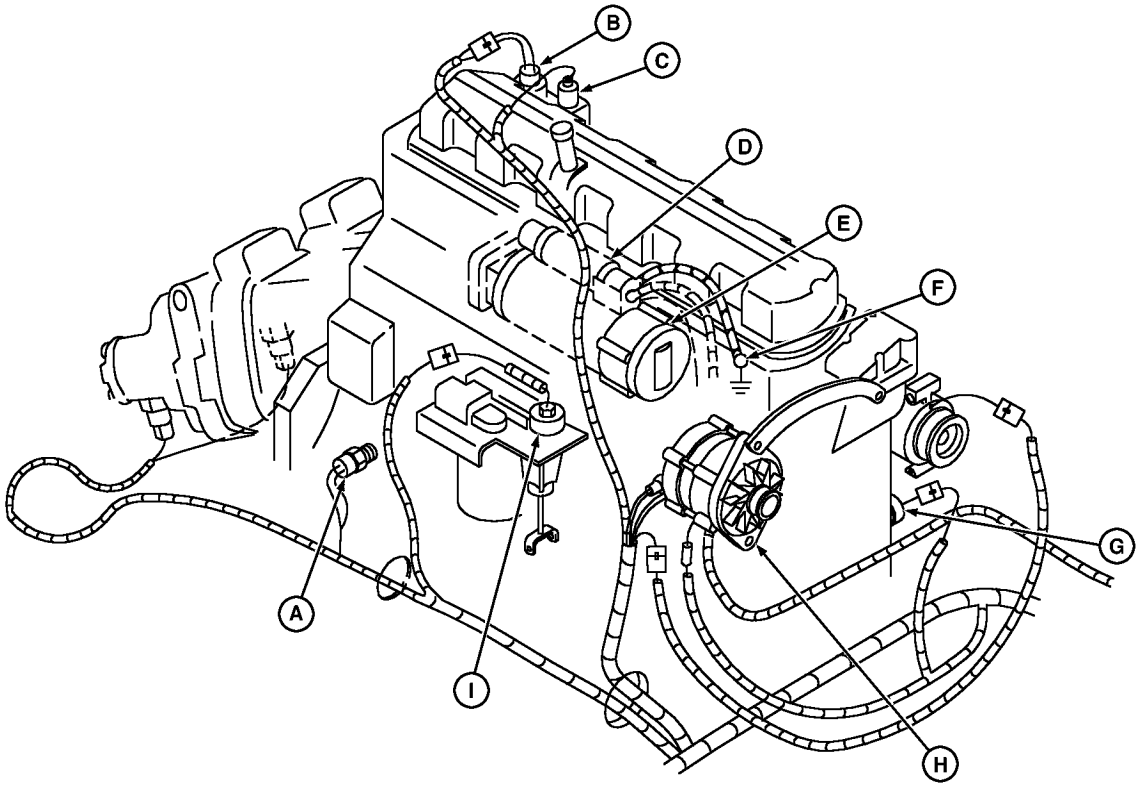



T115653

T115653 –UN–17JUN98

**A—Oil Pressure Switch Connector**
**B—Engine Temperature Switch Connector**
**C—Engine Coolant Temperature Sender**
**D—Start Solenoid Connector**
**E—Starter Motor (RED + Battery Cable)**
**F—Starter-to-Frame Ground Strap**
**G—Oil Level Switch Connector**
**H—Alternator (B+, WHT) (D+, BLU/YEL) (Ground, BLK)**
**I—Fuel Shutoff Solenoid Connector**

6. Connect connectors (A, B, D, G, and I).
7. Install engine coolant temperature sender (C). Tighten nut.
8. Install starter motor RED positive battery cable (E). Tighten nut.
9. Install starter-to-frame ground strap (F). Tighten nut.
10. Install alternator wires (H). Tighten (B+, WHT), (D+, BLU/YEL), and (Ground, BLK) wire nuts to specifications.

**Alternator (B+, WHT) Wire Nut—Specification**

Torque..... 4 N•m (32 lb-in.)

**Alternator (D+, BLU/YEL) Wire Nut—Specification**

Torque..... 2 N•m (20 lb-in.)

**Alternator (Ground, BLK) Wire Nut—Specification**

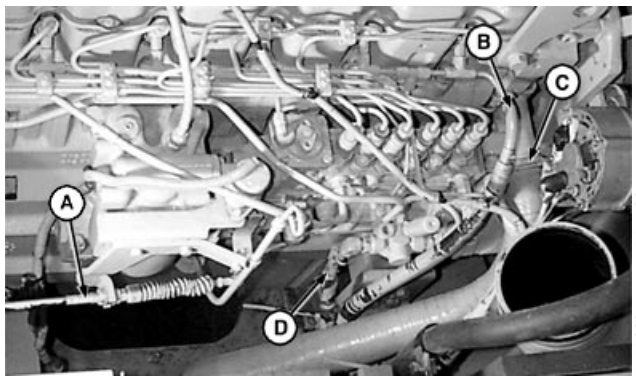
Torque..... 2 N•m (20 lb-in.)

11. Install air conditioning compressor. (See procedure in Group 1830.)
12. Install air conditioning compressor belt. (See procedure in Group 0510.)
13. Install muffler. (See procedure in Group 0530.)

**Continued on next page**

TX,0400,DH5397 –19–11NOV96–3/7

14. Install speed control cable (A). (See procedure in Group 0515.)
15. Install water pump heater hose and engine block heater hose.
16. Install lower radiator hose (C). Tighten clamp.
17. Install fuel supply line (D) and fuel return line (B). Tighten clamps.




T115286 –UN–17JUN98

**A—Speed Control Cable**
**B—Fuel Return Line**
**C—Lower Radiator Hose**
**D—Fuel Supply Line**

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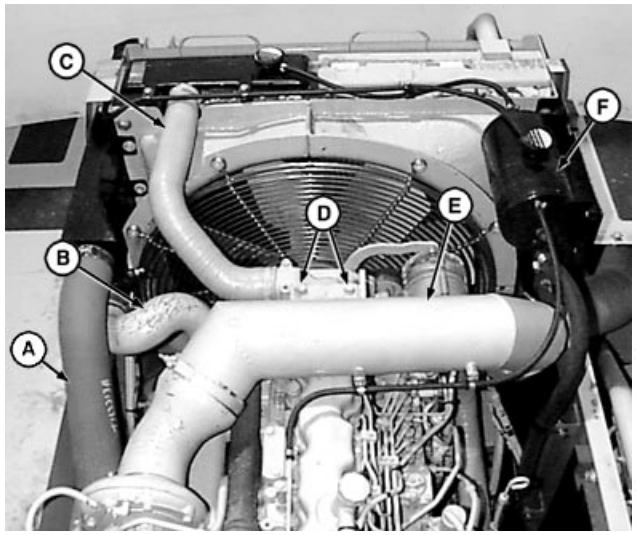
TX,0400,DH5397 –19–11NOV96–4/7

18. Install hoses (A—C). Tighten clamps.
19. Install air intake tube (E). Tighten clamps. Tighten cap screws (D).
20. Install coolant expansion tank (F). (See procedure in Group 0510.)



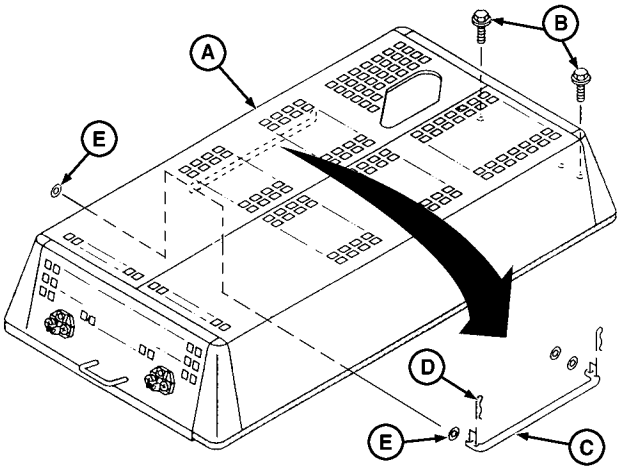

T115285 –UN–17JUN98

**A—Charge Air Cooler-to-Turbocharger Hose**
**B—Charge Air Cooler-to-Intake Manifold Hose**
**C—Upper Radiator Hose**
**D—Cap Screw (2 used)**
**E—Air Intake Tube**
**F—Coolant Expansion Tank**

**Continued on next page**

TX,0400,DH5397 –19–11NOV96–5/7

21. Install engine cover (A). Tighten cap screws (B).
22. Install support (C).
23. Install washer (E) and cotter pin (D).




T115284 –UN–17JUN98

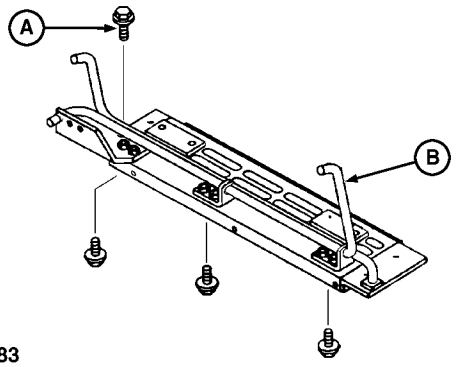
**T115284**

**A—Engine Cover**
**B—Cap Screw (4 used)**
**C—Support**
**D—Cotter Pin**
**E—Washer (2 used)**



TX,0400,DH5397 –19–11NOV96–6/7

24. Install spring assembly (B). Tighten cap screws (A).
25. Fill radiator to proper level.
26. Bleed fuel system. (See procedure in this group.)
27. Connect negative (-) battery cable.




T115283 –UN–17JUN98

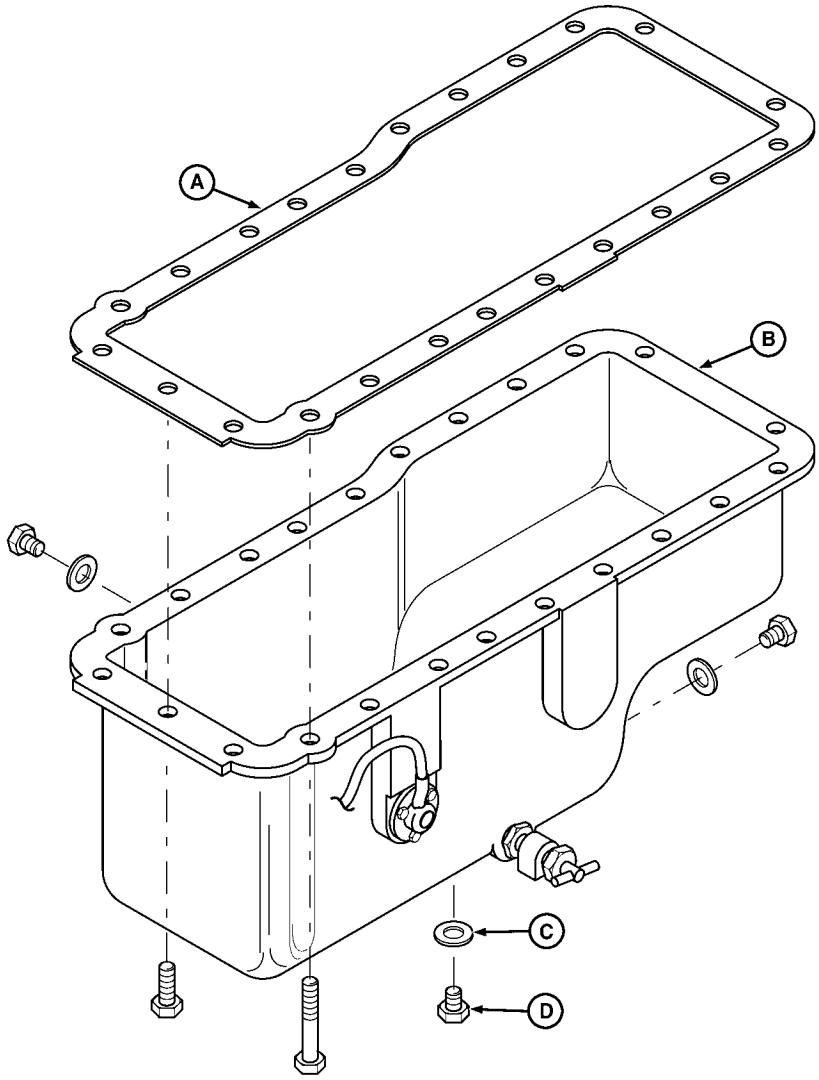
**T115283**

**A—Cap Screw (7 used)**
**B—Spring Assembly**

TX,0400,DH5397 –19–11NOV96–7/7

## REMOVE AND INSTALL ENGINE OIL PAN






T115155 –UN–24JUL98

T115155

**A—Oil Pan Gasket** **B—Oil Pan** **C—O-Ring** **D—Drain Plug**

1. Remove engine. (See procedure in this group.)
2. Drain engine oil. Approximate capacity is 30 L (8 gal).
3. Remove cap screws. Remove engine oil pan.
4. Remove and discard gasket. Clean all mating surfaces.

**Continued on next page**

5. Replace parts as necessary.

*NOTE: At oil pan and cylinder block (including timing gear cover and rear seal housing) gasket sealing surfaces MUST BE free of gasket material or oil and dry.*

6. Apply a thin layer of Permatex Aviation (Form-A-Gasket No. 3, TY6299) at timing gear cover-to-cylinder block mating surfaces.

7. Apply a thin layer of Permatex Aviation (Form-A-Gasket No. 3, TY6299) at rear oil seal housing-to-cylinder block mating surfaces.

04 0400 18

8. Position new oil pan gasket on cylinder block.

9. Apply a thin layer of Permatex Aviation (Form-A-Gasket No. 3, TY6299) to gasket at the same location as cylinder block noted above.

*NOTE: Locate rear of oil pan flush to ± 0.05 mm (0.002 in.) with rear face of cylinder block.*

10. Carefully install oil pan on cylinder block and tighten all oil pan-to-cylinder block cap screws as follows:

    a. First tighten 1/2 in. cap screws.

**Oil Pan-to-Cylinder Block Cap Screw (1/2 in.)—Specification**

Torque..... 156 N•m (117 lb-ft)

    b. Next tighten 3/8 in. cap screws.

**Oil Pan-to-Cylinder Block Cap Screw (3/8 in.)—Specification**

Torque..... 68 N•m (50 lb-ft)

11. Trim oil pan gasket flush at rear surface of cylinder block and oil pan.

12. Retighten all oil pan cap screws as follows:

    a. First retighten 3/8 in cap screws.

**Oil Pan-to-Cylinder Block Cap Screw (3/8 in.)—Specification**

Torque..... 68 N•m (50 lb-ft)

    b. Finally retighten 1/2 in. cap screws.

**Oil Pan-to-Cylinder Block Cap Screw (1/2 in.)—Specification**

Torque..... 156 N•m (117 lb-ft)

13. Fill engine oil. (See Fuels and Lubricants in Group 0004).

14. Install engine. (See procedure in Group 0400).

CED,OUOE024,203 –19–12MAY98–2/2

## DISASSEMBLE AND ASSEMBLE ENGINE

Refer to Engine Repair chapter for disassemble and assemble procedures.

CED,OUOE024,230 –19–21MAY98–1/1

## REMOVE AND INSTALL FUEL INJECTION PUMP

Refer to removal and installation of the fuel injection pump in this chapter.

TX,0400,DH5395 –19–21FEB97–1/1

## REPAIR IN-LINE FUEL INJECTION PUMP



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

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

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

TX,04,DH5308B –19–11NOV96–1/1

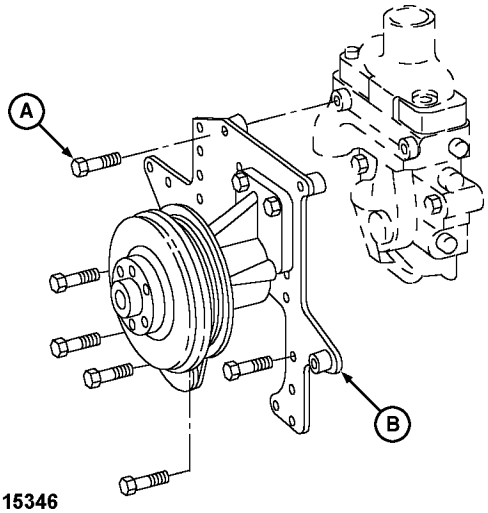
## REMOVE WATER PUMP

1. Drain coolant. Approximate capacity is 30 L (8 gal).
2. Remove fan, shroud, and guards. (See procedure in Group 0510.)
3. Remove fan and air conditioning belts. (See procedure in Group 0510.)
4. Remove water pump coolant hoses.

**Continued on next page**

CED,OUOE024,204 –19–14MAY98–1/5

5. Remove cap screws (A). Remove support plate (B).




T115346

T115346 –UN–17JUN98

**A—Cap Screw**
**B—Support Plate**

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0400
20

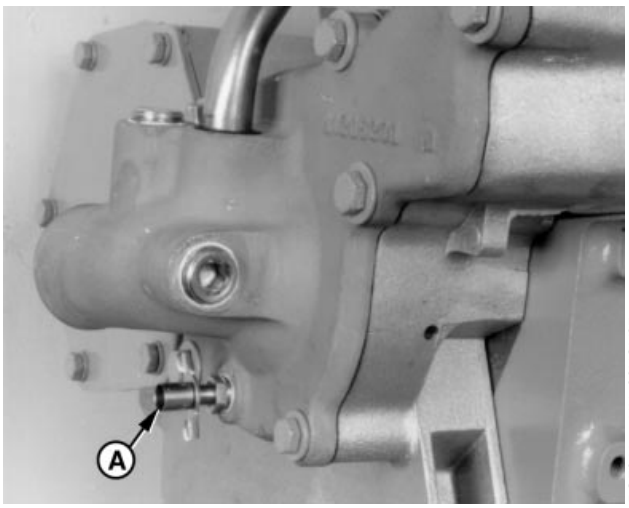
**Continued on next page**

CED,OUOE024,204 –19–14MAY98–2/5

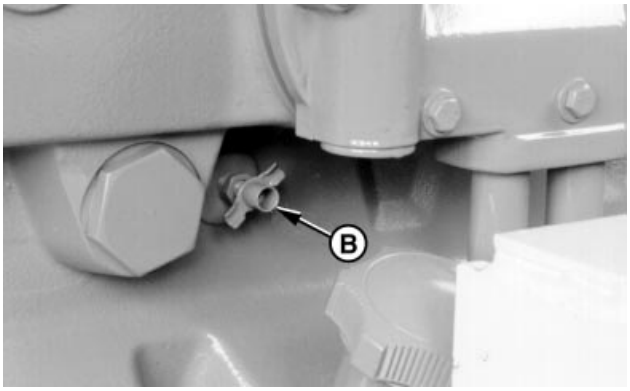
*NOTE: The water pump should be replaced as a complete assembly*

**CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Wait until engine coolant is cool enough to touch with bare hands before draining. Slowly loosen radiator cap to first stop to relieve pressure.**

6. Open water pump drain valve (A) and block drain valve (B) to drain coolant from engine.




RG7044 –UN–26NOV97




RG7143 –UN–26NOV97

**A—Water Pump Drain Valve**
**B—Cylinder Block Drain Valve**

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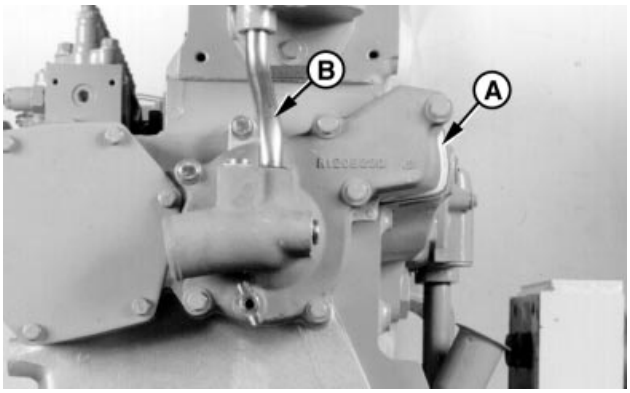
21

CED,OUOE024,204 –19–14MAY98–3/5

7. Remove six cap screws securing water pump cover (A) to timing gear cover and remove water pump cover with bypass tube (B).

8. Remove gasket from timing gear cover and discard. Remove bypass tube from cover. Inspect bypass tube seal in water pump cover, replace seal as needed.




RG7063 –UN–26NOV97

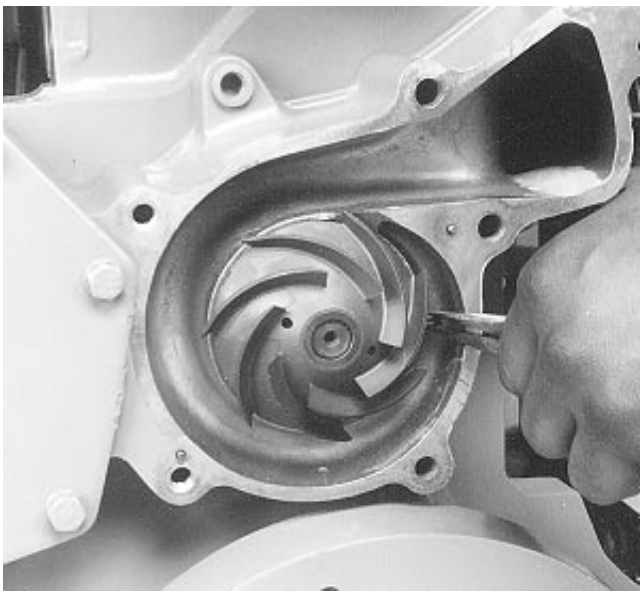
**A—Water Pump Cover**
**B—Bypass Tube**

**Continued on next page**

CED,OUOE024,204 –19–14MAY98–4/5

9. Compress retaining ring ends with a small needle nose pliers as shown.

10. Grasp impeller with a large plier and pull water pump from timing gear cover using a slight rocking motion until assembly is removed from timing gear cover. Discard water pump assembly.



RG7062 –UN–07SEP94



CED,OUOE024,204 –19–14MAY98–5/5

## INSTALL WATER PUMP

1. Thoroughly clean and inspect water pump mounting bore in timing gear cover before installing pump assembly.

**Continued on next page**

CED,OUOE024,205 –19–14MAY98–1/3

2. Install new O-rings (A) in rear grooves of water pump housing and apply a light coat of clean engine oil to O-rings.

3. Install a new retaining ring (B) in front (smallest) groove of water pump housing and compress both ends of retaining ring together with a small needle nose plier.

*NOTE: Retaining ring ends should be at 3 o'clock position and water pump weep hole should align with hole in timing gear cover when installing water pump assembly.*

4. Compress retaining ring ends and install water pump assembly into pilot bore of timing gear cover. Make sure that pump drive gear properly meshes with crankshaft gear.

5. Release retaining ring ends and verify that retaining ring is firmly seated in groove of timing gear cover.

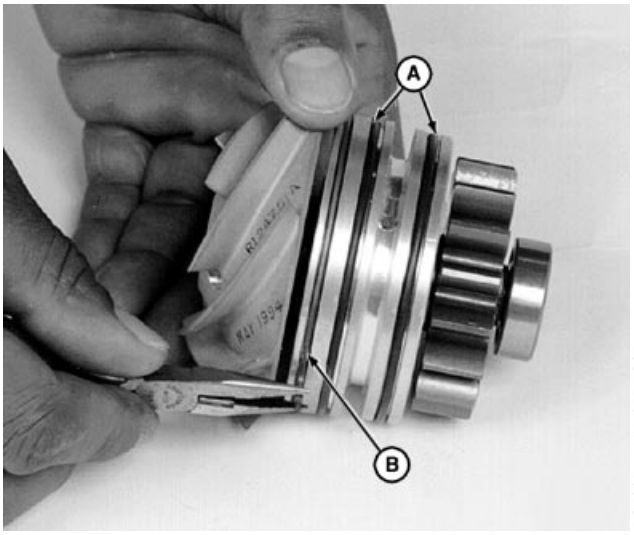
6. Install water pump cover with bypass tube using a new gasket. Tighten all 3/8-in. cap screws and all 5/16 in. cap screws.

**Water Pump Cap Screw (3/8-in.)—Specification**

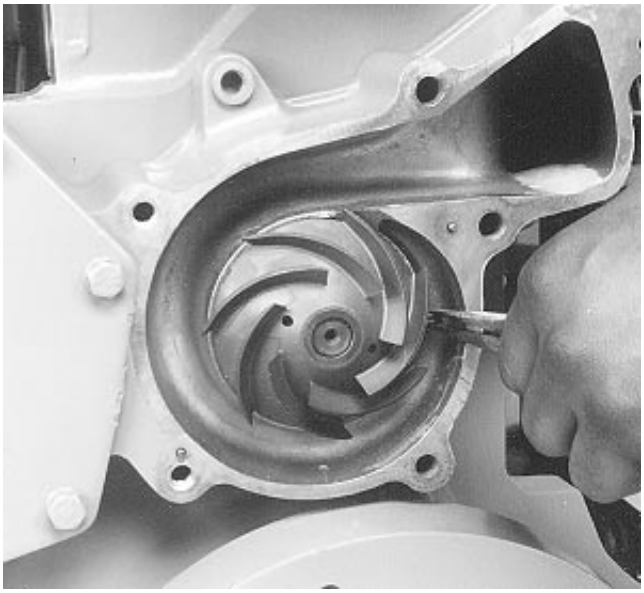
Torque ..... 47 N•m (35 lb-ft)

**Water Pump Cap Screw (5/16-in.)—Specification**

Torque ..... 27 N•m (20 lb-ft)




RG7227 –UN–05DEC97



RG7062 –UN–07SEP94

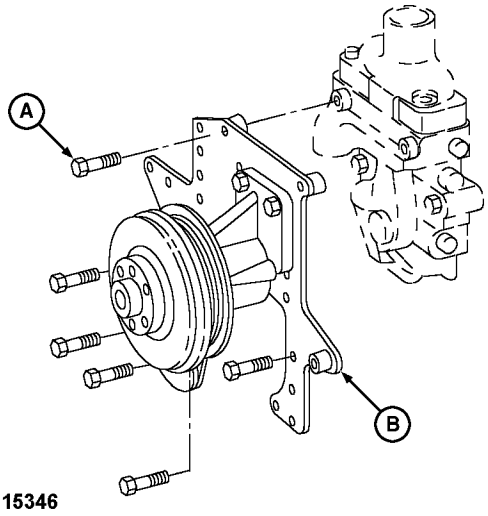
**A—O-Ring (2 used)**
**B—Retaining Ring**

04
0400
23

**Continued on next page**

CED,OUOE024,205 –19–14MAY98–2/3

7. Install support plate (B). Tighten cap screws (A).
8. Install water pump coolant hoses.
9. Install fan and air conditioning belts. (See procedure in Group 0510).
10. Install fan, shroud, and guards. (See procedure in Group 0510).
11. Fill coolant. Approximate capacity is 30 L (8 gal).




T115346

T115346 –UN–17JUN98

**A—Cap Screw**
**B—Support Plate**



CED,OUOE024,205 –19–14MAY98–3/3

## REMOVE AND TEST THERMOSTATS

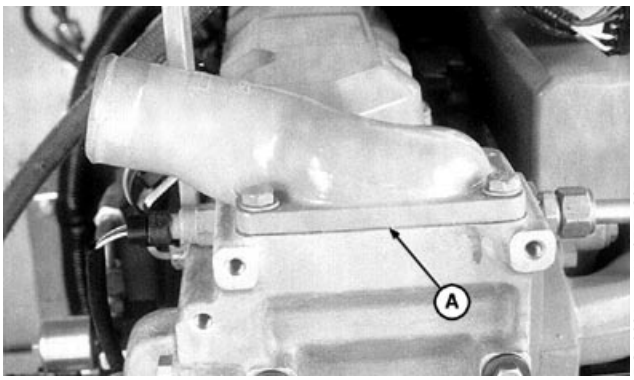
**CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Do not drain coolant until coolant temperature is below operating temperature. Always loosen cooling system filler cap, radiator cap, or drain valve slowly to relieve pressure.**

1. Drain coolant. Approximate capacity is 30 L (8 gal).
2. Remove upper radiator hose.
3. Visually inspect the area around the water manifold for leaks. Partially drain coolant from the cooling system.

**Continued on next page**

CED,OUOE024,206 –19–14MAY98–1/3

4. Remove thermostat cover (A) with gasket. Remove and discard all gasket material.




**A—Thermostat Cover**



CED,OUOE024,206 –19–14MAY98–2/3

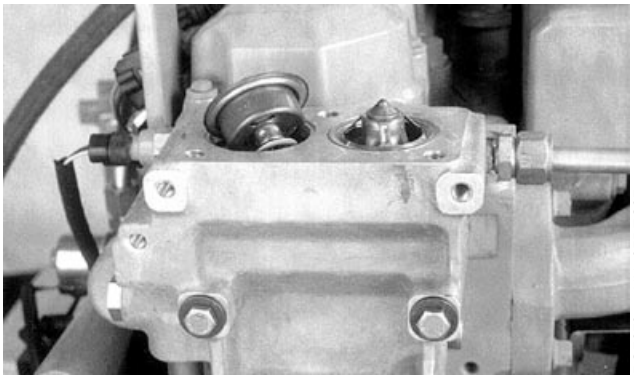
5. Remove thermostats.

6. Inspect thermostats for debris or damage, and test each thermostat using an approved testing procedure. See Inspect Thermostat and Test Thermostat Opening Temperature in Engine Repair chapter for testing procedure. Thermostat should start to open with the specified range.

**Thermostat—Specification**

| | |
|---|---|
| Opening Temperature | 89—100°C (192—212°F) |

If either thermostat fails to open within this range, replace both thermostats as a set.




CED,OUOE024,206 –19–14MAY98–3/3

## INSTALL THERMOSTATS

*NOTE: Install thermostats in groove in housing first, then install gasket after thermostat is properly seated in grooves.*

1. Install thermostats. Install a new gasket on housing.
2. Install cover and tighten cap screws.

**Thermostat Cover Cap Screw—Specification**

Torque ..... 47 N•m (35 lb-ft)

3. Install upper radiator hose.
4. Fill with coolant. Approximate capacity is 30 L (8 gal).



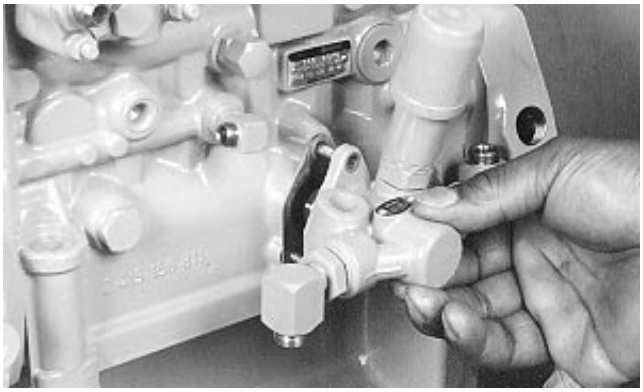
CED,OUOE024,207 –19–14MAY98–1/1

## REMOVE FUEL SUPPLY PUMP

*NOTE: To diagnose fuel supply pump malfunctions, refer to Engine Repair chapter.*

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

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



RG7053 –UN–10AUG94

CED,OUOE024,208 –19–14MAY98–1/1

## INSTALL FUEL SUPPLY PUMP

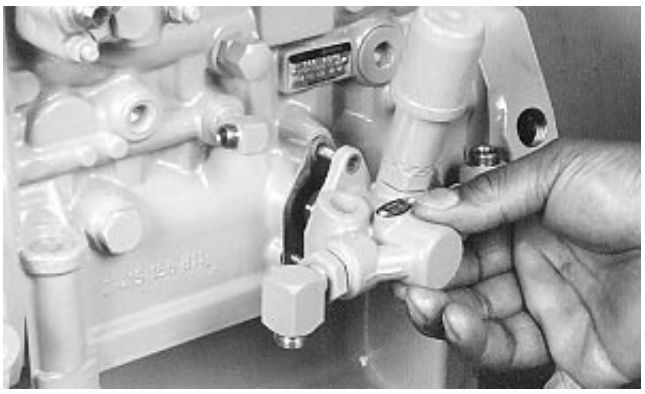
**IMPORTANT: Before installing supply pump, test pump to make sure fuel will not leak around spindle and spindle seal.**

1. Install a new gasket on supply pump mounting face and position pump over mounting studs.
2. Tighten mounting stud nuts.

**Fuel Supply Pump Mounting Stud Nut—Specification**

Torque ..... 5—7 N•m (4—5 lb-ft) (45—60 lb-in.)

3. Install fuel inlet and outlet lines and tighten all connections securely.
4. Bleed fuel system. (See procedure in this group.)



RG7053 –UN–10AUG94

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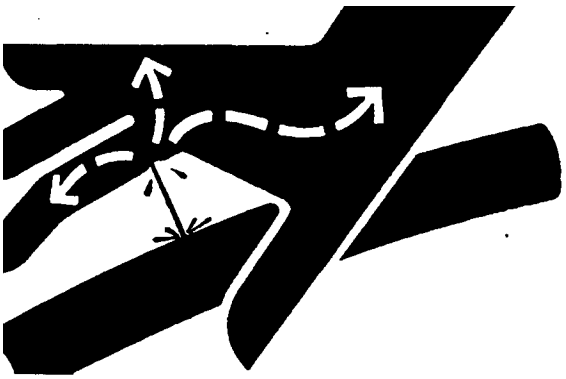
CED,OUOE024,209 –19–14MAY98–1/1

## REMOVE FUEL INJECTION NOZZLES

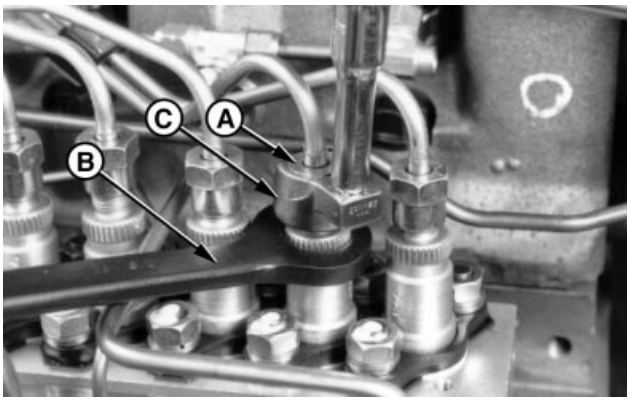


X9811 –UN–23AUG88

**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 pin holes 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 Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.**

04
0400
28




RG5877 –UN–26NOV97

**A—Injection Line Nut**
**B—JDE90 Serrated Wrench**
**C—JDF22 Crowsfoot Wrench**

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

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

**IMPORTANT: JDE90 Serrated Wrench (B) MUST BE used to keep delivery valve fittings stationary while loosening line nuts. If delivery valve and barrel housing rotates while loosening or tightening a fuel line nut, injection pump delivery will be altered. Pump must be recalibrated on a test stand.**

2. Disconnect injection line nuts (A) from injection pump delivery valves using JDF22 Crowsfoot Wrench (C) or a standard 3/4 in. line wrench and JDE90 Serrated Wrench (B).

**Continued on next page**

*Removal and Installation*

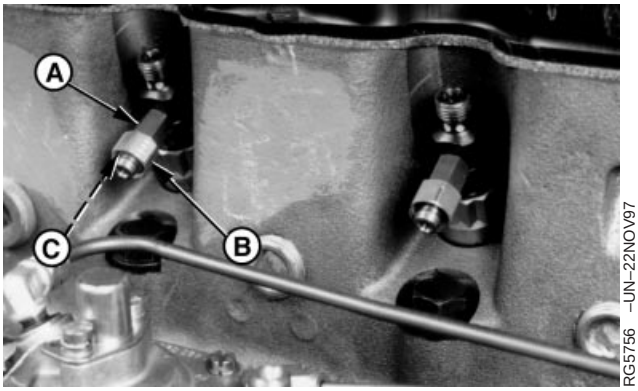
3. Disconnect fuel delivery lines from injection nozzles. Lift injection line assembly from engine.

4. Disconnect fuel leak-off line from injection nozzle leak-off connectors. Remove complete leak off assembly.

CED,OUOE024,210 –19–14MAY98–2/4

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

6. Remove leak off connector (A) with O-ring from each injection nozzle.




RG5756 –UN–22NOV97

**A—Leak-Off Connector**
**B—Line Nut**
**C—Packing**

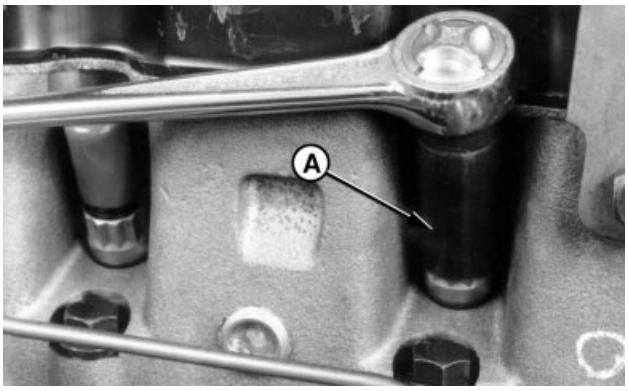


CED,OUOE024,210 –19–14MAY98–3/4

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

7. If JDE92 Nozzle Wrench is not used, use a 24 mm (15/16 in.) deep socket on nozzle gland nut to remove nozzles. Gland nut will act as a jack screw to raise nozzle out of cylinder head bore. Remove hardened steel washer from injection nozzle bore if it does not come out with nozzle.

8. To prevent debris from entering combustion chamber after nozzles are removed, insert a 12.7 mm (1/2 in.) hardwood dowel in nozzle bore.




RG5757 –UN–22NOV97

**A—JDE92 Nozzle Wrench**

CED,OUOE024,210 –19–14MAY98–4/4

## INSTALL FUEL INJECTION NOZZLES

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

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

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

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

3. Insert injection nozzle into cylinder head. Turn gland nut by hand to make sure it is threaded straight in cylinder head.

4. Use outer socket JDE92 Nozzle Socket and turn gland nut down to remove most of the looseness.


**A—Steel Washer**

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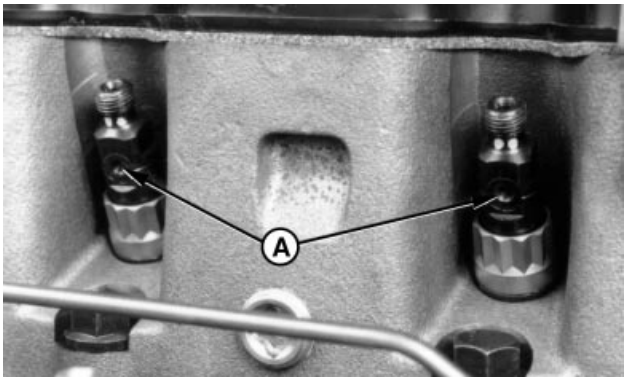
0400
30

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

CED,OUOE024,211 –19–18MAY98–1/7

5. Rotate nozzle holder so hole for leak-off connector threads (A) are facing straight out from cylinder head.




**A—Leak-Off Connector Threads**

**Continued on next page**

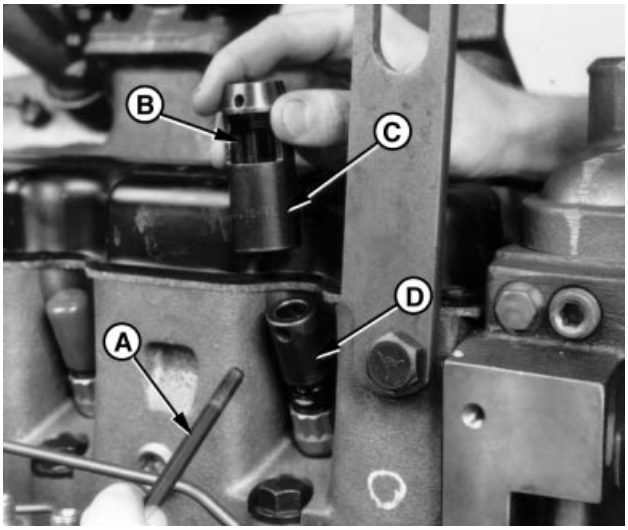
CED,OUOE024,211 –19–18MAY98–2/7

6. Position inner socket (D) over nozzle holder and engage with flats at top of nozzle holder.

7. Place outer socket (C) portion of JDE92 Nozzle Socket on gland nut with socket “window” (B) facing outward.

8. Insert handle (A) through window into inner socket. Ball detent in handle will keep it secured to inner socket.

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




RG5758 –UN–26NOV97

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

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0400
31

CED,OUOE024,211 –19–18MAY98–3/7

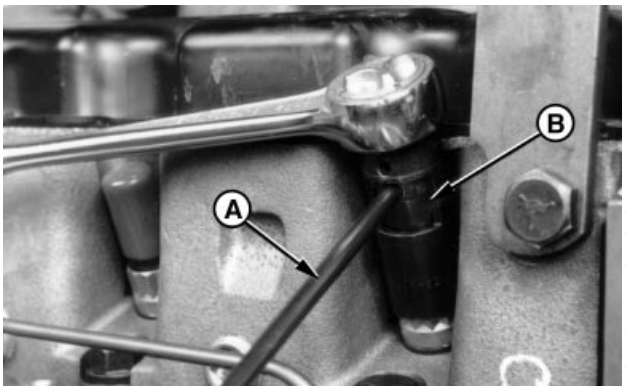
9. Tighten injection nozzle gland nut. Keep handle (A) pointing straight out while tightening.

**Fuel Injection Nozzle Gland Nut—Specification**

Torque ..... 88 N•m (65 lb-ft)

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

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



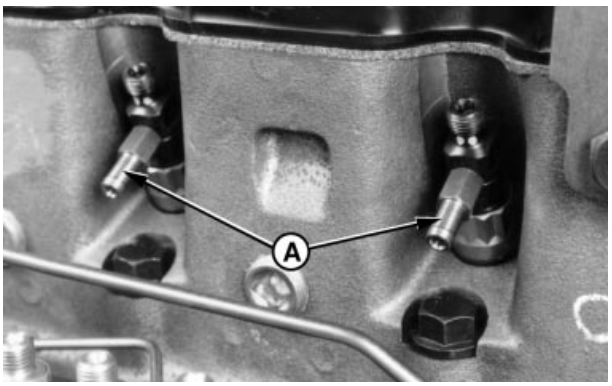

RG5759 –UN–26NOV97

**A—Handle**
**B—Socket Window**

**Continued on next page**

CED,OUOE024,211 –19–18MAY98–4/7

11. Install leak-off connectors (A) with O-rings on injection nozzles. Tighten securely.




**A—Leak-Off Connector**



CED,OUOE024,211 –19–18MAY98–5/7

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

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

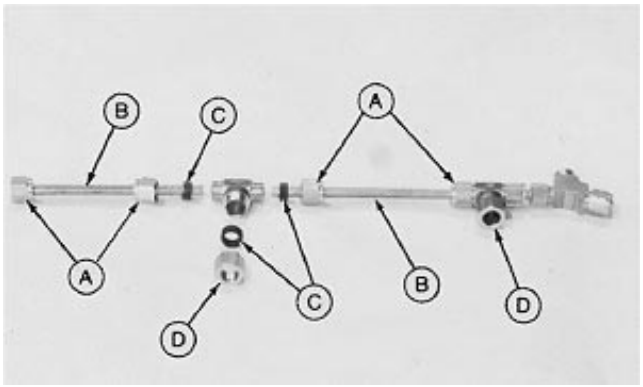
13. Check all pipes and fittings for wear or damage and replace as necessary.

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

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

16. Tighten all leak-off line connections securely at each injection nozzle.

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




**A—Fitting**
**B—Pipe**
**C—Packing**
**D—Nut**

**Continued on next page**

CED,OUOE024,211 –19–18MAY98–6/7

**IMPORTANT: Use JDE90 Serrated Wrench (B) to keep delivery valve fittings stationary while tightening fuel line nuts. If a delivery valve and barrel housing rotates while tightening a fuel line nut, injection pump fuel delivery will be altered, and pump will have to be recalibrated on a test stand.**

18. Remove protective caps and plugs, that were installed during disassembly, from injection lines, nozzles and delivery valves. Install and connect injection line assembly at each respective injection nozzle and delivery valve.

19. Tighten fuel injection line nuts (A).

**Fuel Injection Nozzle Line Nut—Specification**

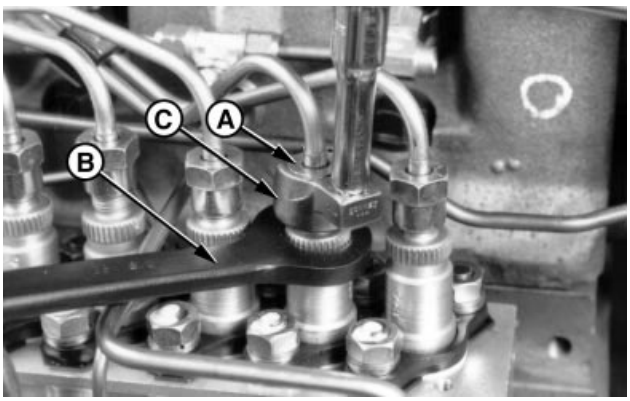
Torque ..... 27 N•m (20 lb-ft)

20. Tighten line nuts at delivery valves using JDF22 Crowsfoot Wrench (C) or a 3/4 in. line wrench along with JDE90 Serrated Wrench.

**Fuel Injection Nozzle Line Nut—Specification**

Torque ..... 27 N•m (20 lb-ft)

21. Bleed fuel system. (See procedure in this group.)




RG5877 –UN–26NOV97

**A—Fuel Injection Line Nut**
**B—JDE90 Serrated Wrench**
**C—JDF22 Crowsfoot Wrench**

04
0400
33

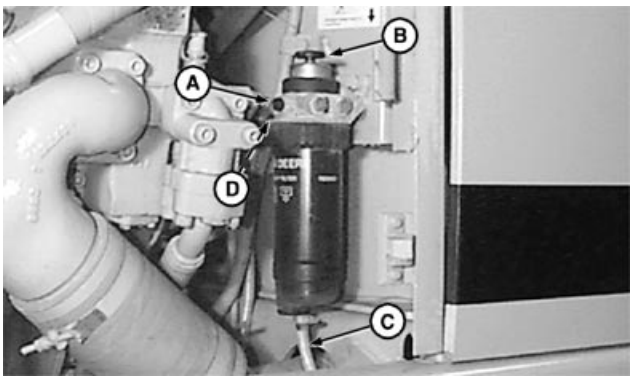
CED,OUOE024,211 –19–18MAY98–7/7

## BLEED THE FUEL SYSTEM

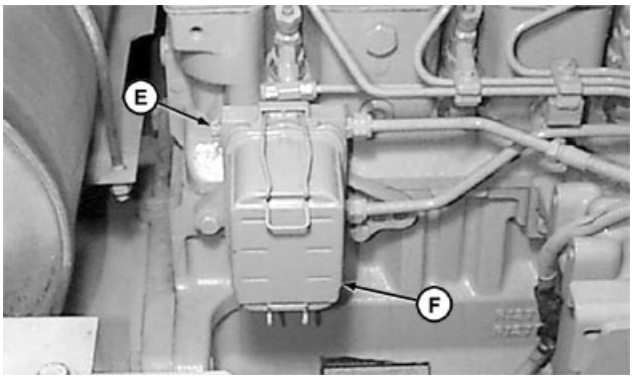
1. Place pan under primary filter (water separator) drain hose (C).
2. Open bleed screw (A) and push pump (B) until fuel free of bubbles flows from around the bleed screw.
3. Close bleed screw (A) and loosen bleed screw (E) from final fuel filter.
4. Push pump until only fuel flows from bleed screw opening.

*NOTE: If you run out of fuel and air is in the supply line to the injection pump continue next step.*

5. Loosen fuel line (D) at injection pump and push pump until fuel free of bubbles flows from connector.
6. Tighten fuel line.




T115054 –UN–17JUN98




T115055 –UN–17JUN98

**A—Bleed Screw**
**B—Pump**
**C—Drain Hose**
**D—Fuel Line**
**E—Bleed Screw**
**F—Final Fuel Filter**

CED,OUOE024,226 –19–20MAY98–1/1

04
0400
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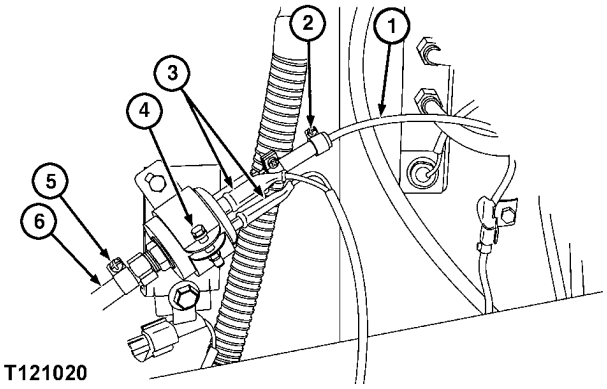
## REMOVE AND INSTALL ARCTIC/COLD WEATHER HEATER FUEL SUPPLY PUMP

1. Remove two electrical connectors (3).
2. Loosen clamp (2) and remove line (1).
3. Remove clamp (5) and remove line (6).
4. Remove cap screw (4) and remove pump.
5. Install fuel supply pump into bracket and install cap screw (4).
6. Install line (1) and tighten clamp (2).
7. Install line (6) and tighten clamp (5).
8. Connect two electrical connectors (3).



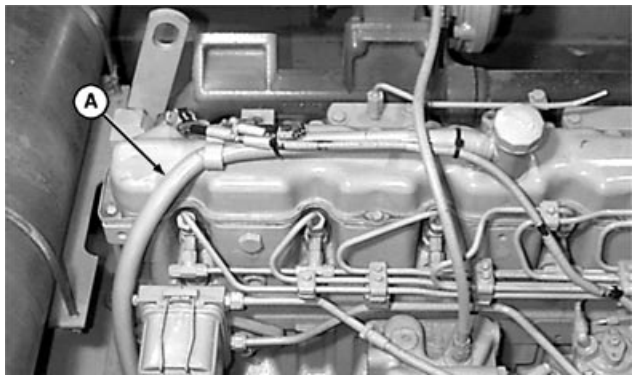

**1—Line**
**2—Clamp**
**3—Connectors**
**4—Cap Screw**
**5—Clamp**
**6—Line**

04
0400
35

CED,OUOE042,5067 –19–15APR99–1/1

## CLEAN THE ENGINE CRANKCASE VENTILATION TUBE

Clean the engine crankcase ventilation tube (A) when you measure and adjust engine valve clearance (lash).




**A—Engine Crankcase Ventilation Tube**

TX,85,DH5354A –19–14DEC96–1/1

## CHECK AND ADJUST ENGINE VALVE LASH (CLEARANCE)

**CAUTION: 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 engine crankcase ventilation tube. Clean tube with solvent or diesel fuel. Check that O-ring in rocker arm cover is in good condition.

04
0400
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**Continued on next page**

TX,0400,DH5389 –19–18MAY98–1/4

**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 plugs from cylinder block bores and install JDE81-1 or JDG820 Flywheel Turning Tool (A) and JDE-81-4 Timing Pin (B).

3. Rotate the engine with the flywheel turning tool until timing pin engages timing hole in flywheel.

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

   If the rocker arms for the No. 6 cylinder are loose, the engine is at No. 6 “TDC” Compression. Rotate the engine one full revolution to No. 1 “TDC” Compression.

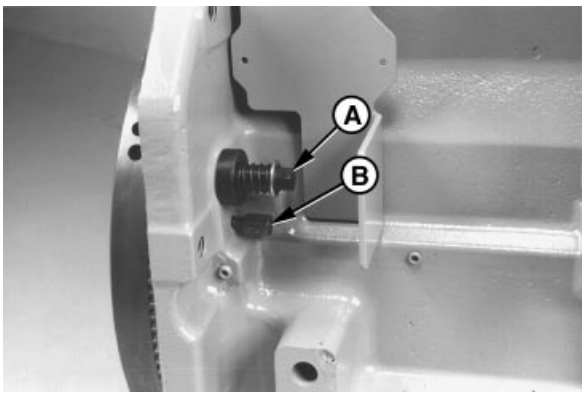
5. With the engine lock-pinned at “TDC” of No. 1 piston’s compression stroke, check and adjust (as needed) valve clearance on Nos. 1,3 and 5 exhaust valves and Nos. 1, 2 and 4 intake valves.

**Intake Valve—Specification**

Clearance ..... 0.331—0.431 mm (0.013—0.017 in.)

**Exhaust Valve—Specification**

Clearance ..... 0.661—0.761 mm (0.026—0.030 in.)




**A—Flywheel Turning Tool**
**B—Timing Pin**

04
0400
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**Continued on next page**

TX,0400,DH5389 –19–18MAY98–2/4

6. If valve clearance needs to be adjusted, loosen the locknut 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.

**Valve Adjusting Screw Locknut—Specification**

Torque ..... 27 N•m (20 lb-ft)

Recheck clearance again after tightening locknut. Readjust clearance as necessary.

RG5241 –UN–06DEC88

7. Rotate flywheel 360° until No. 6 piston is at “TDC” of its compression stroke. Rocker arms for No. 6 piston should be loose.

04
0400
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TX,0400,DH5389 –19–18MAY98–3/4

8. Check and adjust (as needed) valve clearance to the same specifications on Nos. 2, 4 and 6 exhaust and Nos. 3, 5 and 6 intake valves. Tighten valve adjusting screw locknut.

**Intake Valve—Specification**

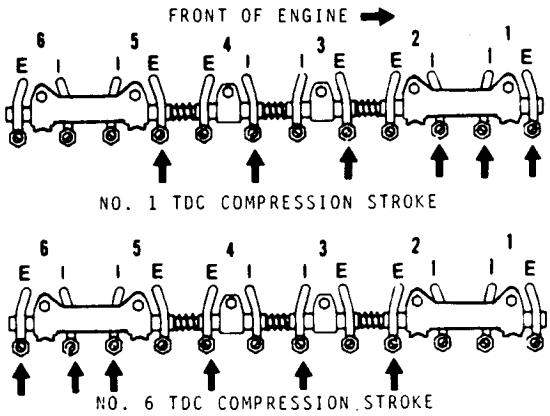
Clearance ..... 0.331—0.431 mm (0.013—0.017 in.)

**Exhaust Valve—Specification**

Clearance ..... 0.661—0.761 mm (0.026—0.030 in.)

**Valve Adjusting Screw Locknut—Specification**

Torque ..... 27 N•m (20 lb-ft)




RG4295 –19–21AUG91

9. Recheck clearance on all valves again after locknut is tightened.

TX,0400,DH5389 –19–18MAY98–4/4

## REMOVE AND INSTALL STARTER

**IMPORTANT: Always disconnect the negative (-) battery cables before removing starter or a short circuit could result.**

1. Disconnect negative (-) battery cables at battery.
2. Disconnect positive battery cable (A).
3. Remove nut (B).
4. Disconnect connector (E).
5. Disconnect ground strap (D).

**CAUTION: The approximate weight of starter is 23 kg (50 lb).**

**Starter—Specification**

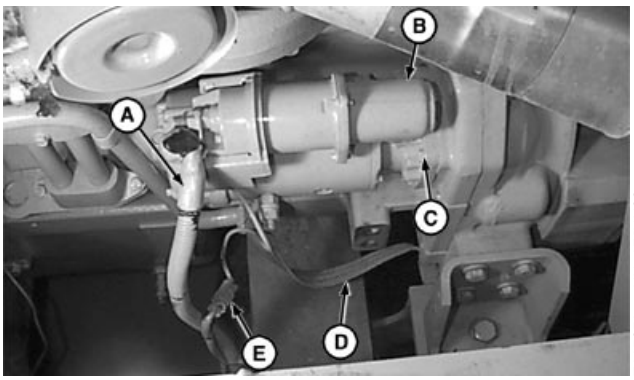
Weight..... 23 kg (50 lb) approximate

6. Remove cap screws (C). Remove starter.
7. Replace parts as necessary.
8. Install starter.
9. Tighten cap screws (C).

**Starter Cap Screw—Specification**

Torque ..... 47 N•m (35 lb-ft)

10. Connect ground strap (D).
11. Connect connector (E).
12. Connect positive battery cable (A).
13. Connect negative (-) battery cables at battery.




T115051 –UN–17JUN98

**A—Positive Battery Cable**
**B—Nut**
**C—Cap Screw (2 used)**
**D—Ground Strap**
**E—Connector**

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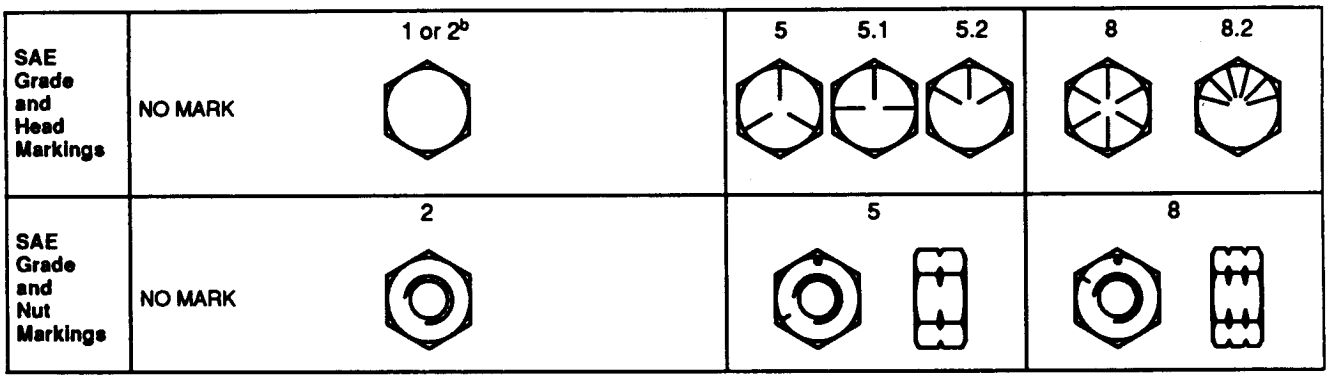
CED,OUOE024,212 –19–18MAY98–1/1

# General Information

## UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES

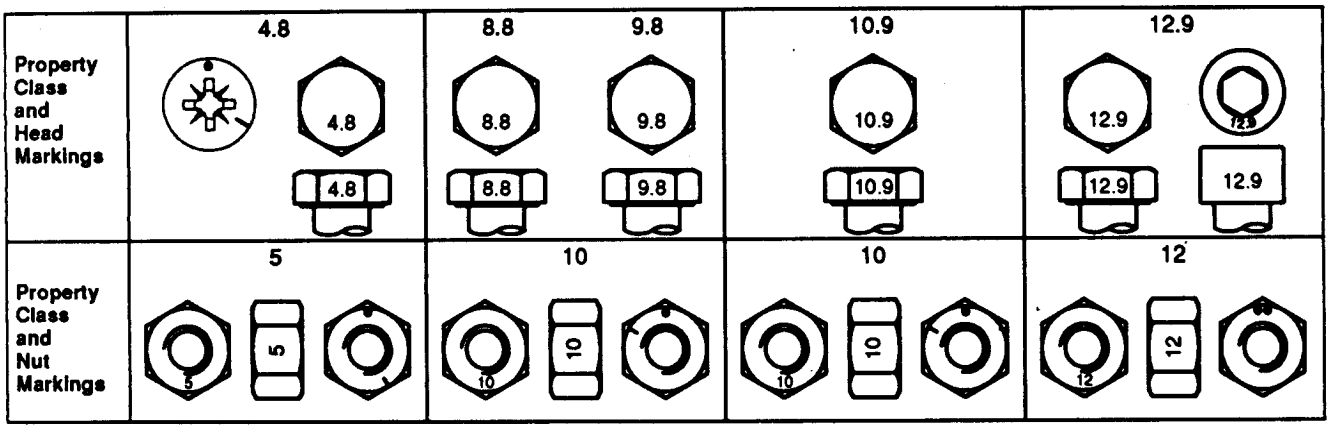



TS1162 –19–04MAR91

*Inch Torque Values*

DX,TORQ1 –19–20JUL94–1/1

## METRIC BOLT AND CAP SCREW TORQUE VALUES




TS1163 –19–04MAR91

*Metric Torque Values*

DX,TORQ2 –19–20JUL94–1/1

## ENGINE MODEL DESIGNATION

JOHN DEERE ENGINE MODEL—6081

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

**6081 HRW01 Engine**

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

**Aspiration Code**

T ..... Turbocharged
A ..... Turbocharged and water-to-air aftercooled
H ..... Turbocharged and air-to-air aftercooled

**User Code**

DW ..... Davenport
F ..... OEM
H ..... Harvester
N ..... Des Moines
RW ..... Waterloo (Tractors)
T ..... Dubuque
Z ..... Zweibrucken

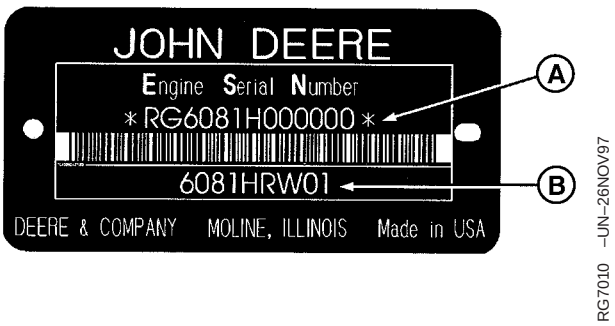
**Application Code**

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

RG,RG34710,1021 –19–23OCT97–1/1

## ENGINE SERIAL NUMBER PLATE INFORMATION

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




*Engine Serial Number Plate*

### ENGINE SERIAL NUMBER (A)

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

**RG6081H000000**
RG ..... Factory code producing engine
6081H ..... Engine model designation
000000 ..... Sequential serial number

**Factory Code**
RG ..... Waterloo Engine Works

**Engine Model Designation**
6801H ..... Definition explained previously. (See ENGINE MODEL DESIGNATION.)

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

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

### ENGINE APPLICATION DATA (B)

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

RG,RG34710,1022 –19–23OCT97–1/1

## GENERAL ENGINE SPECIFICATIONS (OEM APPLICATIONS)

*NOTE: For vehicle engines, see Machine Technical Manual.*

| ITEM | UNIT OF MEASURE | 6081TF | 6081AF | 6081HF |
|---|---|---|---|---|
| Engine Type | —— | In-line, 4 cycle diesel | In-line, 4 cycle diesel | In-line, 4 cycle diesel |
| Aspiration | —— | Turbocharged | Turbocharged, water-to-air aftercooled | Turbocharged and air-to-air aftercooled |
| Number of Cylinders | —— | 6 | 6 | 6 |
| Bore | mm (in.) | 116 (4.56) | 116 (4.56) | 116 (4.56) |
| Stroke | mm (in.) | 129 (5.06) | 129 (5.06) | 129 (5.06) |
| Displacement | L (cu in.) | 8.1 (496) | 8.1 (496) | 8.1 (496) |
| Combustion System | —— | Direct injection | Direct injection | Direct injection |
| Compression Ratio | —— | 16.5:1 | 16.5:1/15.7:1 | 15.7:1 |
| Width | mm (in.) | 727 (28.6) | 727 (28.6) | 555 (21.8) |
| Height | mm (in.) | 1020 (40.2) | 1020 (40.2) | 1040 (40.9) |
| Length | mm (in.) | 1208 (47.6) | 1208 (47.6) | 1208 (47.6) |
| Basic Dry Weight | kg (lb) | 735 (1618) | 869 (1916) | 837 (1845) |
| Net Rated Power (Cont.) at 2200 rpm | kW (hp) | 127 (170) | 160 (215) | 190 (255) |
| Net Peak Torque (Cont.) at 12 rpm | N•m (lb-ft) | 758 (559) | 967 (713) | 1184 (873) |
| Net Rated Power (Intermit.) at 2200 rpm | kW (hp) | 149 (200) | 168 (225) | 224 (300) |
| Net Peak (Intermit.) at 1200 rpm | N•m (lb-ft) | 891 (656) | 1012 (747) | 1393 (1027) |
| Low Idle Speed | rpm | 850 | 850 | 850 |
| Fast Idle Speed | rpm | 2300 | 2300 | 2300 |
| Net Rated Power (Prime) at 1800 rpm | kW (hp) | 142 (190) | 168 (225) | 218 (292) |
| Net Rated Power (Standby) at 1800 rpm | kW (hp) | 157 (211) | 187 (250) | 240 (322) |
| Net Rated Power (Prime) at 1500 rpm | kW (hp) | 119 (160) | 142 (190) | 182 (244) |
| Net Rated Power (Standby) at 1500 rpm | kW (hp) | 130 (175) | 157 (210) | 200 (268) |
| Low Idle Speed | rpm | 850 | 850 | 850 |
| Fast Idle Speed | rpm | 1900 / 1600 | 1900 / 1600 | 1900 / 1600 |

**Continued on next page**

| ITEM | UNIT OF MEASURE | 6081TF | 6081AF | 6081HF |
|---|---|---|---|---|
| Lubrication System | | | | |
| Oil Pressure at Rated rpm | kPa (psi) | 400 (58) | 345 (50) | 345 (50) |
| Cooling System Type | | Liquid, pressurized with centrifugal pump | | |
| Recommended Pressure Cap | kPa (psi) | 69 (10) | 69 (10) | 69 (10) |
| Coolant Flow (Industrial) | L/min (gal/min) | 330 (87) | 330 (87) | 330 (87) |
| Coolant Flow (Generator) | | | | |
| at 1800 rpm | L/min (gal/min) | 270 (71) | 270 (71) | 270 (71) |
| at 1500 rpm | L/min (gal/min) | 210 (55) | 210 (55) | 210 (55) |
| Engine Operation System Hot Cylinder Compression Pressure with Injection Nozzles Removed | kPa (psi) | 2380-2790 (345-405) | 2380-2790 (345-405) | 2380-2790 (345-405) |
| Engine Operation System Valve Clearance (Cold) | | | | |
| Intake | mm (in.) | 0.46 (0.018) | 0.046 (0.018) | 0.046 (0.018) |
| Exhaust | mm (in.) | 0.71 (0.028) | 0.071 (0.028) | 0.071 (0.028) |
| Fuel System | | | | |
| Nozzle Opening Pressure | | | | |
| New | kPa (psi) | 29000 (4200) | 29000 (4200) | 29000 (4200) |
| Used (min.) | kPa (psi) | 26280 (3800) | 26280 (3800) | 26280 (3800) |
| Injection Pump Timing | | Timing lines aligned with flywheel at TDC | | |

RG,RG34710,1026 –19–23OCT97–2/2

# Fuels, Lubricants, and Coolant

## 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 A-A-52557, 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 SL 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.

DPSG,OUOE003,7691 –19–28OCT99–1/1

## 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, Canada, and the European Union now require sulfur content less than 0.05%.

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

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

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

A-A-52557, 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 Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (MIL-PRF-25017) at the recommended 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.

DPSG,OUOE003,7692 –19–28OCT99–1/1

## 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 only as needed to maintain the specified oil level. (For details, see Group 04.)

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

After engine overhaul, also fill the engine with John Deere ENGINE BREAK-IN OIL or oil meeting MIL-PRF-21260.

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
- MIL-PRF-21260

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 trademark of Deere & Company.*

DPSG,OUOE003,7693 –19–28OCT99–1/1

## DIESEL ENGINE OIL

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

The following oil is preferred.

- **John Deere PLUS-50®**

The following oil is also recommended:

- John Deere TORQ-GARD SUPREME®

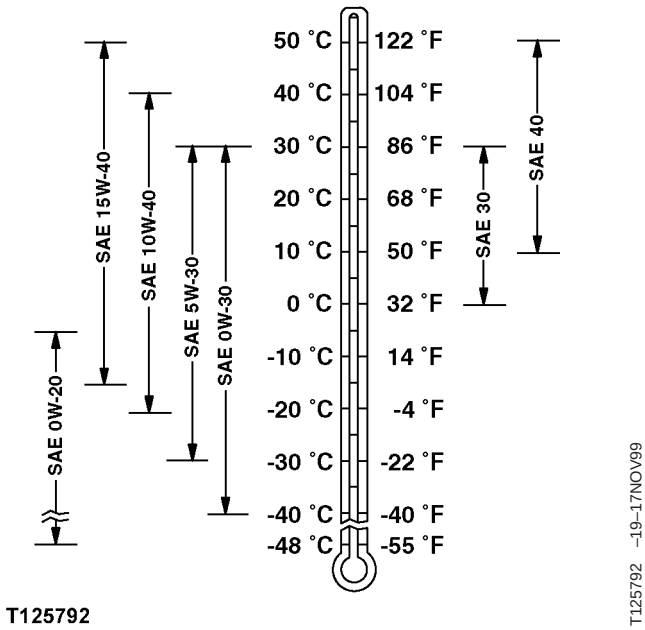
Other oils may be used if they meet one or more of the following:

- API Service Classification CG-4
- API Service Classification CF-4
- ACEA Specification E3
- ACEA Specification E2
- MIL-PRF-2104G
- MIL-PRF-46167C

**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%.

When 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%. Consult your John Deere dealer for specific application recommendations.




T125792 –19–17NOV99

*Diesel Engine Oil*

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

DPSG,OUOE003,7694 –19–28OCT99–1/1

## EXTENDED DIESEL ENGINE OIL SERVICE INTERVALS

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

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

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

RG,RG34710,1031 –19–23OCT97–1/1

## 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.

RG,RG34710,1032 –19–23OCT97–1/1

## MIXING OF LUBRICANTS

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

Mixing different types of 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

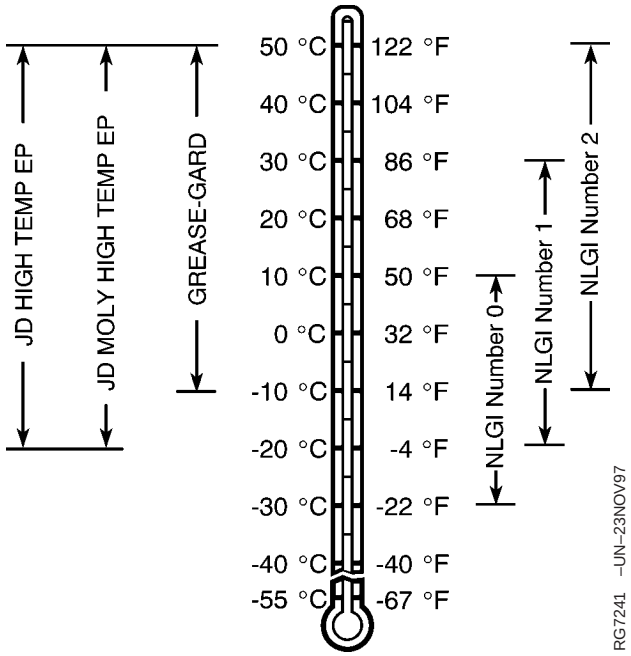
## GREASE

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

The following greases are preferred:

- MIL-PRF-10924
- 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.




*Selection of Grease*

DPSG,OUOE003,7695 –19–28OCT99–1/1

## 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 coolants are preferred for service:

- CID A-A-52624 Type 1 is a fully formulated ethylene glycol-based engine coolant concentrate.
- CID A-A-52624 Type 1P is a prediluted (60% by vol. Glycol) fully formulated ethylene glycol based engine coolant.
- CID A-A-52624 Type 11 is a fully formulated propylene glycol based engine coolant concentrate.
- CID A-A-52624 Type 1 and Type 11 require dilution with water before use.
- CID A-A-52624 Type 1P is ready to use as packaged.
- John Deere PREDILUTED ANTIFREEZE/SUMMER COOLANT
- John Deere COOL-GARD, where available

The following engine coolant is also recommended:

- John Deere ANTIFREEZE/SUMMER COOLANT CONCENTRATE in a 40 to 60 percent mixture of concentrate with quality water

### JOHN DEERE PREDILUTED ANTIFREEZE/SUMMER COOLANT

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

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

### JOHN DEERE COOL-GARD

In certain geographical areas, John Deere 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 has a service life of 2000 hours or 24 months of operation.

### JOHN DEERE ANTIFREEZE/SUMMER COOLANT CONCENTRATE

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

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

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

DPSG,OUOE003,7696 –19–28OCT99–1/1

## 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 and CID A-A-52624, 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 and CID A-A-52624 Type 1, contain both ethylene glycol antifreeze and inhibiting coolant additives. Mix these products and quality water, but do not add an initial charge of supplemental coolant additives.

Coolants meeting ASTM D6210 (prediluted coolant) or ASTM D6211 (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 or CID A-A-52624 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 diesel 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.
- ASTM D6210
- ASTM D6211

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

**Continued on next page**

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

DPSG,OUOE003,7697 –19–28OCT99–2/4

## 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, John Deere Antifreeze/Summer Coolant Concentrate or equivalent supplemental coolant additives are recommended. As the coolant solution loses its effectiveness, additives will need to be added.*


RG7276 –UN–05DEC97

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.

**Continued on next page**

DPSG,OUOE003,7697 –19–28OCT99–3/4

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

**DO NOT use soluble oil.**

Additives eventually lose their effectiveness and must be recharged with additional supplemental coolant additives available in the form of liquid coolant conditioner. See TESTING DIESEL ENGINE COOLANT and REPLENISHING SUPPLEMENTAL COOLANT ADDITIVES (SCAs) BETWEEN COOLANT CHANGES, as described later in this group.

DPSG,OUOE003,7697 –19–28OCT99–4/4

## TESTING DIESEL ENGINE COOLANT

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

Test the coolant solution at 600 hours or 12 month 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 John Deere dealer. These test strips provide a simple, effective method to check the freeze point and additive levels of your engine coolant.

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

### COOLSCAN™

For a more thorough evaluation of your coolant, perform a CoolScan™ analysis, where available. See your John Deere engine distributor or servicing dealer for information about CoolScan™.


RG7297 –UN–22SEP99

*Coolant Test Kit*

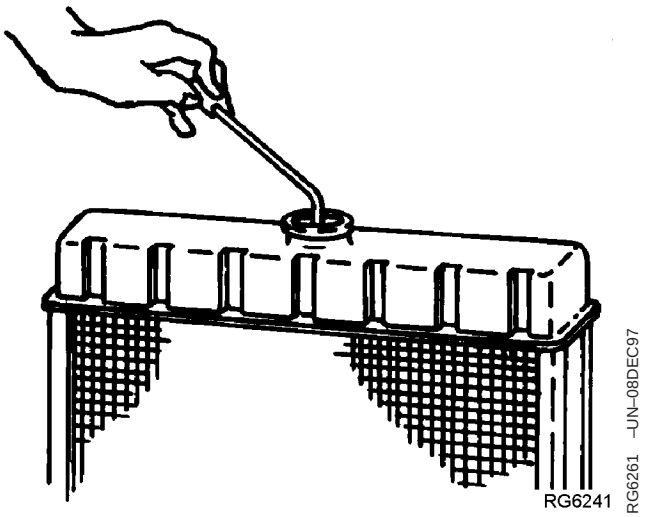
RG7397 –UN–05DEC97

*Coolant and Oil Sampler Tool*

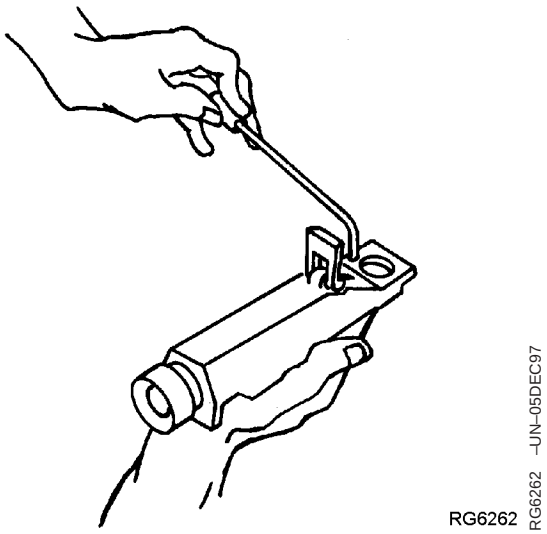
*CoolScan is a trademark of Deere & Company.*

RG,RG34710,1038 –19–23OCT97–1/1

## REPLENISHING SUPPLEMENTAL COOLANT ADDITIVES (SCAS) BETWEEN COOLANT CHANGES




*Sampling of Coolant*




*Testing of Coolant for Glycol Concentration*

**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.**

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 or John Deere Cool-Gard 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.**

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

**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.

*CoolScan is a trademark of Deere & Company.*

**Continued on next page**

RG,RG34710,1039 –19–23OCT97–1/2

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,RG34710,1039 –19–23OCT97–2/2

## 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,RG34710,1040 –19–23OCT97–1/1

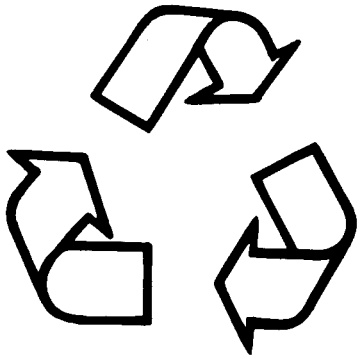
## DISPOSING OF COOLANT

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

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

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

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



TS1133 –UN–26NOV90

*Disposing of Coolant*

RG,RG34710,1041 –19–23OCT97–1/1

## FLUSH AND SERVICE COOLING SYSTEM

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

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

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

TS281 –UN–23AUG88

*Service Cooling System Safely*

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 and replace thermostats 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™ 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 trademark of Cummins Engine Company, Inc.*
*RESTORE is a trademark of Fleetguard Inc.*
*Restore Plus is a trademark of Fleetguard Inc.*

**Continued on next page**

RG,RG34710,1042 –19–23OCT97–1/2

**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 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.**

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 authorized servicing dealer or engine distributor, if there are further questions.*

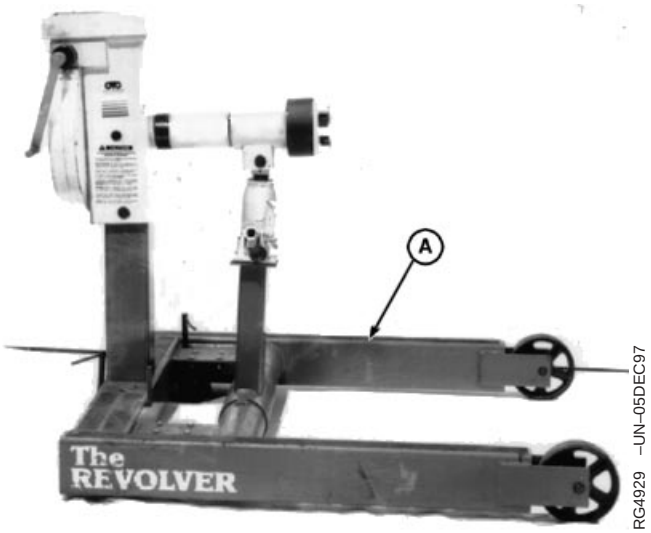
RG,RG34710,1042 –19–23OCT97–2/2

# Engine Mounting

## ENGINE REPAIR STAND

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

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




*Engine Repair Stand*

RG,RG34710,1043 –19–23OCT97–1/1

## 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 a trademark of Loctite Corp.*

RG,RG34710,1044 –19–23OCT97–1/1

## INSTALL ADAPTERS ON ENGINE REPAIR STAND

Attach the No. 205466 Engine Adapter (A) to mounting hub of the engine repair stand using SAE Grade 8 socket-head screws (D). Tighten screws to 135 N•m (100 lb-ft).

RG8183 –UN–08DEC97

*Adapter for Engine Repair Stand*

RG,RG34710,1045 –19–23OCT97–1/1

## ENGINE LIFTING PROCEDURE

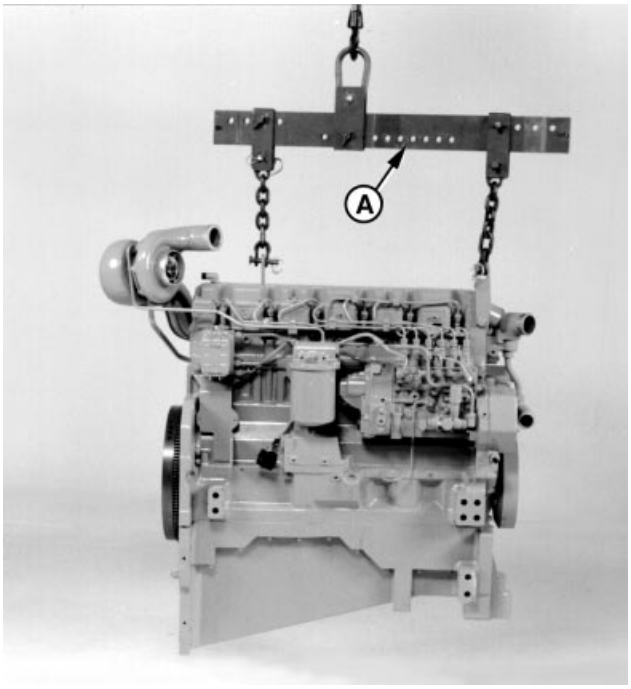
**CAUTION: The only recommended method for lifting the 6081 engine is with JDG23 Engine Lifting Sling and safety approved lifting straps that come with engine. Use extreme caution when lifting and NEVER permit any part of the body to be positioned under an engine being lifted or suspended.**

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

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

*NOTE: If engine does not have lifting straps, they can be procured through service parts 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 to desired location.




*Engine Lifting Sling and Straps*

RG,RG34710,1046 –19–23OCT97–1/1

## 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,RG34710,1047 –19–23OCT97–1/1

## DISCONNECT TURBOCHARGER OIL INLET LINE

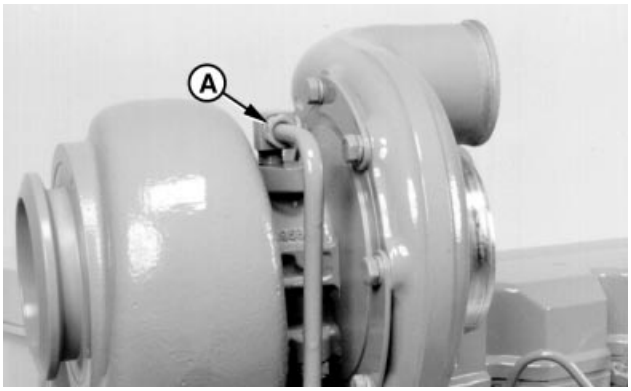
1. Drain all engine oil and coolant, if not previously done.

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

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

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

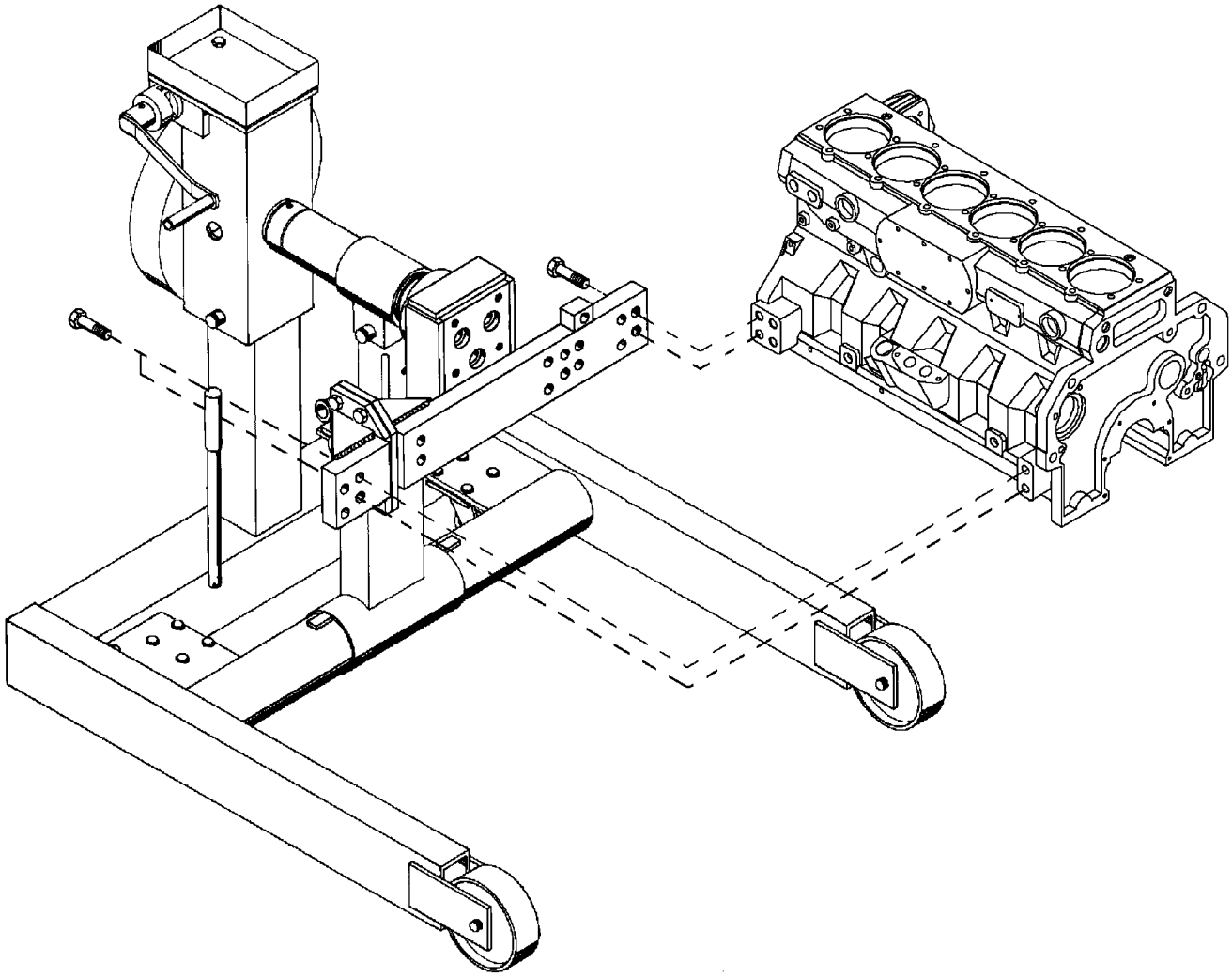
2. Disconnect turbocharger oil inlet line at turbocharger or oil filter base.




*Turbocharger Oil Inlet Line*

RG,RG34710,1048 –19–23OCT97–1/1

## MOUNT ENGINE ON REPAIR STAND




*Mounting Engine on Repair Stand*

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

*NOTE: If starting motor is to be removed from engine, remove before mounting engine onto repair stand.*

1. Mount the starter side of the engine to the engine adapter with four SAE Grade 8 (or higher grade) 5/8-11 UNC x 3-3/4 in. flanged-head cap screws.
2. Tighten cap screws to 203 N•m (150 lb-ft).
3. Carefully remove lift sling from engine.

To remove engine from repair stand, reverse the installation procedures.

**Continued on next page**

RG,RG34710,1049 –19–23OCT97–1/2

*Engine Mounting*

To install engine in vehicle, refer to machine technical manual.

RG,RG34710,1049 –19–23OCT97–2/2

# Engine Rebuild, Break-In, and Tune-Up

## ENGINE DISASSEMBLY SEQUENCE FOR OVERHAUL

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

1. Drain all coolant and engine oil. Check engine oil for metal contaminates.
2. Remove turbocharger oil inlet line and oil return line. Remove turbocharger.
3. Remove fan pulley and water manifold assembly.
4. Remove water pump assembly from timing gear cover.

*NOTE: DO NOT damage option code label (if equipped), when removing rocker arm cover.*

5. Remove breather hose from rocker arm cover. Remove rocker arm cover.
6. Remove rocker arm assembly and push rods. Identify parts for reassembly.
7. Remove front crankshaft pulley and damper assembly.
8. Remove fuel injection lines and injection nozzles.
9. Remove engine oil filter, filter base, and valve housing.
10. Remove injection pump gear cover and remove injection pump. Remove fuel filter and mounting base.
11. Remove engine oil cooler assembly.
12. Remove front and rear exhaust manifolds.
13. Remove air intake manifold.

*NOTE: ALWAYS bolt down liners when rotating engine flywheel with cylinder head removed.*

14. Remove cylinder head with assembly. Remove head gasket.
15. On SAE No. 3 flywheel housings, remove flywheel housing and then remove flywheel.
16. On SAE No. 1 and 2 flywheel housings, remove flywheel and then remove flywheel housing.
17. Revolve engine on repair stand and remove engine oil pump assembly.
18. Remove front timing gear cover.
19. Revolve engine to vertical position. Remove pistons and connecting rods. Identify for reassembly. Perform bearing-to-journal wear checks with PLASTIGAGE®.
20. Remove main bearing caps and remove crankshaft. Perform bearing-to-journal wear checks with PLASTIGAGE®.
21. Remove camshaft and cam followers. Identify for reassembly.
22. Revolve engine to horizontal position, remove liners, O-rings, and packings. Mark liners for reassembly in same bore from which removed.
23. Remove piston cooling orifices from cylinder block.
24. Remove any sensors/gauges, cylinder block plugs and engine serial number plate, if block is to be put in a “hot tank”.
25. Refer to appropriate group for inspection and repair of engine components.

*PLASTIGAGE is a trademark of DANA Corp.*

RG,RG34710,1050 –19–23OCT97–1/1

## 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® thread sealants 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.

**AR31790 SCOTCH-GRIP® EC1099 PLASTIC ADHESIVE:**

- AR31790 118 ml (4 oz)

Rocker arm cover gasket

**LOCTITE® 242—THREAD LOCK & SEALER (MEDIUM STRENGTH) (BLUE):**

- TY9370 6 ml (0.2 oz) tube
- T43512 50 ml (1.7 oz) bottle

Plugs and fittings: fuel filter base, intake manifold, cylinder block (oil galley).

Cap screws: injection pump access cover, electronic tachometer cover, oil filler inlet, flywheel.

Oil pressure sending unit.

**LOCTITE® 271—THREAD LOCK & SEALER (HIGH STRENGTH) (CLEAR):**

- TY9371 6 ml (0.2 oz) tube
- T43513 50 ml (1.7 oz) bottle

Studs: injection pump-to-block and exhaust manifold-to-turbocharger.

*LOCTITE is a trademark of Loctite Corp.*
*SCOTCH-GRIP is a trademark of 3M Co.*

**Continued on next page**

**LOCTITE® 592 PIPE SEALANT WITH TEFLON (WHITE):**

- TY9374 6 ml (0.2 oz) tube
- TY9375 50 ml (1.7 oz) bottle

Pipe plugs: cylinder block (water manifold), thermostat housing, air intake manifold, and water pump.

Injection pump governor cover fitting (fuel return)

Threaded nipples and elbows in water pump housing

Temperature sending unit

Oil pan (drain hose and drain valve)

Connectors: turbo line and turbo drain

Adapter fitting for turbo oil inlet line

**LOCTITE® 680 RETAINING COMPOUND (GREEN):**

- T43515 50 ml (1.7 oz) bottle

Wear ring-to-crankshaft

**PERMATEX AVIATION (FORM-A-GASKET NO. 3):**

- TY6299 227 g (8 oz) container

Rear camshaft bore steel cap plug

**PT569 NEVER-SEEZ® COMPOUND:**

- PT569 227 g (8 oz) Brush
- PT506 453 g (16 oz) Spray

Cap Screws: turbocharger mounting and turbine housing-to-center housing.

**FEL-PRO C-670 MOLYBDENUM DISULFIDE PASTE**

Camshaft nose (gear installation)

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

RG,RG34710,1051 –19–23OCT97–2/2

## 6081 ENGINE ASSEMBLY SEQUENCE AFTER OVERHAUL

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 in cylinder block that were removed to service block. Install engine serial number plate.
2. Install piston cooling orifices.
3. Install cylinder liners without O-rings and measure liner stand-out. Install liner O-rings in block and packings on liners. Install liners.

*NOTE: If new piston and liner kit assemblies are being installed, install the crankshaft first.*

4. Install main bearings and crankshaft. Rotate crankshaft to assure correct assembly. Check crankshaft end play.

*NOTE: ALWAYS bolt liners down before rotating engine with cylinder head removed.*

   If installing new piston/liner kits, assembly kits onto the respective connecting rods using NEW snap rings. Bolt liners down as each kit is installed.

5. Install piston and rod assemblies. Bolt liners down after each piston assembly is installed.
6. Install engine oil pump assembly.
7. Install crankshaft rear oil seal housing and check runout. Install rear oil seal and wear sleeve.
8. Install cam followers in hole from which originally removed.
9. Install camshaft. Align timing marks (camshaft-to-crankshaft gears) with No. 1 piston at “TDC” compression stroke.
10. Install fuel injection pump and drive gear.
11. Install engine oil cooler assembly.
12. Install filter base, valve housing, and new oil filter.
13. Install engine flywheel and housing, if applicable:
    - SAE 3: Flywheel goes on before housing.
    - SAE 1 and SAE 2: Housing goes on before flywheel.
14. Install cylinder head, push rods, and rocker arm assembly. Measure valve lift and adjust valve clearance.
15. Install rocker arm cover. Install breather hose.
16. Install front and rear exhaust manifolds.
17. Install air intake manifold.
18. Install timing gear cover. Install front crankshaft wear sleeve and oil seal.
19. Install water pump assembly and water manifold.
20. Install turbocharger. Install turbocharger oil inlet line and oil return line.
21. Install fuel injection nozzles and delivery line assembly.
22. Install fuel filter base, supply lines, and filter.
23. Install front pulley and damper as an assembly.
24. Install fan pulley assembly. Install starting motor.
25. Fill engine with clean oil and the proper coolant. Install dipstick.

**Continued on next page**

26. Perform engine break-in and normal standard performance checks (See following).

RG,RG34710,1052 –19–23OCT97–2/2

## ENGINE BREAK-IN GUIDELINES

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

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

Pistons, rings, or liners have been replaced.

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

Cylinder head has been removed. (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,RG34710,1053 –19–23OCT97–1/1

## 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 PLUS-50® engine oil or equivalents during break-in period of a NEW engine OR one that has had a major overhaul. PLUS-50® oil will not allow an overhauled engine to properly wear during this break-in period.**

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

Fill engine crankcase with John Deere BREAK-IN OIL to full level for use during the break-in operation. This oil is specifically formulated to enhance break-in of John Deere diesel engines regardless of ambient temperatures. Add John Deere Break-in Oil only as needed to maintain the specified oil level during break-in period. DO NOT add makeup oil until the oil level is BELOW the ADD mark on the dipstick. If more makeup oil is required during break-in, an additional 100-hour break-in period is required.

**PRELIMINARY ENGINE BREAK-IN AFTER MAJOR OVERHAUL**

| Time | Load | Engine Speed |
|---|---|---|
| 5 minutes | No load | 850 rpm |
| 5 minutes | No load | 1500—2000 rpm |
| 5 minutes | 1/4 load | 1900—2100 rpm |
| 10 Minutes | 1/2 load | 1900—2100 rpm |
| 10 Minutes | 1/2—3/4 Load | 1900—2100 rpm |
| 10 Minutes | 3/4—Full Load | Rated Speed |

Check and readjust valve clearance as necessary. Cylinder head retorque is not required. (See Group 05, Cylinder Head and Valves.)

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

**Continued on next page**

RG,RG34710,1054 –19–23OCT97–1/2

Sufficiently load engine during the first 100 hours of operation, but, avoid over-loads, excessive idling, and extended no-load operation.

A second 100-hour service interval with John Deere Engine Break-in Oil may be required if the engine is operated under light loads during the first 100-hour break-in period.

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

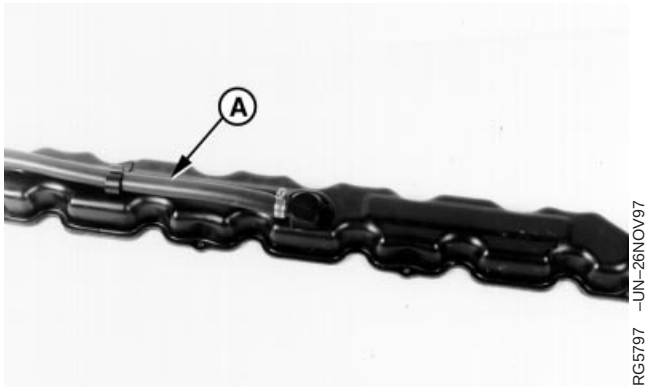
*TORQ-GARD SUPREME is a trademark of Deere & Company.*
*PLUS-50 is a trademark of Deere & Company.*

RG,RG34710,1054 –19–23OCT97–2/2

## CHECK CRANKCASE VENTILATION SYSTEM

1. Inspect crankcase ventilation system for restrictions. Lack of ventilation causes sludge to form in crankcase. This can lead to clogging of oil passages, filters, and screens, resulting in serious engine damage.

2. Clean crankcase vent tube (A) with solvent and compressed air if restricted. Install and tighten hose clamps securely.

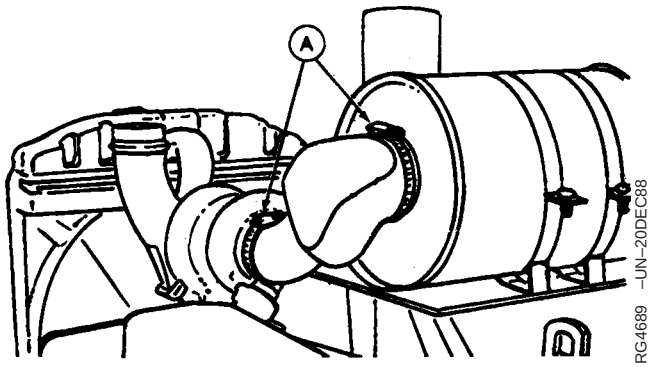



*Crankcase Vent Tube*

RG,RG34710,1055 –19–23OCT97–1/1

## CHECK AIR INTAKE SYSTEM

1. Replace air cleaner primary filter element. (See operator's manual.) 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 (A) 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.




*Air Intake Hose Clamps*

RG,RG34710,1056 –19–23OCT97–1/1

## CHECK EXHAUST SYSTEM

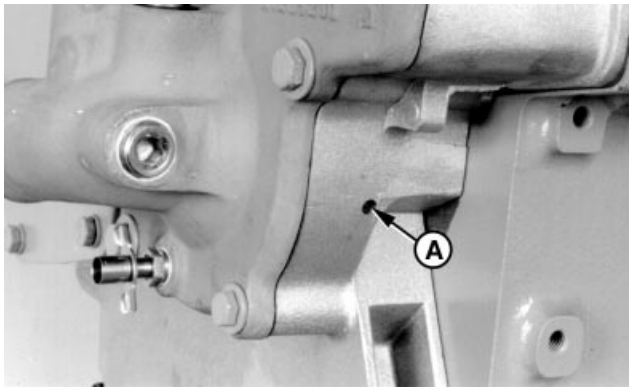
1. Inspect exhaust system for leaks or restrictions. Check manifold for cracks. Repair or replace as necessary.
2. Check that turbocharger-to-exhaust elbow adapter clamps are securely tightened and do not leak.
3. Check exhaust stack for evidence of oil leakage past valve stem seals.

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

RG,RG34710,1057 –19–23OCT97–1/1

## CHECK AND SERVICE COOLING SYSTEM

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




*Cooling System Weep Hole with Foam Filter*

**Continued on next page**

RG,RG34710,1058 –19–23OCT97–1/2

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

**IMPORTANT: Both water pump drain valve and block drain valve must be opened to completely drain the engine.**

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

7. 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, bleed plug at top front of cylinder head, or plug in thermostat housing to allow air to escape when filling system. Retighten fitting or plug when all the air has been expelled.**

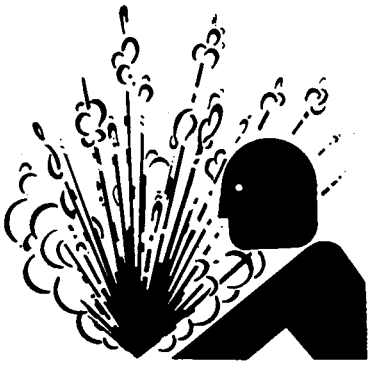
8. Fill cooling system with coolant. Follow recommendations in Group 02.

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

10. After engine cools, check coolant level.

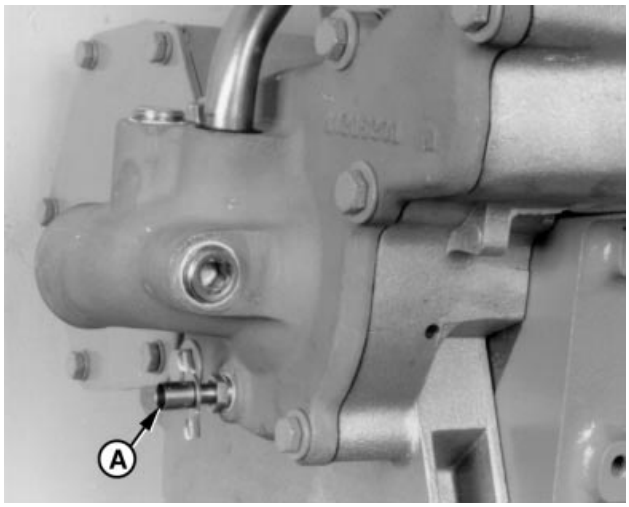
*NOTE: Coolant level should be even with bottom of radiator filler neck.*

11. Check system for holding pressure. (See PRESSURE TEST COOLING SYSTEM AND RADIATOR CAP in Group 105 of CTM134.)



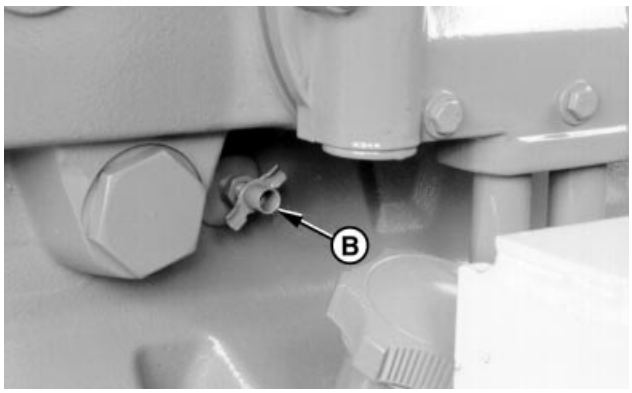
TS281 –UN–23AUG88

*Service Cooling System Safely*




RG7044 –UN–26NOV97

*Water Pump Drain Valve*




RG7143 –UN–26NOV97

*Cylinder Block Coolant Drain Valve*

RG,RG34710,1058 –19–23OCT97–2/2

## CHECK ELECTRICAL SYSTEM

**CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.**

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

**Always remove grounded (-) battery clamp first and replace it last.**

TS204 –UN–23AUG88

*Prevent Battery Explosions*

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

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

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

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

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

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

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

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

7. Check operation of starting motor and gauges.

*NOTE: For test and repair of alternators and starting motors, see Electrical System Repair chapter.*

RG,RG34710,1059 –19–23OCT97–1/1

## PRELIMINARY ENGINE TESTING BEFORE TUNE-UP

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

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

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

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

4. Perform compression test (See TEST ENGINE COMPRESSION PRESSURE in Group 105 of CTM134.)

RG,RG34710,1060 –19–23OCT97–1/1

## GENERAL TUNE-UP RECOMMENDATIONS

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

**IMPORTANT: Engines that are equipped with electronically-controlled governors have a diagnostic feature that will display detailed codes to alert operator of specific performance problems. Refer to CTM68, Electronic Fuel Injection Systems for diagnostic code troubleshooting procedures on Bosch ECU control systems. Refer to CTM134 for later John Deere ECU controls.**

| Operation | Detailed Reference |
|---|---|
| Change engine oil and filters. | Operator's Manual |
| Lubricate PTO clutch internal levers and linkage, if equipped. | Operator's Manual |
| Replace fuel filter. | Group 35/Operator's Manual |
| Clean crankcase vent tube. | This Group/Operator's Manual |
| Check air intake system. Replace air cleaner elements. | This Group/Operator's Manual |
| Check exhaust system. | This Group |
| Check and service engine cooling system. | This Group/Operator's Manual |
| Check and adjust fan and alternator belts. | Operator's Manual |
| Check electrical system. | This Group |
| Check crankshaft vibration damper. | Group 15/Operator's Manual |
| Inspect turbocharger and check turbocharger boost pressure. | Group 105 of CTM134 |
| Check fuel injection system: Check engine/injection pump timing: check and adjust speed advance; clean injection nozzles, and adjust opening pressure. | Group 35/Group 115 (CTM134) |
| Check engine oil pressure. Correct as necessary. | Group 105 of CTM134 |
| Check engine valve clearance. Adjust if necessary. | Group 05/Operator's Manual |
| Check engine speeds. Correct as necessary. | Authorized Servicing Dealer |
| Check engine performance on dynamometer. | This Group |

RG,RG34710,1061 –19–23OCT97–1/1

## DYNAMOMETER TEST

*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.
3. Run engine at fast idle.
4. Gradually increase load on engine until speed is reduced to rated speed rpm.
5. Read horsepower on dynamometer and record reading.
6. Compare readings taken with power rating level for your engine application. OEM power units are shown below.

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

RG,RG34710,1062 –19–23OCT97–1/1

## DYNAMOMETER TEST SPECIFICATIONS (OEM ENGINES)

| | 6081TF | 6081AF | 6081HF |
|---|---|---|---|
| **Industrial Applications** | | | |
| Continuous Net Rated Power at 2200 rpm Load Speed | 127 kW (170 hp) | 160 kW (215 hp) | 190 kW (255 hp) |
| Intermittent Net Rated power at 2200 rpm Load Speed | 149 kW (200 hp) | 168 kW (225 hp) | 224 kW (300 hp) |
| **Generator Applications** | | | |
| Prime Net Rated Power at 1800 rpm Load Speed | 142 kW (190 hp) | 168 kW (225 hp) | 218 kW (292 hp) |
| Standby Net Rated Power at 1500 rpm Load Speed | 130 kW (175 hp) | 157 kW (210 hp) | 200 kW (268 hp) |

RG,RG34710,1063 –19–23OCT97–1/1

## EFFECTS OF ALTITUDE AND TEMPERATURE ON ENGINE PERFORMANCE

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

| ATMOSPHERIC CHANGE | % POWER DECREASE |
|---|---|
| Fuel Temperature Rise of 1°C (1.8°F) above 40°C (104°F) | 0.29 |
| Air Temperature Rise of 5.5°C (10°F) above 25°C (77°F) | 0.50 |
| Naturally Aspirated Engines: Altitude Rise of 300 m (1000 ft) above 180 m (600 ft) | 3.00 |
| Turbocharged Engines: Altitude Rise of 300 m (1000 ft) above 183 m (600 ft) | 0.50 |
| Relative Humidity Rise of 10% above 0% | 0.07 |

If engine requires recalibration of fuel injection pump for acceptable performance at higher elevation, contact your local authorized fuel injection pump repair station for service.

RG,RG34710,1064 –19–23OCT97–1/1

# Cylinder Head and Valves

## SPECIAL OR ESSENTIAL TOOLS

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

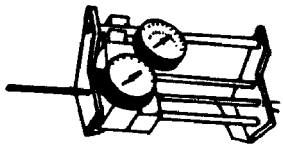
*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1065 –19–23OCT97–1/15

RG5061 –UN–05DEC97

Spring Compression Tester . . . . . D01168AA

Test valve spring compression.



RG5061

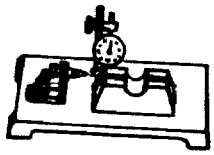
*D01168AA*

RG,RG34710,1065 –19–23OCT97–2/15

RG5062 –UN–05DEC97

Valve Inspection Center . . . . . D05058ST

Check valves for out-of-round.



RG5062

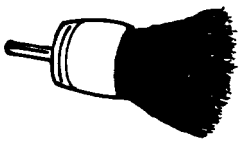
*D05058ST*

RG,RG34710,1065 –19–23OCT97–3/15

RG5063 –UN–05DEC97

End Brush . . . . . D17024BR

Clean valve seat and bores.



RG5063

*D172024BR*

**Continued on next page**

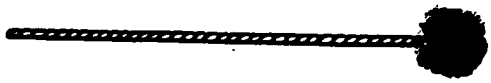
RG,RG34710,1065 –19–23OCT97–4/15

*Cylinder Head and Valves*

RG5099 –UN–23AUG88

Nozzle Threads Cleaning Brush . . . . . D17030BR

Used to clean nozzle threads in cylinder head.



*D17030BR*

RG,RG34710,1065 –19–23OCT97–5/15

RG6246 –UN–05DEC97

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

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

RG6246

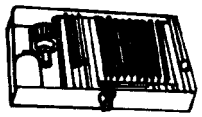
*D17526CI or D17527CI*

RG,RG34710,1065 –19–23OCT97–6/15

RG5064 –UN–05DEC97

Valve Guide Knurler Kit . . . . . JT05949

Knurl valve guides.



RG5064

*JT05949*

RG,RG34710,1065 –19–23OCT97–7/15

RG5065 –UN–05DEC97

Valve Seat Pilot Driver . . . . . JDE7

Install replacement valve seat inserts. Use with JDG605.

RG5065

*JDE7*

**Continued on next page**

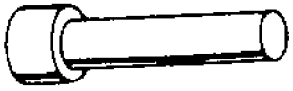
RG,RG34710,1065 –19–23OCT97–8/15

*Cylinder Head and Valves*

RG5068 –UN–05DEC97

Timing Pin . . . . . .JDE81-4

Lock engine at TDC when timing valve train, adjusting valve clearance, and installing fuel injection pump. Use with JDG820, JDE81-1 Flywheel Turning Tools.



RG5068

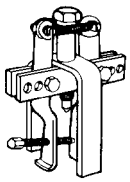
*JDE81-4*

RG,RG34710,1065 –19–23OCT97–9/15

RG5071 –UN–05DEC97

Valve Seat Puller . . . . . .JDE41296

Remove valve seats.



RG5071

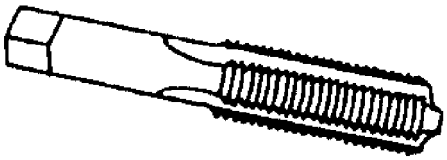
*JDE41296*

RG,RG34710,1065 –19–23OCT97–10/15

RG5100 –UN–05DEC97

Tap . . . . . JDF5

Used to restore nozzle threads in cylinder head.



RG5100

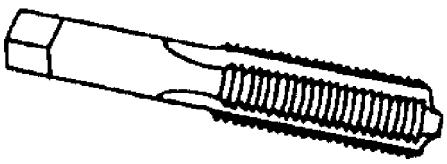
*JDF5*

RG,RG34710,1065 –19–23OCT97–11/15

RG5100 –UN–05DEC97

Tap . . . . . JDG681A

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



RG5100

*JDG681A*

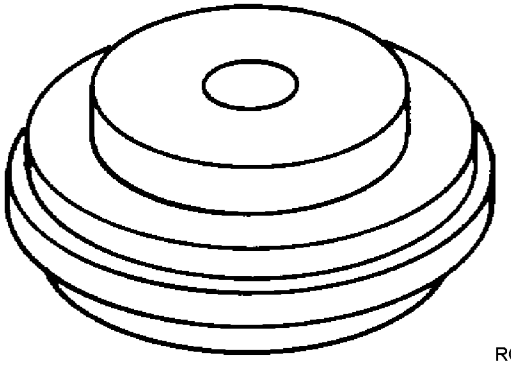
**Continued on next page**

RG,RG34710,1065 –19–23OCT97–12/15

*Cylinder Head and Valves*

Valve Seat Installer . . . . . JDG605

Install intake and exhaust valve seat inserts. Use with JDF7.



RG5240 –UN–05DEC97

*JDG605*

RG,RG34710,1065 –19–23OCT97–13/15

RG5612 –UN–12APR90

Nozzle Seat Reamer . . . . . JDG609

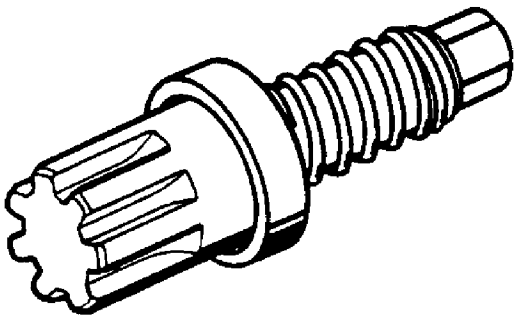
Use to clean carbon from nozzle seats in cylinder head.

*JDG609*

RG,RG34710,1065 –19–23OCT97–14/15

Flywheel Turning Tool . . . . . JDG820

Used to rotate engine to check damper radial runout and time engine. JDE81-1 may be used also if JDG820 is not available.



RG7056 –UN–05DEC97

*JDG820*

RG,RG34710,1065 –19–23OCT97–15/15

## CYLINDER HEAD AND VALVES SPECIFICATIONS

| ITEM | SPECIFICATION | WEAR LIMIT |
|---|---|---|
| Valve Lift at 0.00 mm (in.) Clearance: | | |
| Intake | 13.53—13.71 mm (0.533—0.540 in.) | 12.65 mm (0.498 in.) |
| Exhaust | 14.52—14.70 mm (0.572—0.579 in.) | 13.64 mm (0.537 in.) |
| Valve Clearance With Engine Cold (Rocker Arm-to-Valve Tip): | | |
| Intake | 0.46 ±0.05 mm (0.018 ±0.002 in.) | —— |
| Exhaust | 0.71 ±0.05 mm (0.028 ±0.002 in.) | —— |
| Valve Spring Compressed Height: Valve Closed[a] | | |
| Intake | 52.5 mm @ 345-399 N (2.07 in. @ 78-90 lb-force) | —— |
| Exhaust | 54.5 mm @ 284—338 N (2.15 in. @ 78—90 lb-force) | —— |
| Valve Open-Intake | 38.1 mm @ 810—880 N (1.50 in. @ 182—198 lb-force) | —— |
| Exhaust | 38.5 mm @ 797—867 N (1.52 in. @ 179—195 lb-force) | —— |
| Valve Head O.D.: | | |
| Intake | 50.87—51.13 mm (2.003—2.013 in.) | —— |
| Exhaust | 46.87—47.13 mm (1.845—1.856 in.) | —— |
| Valve Stem O.D.: | | |
| Exhaust | 9.44—9.46 mm (0.3717—0.3724 in.) | —— |
| Intake | 9.46—9.49 mm (0.3724—0.3736 in.) | —— |
| Oversize Valve (Stem) Available | 0.08, 0.38, 0.76 mm (0.003, 0.015, 0.030 in.) | —— |
| Valve Guide I.D. | 9.51—9.54 mm (0.3745—0.3755 in.) | —— |
| Valve Stem-to-Guide Clearance: | | |
| Exhaust | 0.051—0.102 mm (0.002—0.004 in.) | _____ |
| Intake | 0.025—0.076 mm (0.001—0.003 in.) | _____ |
| Valve Face Angle (Intake and Exhaust) | 29.25° ±0.25° | _____ |
| Valve Seat Angle (Intake and Exhaust) | 30° ±0.50° | _____ |
| Valve Seat Width: | | |
| Exhaust | 2.0—3.8 mm (0.79—0.150 in.) | _____ |
| Intake | 1.4—3.8 mm (0.055—0.150 in.) | _____ |
| Valve Seat Concentricity With Guide | 0.051 mm (0.0020 in.) | _____ |

[a]Free length may vary slightly between springs.

**Continued on next page**

*Cylinder Head and Valves*

| ITEM | SPECIFICATION | WEAR LIMIT |
|---|---|---|
| Valve Recess in Cylinder Head: | | |
| Intake | 3.35—3.86 mm (0.132—0.152 in.) | 4.62 mm (0.182 in.) |
| Exhaust | 1.19—1.70 mm (0.047—0.067 in.) | 2.46 mm (0.097 in.) |
| Maximum Valve Seat Runout | 0.051 mm (0.0020 in.) | _____ |
| Maximum Valve Face Runout | 0.051 mm (0.0020 in.) | _____ |
| Cylinder Firing Order | 1-5-3-6-2-4 | _____ |
| Rocker Arm I.D. | 19.07—19.10 mm (0.7507—0.7520 in.) | _____ |
| Rocker Arm Shaft O.D. | 19.01—19.05 mm (0.7484—0.7500 in.) | _____ |
| Cylinder Head Reconditioning: | | |
| Thickness of Head (Rocker Arm Cover Gasket Rail-to-Combustion Face) | 155.45—155.71 mm (6.120—6.130 in.) | _____ |
| Minimum Acceptable Head Out-of-Flat (Entire Length or Width) | 0.102 mm (0.0040 in.) | _____ |
| Combustion Face Surface Finish (Surface Mill Only) | 60—110AA | _____ |
| Maximum Material Removal for Resurfacing Head | 0.762 mm (0.0300 in.) | _____ |

**TORQUES**

Cylinder Head-To-Cylinder Block:[a]

| | |
|---|---|
| Flanged-Head “SPECIAL” Cap Screws (No Washers) | |
| Step 1 | 80 N•m (60 lb-ft) |
| Step 2[b] | Tighten an additional 90° |
| Step 3[b] | Tighten an additional 90° |
| Step 4[b] | Tighten an additional 90° |
| Rocker Arm Shaft Clamps | 75 N•m (55 lb-ft) |
| Rocker Arm Cover-to-Cylinder Head | 8 N•m (6 lb-ft) (72 lb-in.) |
| Intake Manifold-to-Cylinder Head | 47 N•m (35 lb-ft) |
| Exhaust Manifold-to-Cylinder Head | 47 N•m (35 lb-ft) |
| Valve Adjusting Screw Lock nut | 27 N•m (20 lb-ft) |

[a]See TORQUE-TO-YIELD FLANGED-HEAD CAP SCREWS—GRADE 180 MARKED “SPECIAL”, later in this group, for proper cap screw tightening sequence.

[b]Total of three turns MUST TOTAL 270° ± 5°.

RG,RG34710,1066 –19–23OCT97–2/2

*Cylinder Head and Valves*

## SERVICE EQUIPMENT AND TOOLS

*NOTE: Order tools from the U.S. SERVICEGARD™ Catalog. Some tools may be available from a local supplier.*

*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1067 –19–23OCT97–1/6

Valve Spring Compressor . . . . . JDE138

Compress valve springs when removing and installing valves.

RG,RG34710,1067 –19–23OCT97–2/6

Precision “Bevelled Edge” Straightedge . . . . . D05012ST

Check cylinder head flatness.

RG,RG34710,1067 –19–23OCT97–3/6

Plastic Brush . . . . . .

Clean valve guides.

RG,RG34710,1067 –19–23OCT97–4/6

Eccentrimeter . . . . . D11010KW

Measure valve seat-to-stem runout.

RG,RG34710,1067 –19–23OCT97–5/6

Heavy-Duty Seat Grinder Set. . . . . JT05893

Grind valve seats.

RG,RG34710,1067 –19–23OCT97–6/6

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| AR44402 (U.S.) | Valve Stem Lubricant | Lubricate valve stems. |
| PT569 (U.S.)<br>TY6332 (Canadian) | NEVER-SEEZ® Anti-Seize Lubricant | Turbocharger-to-exhaust manifold cap screws. |
| AR31790 (U.S.) | SCOTCH-GRIP® Plastic Adhesive | Rocker arm cover gasket. |

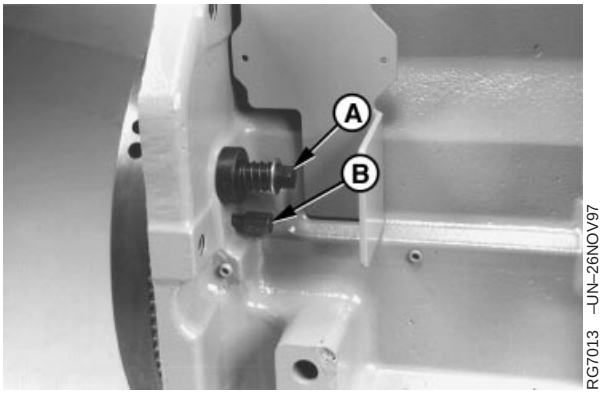
*NEVER-SEEZ is a trademark of Emhart Chemical Group.*
*SCOTCH-GRIP is a trademark of 3M Co.*

RG,RG34710,1068 –19–23OCT97–1/1

## CHECK AND ADJUST VALVE CLEARANCE

Too little valve clearance throws valves out of time. Valves open too early and close too late. This causes the valves to overheat due to hot combustion gases rushing past valves when out of time. Overheating lengthens valve stems which prevents proper seating of valves. The valves seat so briefly or poorly that normal heat transfer into the cooling system does not have time to take place, causing burned valves and low power.

Too much valve clearance causes a lag in valve timing causing engine valve train imbalance. The fuel-air mixture enters the cylinders late during intake stroke. The exhaust valve closes early and prevents waste gases from being completely removed from cylinders. Also, the valves close with a great deal of impact, which may crack or break the valves and scuff the camshaft and followers.




*Flywheel Turning Tool and Timing Pin*

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

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

1. Remove rocker arm cover with ventilator tube.

2. Remove plastic plug from cylinder block bores and install JDE81-1 or JDG820 Flywheel Turning Tool (A) and JDE81-4 Timing Pin (B).

3. Rotate engine with the flywheel turning tool until timing pin engages timing hole in flywheel.

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

   If the rocker arms for No. 6 cylinder are loose, the engine is at No. 6 “TDC-Compression.” Rotate the engine one full revolution to No. 1 “TDC-Compression.”

**Continued on next page**

RG,RG34710,1069 –19–23OCT97–1/2

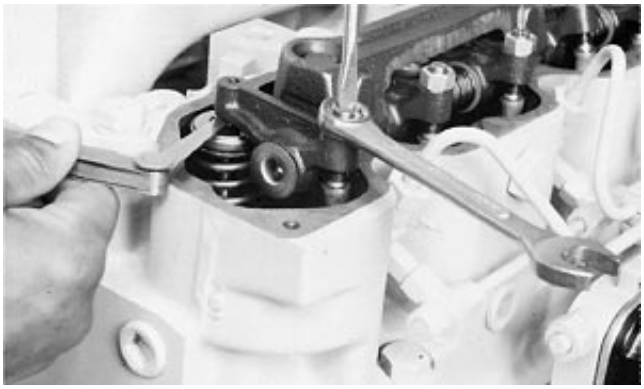
4. With engine lock-pinned at “TDC” of No. 1 piston’s compression stroke, check and adjust (as needed) valve clearance on Nos. 1, 3, and 5 exhaust valves and Nos. 1, 2, and 4 intake valves.

**Intake Valve—Specification**

Clearance ..... 0.46 ± 0.05 mm (0.018 ± 0.002 in.)

**Exhaust Valve—Specification**

Clearance ..... 0.71 ± 0.05 mm (0.028 ± 0.002 in.)



RG5241 –UN–06DEC88

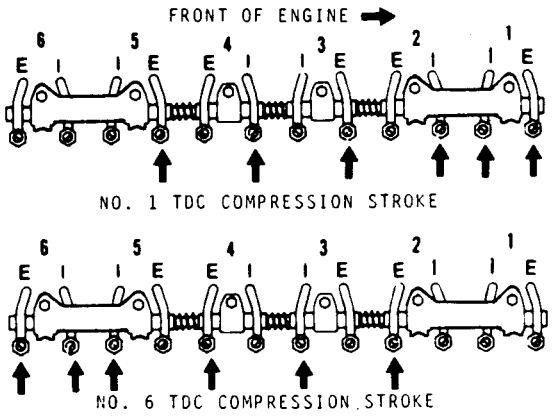
*Adjusting Valve Clearance*

5. If valve clearance needs to be adjusted, loosen the lock nut 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 lock nut to 27 N•m (20 lb-ft). Recheck clearance again after tightening lock nut. Readjust clearance as necessary.

6. Rotate flywheel 360° until No. 6 piston is at “TDC” of its compression stroke. Rocker arms for No. 6 piston should be loose.

7. Check and adjust (as needed) valve clearance to the same specifications on Nos. 2, 4, and 6 exhaust and Nos. 3, 5, and 6 intake valves. Tighten valve adjusting screw lock nut to 27 N•m (20 lb-ft).

8. Recheck clearance on all valves again after lock nut is tightened.




RG4295 –19–21AUG91

*Valve Adjusting Sequence*

RG,RG34710,1069 –19–23OCT97–2/2

## CHECK VALVE LIFT

**IMPORTANT: For a more accurate measurement, it is recommended that valve lift be measured at 0.00 mm (in.) valve clearance and with engine COLD.**

*NOTE: Measuring valve lift can give an indication of wear on camshaft lobes and cam followers or wear on camshaft lobes and cam followers or bent push rods.*

1. Remove turbocharger oil inlet clamp and rocker arm cover. Loosen lock nut on rocker arm. Set valve clearance at 0.00 mm (in.) on valve being checked. Tighten lock nut.
2. Put dial indicator tip on valve rotator. Be sure that valve is fully closed.
3. Check pre-set on dial indicator. Set dial indicator pointer at zero.
4. Manually turn engine in running direction, using the engine rotation tools previously mentioned for checking valve clearance.
5. Observe dial indicator reading as valve is moved to fully open position. Record reading and valve number.

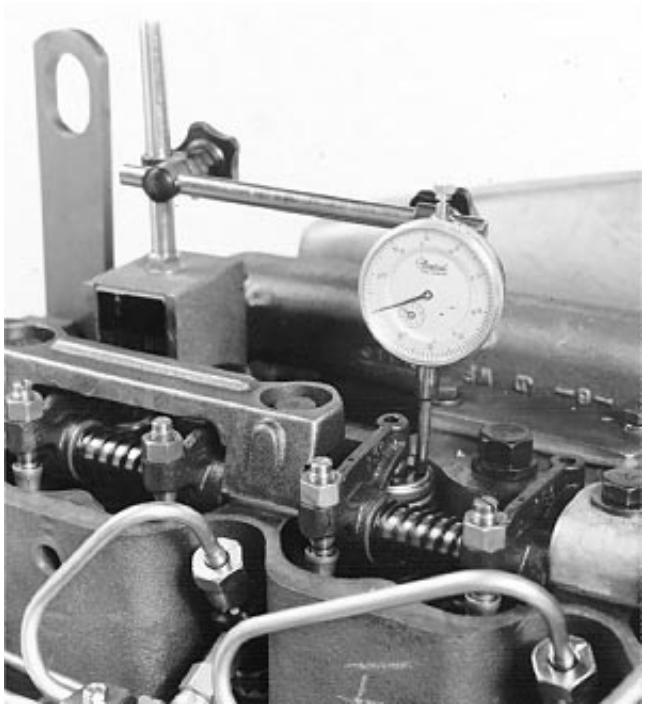
**Intake Valve—Specification**

| | |
|---|---|
| Lift | 13.53—13.71 mm (0.533—0.540 in.) at 0.00 mm (in.) clearance |
| Wear Tolerance | 12.65 mm (0.498 in.) at 0.00 mm (in.) clearance |

**Exhaust Valve—Specification**

| | |
|---|---|
| Lift | 14.52—14.60 mm (0.572—0.579 in.) at 0.00 mm (in.) clearance |
| Wear Tolerance | 13.64 mm (0.537 in.) at 0.00 mm (in.) clearance |

6. Reset valve clearance to specification after measuring lift. (See CHECK AND ADJUST VALVE CLEARANCE, earlier in this group.)
7. Repeat procedure on all remaining valves.



RG5789 –UN–09AUG91

*Checking Valve Lift*

RG,RG34710,1070 –19–23OCT97–1/1

## REMOVE CYLINDER HEAD

It is not necessary to remove engine from machine to service cylinder head on all applications. Refer to your Machine Technical Manual for engine removal procedure, if required.

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

**DO NOT drain coolant until the coolant temperature is below operating temperature. Always loosen drain valve slowly to relieve any excess pressure.**

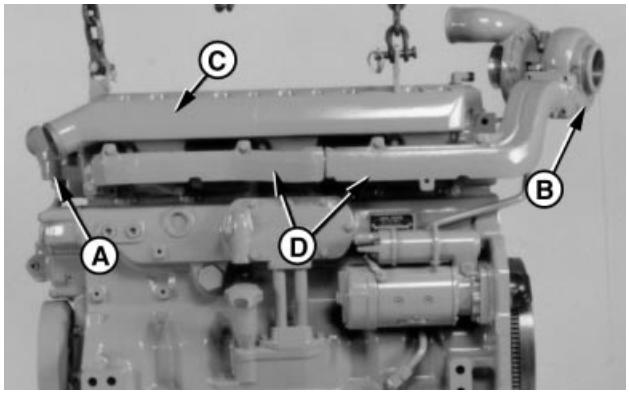
1. Drain engine oil and coolant. Disconnect turbocharger oil inlet line at turbocharger or oil filter base. (See DISCONNECT TURBOCHARGER OIL INLET LINE in Group 03.)

*NOTE: If cylinder head is being removed for piston and liner repairs or any other service that does not require disassembly of head, cylinder head can be removed with water manifold (A), turbocharger (B), intake manifold (C), and exhaust manifold (D) installed.*

2. Remove water manifold and all coolant piping. (See Group 25, Cooling System.)
3. Remove turbocharger. Remove front and rear exhaust manifold (D). (See Group 30, Air Intake and Exhaust System.)
4. Remove air intake manifold. (Group 30.)
5. Remove fuel injection delivery lines and injection nozzles. (See Group 35, Fuel System.)
6. Remove rocker arm cover with ventilator outlet hose assembly.

TS218 –UN–23AUG88

*Service Cooling System Safely*




RG7014 –UN–26NOV97

*Removing Cylinder Head*

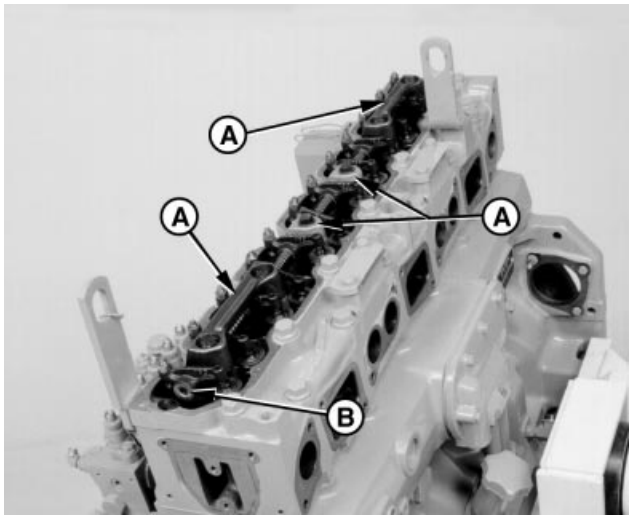
**A—Water Manifold**
**B—Turbocharger**
**C—Intake Manifold Assembly**
**D—Exhaust Manifold Assembly**

**Continued on next page**

7. Remove six cap screws and remove all four rocker arm shaft clamps (A). Lift rocker arm assembly (B) up and remove. Remove wear caps from valve stems.

8. Remove all 12 push rods and identify for reassembly.

*NOTE: Clean and inspect push rods as explained later in this group.*




RG7017 –UN–26NOV97

*Removing Rocker Arm Assembly*

RG7018 –UN–05DEC97

*Removing Push Rods*

**Continued on next page**

RG,RG34710,1071 –19–23OCT97–2/3

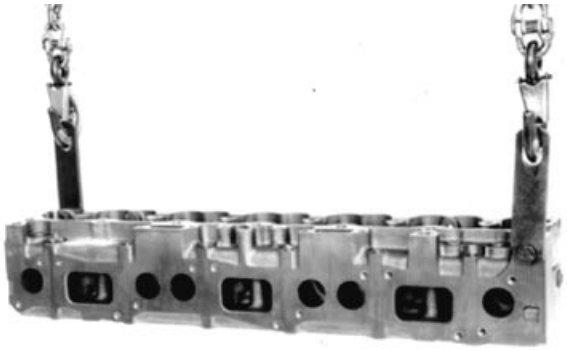
9. Remove all 26 cylinder head cap screws. Discard cap screws, they are not reusable.

**IMPORTANT: DO NOT use screwdrivers or pry bars between cylinder block and cylinder head to loosen head-to-block gasket seal.**

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

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

*NOTE: Do not rotate crankshaft with cylinder head removed unless all cylinder liners are secured with cap screws and large flat washers as described in Group 10, Cylinder Block, Liners, Piston, and Rods.*

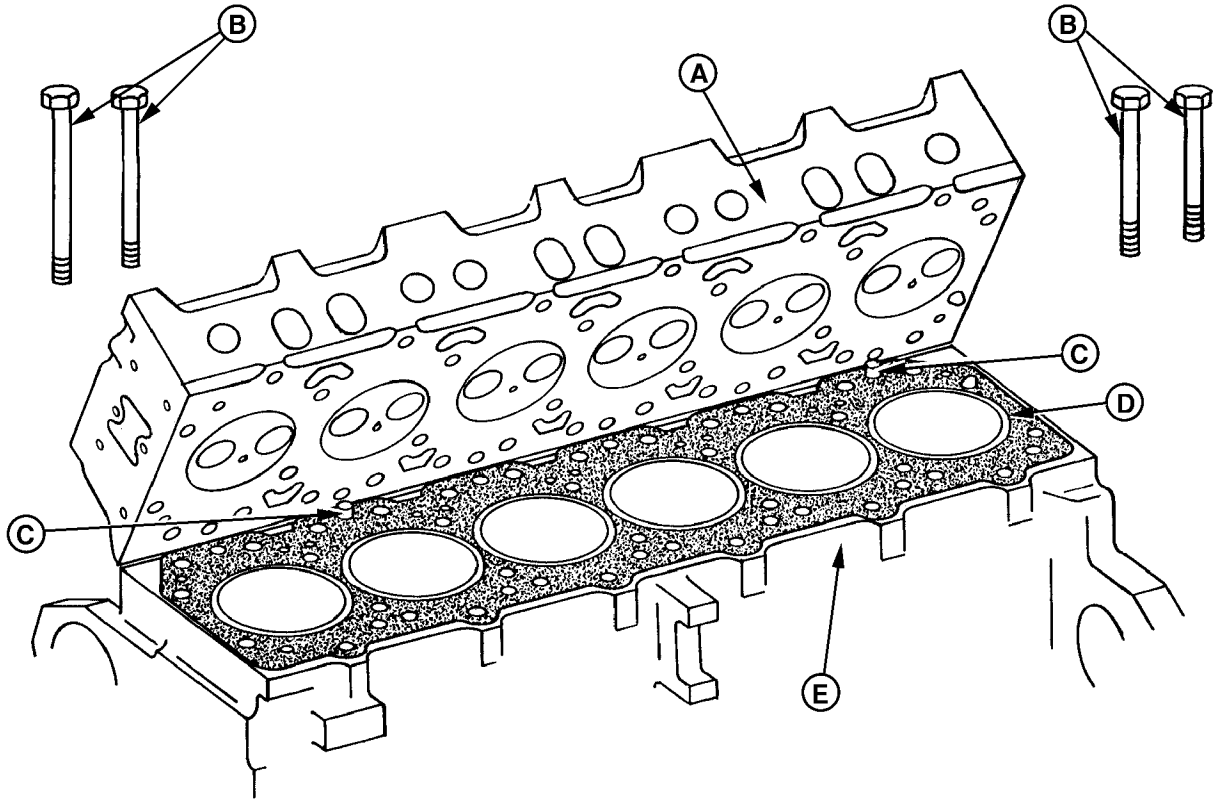


RG5245 –UN–05DEC97

*Lifting Cylinder Head From Block*

RG,RG34710,1071 –19–23OCT97–3/3

## HEAD GASKET JOINT CONSTRUCTION AND OPERATION

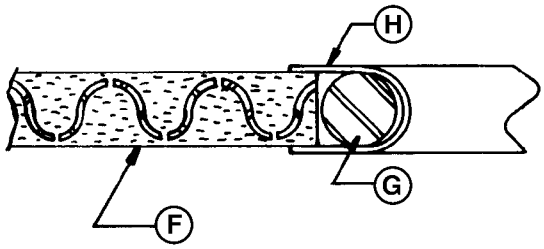



RG6447 –UN–26NOV97

The head gasket joint consist of:

- 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).




RG6430 –UN–03NOV97

**A—Cylinder Head**
**B—Cylinder Head Cap Screws**
**C—Dowel Pins**
**D—Cylinder Liners**
**E—Cylinder Block**
**F—Gasket Body**
**G—Fire Ring Combustion Seal**
**H—Stainless Flange**

**Continued on next page**

RG,RG34710,1072 –19–23OCT97–1/2

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 local 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.

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,RG34710,1072 –19–23OCT97–2/2

## DIAGNOSING HEAD GASKET JOINT FAILURES

Head gasket failures generally fall into three categories:

- Combustion seal failures.
- Coolant seal failures.
- Oil seal failures.

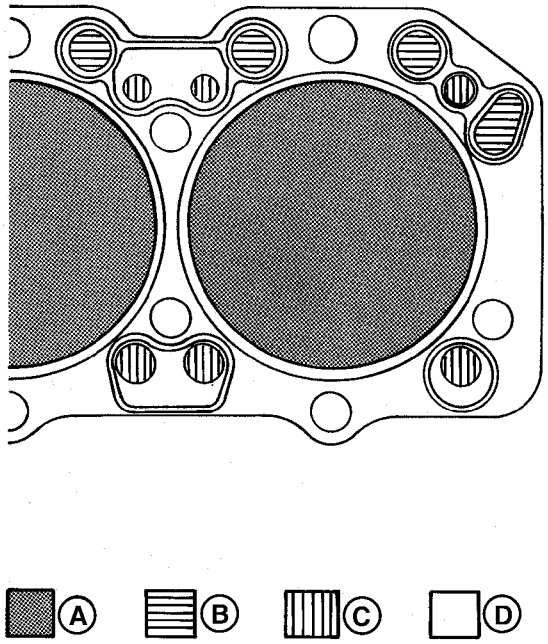
Combustion seal failures occur when combustion gases escape between cylinder head and head gasket combustion flange, or between combustion flange and cylinder liner. Leaking combustion gases may vent to an adjacent cylinder, to a coolant or oil passage, or externally.

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.
   - Damaged or incorrect radiator pressure cap.
   - Presence of oil in coolant.
   - Low coolant levels.
   - Improper coolant.
   - Unusually high or low oil levels.
   - Unburned fuel or coolant in exhaust system.




RG6449 –UN–26NOV97

*Diagnosing Cylinder Head Gasket Joints*

**A—Combustion Sealing Areas**
**B—Oil Sealing Areas (Push Rod)**
**C—Coolant Sealing Areas**
**D—Cylinder Head Cap Screws**

**Continued on next page**

- Oil degradation, dilution, or contamination.
- Incorrectly specified injection pump.
- Indications of fuel or timing adjustments.

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 measuring equipment, check for the following:

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

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
- Engine overheating
- Power loss
- Engine runs rough
- White exhaust smoke
- Loss of cab heat (vehicle engines)

**Continued on next page**

- 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
- Leaks in cooling system or engine overheating

*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
- Damage/voids in elastomer beading of gasket

**Continued on next page**

*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)

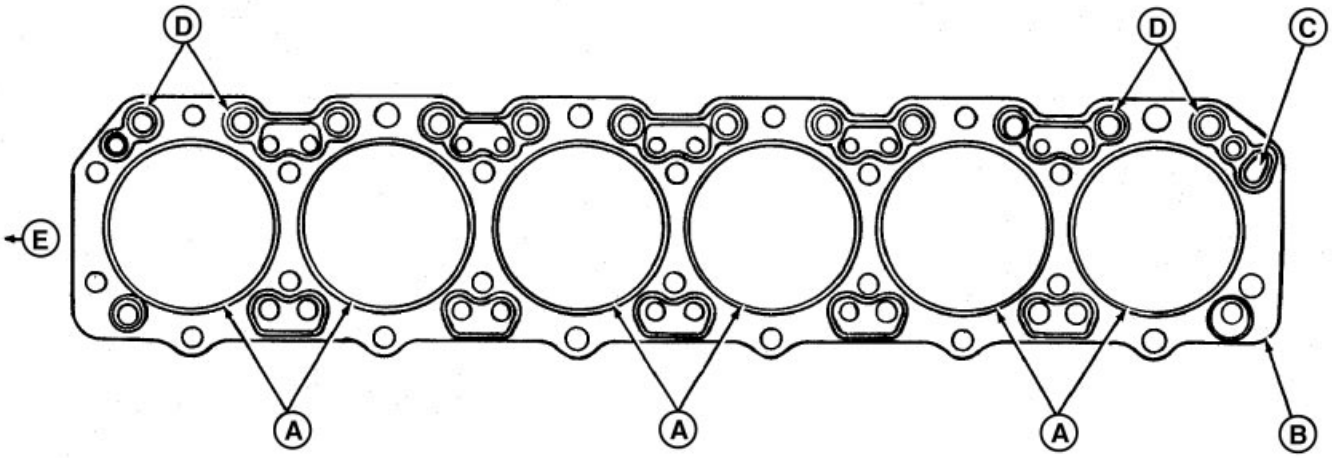
**Possible Causes:**

- 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 of gasket
- Damaged/missing O-ring seal at oil port to rocker arms

*NOTE: Defective oil cooler may also allow oil leakage into coolant.*

RG,RG34710,1073 –19–23OCT97–4/4

## HEAD GASKET INSPECTION AND REPAIR SEQUENCE




RG6448 –UN–26NOV97

*Inspecting Cylinder Head Gasket*

**A—Combustion Seals (Flange)** **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 area (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.)

**Continued on next page**

RG,RG34710,1074 –19–23OCT97–1/2

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

   Cylinder Head (See Group 05.)

   - Check surface flatness/finish.
   - 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,RG34710,1074 –19–23OCT97–2/2

## DISASSEMBLE AND INSPECT ROCKER ARM SHAFT ASSEMBLY

*NOTE: Make preliminary inspection during disassembly. Look for:*

- *Worn or scored rocker arms, shaft, and shaft support*
- *Weak or broken springs*
- *Lube oil restriction*

1. Remove plugs (A) and washers (B) from ends of rocker arm shaft.

2. Slide springs, rocker arms, and rocker arm supports off rocker arm shaft identifying their parts for reassembly in the same sequence they were in before disassembly.


*Rocker Arm Shaft Assembly*

**Continued on next page**

RG,RG34710,1075 –19–23OCT97–1/3

3. Inspect rocker arm shaft (A) for severe scratching, scoring, or excessive wear at points of rocker arm contact. Measure rocker arm and shaft. Compare with specifications given below

**Rocker Arm Assembly—Specification**

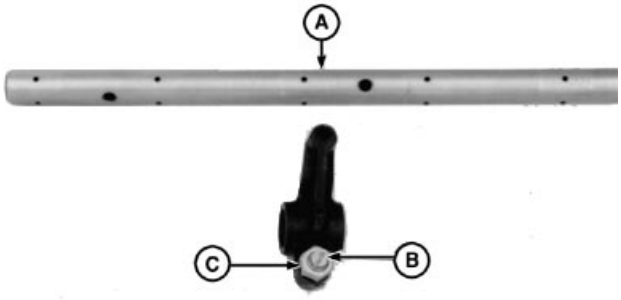
| | |
|---|---|
| I.D. | 19.07—19.10 mm (0.7507—0.7520 in.) |
| Shaft O.D. | 19.01—19.05 mm (0.7484—0.7500 in.) |

*NOTE: Wear could indicate weak valve springs, bent push rods, or loose rocker arm shaft clamps.*

4. Check rocker arm adjusting nut (C) and screw (B) for damage. Visually inspect rocker arm for hairline cracks. Replace if necessary.

**IMPORTANT: Be sure all oil holes in rocker arm shaft are clean and open.**

5. Clean all rocker arm parts with clean solvent. Dry with compressed air.




RG3802 –UN–04DEC97

*Rocker Arm Parts*

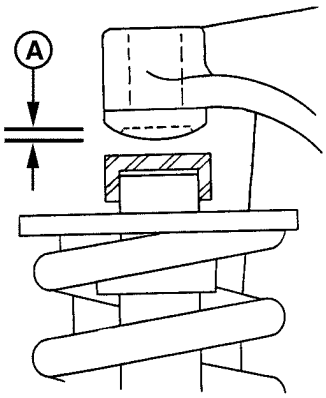
RG,RG34710,1075 –19–23OCT97–2/3

6. Check for cups or concave wear (A) on ends of rocker arms where they contact wear caps.

7. Examine spacer springs on shaft between rocker arms. Be sure they are strong enough to exert a positive pressure on rocker arms.

*NOTE: If the rocker arm has been damaged by a valve failure, replace it and the push rods when replacing valves.*

8. Roll rocker arm shaft and push rods on a flat surface to check for bends or distortion. Replace parts as necessary.




RGR26131 –UN–12JAN98

*Rocker Arm Wear Area*

RG,RG34710,1075 –19–23OCT97–3/3

## ASSEMBLE ROCKER ARM SHAFT ASSEMBLY

Assemble parts on rocker arm shaft in reverse of removal procedure.

Make sure rocker arm shaft end plugs (A) are firmly seated against end of shaft, and washers (B) are installed on shaft.


*Rocker Arm Shaft Assembly*

RG,RG34710,1076 –19–23OCT97–1/1

## MEASURE VALVE RECESS

Measure and record valve recess dimensions for all valves using JDG451 Gauge with D17526CI (English, in.) or D17527CI (Metric, mm) Dial Indicator or KJD10123 Gauge. Compare measurements to specifications given below.

**Exhaust Valve—Specification**

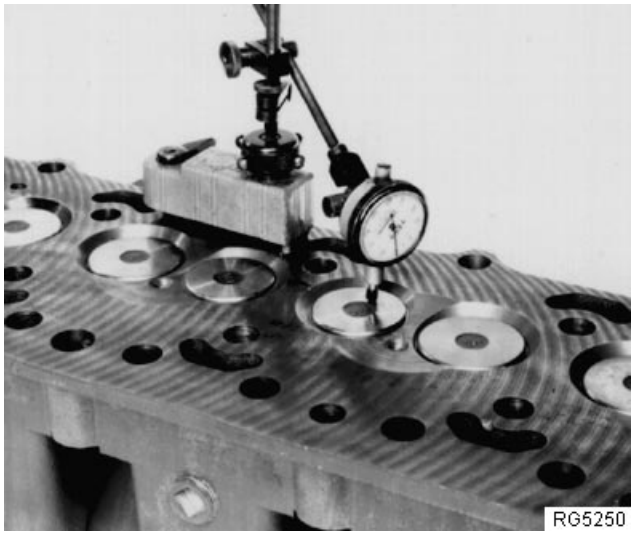
Recess..... 1.19—1.70 mm (0.047—0.067 in.) below cylinder head
Recess..... 2.46 mm (0.097 in.) maximum below cylinder head

**Intake Valve—Specification**

Recess..... 3.345—3.86 mm (0.132—0.152 in.) below cylinder head
Recess..... 4.62 mm (0.182 in.) maximum below cylinder head

*NOTE: Thoroughly clean all gasket material from cylinder head combustion face before measuring.*

*If measurement does not meet specifications, check valve face angle and valve seat angle. If valve is recessed beyond the maximum specification, install either new valves, valve seat inserts, or both to obtain proper valve recess. (See REMOVE VALVE SEAT INSERTS AND MEASURE BORES IN CYLINDER HEAD, later in this group.)*




*Measuring Valve Recess*

RG,RG34710,1077 –19–23OCT97–1/1

## PRELIMINARY CYLINDER HEAD AND VALVE CHECKS

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

Look for the following conditions:

**STICKING VALVES:**

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

**WARPED, WORN, OR DISTORTED VALVE GUIDES:**

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

**DISTORTED CYLINDER HEAD AND GASKET LEAKAGE:**

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

**WORN OR BROKEN VALVE SEATS:**

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

**BURNED, PITTED, WORN, OR BROKEN VALVES:**

- Worn or distorted valve seats.
- Loose valve seats.
- Worn valve guides.
- Insufficient cooling.
- Cocked or broken valve springs.
- Improper engine operation.
- Improper valve train timing.
- Faulty valve rotators.
- Warped or distorted valve stems.
- “Stretched” valves due to excessive spring tension.
- Warped cylinder head.
- 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 VALVE RECESSION:**

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

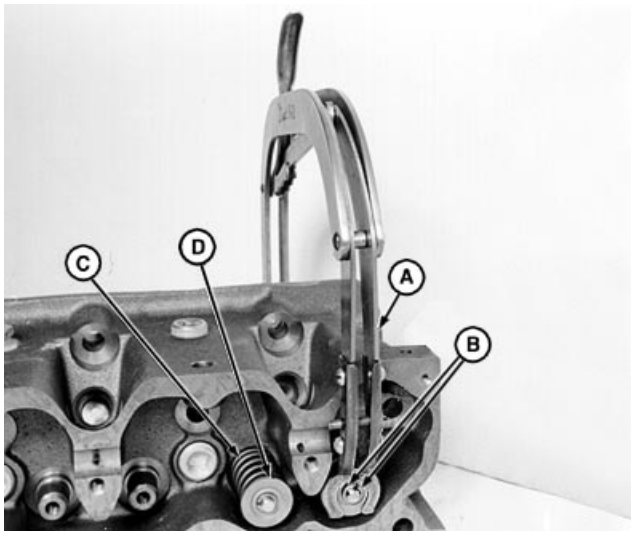
RG,RG34710,1078 –19–23OCT97–1/1

## REMOVE VALVE ASSEMBLY

Refer to PRELIMINARY CYLINDER HEAD AND VALVE CHECKS, earlier in this group as valves are removed from head.

**IMPORTANT: Identify all usable parts for correct reassembly in same location as removed.**

1. Compress valve spring using JDE138 Valve Spring Compressor (A) as shown.
2. Remove retaining locks (B) using a small magnet.
3. Remove valve spring compressor from head.
4. Remove valve spring cap (D) and valve spring (C).




RG7228 –UN–05DEC97

*Removing Valve Assemblies*

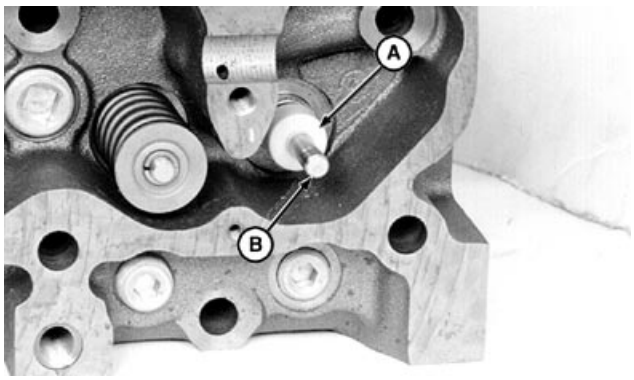
**A—JDE138 Valve Spring Compressor**
**B—Retainer Locks**
**C—Valve Springs**
**D—Valve Spring Caps**

RG,RG34710,1079 –19–23OCT97–1/2

5. Remove oil shield (A) from exhaust valves. Remove valve (B) from cylinder head. Identify valve for reassembly, if valve is to be reused.

*NOTE: Intake valves do not have stem seals.*

6. Repeat procedure on remaining valves.




RG7229 –UN–05DEC97

*Removing Valves*

RG,RG34710,1079 –19–23OCT97–2/2

## INSPECT AND MEASURE VALVE SPRINGS

1. Inspect valve springs for alignment, wear, and damage.
2. Put springs on a flat surface to see that they are square and parallel.
3. Check valve spring tension using D01168A Spring Compression Tester.

**Intake Valve Spring—Specification**

Tension ..... 810—880 N (182—198 lb-force) with valve open
Height ..... 38.1 mm (1.50 in.) with valve open
Tension ..... 345—399 N (78—90 lb-force) with valve closed
Height ..... 52.5 mm (2.07 in.) with valve closed

**Exhaust Valve Spring—Specification**

Tension ..... 797—867 N (179—195 lb-force) with valve open
Height ..... 38.5 mm (1.52 in.) with valve open
Tension ..... 284—338 N (64—76 lb-force) with valve closed
Height ..... 54.5 mm (2.15 in.) with valve closed

*NOTE: Free spring length of 65 mm (2.56 in.) springs differ slightly, but compressed height must be the same.*

RG2732 –UN–04DEC97

*Valve Spring*

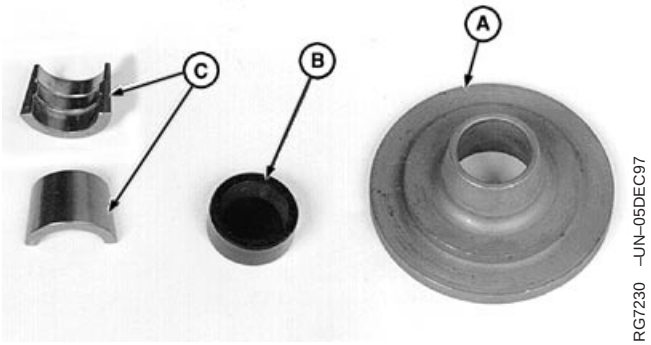
T82054 –UN–08NOV88

*Checking Valve Spring Tension*

RG,RG34710,1080 –19–23OCT97–1/1

## INSPECT VALVE SPRING CAPS, WEAR CAPS, AND RETAINER LOCKS

1. Inspect valve spring caps (A) in area where valve springs and retaining locks seat for excessive wear. Replace as needed.
2. Inspect retainer locks (C) for excessive wear. Replace as needed.
3. Inspect valve wear cap (B) contact surfaces. Replace wear caps if pitted or worn.




*Inspecting Valve Parts*

RG,RG34710,1081 –19–23OCT97–1/1

## 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 stem. Polish valve stem with steel wool or crocus cloth to remove scratch marks left by wire brush.

**IMPORTANT: Any carbon left on valve stem will affect alignment in refacer if valves need to be refaced.**

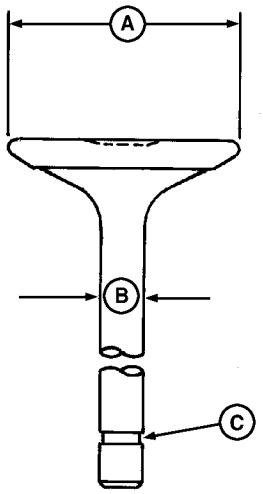
RG,RG34710,1082 –19–23OCT97–1/1

## INSPECT AND MEASURE VALVES

1. Thoroughly clean and inspect valves to help determine if they can be restored to a serviceable condition. Replace valves that are burned, cracked, eroded, or chipped.

2. Inspect valve retainer lock groove (C) on valve stem for damage. Also inspect stems for signs of scuffing, which may indicate insufficient valve guide-to-valve stem clearance. Replace if defects are evident.

3. Measure valve head O.D. (A). Compare valve stem O.D. (B) with guide I.D. to determine clearance, as outlined later in this group.VALVE STEM OD SPECIFICATIONS




RG5795 –UN–05DEC97

*Measuring Valves*

**Intake Valve Stem—Specification**

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

**Exhaust Valve Stem—Specification**

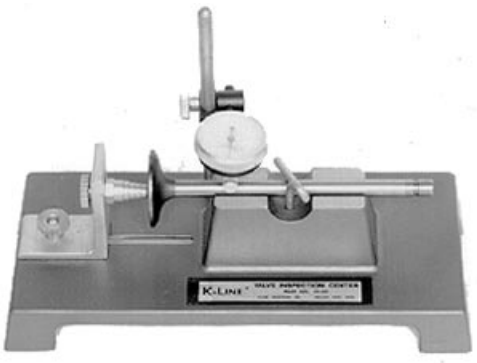
OD ..... 7.848—7.874 mm (0.3090—0.3100 in.)

RG,RG34710,1083 –19–23OCT97–1/2

4. Using D05058ST Valve Inspection Center to determine if valves are out of round, bent or warped.

**Valve Face—Specification**

Runout ..... 0.05 mm (0.002 in.) maximum permissible



RG4234 –UN–05DEC97

*Valve Face Runout Check*

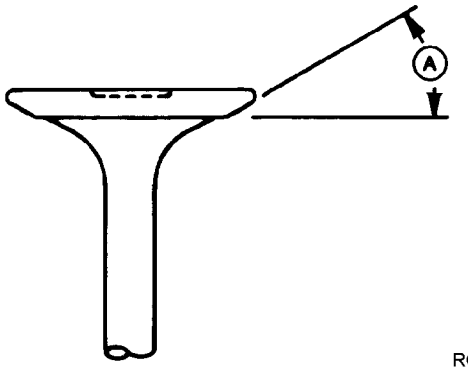
RG,RG34710,1083 –19–23OCT97–2/2

## GRIND (REFACE) VALVES

**IMPORTANT: Valve grinding should only be done by experienced personnel familiar with equipment and capable of maintaining required specifications.**

If necessary to reface valve, grind valve face to an angle of 29.25° ± 0.25° (A).

**IMPORTANT: When valve faces are ground, it is important not to nick valve head-to-stem radius with facing stone. A nick could cause the valve to break. Radius all sharp edges after grinding.**




*Valve Face Angle*

RG,RG34710,1084 –19–23OCT97–1/1

## 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 brass or copper wire brush to clean sealing surfaces.

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

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

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

RG,RG34710,1085 –19–23OCT97–1/1

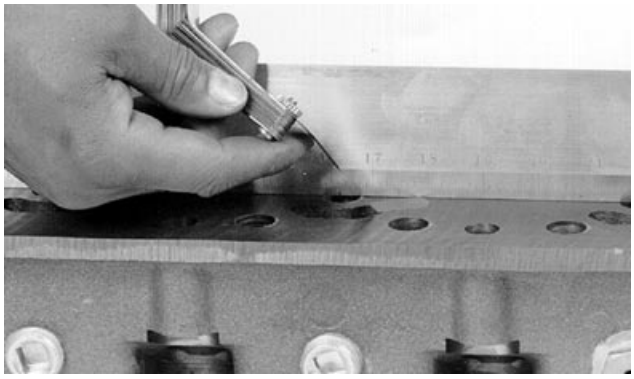
## CHECK CYLINDER HEAD COMBUSTION FACE FLATNESS

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

If any measurement exceeds this specification, the cylinder head must be either resurfaced or replaced. (See MEASURE CYLINDER HEAD THICKNESS, later in this group.)

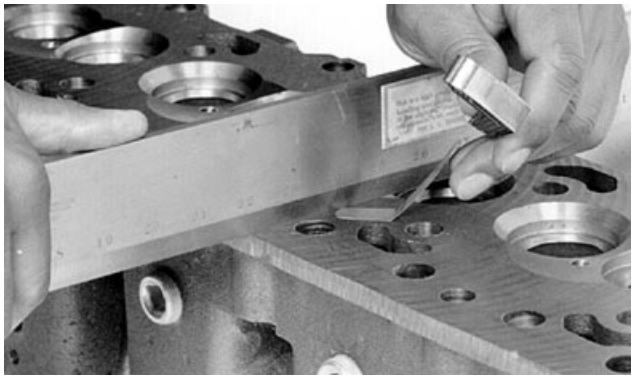
**Cylinder Head—Specification**

| | |
|---|---|
| Flatness | 0.08 mm (0.003 in.) maximum acceptable out-of-flat over entire length or width |
| Straightness | Within 0.025 mm (0.001 in.) per any 305 mm (12 in.) length |



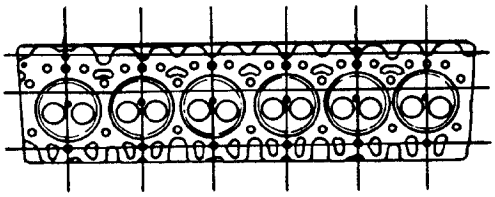
RG7231 –UN–05DEC97

*Checking Flatness of Cylinder Head (1)*



RG7232 –UN–05DEC97

*Checking Flatness of Cylinder Head (2)*



RG4629 –UN–05DEC97

RG4629

*Location to Check for Head Flatness*

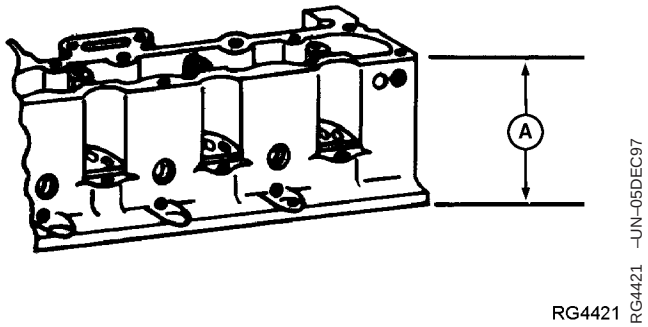
RG,RG34710,1086 –19–23OCT97–1/1

## MEASURE CYLINDER HEAD THICKNESS

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

**Cylinder Head—Specification**

| | |
|---|---|
| Thickness | 155.45—155.71 mm (6.120—6.130 in.) |
| Wear Limit | 154.69 mm (6.09 in.) |
| Combustion Face Surface Finish (Surface Mill Only to AA Finish) | 1.5—2.8 micrometers (60—110 micro-in.) |
| Wave Depth | 0.012 mm (0.0005 in.) maximum |




*Cylinder Head Thickness*

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

**IMPORTANT: After resurfacing, check flatness as described earlier and check surface finish on combustion face of head.**

**Check valve recess after grinding. (See MEASUREMENT VALVE RECESS, earlier in this group.) Valve face may be ground to bring this characteristic within specification.**

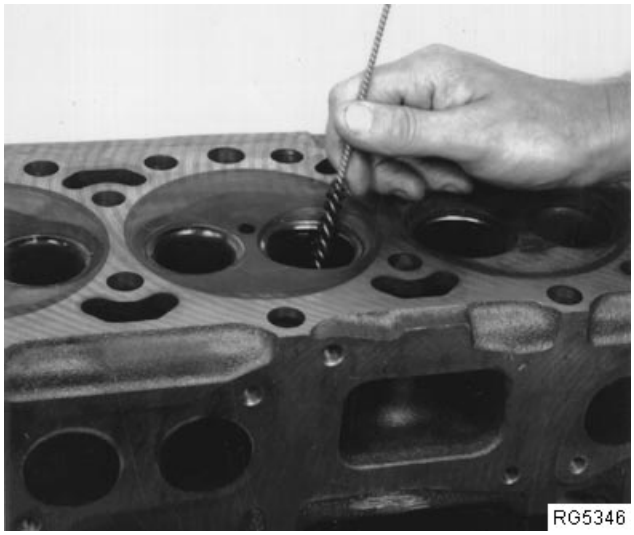
*NOTE: If necessary to resurface cylinder head, a MAXIMUM of 0.762 mm (0.030 in.) can be ground from new part dimension. Remove ONLY what is necessary to restore flatness.*

RG,RG34710,1087 –19–23OCT97–1/1

## CLEAN VALVE GUIDES

Use a D17011BR Valve Guide Cleaning Brush to clean valve guides before inspection or repair.

*NOTE: A few drops of light oil or kerosene will help to fully clean the guide.*




*Cleaning Valve Guides*

RG,RG34710,1088 –19–23OCT97–1/1

## MEASURE VALVE GUIDES

Measure valve guides (A) for wear using a telescope gauge (B) and micrometer.

**Valve Guide—Specification**

ID ..... 9.51—9.54 mm (0.3745—0.3755 in.) in new head

**New Guide-to-Exhaust Valve Stem—Specification**

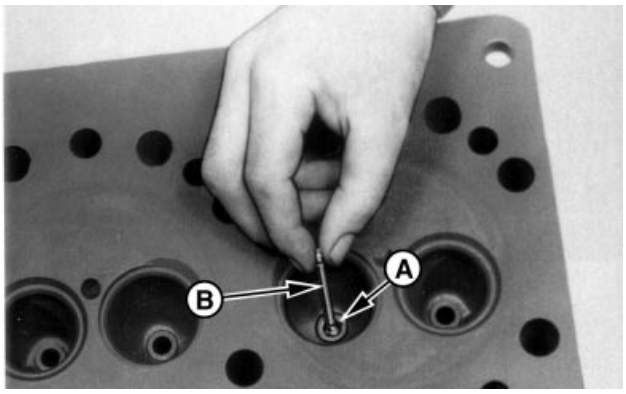
Clearance ..... 0.051—0.102 mm (0.002—0.004 in.)

**New Guide-to-Intake Valve Stem—Specification**

Clearance ..... 0.025—0.076 mm (0.001—0.003 in.)

**IMPORTANT: ALWAYS knurl exhaust valve guides before reaming to assure proper valve guide-to-stem clearance.**

*NOTE: Worn guides can allow a clearance of 0.15 mm (0.006 in.) and still be acceptable. Worn guides may be knurled to return them to specified clearance if valve-to-guide clearance is 0.25 mm (0.010 in.) or less. If clearance exceeds 0.25 mm (0.010 in.), install oversize valves.*




*Measuring Valve Guides*

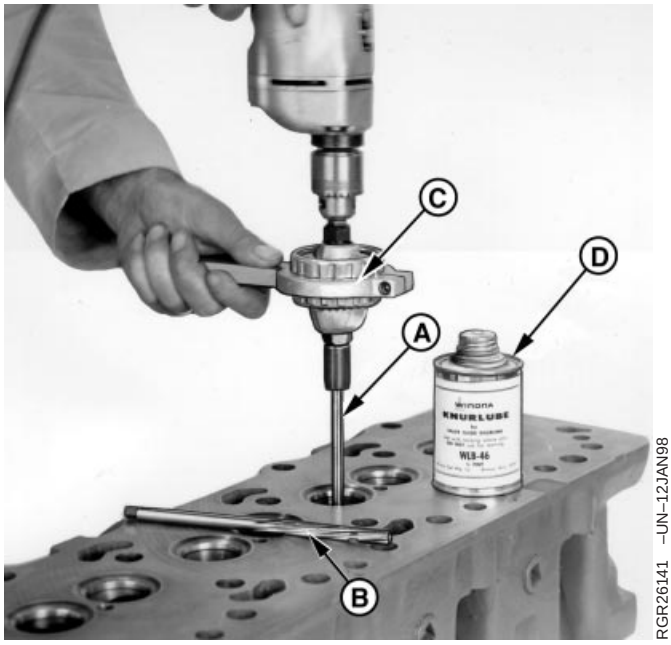
RG,RG34710,1089 –19–23OCT97–1/1

## KNURL VALVE GUIDES

1. Use JT05949 (formerly D20002) Valve Guide Knurler Kit to knurl valve guides.

*NOTE: Use tool set exactly as directed by the manufacturer.*

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




*Knurling Valve Guides*

**A—Knurler**
**B—Reamer**
**C—Speed Reducer**
**D—Lubricant**

RG,RG34710,1090 –19–23OCT97–1/1

## CLEAN AND INSPECT VALVE SEATS

1. Use an electric hand drill with D17024BR Wire Cleaning Brush or equivalent brush to remove all carbon on valve seats.

2. Check seats for cracks, pits, or excessive wear.

3. Check entire combustion face for rust, scoring, pitting, or cracks.


*Cleaning Valve Seats*

RG,RG34710,1091 –19–23OCT97–1/1

## MEASURE VALVE SEATS

1. Measure valve seats for proper specifications listed below.
2. Using D11010KW Eccentrimeter, measure valve seat runout (D).
3. If valve seat is not within specification, recondition valve seat by grinding or replace valve seat inserts (A) if reconditioning is not possible. (See GRIND VALVE SEATS or INSTALL VALVE SEAT INSERTS, later in this group.)

**Valve Seat—Specification**

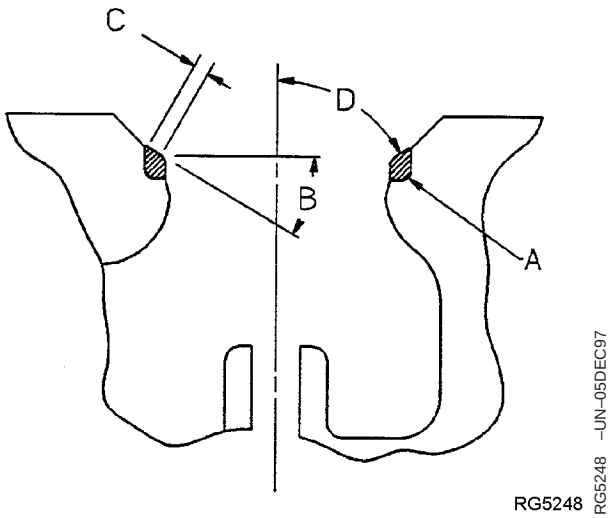
Angle ..... 30° ± 0.50°
Maximum Runout ..... 0.051 mm (0.0020 in.)

**Exhaust Valve—Specification**

Width..... 2.0—3.8 mm (0.079—0.150 in.)

**Intake Valve—Specification**

Width..... 1.4—3.8 (0.055—0.150 in.)




*Measuring Valve Seats*

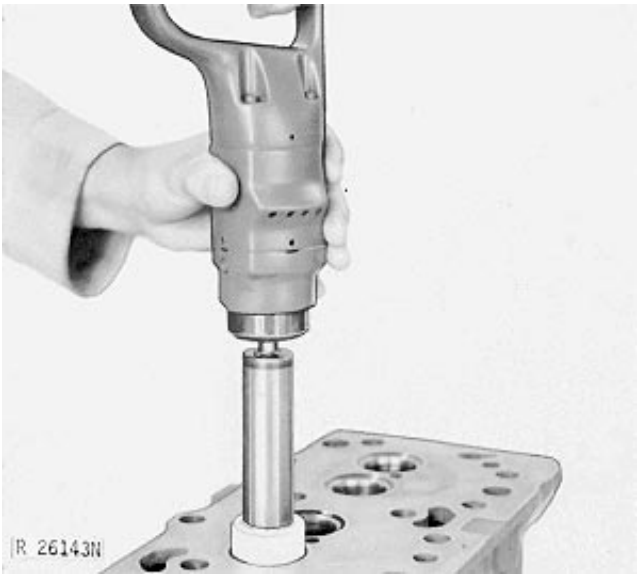
**A—Valve Seat Insert**
**B—Valve Seat Angle**
**C—Valve Seat Width**
**D—Valve Seat Runout**

RG,RG34710,1092 –19–23OCT97–1/1

## 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 work area clean when grinding valve seats. A 120-grit stone MUST BE used for grinding both intake and exhaust valve seat inserts (A).**

**Using JT05893 Heavy-Duty Seat Grinder Set, grind valve seats to obtain correct valve recess in cylinder head. (See MEASURE VALVE RECESS earlier in this group.) Be sure valve guide bores are clean before grinding valve seats. (See CLEAN VALVE GUIDES earlier in this group.)**




R26143N –UN–09DEC88

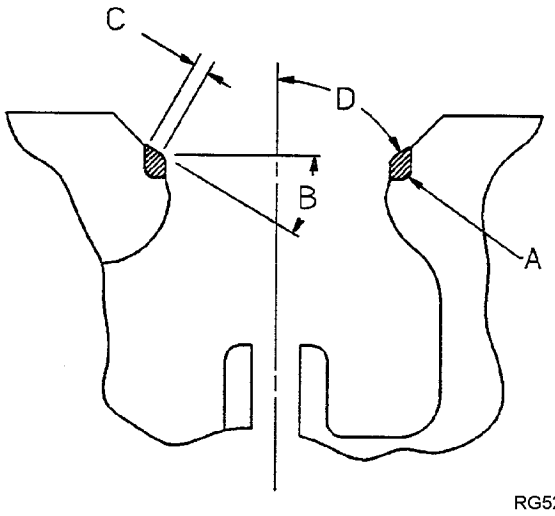
*Grinding Valve Seats*

If valve seats need grinding, only a few seconds are required to recondition the average valve seat. Avoid the tendency to grind off too much. Do not use excessive pressure on the grinding stone.

1. Check the seat width (C) and contact pattern between the seat and valve with bluing. Seat width MUST BE maintained within specification. Use a vernier caliper or scale to measure seat width. Thoroughly clean seat area after grinding and replace valves and valve seat inserts as necessary.

*NOTE: Valve seat width can be reduced with a narrowing stone. This will change the angle (B) at the top of the seat and increase the diameter. If valve seat width is too narrow, valve may burn or erode. Varying the width changes the fine contact between valve face and seat.*

2. ALWAYS measure valve seat runout after grinding using D11010KW Eccentrimeter and check recess in cylinder head after grinding as described later.




RG5248 –UN–05DEC97

*Measuring Valve Seats*

**A—Valve Seat Insert**
**B—Valve Seat Angle**
**C—Valve Seat Width**
**D—Valve Seat Runout**

**Continued on next page**

**Valve Seat—Specification**

| | |
|---|---|
| Angle | 30° ± 0.50° |
| Exhaust Width | 2.0—3.8 mm (0.079—0.150 in.) |
| Intake Width | 1.4—3.8 mm (0.055—0.150 in.) |
| Maximum Seat Runout | 0.051 mm (0.0020 in.) |

RG,RG34710,1093 –19–23OCT97–2/2

## REMOVE VALVE SEAT INSERTS AND MEASURE BORES IN CYLINDER HEAD

In some cases the valve seat bore in the cylinder head may become damaged or oversized and will require machining. In this case, oversize inserts are available in 0.25 mm (0.010 in.) oversize only.

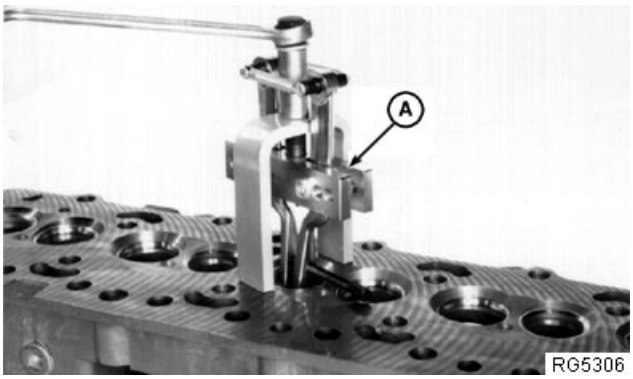
**IMPORTANT: Be careful not to damage cylinder head when removing seats.**

1. Remove valve seat insert (if necessary) with JDE41296 Valve Seat Puller (A). Adjusting screw on puller may need to be retightened during removal of inserts.

   Valve seat inserts may be also removed using the following method:

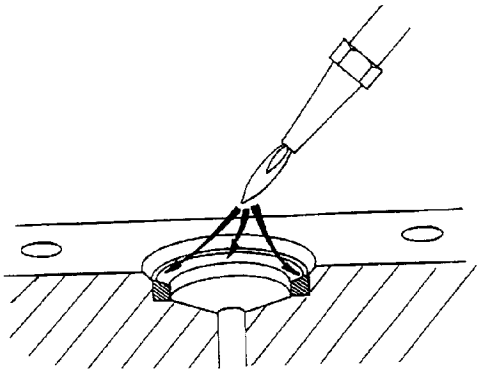
   - Carefully heat insert at four points around face until insert becomes red hot. Allow seat to cool and carefully pry out the insert(s) with a screwdriver.

2. After removal of inserts, thoroughly clean area around valve seat bore and inspect for damage or cracks.




RG5306 –UN–07NOV97

*Removing Valve Seat Inserts*



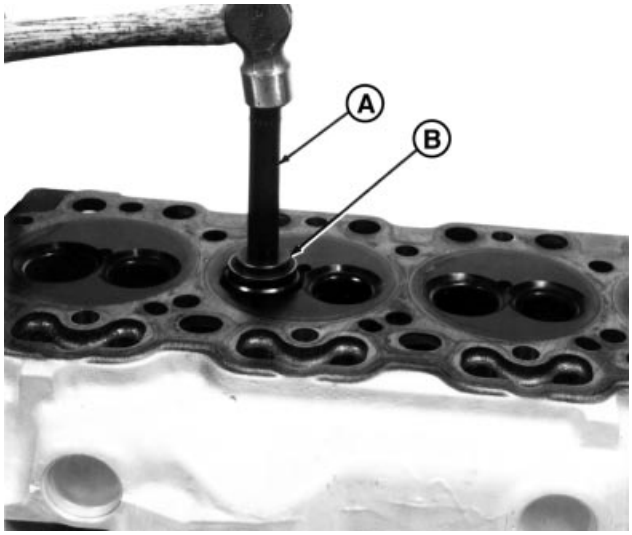

RG5605 –UN–05DEC97

*Heating Valve Seat Inserts*

RG,RG34710,1094 –19–23OCT97–1/1

## INSTALL VALVE SEAT INSERTS

1. Use the JDE7 Driver (A) along with JDG605 Valve Seat Installer (B) to drive inserts into place. The larger end of JDG605 Installer is used to install intake valves and the smaller end is used to install exhaust valves.
2. Install new or refaced valves and check valve recess. (See MEASURE VALVE RECESS, earlier in this group.)
3. Grind valve seats as required to maintain correct valve recess and valve-to-seat seal. (See GRIND VALVE SEATS, earlier in this group.)




*Installing Valve Seat Inserts*

RG,RG34710,1095 –19–23OCT97–1/1

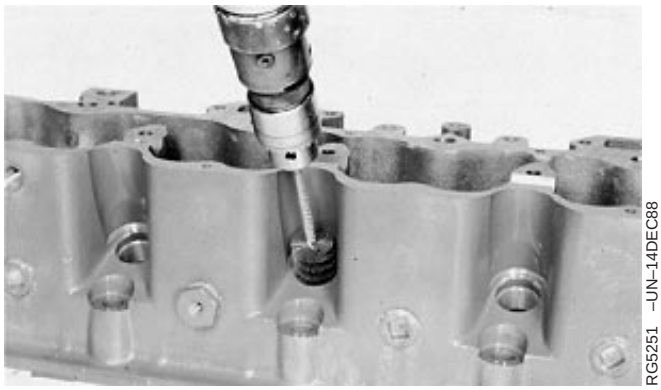
## INSPECT AND CLEAN CYLINDER HEAD NOZZLE BORE

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

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

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

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

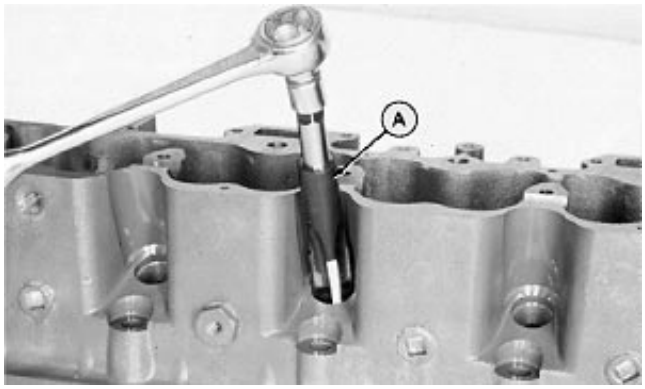



*Cleaning Cylinder Head Nozzle Bores*

**Continued on next page**

RG,RG34710,1096 –19–23OCT97–1/3

4. Clean threads with heavy foreign deposits or clean up damaged threads using the JDE5 Tap (M28 x 1.5 mm) or an equivalent M28 x 1.5 mm (metric) tap (A). Be sure to start tap straight to avoid possible cross-threading. A light coat of grease on tap will help collect foreign deposits on tap and prevent them from falling into the nozzle bore.

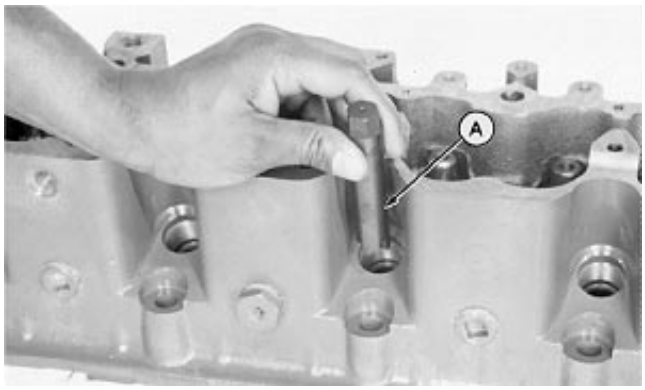



*Using Tap on Nozzle Bore Threads*

RG,RG34710,1096 –19–23OCT97–2/3

5. Clean nozzle seating surface by using the JDG609 Nozzle Seat Reamer (A) to remove carbon.

6. Blow out debris with compressed air and thoroughly clean all nozzle bores.

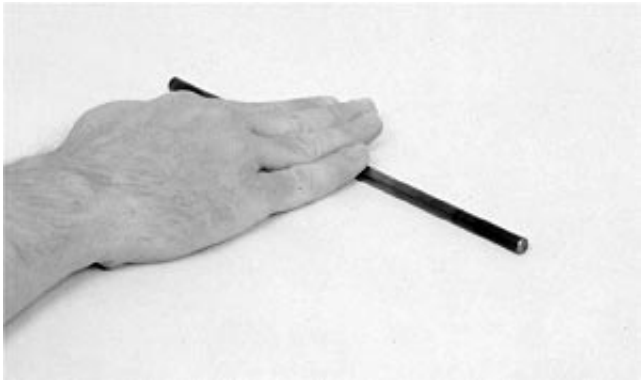



*Cleaning Nozzle Seating Surface*

RG,RG34710,1096 –19–23OCT97–3/3

## CLEAN AND INSPECT PUSH RODS

1. Clean push rods with solvent and compressed air.
2. Check push rods for straightness by rolling on a flat surface.
3. Inspect contact ends for wear and damage.
4. Replace defective push rods.



T81233 –UN–01NOV88

*Checking Valve Push Rods for Straightness*

RG,RG34710,1097 –19–23OCT97–1/1

## 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 if restricted.

RG,RG34710,1098 –19–23OCT97–1/1

## CLEAN AND INSPECT TOP DECK OF CYLINDER BLOCK

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

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

3. Clean all cylinder head mounting cap screw holes using JDG681 or an equivalent 9/16-12 UNC-2A tap about 88.9 mm (3.5 in.) long. Use compressed air to remove debris and any fluids which may be present in the cap screw holes.

4. Measure top deck flatness. See MEASURE CYLINDER BLOCK in Group 10.

RG,RG34710,1099 –19–23OCT97–1/1

## MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK)

1. Bolt down liners using cap screws and flat washers in the seven locations as shown. Flat washers should be at least 3.18 mm (1/8 in.) thick. Tighten cap screws to 68 N•m (50 lb-ft) to achieve an accurate standout reading.

*NOTE: Liners having obvious defects must be replaced.*

2. Using JDG451 Gauge (A) along with D17526CI (English) or D17527CI (Metric scale) Dial Indicator (B) or KJD10123 Gauge to measure the height of bolted down liners that are not obviously defective before removal from block.

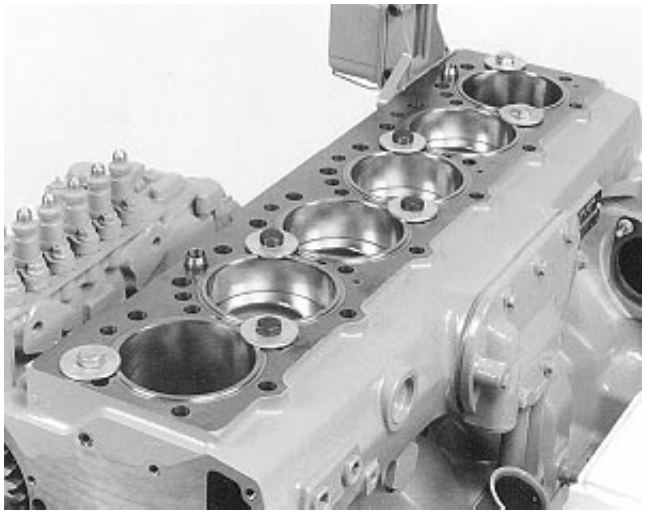
*NOTE: Variations in measurement readings may occur within one cylinder and/or between adjacent cylinders.*

3. Measure each liner in four places, approximately at 1, 5, 7 and 11 O'clock positions as viewed from the rear of the engine (flywheel end). Record all measurements by cylinder number.

4. Remove any liner that does not meet standout specification at any location and install liner shims or replace piston/liner sets as necessary. (See INSTALL LINER SHIMS—IF REQUIRED, in Group 10.)

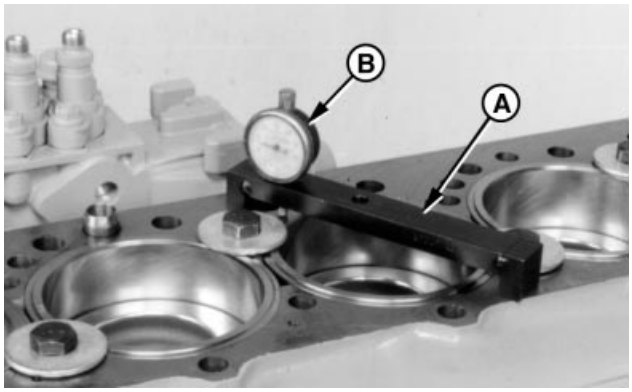
**Liner—Specification**

| | |
|---|---|
| Height ..... | 0.051—0.127 mm (0.002—0.005 in.) above block |



RG7144 –UN–28JUL94

*Bolting Down Cylinder Liners*




RG7145 –UN–26NOV97

*Checking Cylinder Liner Height Above Block*

RG,RG34710,1100 –19–23OCT97–1/1

## ASSEMBLE VALVE ASSEMBLY

Remember valve stem seals (A) are installed onto exhaust valve stems (B) only.

Valves are marked on the head as follows: Intake (“I 30”). Exhaust (“E 30”).

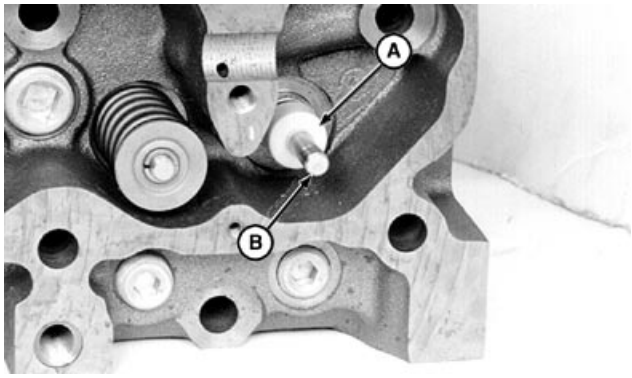
1. Apply AR44402 Valve Stem Lubricant or clean engine oil to valve stems and guides.

*NOTE: Exhaust valve stem oil shields will not seat on valve guide tower; they ride up and down with valve stem.*

2. Install reconditioned or new valves in head. Reconditioned valves MUST BE installed in same location from which removed.

*NOTE: Valve stems must move freely in guide bore and seat properly with insert.*

3. Install oil shield onto exhaust valve stem until shield bottoms on valve guide tower.




RG7229 –UN–05DEC97

*Seal on Exhaust Valve Stem*

**Continued on next page**

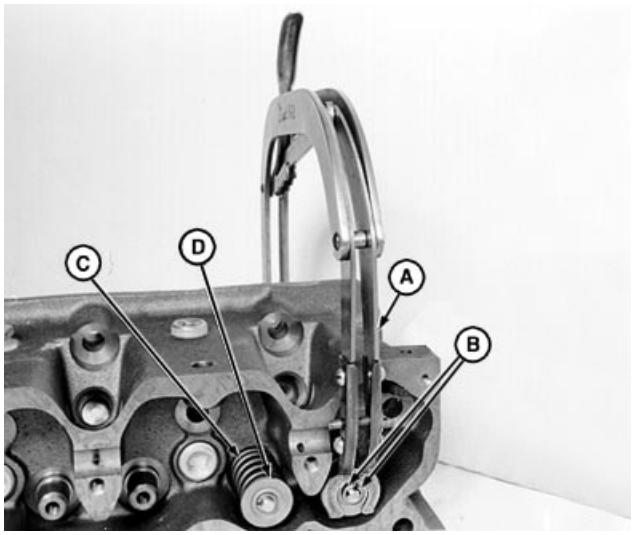
RG,RG34710,1101 –19–23OCT97–1/3

*NOTE: There is no top or bottom to valve springs (C); they may be installed either way.*

4. Install valve spring and spring cap (D). Spring must seat in machined counterbore of head.

5. Compress valve springs with JDE138 Valve Spring Compressor (A) and install retainer locks (B).

*NOTE: Install wear caps just before installing rocker arm assembly.*




RG7228 –UN–05DEC97

*Installing Valve Assemblies*

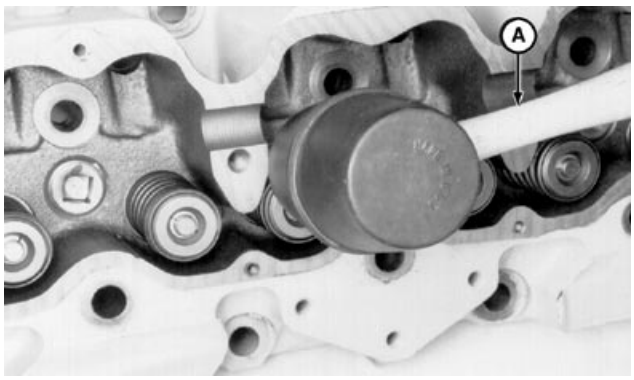
**A—JDE138 Valve Spring Compressor**
**B—Valve Retainer Locks**
**C—Valve Spring**
**D—Valve Spring Cap**

RG,RG34710,1101 –19–23OCT97–2/3

6. Strike each valve assembly with a soft mallet (A) three or four times to insure retainer locks are properly seated.

   Repeat procedure for all remaining valves.

7. Measure valve recess in head as directed earlier in this group.




RG3807 –UN–04DEC97

*Seating Retainer Locks on Valves*

RG,RG34710,1101 –19–23OCT97–3/3

## INSTALL CYLINDER HEAD AND CAP SCREWS

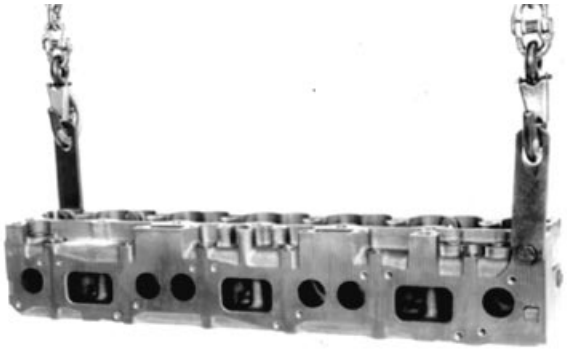
**IMPORTANT: ALWAYS thoroughly inspect new cylinder head gasket for possible manufacturing imperfections. Return any gasket that does not pass inspection.**

**Be sure cylinder head and block gasket surfaces are clean, dry, and free of any oil.**

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

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

2. Lower cylinder head evenly to correct position on block using appropriate lifting equipment. Make sure that head is positioned correctly over dowels and sits flat on cylinder block top deck.



RG5245 –UN–05DEC97

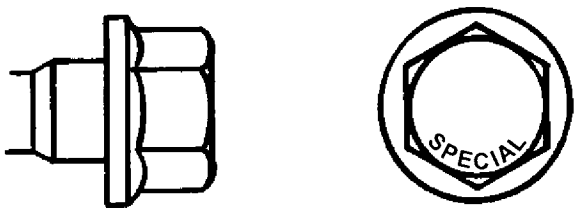
*Installing Cylinder Head*

**Continued on next page**

RG,RG34710,1102 –19–23OCT97–1/2

**IMPORTANT: Only ASTM Grade 180 Flanged-Head cap screws marked “SPECIAL” (upper illustration) are recommended for use on 6081 engines. ALWAYS use NEW cap screws when installing cylinder head. Cap screws may be used only one time.**

**DO NOT use multi-viscosity oils to lubricate cap screws, SAE30 is recommended.**



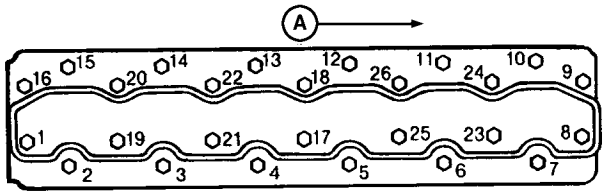

RG7137 –UN–05DEC97

*Special Cap Screw for Cylinder Head*

3. Dip entire cap screw in clean SAE30 engine oil. Allow excess oil to drip off.

4. Install correct length cap screws marked “SPECIAL” in proper locations shown and tighten using the TORQUE-TO-YIELD tightening procedure, described next in this group. (See TORQUE-TO-YIELD FLANGE-HEAD CAP SCREWS—GRADE 180 MARKED “SPECIAL”.)

   Arrow (A) points toward front of engine.




RG4471 –UN–05DEC97

*Head Cap Screw Locations*

| Cap Screw Length | Location on Cylinder Head |
|---|---|
| 134 mm (5.2 in.) | 2, 3, 4, 5, 6, 7 |
| 149 mm (5.9 in.) | 23, 25, 17, 21, 19 |
| 175 mm (6.9 in.) | 1, 15, 14, 13, 12, 11, 10, 8, |
| 203 mm (8.0 in.) | 16, 20, 22, 18, 26, 24, 9 |

RG,RG34710,1102 –19–23OCT97–2/2

## TORQUE-TO-YIELD FLANGED-HEAD CAP SCREWS—GRADE 180 MARKED “SPECIAL”

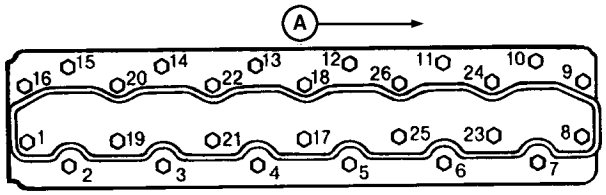
Arrow (A) points toward front of engine.

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

1. Lubricate cap screws with clean SAE30 engine oil and install in their proper locations as outlined previously.
2. Tighten cap screw No. 17 to 80 N•m (60 lb-ft). Sequentially (start at cap screw No. 1 and proceed through cap screw No. 26) tighten all cap screws to 80 N•m (60 lb-ft).
3. Using an oil-proof pen, pencil, or marker, draw a line parallel to the crankshaft across the entire top of each cap screw head. This line will be used as a reference mark.

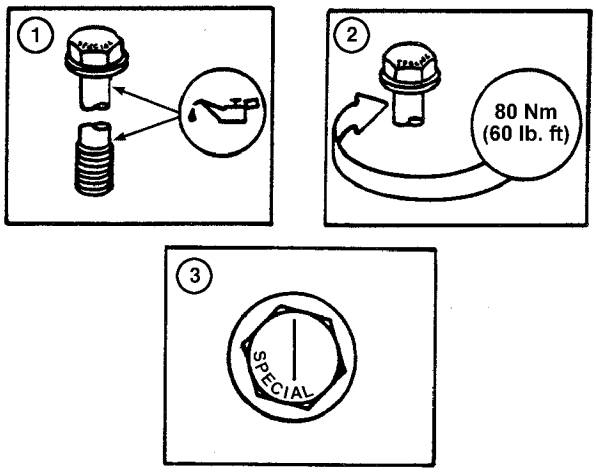
**IMPORTANT: If a cap screw is accidentally tightened more than 90° in any one sequence, DO NOT loosen cap screw but make adjustments in the next tightening sequence.**

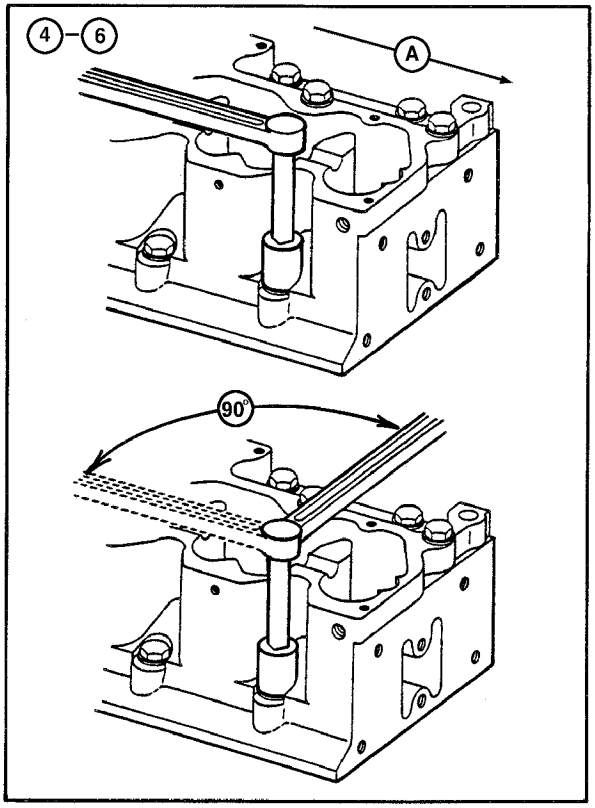
4. Sequentially (start at cap screw No. 1 and proceed through cap screw No. 26) turn each cap screw 90°. Line on top of cap screw will be perpendicular to crankshaft.
5. Again, sequentially (start at cap screw No. 1 and proceed through cap screw No. 26) turn each cap screw 90°. Line on top of cap screw will now be parallel to crankshaft.
6. Finally, sequentially (start at cap screw No. 1 and proceed through cap screw No. 26). Turn each cap screw 90°, SO THAT LINE ON TOP OF CAP SCREW IS AS CLOSE AS POSSIBLE TO BEING PERPENDICULAR TO THE CRANKSHAFT. It is not necessary to obtain the final turn in one swing of the wrench. TOTAL AMOUNT OF TURN FROM STEPS 4, 5, AND 6 IS 270° ± 5°.




RG4471 –UN–05DEC97

*Head Cap Screw Locations*




RG7139 –UN–05DEC97

Continued on next page



*Torque-to-Yield Tightening of Head Cap Screws*

**IMPORTANT: Cap screws MUST NOT be tightened more than a total of 270° ± 5°.**

RG,RG34710,1103 –19–23OCT97–2/2

## INSTALL ROCKER ARM ASSEMBLY

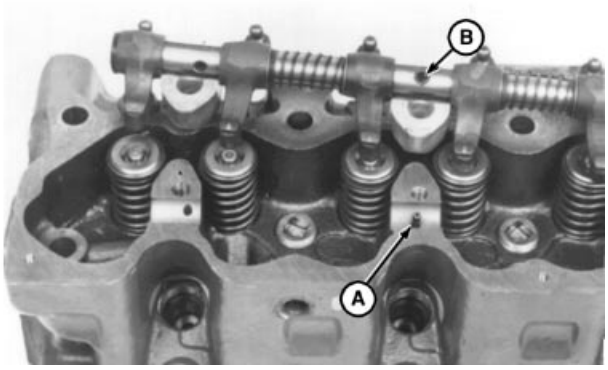
1. Install push rods in holes from which removed.
2. Install wear caps on valve stem tips, make certain caps rotate freely on valve stems.

RG7018 –UN–05DEC97

*Installing Push Rods and Caps*

RG,RG34710,1104 –19–23OCT97–1/2

3. Make sure spring pin (A) engages with hole (B) in shaft.
4. Install shaft clamps and all six cap screws. Tighten cap screws to 75 N•m (55 lb-ft).
5. Adjust engine valve clearance. (See CHECK AND ADJUST VALVE CLEARANCE, earlier in this group.)




RG3810 –UN–04DEC97

*Installing Rocker Arm Assembly*

RG,RG34710,1104 –19–23OCT97–2/2

## COMPLETE FINAL ASSEMBLY OF INJECTION PUMP SIDE OF ENGINE

1. Adjust valve clearance, if not previously done.

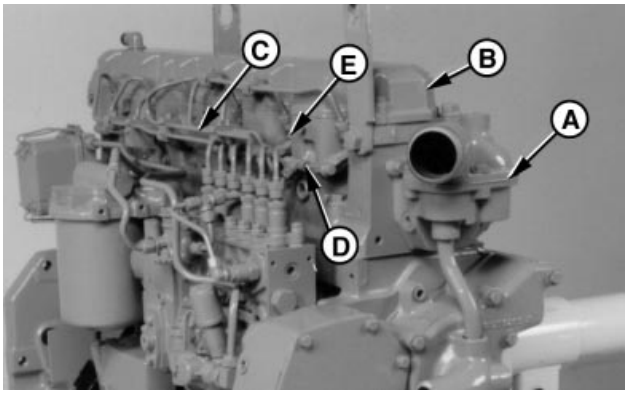
*NOTE: Apply AR31790 SCOTCH-GRIP® Adhesive or equivalent to seal gasket to rocker arm cover (B). Follow manufacturer's directions on the package for correct application procedure and curing time.*

2. Position rocker arm cover gasket on cylinder head and install rocker arm cover. Tighten cap screws to 8 N•m (6 lb-ft) (72 lb-in.).

3. Install fuel injection nozzles (E), fuel leak-off lines (D) and fuel delivery lines (C). (See INSTALL FUEL INJECTION NOZZLES in Group 35.)

4. Connect ventilator outlet hose to adapter on rocker arm cover and tighten clamp securely.

5. Install water manifold (A). (See INSTALL WATER MANIFOLD in Group 25.)




*Final Assembly of Injection Pump Side of Engine*

**A—Water Manifold**
**B—Rocker Arm Cover**
**C—Fuel Delivery (Pressure) Lines**
**D—Fuel Leak-off Lines**
**E—Fuel Injection Nozzles**

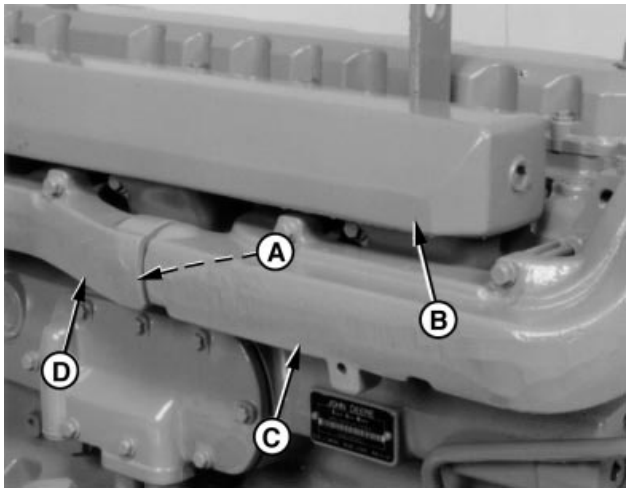
*SCOTCH-GRIP is a trademark of 3M Co.*

RG,RG34710,1105 –19–23OCT97–1/1

## COMPLETE FINAL ASSEMBLY ON EXHAUST MANIFOLD SIDE OF ENGINE

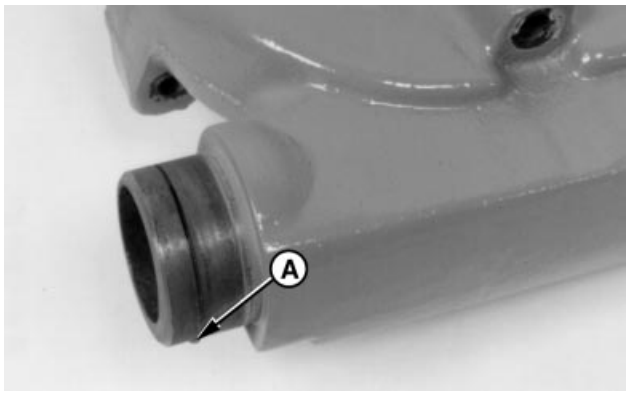
*NOTE: APPLY PT569 NEVER-SEEZ® Compound or equivalent to all turbocharger cap screws. NEVER-SEEZ® is not needed on exhaust manifold cap screws. Guide studs may be used to aid assembly.*

1. Install intake manifold (B) using new gaskets. Tighten cap screws to 47 N•m (35 lb-ft).
2. Install a new sealing ring (A) in groove of rear exhaust manifold (C).
3. Assemble front exhaust manifold (D) and rear exhaust manifold.
4. Install exhaust manifold assembly using new gaskets and guide studs. Tighten cap screws to 47 N•m (35 lb-ft).
5. Install turbocharger using a new metal gasket. Apply PT569 NEVER-SEEZ® Compound and tighten cap screws to 24 N•m (18 lb-ft).
6. Connect turbocharger oil return pipe to turbocharger using a new gasket. Tighten cap screws to 27 N•m (20lb-ft).
7. Connect turbocharger oil inlet and tighten securely.
8. If engine oil was drained from crankcase, install new oil filter and fill with clean oil of correct grade and viscosity. (See DIESEL ENGINE OIL in Group 02.)
9. Fill cooling system with clean coolant. (See ENGINE COOLANT SPECIFICATIONS in Group 02.)
10. Perform engine break-in. (See PERFORM ENGINE BREAK-IN, later in this group.)




RG7043 –UN–26NOV97

*Installing Intake and Exhaust Manifolds*




RG7024 –UN–26NOV97

*Sealing Ring in Exhaust Manifold*

**A—Sealing Ring**
**B—Intake Manifold**
**C—Rear Exhaust Manifold**
**D—Front Exhaust Manifold**

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

RG,RG34710,1106 –19–23OCT97–1/1

## PERFORM ENGINE BREAK-IN

1. Run engine at slow idle no load for 2 minutes. Check for liquid leaks.

2. Increase RPM to fast idle, then load down to 50 rpm above rated speed for 20 minutes.

*NOTE: Dynamometer is the preferred load control, but engine can be loaded by matching drag loads to gear selection.*

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

4. Install rocker arm cover gasket and cover. Tighten rocker arm cover cap screws to 8 N• m (6 lb-ft) (72 lb-in.). (See COMPLETE FINAL ASSEMBLY OF INJECTION PUMP SIDE OF ENGINE, 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,RG34710,1107 –19–23OCT97–1/1

# Cylinder Block, Liners, Pistons, and Rods

## SPECIAL OR ESSENTIAL TOOLS

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

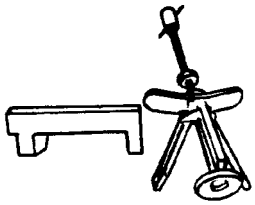
*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1108 –19–23OCT97–1/16

RG5019 –UN–05DEC97

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

Remove cylinder liners.



RG5019

*D01062AA, D01073AA, or KCD 10001*

RG,RG34710,1108 –19–23OCT97–2/16

RG5074 –UN–07NOV97

Flexible Cylinder Hone . . . . . D17005BR

Hone cylinder liners.

RG5074

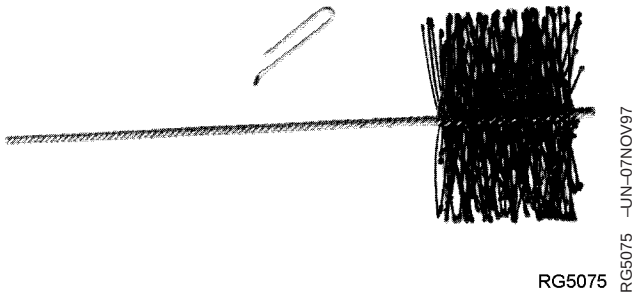
*D17005BR*

**Continued on next page**

RG,RG34710,1108 –19–23OCT97–3/16

O-Ring Groove Cleaning Brush . . . . . D17015BR

Clean cylinder liner O-ring groove in block.



RG5075 –UN–07NOV97

*D17015BR*

RG,RG34710,1108 –19–23OCT97–4/16

RG6246 –UN–05DEC97

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

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

RG6246

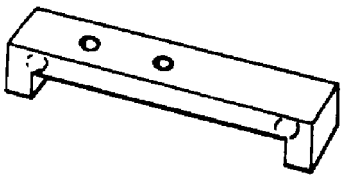
*D17526CI or D17527CI*

RG,RG34710,1108 –19–23OCT97–5/16

RG7029 –UN–05DEC97

Piston and Liner Height Gauge . . . . . JDG451

Measure piston and liner heights.



RG7029

*JDG451*

RG,RG34710,1108 –19–23OCT97–6/16

*NOTE: A dial indicator is not supplied with JDG451. Use D17526CI (English, in.) or D17527CI (Metric, mm) Dial Indicator with JDG451.*

**Continued on next page**

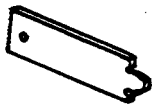
RG,RG34710,1108 –19–23OCT97–7/16

*Cylinder Block, Liners, Pistons, and Rods*

RG5076 –UN–23AUG88

No. 1 Ring Groove Wear Gauge. . . . . JDE55

Check upper compression ring groove wear.



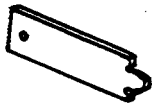
*JDE55*

RG,RG34710,1108 –19–23OCT97–8/16

RG5076 –UN–23AUG88

No. 2 Ring Groove Wear Gauge. . . . . JDG852

Check lower compression ring groove wear.



*JDG852*

RG,RG34710,1108 –19–23OCT97–9/16

RG5077 –UN–07NOV97

Piston Ring Expander . . . . . JDE93

Remove and install piston rings.

RG5077

*JDE93*

RG,RG34710,1108 –19–23OCT97–10/16

RG5031 –UN–05DEC97

Piston Ring Compressor. . . . . JDE96

Compress rings while installing pistons.

RG5031

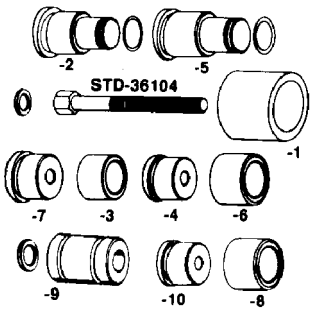
*JDE96*

**Continued on next page**

RG,RG34710,1108 –19–23OCT97–11/16

Connecting Rod Bushing Service Set . . . . . JDE98A

Remove and install connecting rod bushings.




RG5078 –UN–07NOV97

RG5078

*JDE98A*

RG,RG34710,1108 –19–23OCT97–12/16

JDE98A Connecting Rod Bushing Service Set consists of:

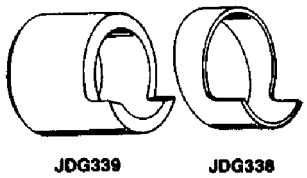
| | |
|---|---|
| 1–Cup | JDE98-1 |
| 2–Driver | JDE98-2 |
| 3–Pilot | JDE98-3 |
| 4–Driver | JDE98-4 |
| 5–Driver | JDE98-5 |
| 6–Pilot | JDE98-6 |
| 7–Driver | JDE98-7 |
| 8–Cup | JDE97-8 |
| 9–Pilot | JDE98-9 |
| 10–Remover Bushing | JDE98-10 |
| Forcing Screw | STD36104 |

RG,RG34710,1108 –19–23OCT97–13/16

RG5079 –UN–07NOV97

Connecting Rod Bushing Service Set . . . . . JDG337

Use with JDE98A Bushing Service Set to remove and install connecting rod bushings.




RG5079

*JDG337*

**Continued on next page**

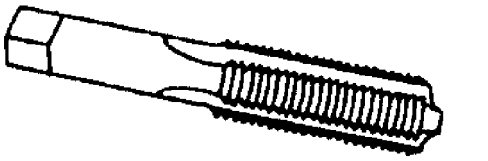
RG,RG34710,1108 –19–23OCT97–14/16

*Cylinder Block, Liners, Pistons, and Rods*

RG5100 –UN–05DEC97

Tap . . . . . JDG681

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



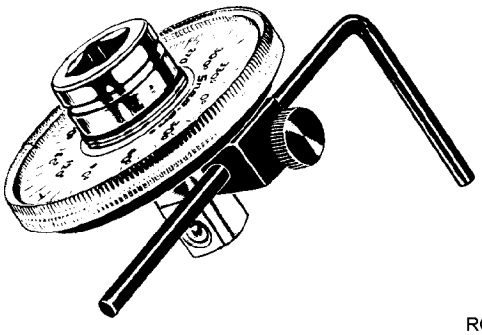
RG5100

*JDG681*

RG,RG34710,1108 –19–23OCT97–15/16

Torque Angle Gauge . . . . . JT05993

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



RG5698 –UN–05DEC97

RG5698

*JT05993*

RG,RG34710,1108 –19–23OCT97–16/16

*Cylinder Block, Liners, Pistons, and Rods*

## SERVICE EQUIPMENT AND TOOLS

*NOTE: Order tools from 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.*

RG,RG34710,1109 –19–23OCT97–1/4

Precision “Bevelled Edge” Straightedge . . . . . D05012ST

Check cylinder head flatness

RG,RG34710,1109 –19–23OCT97–2/4

Piston Ring Groove Cleaner

Clean piston ring grooves.

RG,RG34710,1109 –19–23OCT97–3/4

Cylinder Bore Ridge Reamer

Remove carbon from liner bore.

RG,RG34710,1109 –19–23OCT97–4/4

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| AR54749 (U.S.) | Soap Lubricant | Coat O-rings on cylinder liners. |
| | PLASTIGAGE® | Determine connecting rod bearing-to-journal oil clearance. |

*PLASTIGAGE is a trademark of DANA Corp.*

RG,RG34710,1110 –19–23OCT97–1/1

## CYLINDER BLOCK, LINERS, PISTONS, AND RODS SPECIFICATIONS

| ITEM | SPECIFICATION | WEAR LIMIT |
|---|---|---|
| Cylinder Liner Height Above Block (Liner Standout) | 0.051—0.127 mm (0.002—0.005 in.) | _____ |
| Maximum Piston Protrusion Above Block | 0.051—0.787 mm (0.002—0.031 in.) | _____ |
| Oil Compression Ring-to-Piston Groove Clearance | 0.064—0.102 mm (0.0025—0.0040 in.) | 0.165 mm (0.0065 in.) |
| Piston Compression Ring End Gap | | |
| No. 1 | 0.43—0.69 mm (0.017—0.027 in.) | _____ |
| No. 2 | 1.01—1.27 mm (0.040—0.050 in.) | _____ |
| Piston O.D. 15.16 mm (0.597 in.) from Bottom of Skirt | 115.771—115.789 mm (4.5579—4.5586 in.) | _____ |
| Piston-to-Liner Clearance at Bottom of Skirt | 0.076—0.124 mm (0.003 in.) | 0.152 mm (0.0060 in.) |
| Cylinder Liner | | |
| I.D. | 115.865—115.895 mm (4.5616—4.5628 in.) | _____ |
| O.D. | 127.94—128.24 mm (5.037—5.049 in.) | _____ |
| Cylinder Liner Thickness | 6.05—6.15 mm (0.238—0.242 in.) | _____ |
| Cylinder Liner Packing Step Dimension | 1.45—1.55 mm (0.057—0.061 in.) | _____ |
| Cylinder Liner Maximum Taper | 0.051 mm (0.0020 in.) | _____ |
| Cylinder Liner Maximum Out-of-Round | 0.051 mm (0.0020 in.) | _____ |
| Liner Flange Counterbore Depth in Block | 11.913—11.963 mm (0.469—0.471 in.) | _____ |
| Liner Flange Thickness | 11.989—12.039 mm (0.472—0.474 in.) | _____ |
| Liner Flange O.D. | 135.10—135.16 mm (5.319—5.321 in.) | _____ |
| Outer Diameter of Liner at Upper Bore | 129.08—129.14 mm (5.082—5.084 in.) | _____ |
| Outer Diameter of Liner at Lower Bore | 125.044—125.120 mm (4.923—4.926 in.) | _____ |

**Continued on next page**

*Cylinder Block, Liners, Pistons, and Rods*

| ITEM | SPECIFICATION | WEAR LIMIT |
|---|---|---|
| Upper Bore Diameter in Block for Seating Liners | 129.155—129.205 mm (5.085—5.087 in.) | _____ |
| Lower Bore Diameter in Block for Seating Liners | 125.133—125.183 mm (4.9265—4.9285 in.) | _____ |
| Liner-to-Block Clearance at Upper Bore | 0.026—0.126 mm (0.001—0.005 in.) | _____ |
| Liner-to-Block Clearance at Lower Bore | 0.012—0.140 mm (0.0005—0.0055 in.) | _____ |
| Liner Shim Thickness | 0.05 mm (0.002 in.) | _____ |
| Piston Pin O.D. | 47.60—47 61 in.) (1.8739—1.8745 in.) | _____ |
| Piston Pin Bore I.D. in Piston | 47.620—47.630 mm (1.9748—1.8752 in.) | _____ |
| Rod Pin Bushing I.D. (After Honing) | 47.655—47.681 mm (1.8762—1.8772 in.) | _____ |
| Rod Pin Bore Diameter Without Bushing | 52.354—52.380 mm (2.0612—2.0622 in.) | _____ |
| Rod Pin-to-Bushing Oil Clearance | 0.042—0.084 mm (0.0017—0.0033 in.) | 0.102 mm (0.0040 in.) |
| Rod-to-Pin Bushing Press Fit Specification | 0.084—0.147 mm (0.0033—0.0058 in.) | _____ |
| Connecting Rod Bore Without Bearings | 81.051—81.077 mm (3.191—3.192 in.) | _____ |
| Connecting Rod Bearing Assembled I.D. | 76.21—76.26 mm (3.0004—3.0024 in.) | _____ |
| Crankshaft Rod Journal O.D. | 76.149—76.175 mm (2.9980—2.9990 in.) | _____ |
| Rod Bearing-to-Journal Clearance | 0.030—0.110 mm (0.0012—0.0044 in.) | _____ |
| Connecting Rod Cap End Gap | | 0.254 mm (0.0100 in.) |
| Connecting Rod Out-of-Round | | 0.025mm (0.0010 in.) |
| Centerline of Main Bearing Bore-to-Top Deck of Cylinder Block | 352.35—352.50 mm (13.872—13.878 in.) | _____ |
| Camshaft Bushing Bore in Block | | |
| Maximum Runout of Camshaft Bushing Bore in Block | 0.038 (0.0015 in.) | |
| New Camshaft Bushing-to-Journal Clearance | 0.063—0.115 mm (0.0025—0.0045 in.) | _____ |
| Camshaft Bushing I.D. | 67.076—67.102 mm (2.6408—2.6418 in.) | _____ |
| Cylinder Block Top Deck Maximum Out-of-Flat | 0.100 mm (0.004 in.) | _____ |
| Cylinder Block Top Deck Straightness Per Any 305 mm (12.0 in.) Length | 0.025 mm (0.001 in.) | _____ |
| Centerline of Connecting Rod Pin Journal-to-Centerline of Piston Pin Bore | 222.20—222.30 mm (8.748—8.752 in.) | _____ |

**Continued on next page**

RG,RG34710,1111 –19–23OCT97–2/3

*Cylinder Block, Liners, Pistons, and Rods*

**TORQUES**

Connecting Rod Cap Screws:
Initial[a] ..... 27 N•m (20 lb-ft)
Final (All Cap Screws) ..... 75 N•m (55 lb-ft) plus 90-100° turn clockwise[b]

Piston Cooling Orifices into Cylinder Block ..... 9.6—12.4 N•m (85—110 lb-in.)

Cylinder Liner Cap Screws (for checking liner standout) ..... 68 N•m (50 lb-ft)

[a]See INSTALL PISTON AND CONNECTING RODS, later in this group, before tightening cap screws.
[b]Resulting torque is 175—285 N•m (130—210 lb-ft).

RG,RG34710,1111 –19–23OCT97–3/3

## PRELIMINARY LINER, PISTON, AND ROD CHECKS

**SCUFFED OR SCORED PISTONS:**

- Overheating.
- Overfueling.
- Insufficient lubrication.
- Insufficient cooling.
- Improper piston-to-liner clearance.
- Coolant leakage into crankcase.
- Misaligned or bent connecting rod.
- Improperly installed piston.
- Low oil level.
- Improper operation.
- Incorrect connecting rod bearing clearance.
- Carbon build-up in ring groove.
- Improper engine break-in.
- Worn piston.
- Contaminated oil.
- Distorted cylinder liner.
- Plugged piston cooling orifice.
- Ingestion of dust through air intake.

**WORN OR BROKEN COMPRESSION RINGS:**

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

**CLOGGED OIL CONTROL RING:**

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

**STUCK RINGS:**

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

**CYLINDER LINER WEAR AND DISTORTION:**

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

**WARPED CYLINDER BLOCK:**

- Insufficient cooling.

**BROKEN CONNECTING ROD:**

- Inadequate piston-to-liner clearance.
- Worn connecting rod bearing.
- Distorted cylinder line.
- 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.

**DULL SATIN FINISH AND FINE VERTICAL SCRATCHES ON RINGS:**

- Dirt and abrasives in air intake system.

RG,RG34710,1112 –19–23OCT97–1/1

## REMOVE PISTONS AND CONNECTING ROD ASSEMBLIES

6081HRW Engines must be removed from 8100-8400 Tractors to service the pistons and connecting rods. Refer to machine technical manual TM1575 (8100, 8200, 8300, and 8400 Tractors—Repair) for engine removal procedure. (For 8000T Tracks tractors, refer to TM1621.)

**CAUTION: Do not drain engine coolant until it cools below operating temperature. Then slowly loosen water pump cover drain valve (A) and block drain valve (B) to relieve any pressure. Drain coolant and engine oil.**

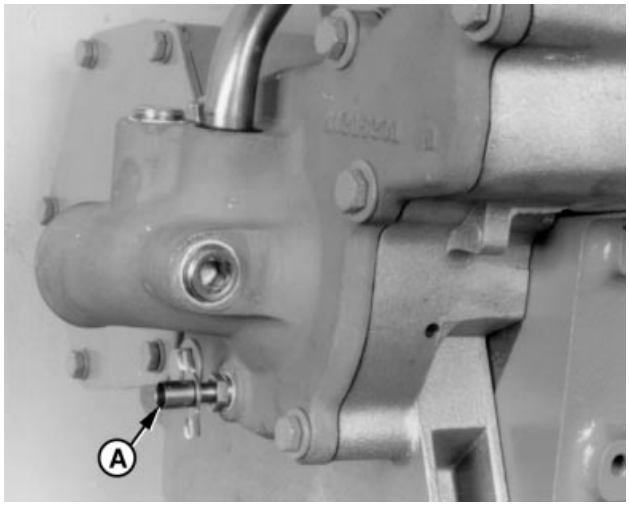
**IMPORTANT: Both drain valves must be opened to completely drain engine block.**

1. Drain all engine coolant and engine oil.

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

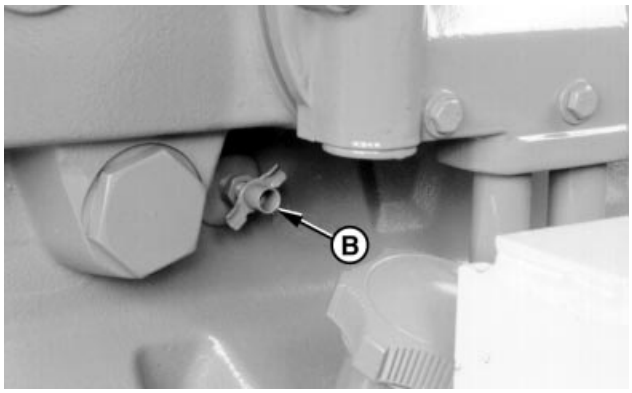
2. Remove cylinder head. (See REMOVE CYLINDER HEAD in Group 05.)

3. Remove oil pan and oil pump. (See REMOVE ENGINE OIL PUMP in Group 20.)




RG7044 –UN–26NOV97

*Water Pump Drain Valve*




RG7143 –UN–26NOV97

*Cylinder Block Drain Valve*

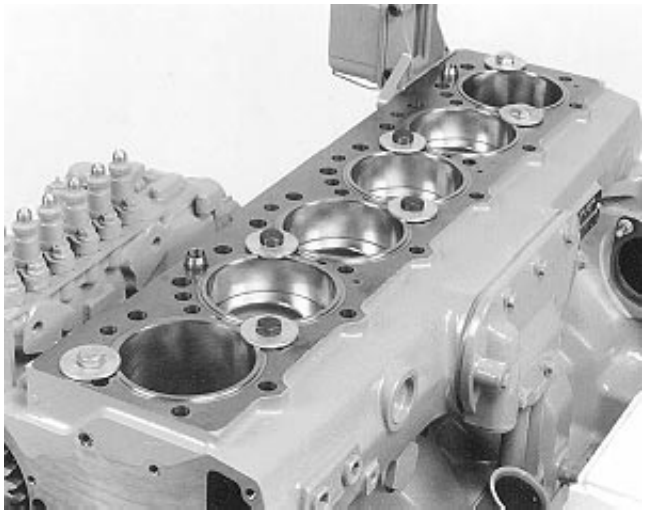
**Continued on next page**

RG,RG34710,1113 –19–23OCT97–1/5

**IMPORTANT: Do not rotate crankshaft with cylinder head removed unless liners are bolted down. Bolt liners down before removing piston.**

**Cap screws and washers must be tightened to the above specification to achieve an accurate reading when measuring liner standout (height above block). See MEASURE LINER STANDOUT (HEIGHT ABOVE BLOCK), later in this group.**

4. Use 9/16-18 cap screws, approximately 51 mm (2.0 in.) long and 5/8 in. I.D. 1-3/4 in. O.D. x 3.18 mm (1/8 in.) thick washers to bolt down cylinder liners in the seven locations as shown. Tighten cap screws to 68 N•m (50 lb-ft).



RG7144 –UN–28JUL94

*Bolting Down Cylinder Liners*

**Continued on next page**

As the cylinder liner wears, a ridge is formed at the top of piston ring travel zone. If this ridge gets too high, pistons and rings can be damaged when they are removed. Remove any ridges from liner bores with a scraper or ridge reamer before removing pistons.

5. Before removing pistons, visually inspect condition of cylinder liners with pistons at bottom dead center “BDC”. Liners will require replacement if:

   The crosshatch honing pattern is not visible immediately below the top ring turn around area.

   Liners are pitted or contain deep vertical scratches that can be detected by the fingernail.

   No further inspection is required if any one of the above conditions are found.

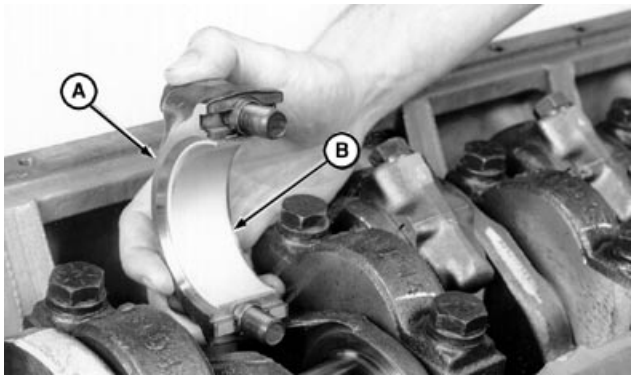
*NOTE: Connecting rod bearing-to-journal oil clearance should be measured before removing piston/rod assembly.*

*Use PLASTIGAGE® as directed by the manufactured. Remember, the use of PLASTIGAGE® will determine bearing-to-journal oil clearance, but will not indicate the condition of either surface.*

6. Rod bearing-to-journal oil clearance can be checked with PLASTIGAGE® if rod is connected to crankshaft. If rod is out of engine, measure I.D. of assembled connecting rod bearings and compare with O.D. of crankshaft journal.

RG5807 –UN–05DEC97

*Measuring Rod Bearing-to-Journal Clearance*




RG5806 –UN–05DEC97

*Removing Connecting Rod Caps*

*PLASTIGAGE is a trademark of DANA Corp.*

**Continued on next page**

RG,RG34710,1113 –19–23OCT97–3/5

**IMPORTANT: DO NOT use pneumatic wrenches to tighten rod cap screws. Using pneumatic wrenches may cause thread damage.**

**Keep bearing inserts with their respective rods and caps. Mark rods, pistons, and caps to insure correct assembly in same location as removed.**

7. Remove rod cap screws and rod caps (A) with bearings (B).

RG,RG34710,1113 –19–23OCT97–4/5

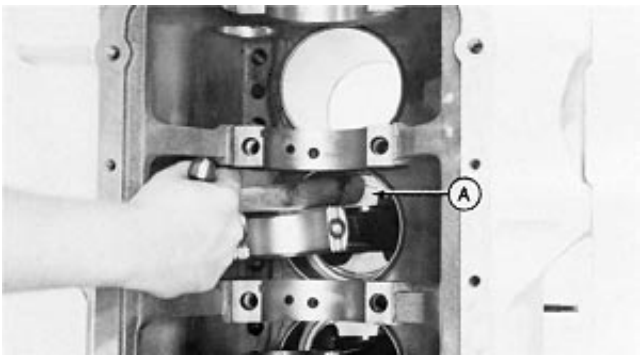
Crankshaft is shown removed, but piston and rod assembly can be removed with crankshaft installed.

**IMPORTANT: Be careful not to let rod nick crankshaft bearing surface as piston and rod assembly is removed.**

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

**Piston and liners are selectively fitted to maintain piston-to-liners clearance. Always keep matched pistons and liners together as a set and each set MUST BE installed in the same cylinder as removed.**

8. Gently tap piston (A) through top of cylinder block from the bottom. Once piston rings have cleared cylinder liner bore, hold on to piston to prevent piston from dropping.




*Removing Pistons*

RG,RG34710,1113 –19–23OCT97–5/5

## MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK)

**IMPORTANT: Remove all old gasket material, rust, carbon, and other foreign material from top deck of block. Gasket surface MUST BE CLEAN. Use compressed air to remove all loose foreign material from cylinder and top deck.**

*NOTE: Liners having obvious defects must be replaced as a matched piston and liner set.*

1. Bolt liners down 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. Use JDG451 Gauge Block (A) along with D17526CI (English, in.) or D17527CI (Metric, mm) Dial Indicator (B) or KJD10123 Gauge to measure the height of bolted down liners that are not obviously defective before removal from block.

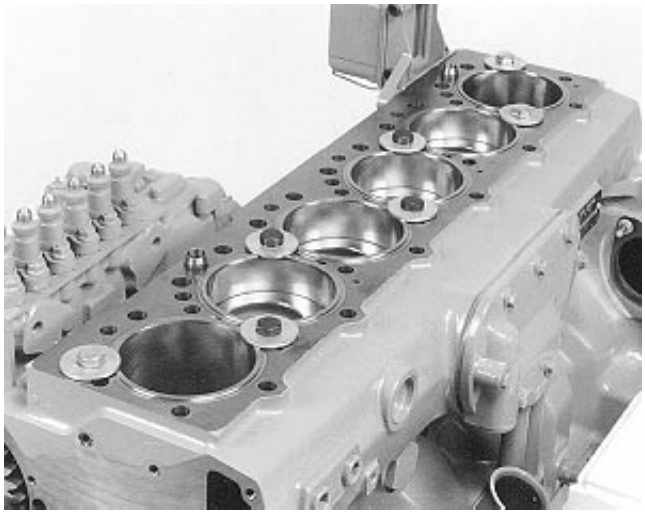
*NOTE: Variations in measurement readings may occur within one cylinder and /or between adjacent cylinders.*

3. Measure each liner in four places, approximately at 1, 5, 7, and 11 O'clock positions as viewed from the rear of the engine (flywheel end). Record all measurements.

4. Remove any liner that does not meet standout specification at any location and measure liner flange thickness, as explained later in this group. Use liner shims or replace piston/liner sets as necessary.

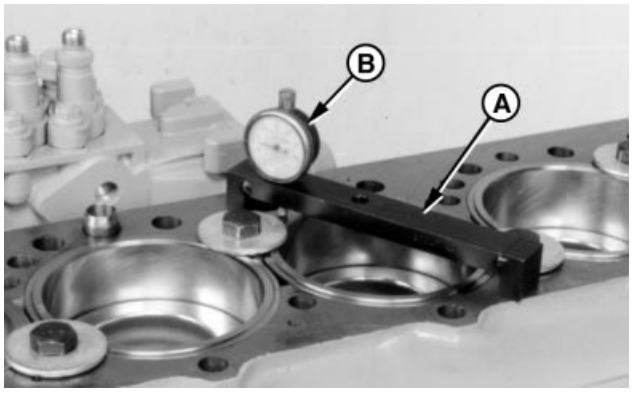
**Liner—Specification**

| | |
|---|---|
| Height Above Block | 0.051—0.127 mm (0.002—0.005 in.) |



RG7144 –UN–28JUL94

*Bolting Down Cylinder Liners*




RG7145 –UN–26NOV97

*Checking Cylinder Liner Height Above Block*

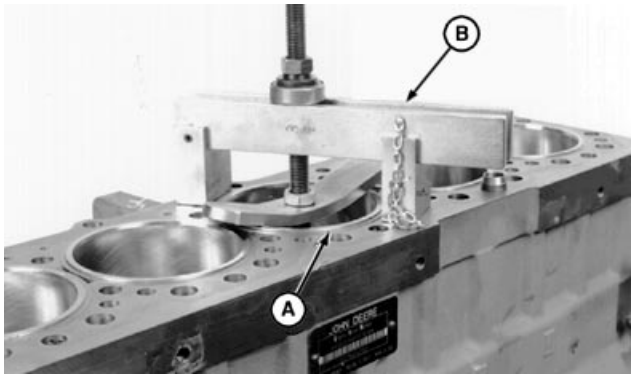
RG,RG34710,1114 –19–23OCT97–1/1

## REMOVE CYLINDER LINERS

1. Remove cap screws and washers securing liners to cylinder block.
2. Number cylinder liners and mark fronts to assure correct assembly.

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

3. Use D1062AA or D01073AA Cylinder Liner Puller (B) to remove cylinder liner (A).

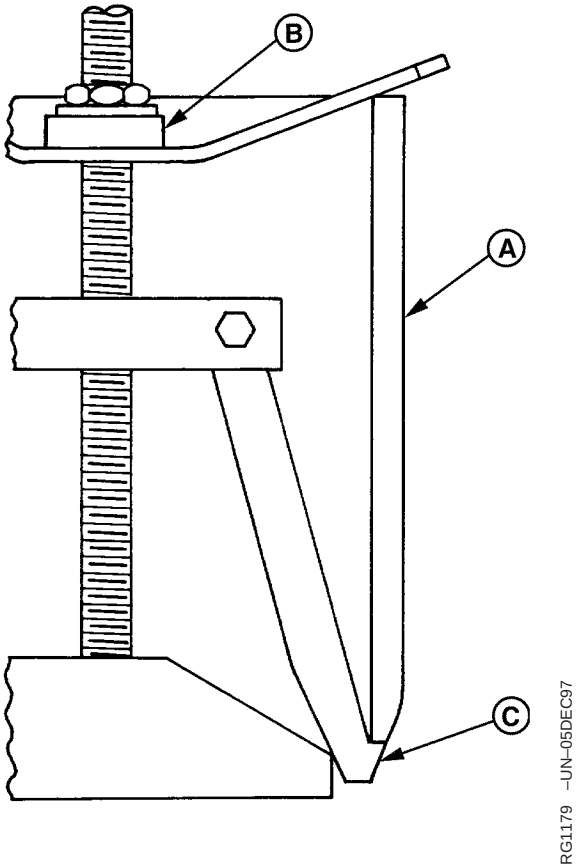



*Removing Cylinder Liners*

RG,RG34710,1115 –19–23OCT97–1/3

**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.**

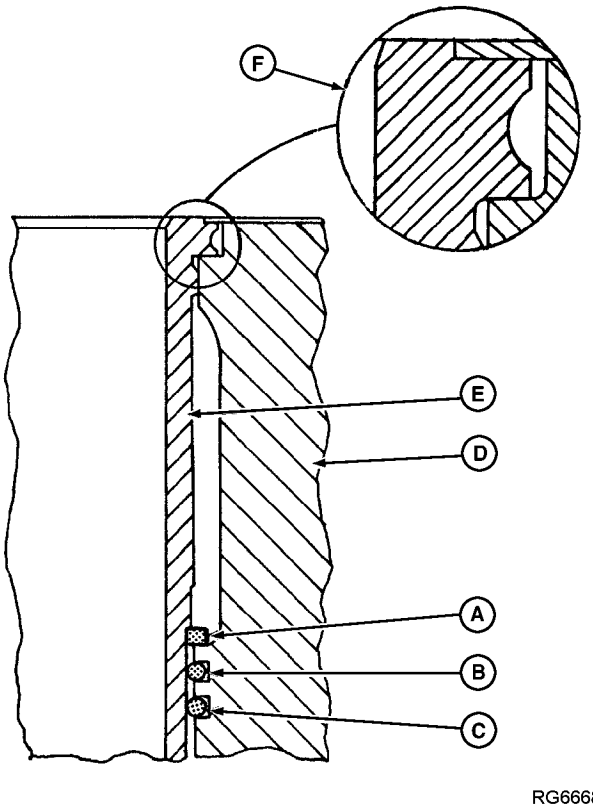



*D01062AA or D017073AA Cylinder Liner Puller*

**Continued on next page**

RG,RG34710,1115 –19–23OCT97–2/3

4. Remove the cylinder liner square packing (A) from liner (E).
5. Remove red O-ring (B) and black O-ring (C) from cylinder block (D).




*Cylinder Liner and Seals*

**A—Square Packing (Neoprene)**
**B—Red O-Ring (Silicone)**
**C—Black O-Ring (Viton)**
**D—Cylinder Block**
**E—Cylinder Liner**
**F—Coolant Passage**

RG,RG34710,1115 –19–23OCT97–3/3

## DEGLAZE CYLINDER LINERS

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

2. Use D17006BR Flexible Cylinder Hone to deglaze cylinder liner.

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

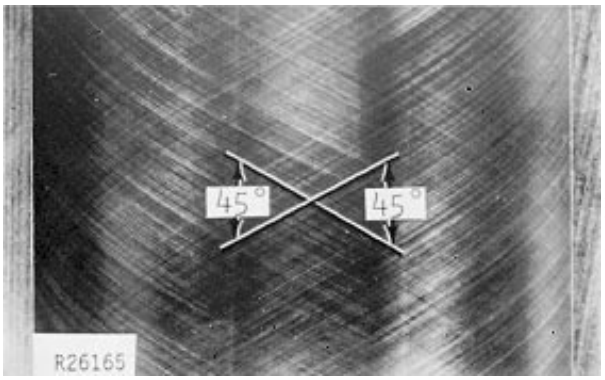
R26164 –UN–13DEC88

*Deglazing Cylinder Liners*

RG,RG34710,1116 –19–23OCT97–1/2

3. Use D17006BR Hone according to instructions supplied with tool to obtain a 45 ° cross-hatch pattern.

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




R26165 –UN–13DEC88

*Honing Pattern on Cylinder Liners*

RG,RG34710,1116 –19–23OCT97–2/2

## 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 solvent to clean liners. Solvents will not remove all the 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 many times as necessary with clean SAE 10W oil.

5. Clean liner until a white rag shows no discoloration.

RG,RG34710,1117 –19–23OCT97–1/1

## DISASSEMBLE PISTON/ROD ASSEMBLY

1. Remove piston snap rings. Remove piston pin and connecting rod from piston.

*NOTE: Discard snap rings, DO NOT reuse.*

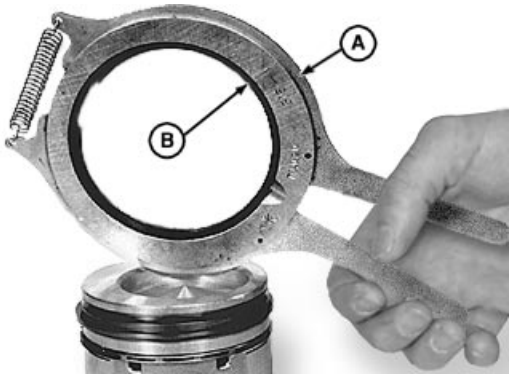
RG5228 –UN–05DEC97

*Disassembling Piston and Rod*

**Continued on next page**

RG,RG34710,1118 –19–23OCT97–1/2

2. Remove piston rings (B) using the JDG967 Piston Ring Expander (A). Discard all rings.




*Removing Piston Rings*

RG,RG34710,1118 –19–23OCT97–2/2

## 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—NOT A WIRE BRUSH—to loosen carbon residue. Dry with compressed air.


*Cleaning Piston Ring Grooves*

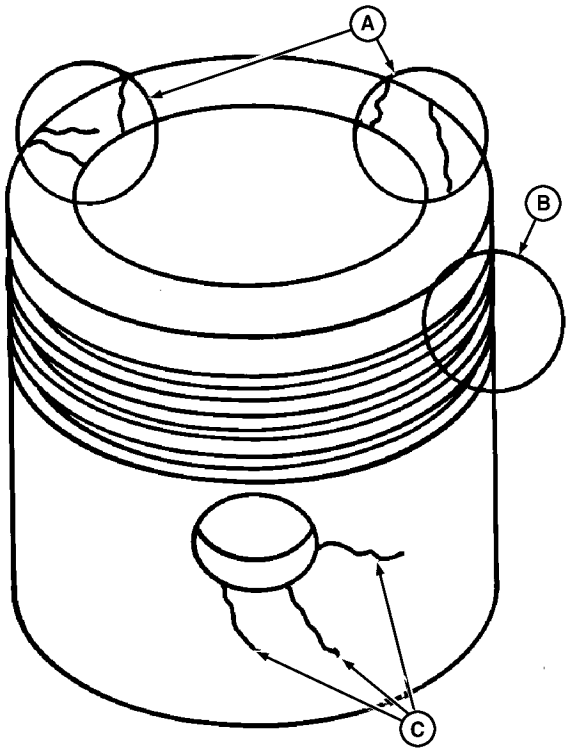
RG,RG34710,1119 –19–23OCT97–1/1

## VISUALLY INSPECT PISTONS

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.




RG3326 –UN–04DEC97

*Piston Defects (Exaggerated)*

RG,RG34710,1120 –19–23OCT97–1/1

## CHECK PISTON RING GROOVE WEAR

Check grooves at several locations around the circumference of piston.

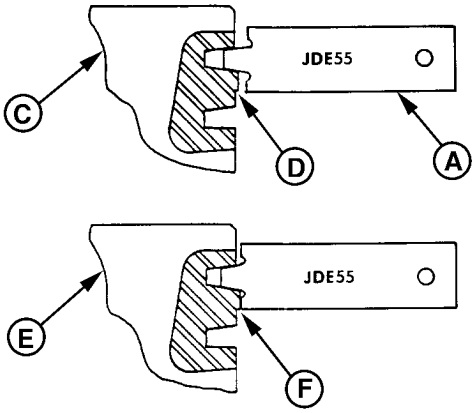
1. Use the JDE55 Ring Groove Wear Gauge (A) to check wear of top full keystone (compression) ring groove.
2. Use JDG852 Ring Groove Wear Gauge (B) to check wear of middle half-keystone (compression) ring groove.

   If gauge shoulder contacts ring land of piston, ring groove is worn. Replace piston and liner as a set.

   If ring grooves are good (D), proceed with piston inspection.

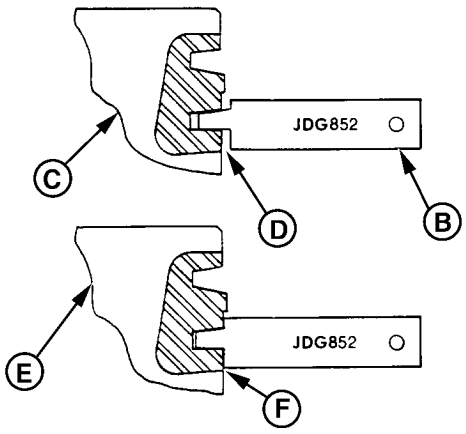
RG5230 –UN–05DEC97

*Checking Piston Ring Groove Wear*




RG7058 –UN–26NOV97

*Checking Piston Top Ring Groove*




RG7059 –UN–26NOV97

*Checking Piston Middle Ring Groove*

**A—JDE55 Keystone Ring Groove Wear Gauge**
**B—JDG852 Half-Keystone Ring Groove Wear Gauge**
**C—Piston With Good Ring Groove**
**D—Acceptable Clearance**
**E—Piston With Worn Ring Groove**
**F—Gauge Shoulder Contacting Piston Ring Land**

**Continued on next page**

RG,RG34710,1121 –19–23OCT97–1/2

3. Check oil control ring-to-groove clearance by installing a new ring in groove.

4. Measure clearance with a feeler gauge at several points. Compare measurements with specifications given below.

**Oil Control Ring-to-Groove—Specification**

| | |
|---|---|
| New Part Clearance | 0.064—0.102 mm (0.0025—0.0040 in.) |
| Maximum Serviceable Clearance | 0.165 mm (0.0065 in.) |

*NOTE: Replace piston and liner (as a set) if oil control ring clearance exceeds specifications given.*

RG5234 –UN–05DEC97

*Checking Piston Oil Control Ring Clearance*

RG,RG34710,1121 –19–23OCT97–2/2

## INSPECT PISTON PIN AND BORE

*NOTE: Piston pin must be in good condition and not worn beyond specification given below.*

1. Dip piston in clean engine oil.
2. Install pin (A) through piston.

   Pin should pass through piston using only light thumb pressure.
3. Check taper in piston pin bore by inserting pin from both sides. If pin enters freely, but binds in the center, the bore could be tapered (B).
4. Insert pin in piston to check for bore alignment. Pin should not “click” or need to be forced into bore on opposite side (C).
5. Measure piston pin and piston bore specifications. If either are not within specification, replace pin, piston, and liner.

**Piston Pin—Specification**

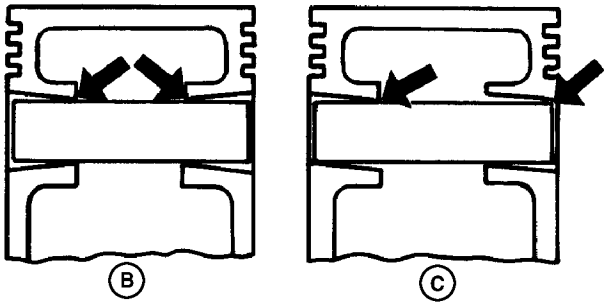
OD ..... 47.60—47.61 mm (1.8739—1.8745 in.)

**Piston Bore—Specification**

ID ..... 47.62—47.63 mm (1.8748—1.8752 in.)


RG5231 –UN–05DEC97

*Installing Pin in Piston*




RG4984 –UN–05DEC97

RG4984

*Inspecting for Piston Pin Bore Wear*

RG,RG34710,1122 –19–23OCT97–1/1

## VISUALLY INSPECT CYLINDER LINERS

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

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

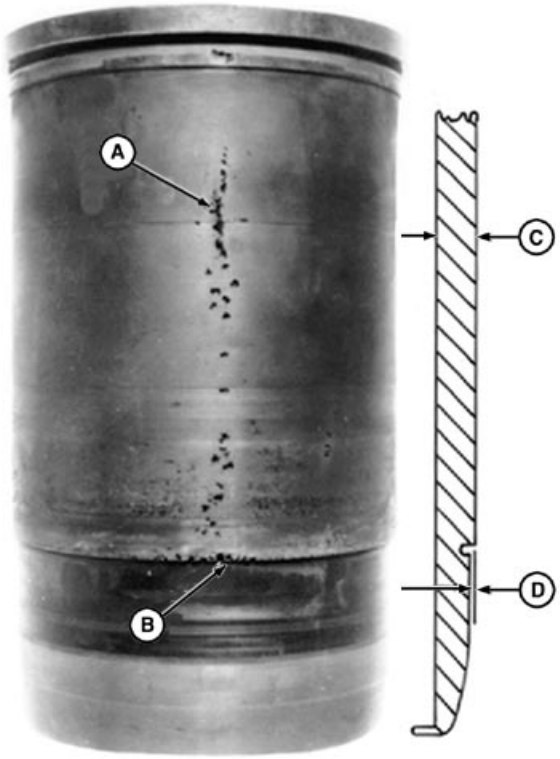
   Depth of any pit is one-half or more of liner thickness (C) or more.

   Depth of erosion is one-half or more of the packing step (D) or more.

**Cylinder Liner—Specification**

| | |
|---|---|
| Thickness | 6.05—6.15 mm (0.238—0.242 in.) |
| Packing Step Dimension | 1.45—1.55 mm (0.057—0.061 in.) |

*NOTE: Liners are reusable if the depth of pits or erosion is less than one-half the amount specified. When installing reusable liners, rotate 90° from original position. The liners should be also deglazed and new ring sets installed in pistons.*




RG4643 –UN–05DEC97

*Inspecting Cylinder Liners*

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

**Continued on next page**

RG,RG34710,1123 –19–23OCT97–1/2

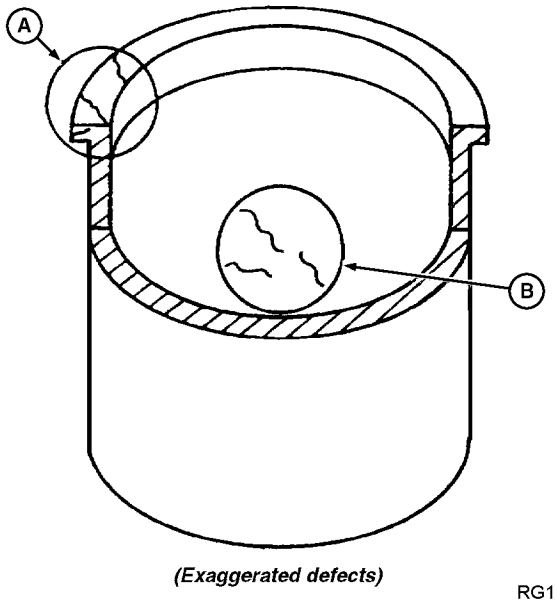
2. Visually examine liner I.D. Replace piston and liner if:

   The crosshatch honing pattern is not visible immediately below the top ring turn-around area.

   Liners are pitted or contain deep vertical scratches that can be detected by the fingernail.

3. Carefully examine liner for signs of fatigue, such as fine cracks in the flange area (A) and cracks in the ring travel area (B).

*NOTE: Inspect block for cracks or erosion in the O-ring packing areas. (See INSPECT AND CLEAN CYLINDER BLOCK later in this group.)*




*Cylinder Liner Defects (Exaggerated)*

RG,RG34710,1123 –19–23OCT97–2/2

## CYLINDER LINER MANUFACTURING DATE CODE EXPLANATION

A manufacturing four-digit date code will appear on each liner. For example, HJ94 means the liner has a hardened bore and was manufactured in October of 1994.

**HJ94**
H ..... Liner Material Type
J ..... Month Liner was Manufactured
94 ..... Year Liner was Manufactured

**Liner Material Specification:**
H ..... Hardened Liner Bore

**Month Liner was Manufactured:**
A ..... January
B ..... February
C ..... March
D ..... April
E ..... May
F ..... June
G ..... July
H ..... August
I ..... September
J ..... October
K ..... November
L ..... December

**Year Liner was Manufactured:**
94 ..... 1994
95 ..... 1995
etc.


*Four-Digit Date Code on Cylinder Liner*

RG,RG34710,1124 –19–23OCT97–1/1

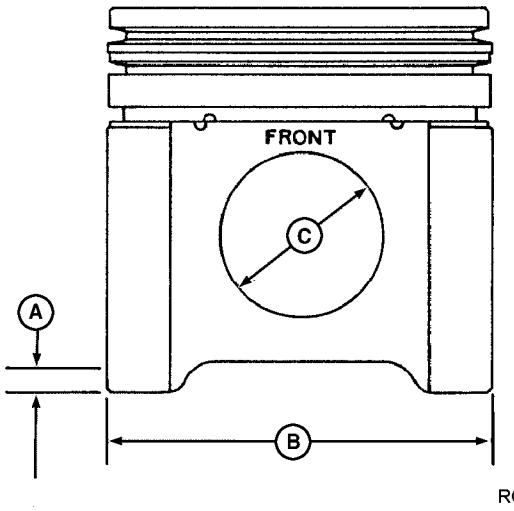
## DETERMINE PISTON-TO-LINER CLEARANCE

1. Measure piston skirt diameter (B) at right angles to piston pin bore (C), 15.16 mm (0.597 in.) from the bottom of the piston (A).

2. Record measurement and compare measurement obtained from matching liner.

**Piston Skirt—Specification**

| | |
|---|---|
| OD 15.16 mm (0.597 in.) from Bottom of Piston | 115.771—115.789 mm (4.5579—4.5586 in.) |



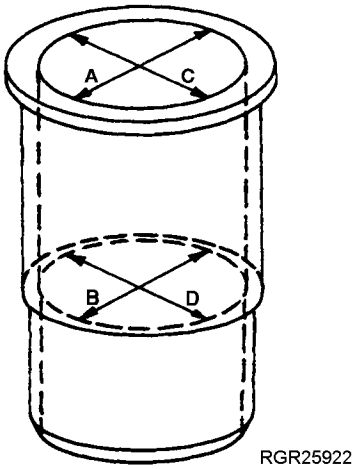

*Measuring Piston Skirt Diameter*

**Continued on next page**

RG,RG34710,1125 –19–23OCT97–1/2

**IMPORTANT: ALWAYS measure liners at room temperature.**

3. Measure liner bore parallel to piston pin at top end of ring travel (A).
4. Measure bore in same position at bottom end of ring travel (B).
5. Measure bore at right angle to piston pin at top end of ring travel (C).
6. Measure bore in same position at bottom end of ring travel (D).
7. Compare measurements A, B, C, and D to determine if liner is tapered or out-of-round.
8. Compare liner I.D. with matched piston O.D.




RGR25922 –UN–11DEC97

*Measuring Cylinder Liners*

**Cylinder Liner—Specification**

| | |
|---|---|
| ID | 115.865—115.895 mm (4.5616—4.5628 in.) |
| Maximum Out-of-Round | 0.051 mm (0.0020 in.) |

**Cylinder Liner in Ring Travel Area—Specification**

| | |
|---|---|
| Wear | 0.051 mm (0.0020 in.) maximum |

**Piston-to-Liner—Specification**

| | |
|---|---|
| New Part Clearance | 0.076—0.124 mm (0.0030—0.0049 in.) |
| Maximum Clearance | 0.152 mm (0.0060 in.) |

Replace piston and liners (as a set) if they exceed wear specifications given.

RG,RG34710,1125 –19–23OCT97–2/2

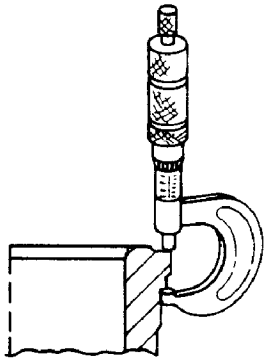
## MEASURE LINER FLANGE THICKNESS

Measure cylinder liner flange thickness at several locations and compare with specification given below.

If liner flange is not within specification, either use liner shims as needed or replace piston and liner as a set if shims don't bring liner standout within specification. (See RECHECK CYLINDER LINER STANDOUT AND INSTALL LINER SHIMS—IF REQUIRED, later in this group.)

**Liner Flange—Specification**

| | |
|---|---|
| Thickness | 11.989—12.039 mm (0.472—0.474 in.) |



RG4727 –UN–05DEC97

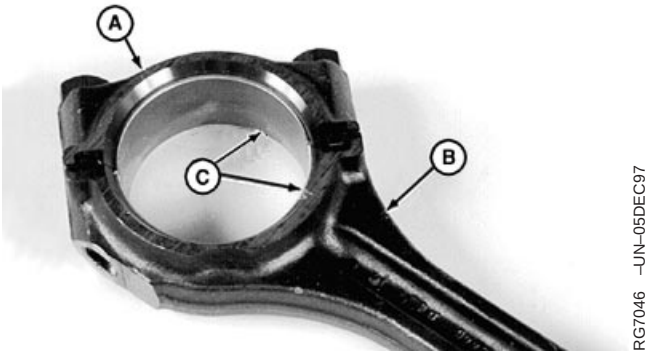
*Measuring Liner Flange*

RG,RG34710,1126 –19–23OCT97–1/1

## INSPECT AND MEASURE CONNECTING ROD BEARINGS

**IMPORTANT: Never use new connecting rod cap screws when checking rod bearing I.D. Use new cap screws only for final assembly of connecting rods.**

Rod bearing-to-journal oil clearance can be checked with PLASTIGAGE®, if rod is connected to crankshaft. If rod is out of engine, measure I.D. of connecting rod bearings and compare with O.D. of crankshaft journal.




*Connecting Rod Bearings*

1. With crankshaft removed, measure connecting rod journal O.D. at several points.

2. Carefully clamp rod in a soft-jawed vise and install connecting rod cap (A) on rod (B) with bearings (C) in correct position.

3. Initially tighten blind-hole cap screw to 27 N•m (20 lb-ft), then, tighten open-hole cap screw to same torque.

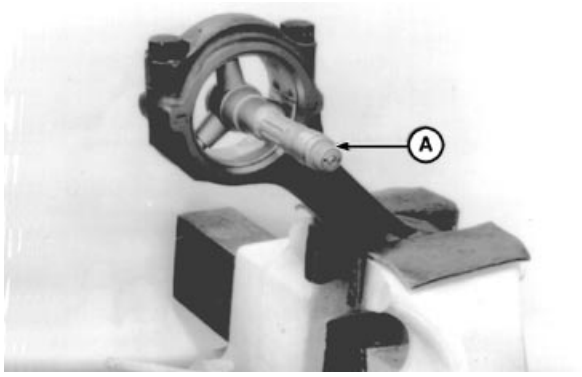
4. Next, tighten rod cap screws to 75 N• m (55 lb-ft), then tighten each cap screw an additional 90–100°. (See USE TORQUE-TURN METHOD FOR PROPER TORQUE, described later in this group.)

*PLASTIGAGE is a trademark of DANA Corp.*

**Continued on next page**

RG,RG34710,1127 –19–23OCT97–1/2

5. Using an inside micrometer (A) measure I.D. of bearing.
6. Subtract O.D. of crankshaft journals from I.D. of rod bearings to obtain oil clearance.
7. Compare measurements with the following specifications.
8. Inspect connecting rod bearings for wear or damage. If bearings are worn or not within specification, replace connecting rod bearings.




RG3824 –UN–04DEC97

*Measuring Connecting Rod Bearings*

**Crankshaft Journal—Specification**

| | |
|---|---|
| OD | 76.150—76.180 mm (2.9980—2.9992 in.) |

**Assemble Rod Bearing—Specification**

| | |
|---|---|
| ID | 76.210—76.260 mm (3.0005—3.0025 in.) |

**Oil (New Parts)—Specification**

| | |
|---|---|
| Clearance | 0.030—0.110 mm (0.012—0.0044 in.) |

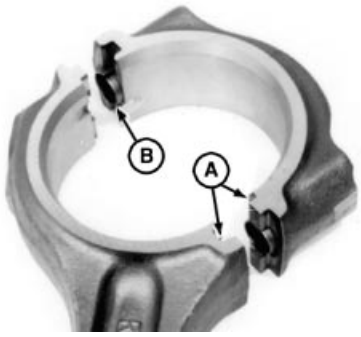
RG,RG34710,1127 –19–23OCT97–2/2

## INSPECT ROD AND CAP

1. Inspect rod and cap for wear or damage, such as chips or cracks in the joint area of the tongue-and-groove joints (A).
2. Inspect in and around cap screw holes (B) in cap. If any defects are found, replace rod and cap.
3. Carefully clamp rod in a soft-jawed vise (cap end upward).
4. Install cap WITHOUT bearing.

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

5. Initially tighten cap screws to 27 N•m (20 lb-ft), then tighten open hole cap screw to same torque.
6. Next, tighten rod cap screws to 75 N• m (55 lb-ft), then,tighten each cap screw an additional 90–100°. (See TORQUE-TURN METHOD FOR PROPER TORQUE, described later in this group.)




RG3749 –UN–04DEC97

*Inspecting Rod and Cap*

RG4982 –UN–05DEC97

*Clamping Rod in Vise*

**Continued on next page**

RG,RG34710,1128 –19–23OCT97–1/3

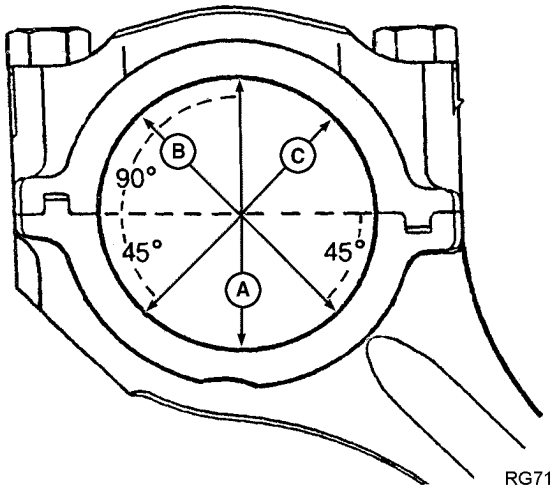
7. Using an inside micrometer, measure rod bore at center of bore and record measurements as follows:

   - At right angle to rod/cap joint (A).
   - At 45° left of measurement step “A” (B).
   - At 45° right of measurement step “A” (C).

**Rod Bore—Specification**

ID ..... 81.051—81.077 mm (3.191—3.192 in.)

8. Compare the measurements. If difference between the greatest and least measurement is more than 0.04 mm (0.0016 in.), the rod and cap are out-of-round. Replace both connecting rod and cap.



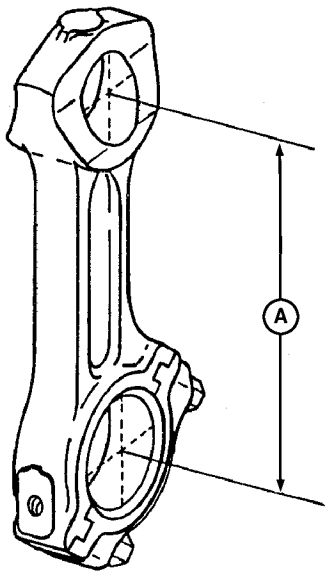

*Measuring Connecting Rod and Cap Bore*

RG,RG34710,1128 –19–23OCT97–2/3

9. Measure rod’s piston pin bore-to-crankshaft bore center-to-center dimension (A) and compare with specification given. If measurement is not within specification, replace rod.

**Centerline of Piston Pin Bore-to-Crankshaft Bore—Specification**

Dimension ..... 222.20—222.30 mm (8.748—8.752 in.)

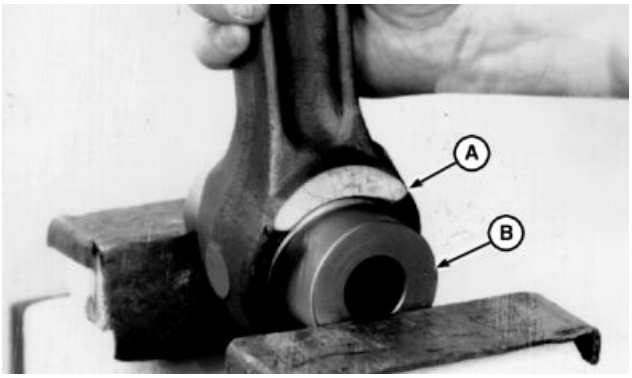



*Measuring Pin Bore-to-Crankshaft Bore*

RG,RG34710,1128 –19–23OCT97–3/3

## INSPECT PISTON PINS AND BUSHINGS

1. Insert piston pin (A) through piston pin bushing and carefully clamp in a soft-jawed vise.
2. Rotate connecting rod (B) back and forth several times to make sure connecting rod moves freely on piston pin.
3. Remove piston pin from connecting rod.




*Checking Piston Pin and Rod*

**Continued on next page**

RG,RG34710,1129 –19–23OCT97–1/2

4. Insert pin from either side of rod bushing. If pin is free on one end, but tight on the other, the bore could be tapered (A). If pin enters freely from both sides, but is tight in the center, bore is bell-mouthed (B).

5. Measure I.D. of rod pin bushing and O.D. of piston pin. Compare measurements with specifications given below:

**Piston Pin—Specification**

OD ..... 47.597—47.613 mm (1.8739—1.8745 in.)

**Pin Bore—Specification**

ID ..... 47.620—47.630 mm (1.8739—1.8745 in.)

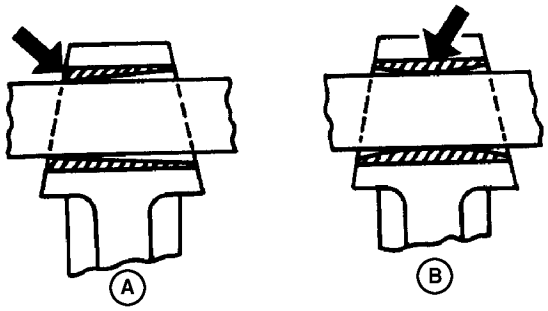
**Installed Rod Pin Bushing (after Boring)—Specification**

ID ..... 47.655—47.681 mm (0.0017—0.0033 in.)

**Rod Pin-to-Bushing Oil—Specification**

Clearance ..... 0.042—0.084 mm (0.0017—0.0033 in.)
Wear Limit ..... 0.102 mm (0.0040 in.)

6. If necessary, remove and replace piston pin bushing. See REMOVE PISTON PIN BUSHING, CLEAN AND INSPECT PIN BORE, later in this group.




RG4983 –UN–05DEC97

*Inspecting Piston Pin Bores*

RG,RG34710,1129 –19–23OCT97–2/2

## REMOVE PISTON PIN BUSHING, CLEAN AND INSPECT PIN BORE

1. If necessary, remove pin bushing with the JDG337 and JDE98A Connecting Rod Bushing Service Sets.

   Use the following tools from the service sets:

   - JDG339 Cup (A)
   - JDG338 Adapter (B)
   - JDE98-4 Driver (C)
   - STD36104 Forcing Screw with Washer (D)

**IMPORTANT: Use care to properly align the JDE98-4 Driver with bushing so that the connecting rod bushing bore is not damaged.**

2. Clean rod bushing bore using a medium grit emery cloth, as burrs will distort bushing. Install bushing on opposite side of rod burr.

**IMPORTANT: If piston pin bushing bore diameter in rod is not within specification or bushing has spun in rod, discard rod and replace with a new one.**

3. Measure rod bushing bore in three places approximately 45° apart. Compare the measurements with the specifications given below:

**Rod Pin Bore—Specification**

| | |
|---|---|
| Diameter without Bushing | 52.354—52.380 mm (2.0612—2.0622 in.) |

**Rod Pin Bore-to-Bushing—Specification**

| | |
|---|---|
| Press Fit | 0.084—0.147 mm (0.0033—0.0058 in.) |

**Installed Service Rod Pin Bushing—Specification**

| | |
|---|---|
| ID before Boring | 47.58—47.63 mm (1.8732—1.8751 in.) |
| ID after Boring | 47.655—47.681 mm (1.8762—1.8772 in.) |


*Removing Piston Pin Bushing from Rod*

**A—JDG339 Cup**
**B—JDG338 Adapter**
**C—JDE98-4 Driver**
**D—STD36104 Forcing Screw With Washer**

RG,RG34710,1130 –19–23OCT97–1/1

## INSTALL PISTON PIN BUSHING IN CONNECTING ROD

**IMPORTANT: Always push new bushing into rod from back side and burnish bushing after installation for proper form and seating in rod bore.**

1. Lubricate rod bushing bore and bushing with clean engine oil. Install bushing using the JDG337 and JDE98A Connecting Rod Bushing Service Sets.

   Use the following tools from the above sets and assemble in sequence as shown:

   - STD36104 Forcing Screw With Washer (A)
   - JDE98A Drive (B)
   - JDG338 Adapter (C)
   - Service Bushing (D)
   - JDE98-3 Pilot (E)
   - JDE339 Cup (F)

**IMPORTANT: Boring of the rod bushing should be done ONLY by experienced personnel on equipment capable of maintaining bushing specification.**

2. Bore I.D. of newly installed bushing to 47.655—47.681 mm (1.862—1.8772 in.) after installation. Remove all residue from boring operation.

3. Check rod pin-to-bushing clearance. See INSPECT PISTON PINS AND BUSHINGS, earlier in this group.

4. Replace rod pin as required.


RG4986 –UN–05DEC97

*Installing Piston Pin Bushing in Rod*

**A—STD36104 Forcing Screw With Washer**
**B—JDE98A Driver**
**C—JDG338 Adapter**
**D—Service Bushing**
**E—JDE98-3 Pilot**
**F—JDE339 Cup**

RG,RG34710,1131 –19–23OCT97–1/1

## COMPLETE DISASSEMBLY OF CYLINDER BLOCK (IF REQUIRED)

If complete inspection and “Hot Tank” cleaning of cylinder block is required, refer to the appropriate group for removal of all external and internal mounted components listed below:

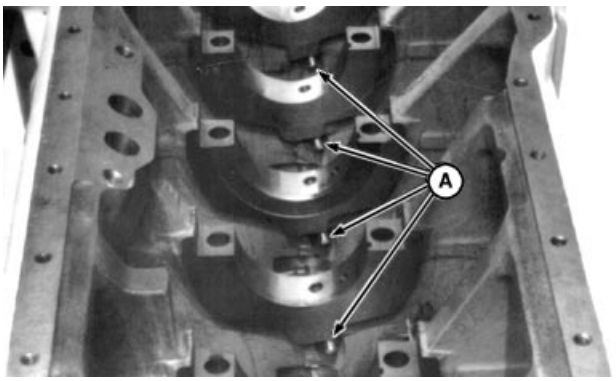
1. Remove crankshaft and pulley if not previously removed. (Group 15.)
2. Remove all remaining lubrication system components. (Group 20.)
3. Remove water pump and all remaining cooling system components (Group 25.)
4. Remove timing gear train and camshaft. (Group 16.)
5. Remove fuel injection pump and fuel filter assembly. (Group 35.)
6. If necessary to “Hot Tank” the block, remove oil gallery plugs, water gallery plugs, piston cooling orifices and the engine serial number plate. (See REMOVE AND CLEAN PISTON COOLING ORIFICES, later in this group.)

RG,RG34710,1132 –19–23OCT97–1/1

## REMOVE AND CLEAN PISTON COOLING ORIFICES

**IMPORTANT: A piston cooling orifice failure could cause damage to pistons, piston pins, rod pin bushings, and liners. If a piston cooling orifice is left out, low or no oil pressure will result.**

1. Remove all six (four shown) piston cooling orifices (A) and inspect each cooling orifice to make sure it is not plugged or damaged.
2. Use a soft wire and compressed air to clean orifice. Replace if condition is questionable.




RG3752 –UN–04DEC97

*Piston Cooling Orifices in Block*

RG,RG34710,1133 –19–23OCT97–1/1

## INSPECT AND CLEAN CYLINDER BLOCK

**IMPORTANT: If cylinder block is cleaned in a hot tank, be sure to remove any aluminum parts. Aluminum parts can be damaged or destroyed by hot tank solutions. Remove all serial number plates.**

*NOTE: All components (including piston cooling orifices), water gallery plugs and oil gallery plugs must be removed from the cylinder block for inspection and cleaning. Refer to the proper group for removal of all external and internal mounted components.*

1. Use D17015BR O-ring Bore Cleaning Brush or an equivalent brush to thoroughly clean all debris from cylinder liner O-ring bores.

2. Remove cylinder head locating dowels, if not previously removed. Clean out all threaded holes for cylinder head mounting cap screws in top deck of cylinder block. Use JDG681 Tap or an equivalent 9/16-12 UNC-2A tap approximately 88.9 mm (3.5 in.) long. Use compressed air to remove any debris or fluid which may be present in the cap screw hole.

RG5796 –UN–05DEC97

*Tap for Head Mounting Holes in Block*

**Continued on next page**

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

4. Inspect liner support flange (C) for burrs. If burrs are present, use a small half-moon file and LIGHTLY file (in a circular motion) burr off at approximately a 60° angle. DO NOT let file hit top deck of cylinder block (B) while filing.

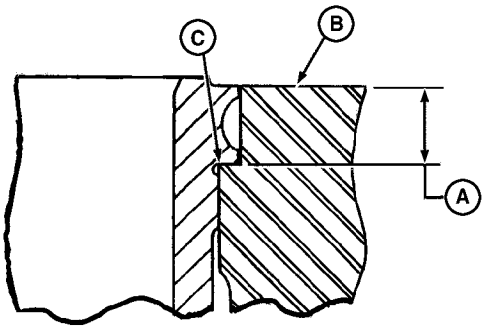
*NOTE: DO NOT file liner support flange excessively. Excess filing can damage liner support flange and allow an improper liner fit. Thoroughly clean all filings from cylinder block.*

5. Measure liner flange counterbore depth (A) in block and compare with specification given below.

**Cylinder Block Counterbore—Specification**

| | |
|---|---|
| Depth | 11.913—11.963 mm (0.469—0.471 in.) |

Carefully inspect block for cracks or any other physical damage. If a cracked block is suspected, pressure-test the block. A procedure for pressure testing is outlined in FOS (Fundamentals of Service) Manual-ENGINES. Replace block if there is evidence of a crack or physical damage.




*Measuring Liner Flange Counterbore Depth in Block*

RG,RG34710,1134 –19–23OCT97–2/2

## MEASURE CYLINDER BLOCK

Refer to the appropriate groups for a more detailed description of the features being measured. Compare measurements with specifications given below.

1. Assemble and measure main and thrust bearing bores. Compare measurements with specifications given below:

**Main Bearing—Specification**

| | |
|---|---|
| Bore ID without Bearing | 101.651—101.67 mm (4.0020—4.0030 in.) |
| Surface Width | 36.28—36.78 mm (1.428—1.448 in.) |

**Thrust Bearing—Specification**

| | |
|---|---|
| Bore ID without Bearing | 101.651—101.67 mm (4.0020—4.0030 in.) |
| Surface Width (No. 5 Main) | 37.44—37.54 mm (1.474—1.478 in.) |
| Overall Cap Width | 41.81—42.31 mm (1.646—1.666 in.) |

If any main or thrust bearing cap assembled I.D. is not within specification, blank (generic) bearing caps are available and must be line bored to specification by a qualified machine shop. (See Group 15 CRANKSHAFT, MAIN BEARINGS, AND FLYWHEEL.)

2. Measure camshaft follower bore diameter at all bore locations.

**Camshaft Follower—Specification**

| | |
|---|---|
| ID in Block | 17.384—17.440 mm (0.6845—0.6865 in.) |
| OD (New) | 17.33—17.35 mm (0.682—0.683 in.) |
| Clearance | 0.114 mm (0.0045 in.) |

If any one camshaft follower bore is not within specification, install a new cylinder block.

3. Measure camshaft bore diameter at all locations and record readings. Compare measurements with specifications given in chart below:

**Camshaft Bushing—Specification**

| | |
|---|---|
| Installed ID | 67.076—67.102 mm (2.6408—2.6418 in.) |
| Bore in Block | 69.987—70.013 mm (2.7554—2.7564 in.) |
| Minimum Runout of Bore in Block | 0.038 mm (0.0015 in.) |
| Journal Clearance | 0.0063—0.115 mm (0.0025—0.0045 in.) |

If camshaft bushing bore diameter in block is more than specified, install a new cylinder block.

4. Measure cylinder block top deck flatness using D05012ST Precision Straightedge and feeler gauge. Resurface as required.

**Cylinder Block Top Deck—Specification**

| | |
|---|---|
| Out-of-Flat | 0.10 mm (0.004 in.) over entire length or width |
| Straightness | 0.025 mm (0.001 in.) per any 305 mm (12.0 in) of Length |
| Maximum Wave Depth | 2.0 micrometers (79 micro-inch) |
| Minimum Main Bearing Bore Centerline-to-Top Deck Distance | 352.35 mm (13.872 in.) |

**Continued on next page**

**IMPORTANT: The centerline of the main bearing bore-to-top deck of cylinder block MUST BE 352.35—352.50 mm (13.872—13.878 in.). If not, replace cylinder block.**

RG,RG34710,1135 –19–23OCT97–2/2

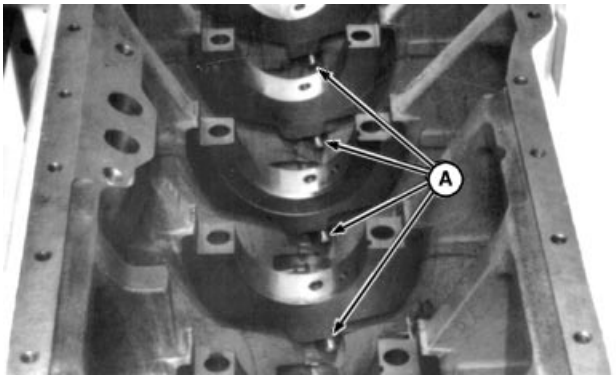
## INSTALL PISTON COOLING ORIFICES AND GALLERY PLUGS

1. Use a soft wire and compressed air to clean orifices. Replace if condition is questionable.

**IMPORTANT: A piston cooling orifice failure could cause damage to pistons, piston pins, rod pin bushings, and liners. If a piston cooling orifice is left out, low or no oil pressure will result.**

2. Install all six (four shown) piston cooling orifices (A) and tighten to 11 N•m (97 lb-in.) (8 lb-ft).

3. Install new oil and water gallery plugs as required, if removed.




*Piston Cooling Orifices in Block*

RG,RG34710,1136 –19–23OCT97–1/1

## RECHECK 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.*

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

Install liners without packing. Secure with cap screws and washers and measure liner standout. See MEASURE CYLINDER LINER STANDOUT (HEIGHT ABOVE BLOCK), earlier in this group.

Liner shims may be used to bring standout within specification. (See INSTALL LINER SHIMS—IF REQUIRED, later in this group.)

RG,RG34710,1137 –19–23OCT97–1/1

## INSTALL LINER SHIMS—IF REQUIRED

If the liner flange thickness is within specification, but recorded standout was no more than 0.08 mm (0.003 in.) BELOW top deck of block, install liner shims on bottom of liner flange.

The liner shim is 0.05 mm (0.002 in.) thick. A maximum of two liner shims may be used per cylinder, as required. Shims have tangs in the I.D. to help hold them in place against bottom of liner flange during liner installation.

1. Make sure counterbore in block is clean and free of burrs. Install liner(s), and shim(s), in block bore without O-rings. Secure liners with cap screws and washers as done previously. Tighten cap screws to 68 N•m (50 lb-ft).

   Liner standout MUST NOT exceed 0.102 mm (0.004 in.) after shim installation.

2. Measure liner standout again at 1, 5, 7, and 11 O'clock positions. Record measurements.

   If standout is still not within specification, remove liner and determine cause.

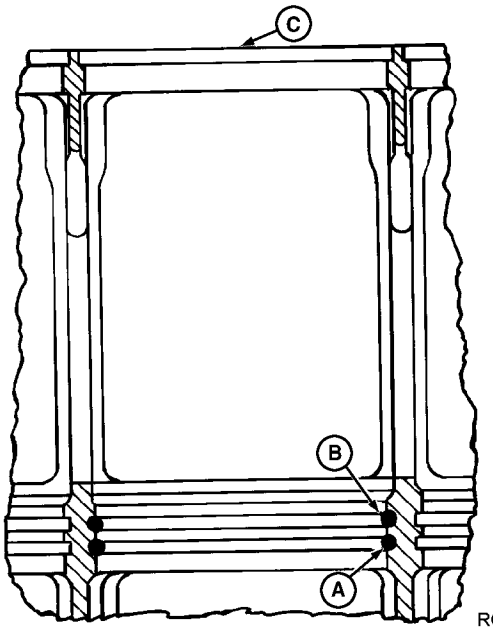
   If standout is within specification, proceed to next step.

RG,RG34710,1138 –19–23OCT97–1/1

## INSTALL PACKING ON CYLINDER LINER AND O-RINGS IN BLOCK

**IMPORTANT: DO NOT use oil on cylinder liner packing or O-rings. Oil can cause the red packing to swell, which squeezes liner and could possibly cause a scored piston.**

1. Pour AR54749 Soap Lubricant into a suitable container.
2. Dip new packings and O-rings in soap before installation. Do not leave packings or O-ring in soap to soak.
3. Install the black viton O-ring (A) in the lower O-ring groove in the cylinder block (C).
4. Install the red silicone O-ring (B) in the upper O-ring groove in the cylinder block.



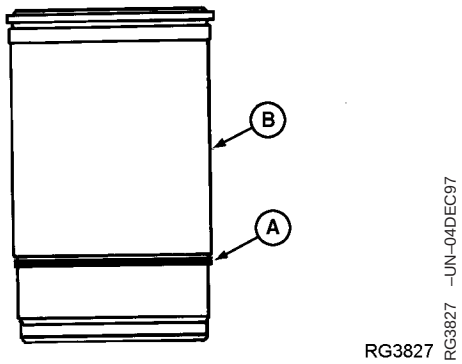

*Cylinder Liner Seals*

RG,RG34710,1139 –19–23OCT97–1/2

5. Turn cylinder liner (B) upside-down and install the square neoprene packing (A) over outside of liner.
6. Slide packing down firmly against second shoulder on liner.

*NOTE: Make sure the square packing is not twisted.*

7. Coat the liner packing sealing area of the cylinder liner and block O-rings with liquid soap.




*Installing Cylinder Liner Packing*

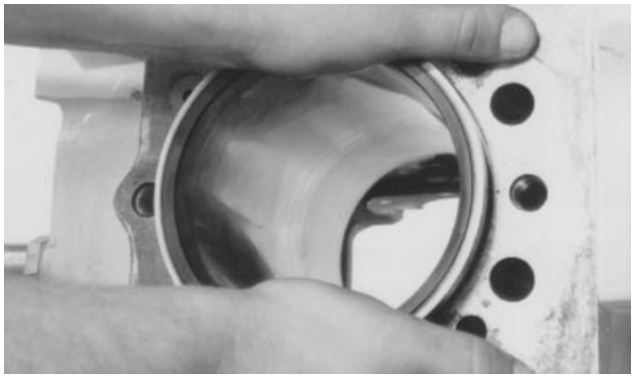
RG,RG34710,1139 –19–23OCT97–2/2

## INSTALL CYLINDER LINER IN BLOCK

**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.)**




*Installing Cylinder Liners in Block*

1. Install liner in block bore with manufacturing data code (stamped on flange) toward front of engine, unless liner O.D. is pitted or eroded.

   If liner O.D. is pitted or eroded, but still within acceptable service limits, rotate liner 90° from it's removed position. Pitted sections of the liner should be facing the front or rear of engine.

2. A resistance will be felt when cylinder liner is aligned in pilot bore.

3. Using only the pressure of both palms, the cylinder liner should drop to a point nearly flush with upper flange of the cylinder liner and cylinder block.

**Continued on next page**

RG,RG34710,1140 –19–23OCT97–1/2

4. Finish seating cylinder liners using a clean, hardwood block and hammer.

5. Gently tap hardwood block over top of cylinder liner with mallet.

*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.**

6. Hold liners in place with large flat washers and cap screws. Turn cap screws snug but do not tighten.

7. Clean cylinder liner bores with waterless hand cleaner after installation. Wipe dry with clean towels.

8. Apply clean engine oil to liner bores immediately to prevent corrosion.

RG6092 –UN–27JAN92

*Seating Cylinder Liners in Block*

RG,RG34710,1140 –19–23OCT97–2/2

## INSTALL PISTON AND CONNECTING ROD

**IMPORTANT: Piston must be installed on same connecting rod from which they were removed and new piston pin snap rings must be used.**

**If a new piston and liner assembly is to be installed, DO NOT remove piston from liner. Push piston out of liner bottom only far enough to install piston pin.**

1. Lubricate piston pin (A) and bushing with clean engine oil.

2. Install piston pin through piston (B) and connecting rod (C). Be sure “FRONT” of rod aligns with arrow or “FRONT” of piston.

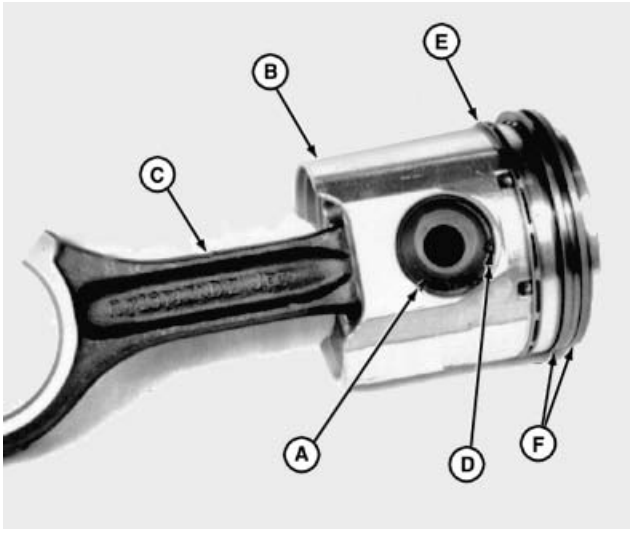
3. Install NEW piston pin snap rings (D) in grooves. Make certain snap rings have expanded in grooves of piston.

*NOTE: Full keystone compression ring (one “Pip” mark) goes in top piston ring groove. Half keystone ring (two “Pip” or “Top” marks) goes in second ring groove of piston.*

*“Pip” mark(s) on No. 1 and No. 2 compression rings must face top of piston.*

4. Use the JDE93 Ring Expander to install oil control ring with expander ring (E) and then compression rings.

*NOTE: New rings are furnished with the correct end gap, therefore, fitting to the liner is not necessary.*




RG5239 –UN–05DEC97

*Installing Piston and Connecting Rod*

**A—Piston Pin**
**B—Piston**
**C—Connecting Rod**
**D—Snap Rings (2 used)**
**E—Oil Control Ring with Expander Ring**
**F—Compression Rings**

**Continued on next page**

5. Stagger ring gap on piston as shown.

*NOTE: If crankshaft was removed, see INSTALL CRANKSHAFT in Group 15.*

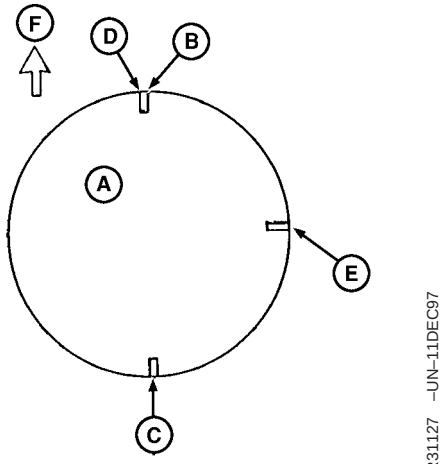
6. Coat piston, liners and I.D. of JDE96 Piston Ring Compressor with clean engine oil.

7. Carefully place ring compressor with piston and rod over liner.

**IMPORTANT: Be sure crankshaft journals and liner walls are not damaged when installing piston and rod in liner.**

*NOTE: Be sure the word "FRONT" on piston and rod face toward the front of the engine.*

8. With piston centered in ring compressor and rings staggered correctly, push piston into liner as shown.




*Position of Piston Ring Gaps*


*Installing Piston in Cylinder Liners*

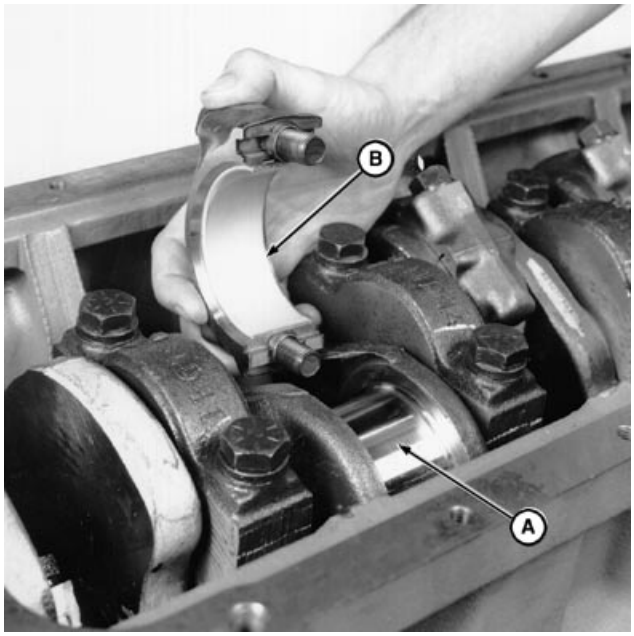
**A—Top of Piston**
**B—Top Compression Ring Gap**
**C—Oil Control Ring Gap**
**D—Expander Ring Gap**
**E—Bottom Compression Ring Gap**
**F—Front of Engine**

**Continued on next page**

9. Apply clean engine oil to bearing inserts (B) and crankshaft rod journals (A).

**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 final assembly.**

10. Install connecting rod caps.




*Installing Connecting Rod Caps with Bearing Inserts*

RG,RG34710,1141 –19–23OCT97–3/4

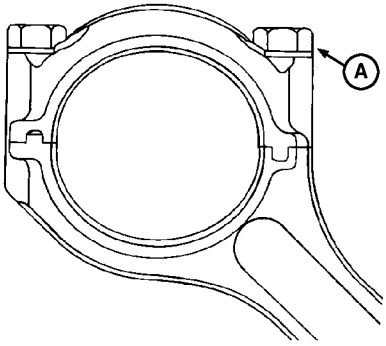
11. Dip NEW cap screws and washers in clean engine oil. Make sure top of cap screws have oil on them also.

**IMPORTANT: DO NOT use pneumatic wrenches to install connecting rod cap screws. Doing so may damaged threads.**

12. Initially, tighten (blind hole) cap screw (A) to 27 N•m (20 lb-ft) before tightening the other (open hole) cap screw.

13. Secondly, tighten all cap screws to 75 N•m (55 lb-ft).

14. Finally TORQUE-TURN all cap screws 90-100°. (See TORQUE-TURN CONNECTING ROD CAP SCREWS, described next in this group.)




*Blind-Hole Cap Screw in Rod Cap*

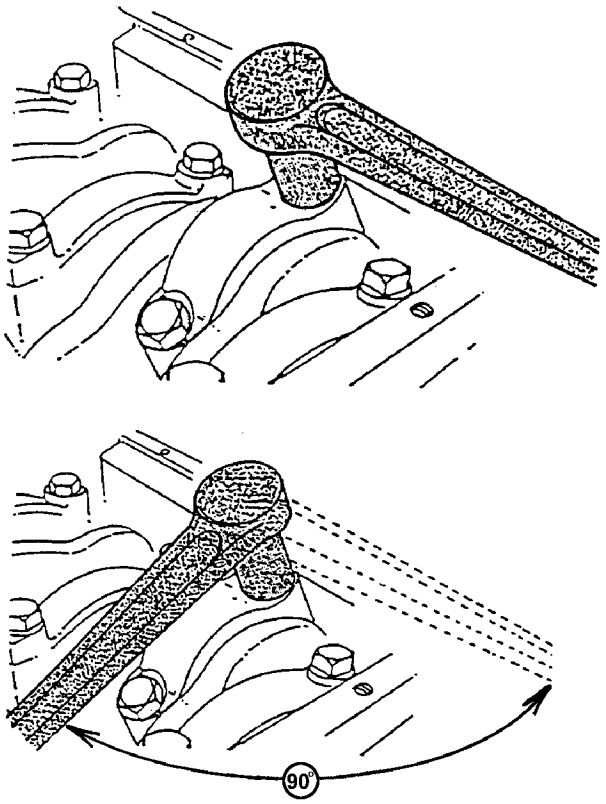
RG,RG34710,1141 –19–23OCT97–4/4

## 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.

*NOTE: Resulting torque is 175–285 N•m (129–210 lb-ft).*



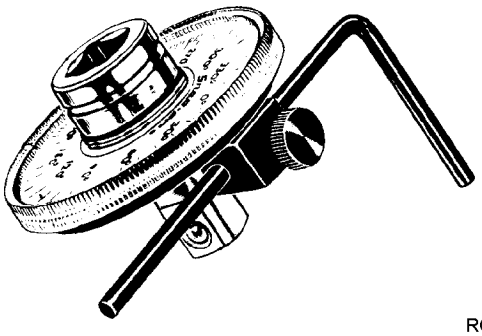

RG7047 –UN–05DEC97

*Tightening Rod Cap Screws by TORQUE-TURN Method*

RG,RG34710,1142 –19–23OCT97–1/2

### 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 gauge and TORQUE-TURN each cap screw 90°–100°.



RG5698 –UN–05DEC97

*JT05993 Torque Angle Gauge*

RG,RG34710,1142 –19–23OCT97–2/2

## 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.

RG,RG34710,1143 –19–23OCT97–1/1

## COMPLETE FINAL ASSEMBLY

*NOTE: Refer to the proper group for installation of components.*

1. Install camshaft, and timing gear cover. (Group 16.)
2. Install oiling system components. (Group 20.)
3. Install cylinder head using a new gasket and cap screws. Install valve train components. (Group 05.)
4. Install fuel injection system components. (Group 35.)
5. Install thermostat housing and water bypass pipe, if removed. (Group 25.)
6. Install vibration damper and crankshaft pulley. (Group 15.)
7. Install alternator. (Group 40.) To install fan and fan belt, see machine Technical Manual.
8. Install exhaust manifold and intake assembly. (Group 30.)
9. Install starting motor. (Group 40.)
10. Fill engine with clean oil and proper coolant.
11. Install engine in vehicle (if removed). (See machine Technical Manual.)
12. Perform engine break-in. (Group 05.)

RG,RG34710,1144 –19–23OCT97–1/1

# Crankshaft, Main Bearings, and Flywheel

## SPECIAL OR ESSENTIAL TOOLS

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

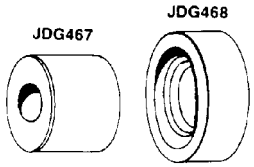
*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1145 –19–23OCT97–1/19

RG5508 –UN–05DEC97

Front Wear Sleeve Installer Set . . . . . JDE3

Install front crankshaft wear sleeve.




RG5508

*JDE3*

RG,RG34710,1145 –19–23OCT97–2/19

JDE3 Front Wear Sleeve Install Set consists of:

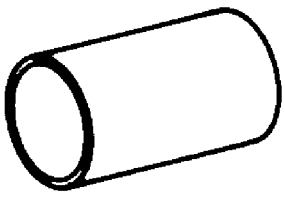
| | |
|---|---|
| Driver | JDG467 |
| Spacer | JDG468 |

RG,RG34710,1145 –19–23OCT97–3/19

RG5108 –UN–05DEC97

Gear Driver . . . . . JDH7

Install crankshaft drive gear.



RG5108

*JDH7*

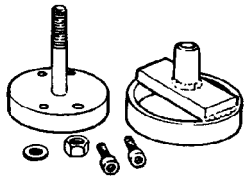
**Continued on next page**

RG,RG34710,1145 –19–23OCT97–4/19

RG5106 –UN–05DEC97

Seal and Wear Sleeve Installer . . . . . JDG476 (85)

Used to simultaneously install the new teflon unitized oil seal and wear sleeve on the rear crankshaft flange. Also use with JDG796 Alignment Tool to install rear oil seal housing, eliminating need for dial indicator to measure runout.



RG5106

*JDG476 (85)*

RG,RG34710,1145 –19–23OCT97–5/19

Seal and Wear Sleeve Installer Set consists of:

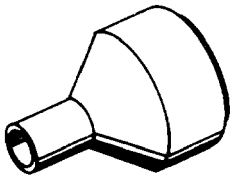
Pilot ..... JDG477 (85)
Driver ..... JDG478

RG,RG34710,1145 –19–23OCT97–6/19

RG6214 –UN–05DEC97

Seal Puller Adapter . . . . . JDG719

Used with a standout 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.



RG6214

*JDG719*

RG,RG34710,1145 –19–23OCT97–7/19

JDG719 Seal Puller Adapter Set consists of:

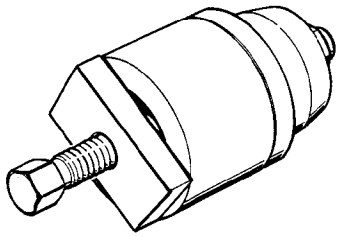
Adapter ..... JDG719-1
Screw (not shown) ..... 11200

**Continued on next page**

RG,RG34710,1145 –19–23OCT97–8/19

Seal Installer . . . . . JDG720A

Used to install front crankshaft oil seal with timing gear cover installed.



RG6215 –UN–05DEC97

*JDG720A*

RG,RG34710,1145 –19–23OCT97–9/19

JDG720A Seal Installer Set consists of:

1-Forcing Screw ..... JDG720-1
2-Seal Protector ..... JDG720-2
3-Seal Installer ..... JDG720-5
4-Ring (500 Series Engines) ..... JDG720-4

RG,RG34710,1145 –19–23OCT97–10/19

Hub Puller Kit. . . . . JDG721

Used with JDG787 Thread Protector to remove vibration damper pulley assembly.

RG5763 –UN–05DEC97

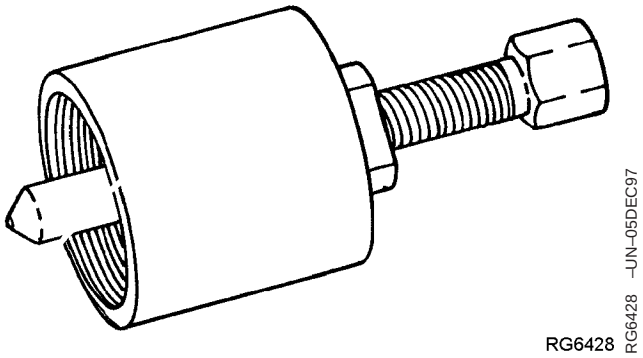
*JDG721*

**Continued on next page**

RG,RG34710,1145 –19–23OCT97–11/19

Front Wear Sleeve Puller . . . . . JDG786

Used to remove front crankshaft wear sleeve with timing gear cover installed.

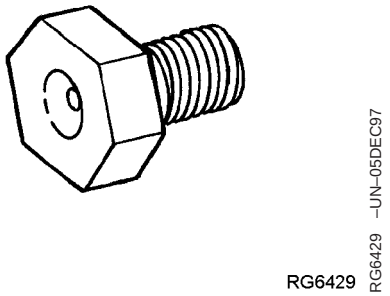



*JDG786*

RG,RG34710,1145 –19–23OCT97–12/19

Thread Protector . . . . . JDG787

Used with JDG721 Hub Puller Kit to remove vibration damper puller assembly.




*JDG787*

RG,RG34710,1145 –19–23OCT97–13/19

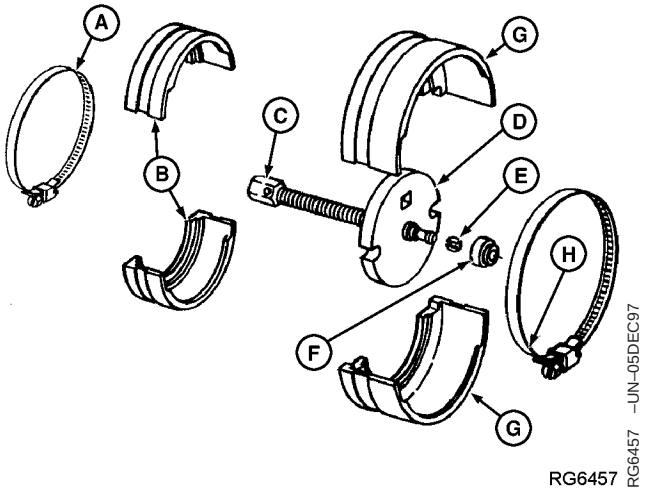
*NOTE: May be used with any puller set where limited space makes it difficult to use puller without a thread protector.*

**Continued on next page**

RG,RG34710,1145 –19–23OCT97–14/19

Rear Wear Sleeve Puller Kit . . . . . JDG790

Used to remove rear wear sleeve with oil seal housing installed on Series 400, 450, and 500 Engines.




*JDG790*

RG,RG34710,1145 –19–23OCT97–15/19

Rear Wear Sleeve Puller Kit consists of:

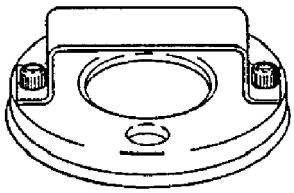
A–Hose Clamp (Series 500) ..... 219469
B–Collet Halves (Series 400/450) ..... JDG790-1
C–Forcing Screw ..... 35945
D–Pulling Plate (Series 400/450/500) ..... JDG790-2
E–Retainer Clip (Series 400/450/500) ..... 13876
F–Shaft Protector (Series 400/450/500) ..... 215177
G–Collet Halves (Series 500) ..... JDG790-3
H–Hose Clamp (Series 400/450) ..... 19311

RG,RG34710,1145 –19–23OCT97–16/19

RG6590 –UN–05DEC97

Oil Seal Housing Alignment Tool . . . . . JDG796

Use with oil seal housing casting numbers R115050 and R125027.



RG6590

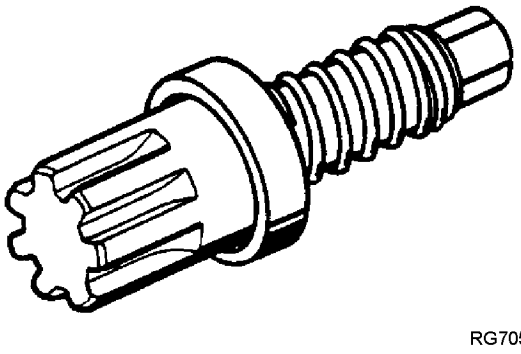
*JDG796*

**Continued on next page**

RG,RG34710,1145 –19–23OCT97–17/19

Flywheel Turning Tool . . . . . JDG820

Used to rotate engine to check damper radial runout and time engine. JDE81-1 may be used also if JDG820 is not available.

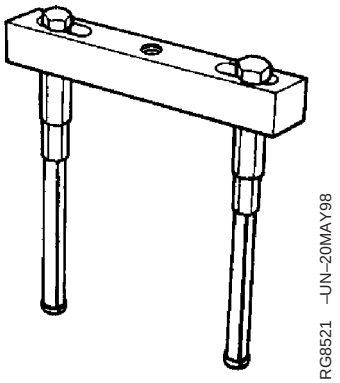



*JDG820*

RG,RG34710,1145 –19–23OCT97–18/19

Main Bearing Cap Puller/Installer . . . . . JDG1069

Use to remove and install the main bearing caps. Due to wider bearing surface, these caps are installed with an increased interference fit.




*JDG1069*

RG,RG34710,1145 –19–23OCT97–19/19

## SERVICE EQUIPMENT AND TOOLS

*NOTE: Order tools from 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*

RG,RG34710,1146 –19–23OCT97–1/3

Puller[1] . . . . . D01251AA

Remove crankshaft gear.

[1]*Part of D01047AA 17-1/2 and 30 Ton Puller Set*

RG,RG34710,1146 –19–23OCT97–2/3

Slide Hammer . . . . . D01300AA

Remove main bearing caps.

RG,RG34710,1146 –19–23OCT97–3/3

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| T43512 (U.S.)<br>TY9473 (Canadian)<br>242 (LOCTITE®) | Thread Lock and Sealer (Medium Strength) | Coat threads of flywheel mounting cap screws. |
| TY6304 (U.S.)<br>TY9484 (Canadian)<br>515 (LOCTITE®) | Flexible Sealant | Coat trimmed flywheel housing-to-cylinder block gasket. |
| TY15969 (U.S.)<br>TY9479 (Canadian)<br>680 (LOCTITE®) | Retaining Compound (Maximum Strength) | Coat O.D. of crankshaft flange for installation of rear oil seal/wear sleeve. |
| | PLASTIGAGE® | Check main bearing-to-crankshaft journal oil clearance during engine disassembly. |
| | Brake Kleen or Ignition Cleaner | Remove sealant from crankshaft flange. |

*LOCTITE is a trademark of Loctite Corp.*
*PLASTIGAGE is a trademark of DANA Corp.*

RG,RG34710,1147 –19–23OCT97–1/1

## CRANKSHAFT, MAIN BEARINGS, AND FLYWHEEL SPECIFICATIONS

| ITEM | SPECIFICATION | WEAR LIMIT |
|---|---|---|
| Crankshaft Fillet Radius: | | |
| Thrust Journal (Tangential) | 3.56—4.06 mm (0.140—0.160 in.) | _____ |
| Main Journals (Tangential) | 3.94—4.44 mm (0.156—0.175 in.) | _____ |
| Rod Journals (Undercut) | 4.01—4.37 mm (0.158—0.172 in.) | _____ |
| Engine Stroke | 128.5mm (5.059 in.) | _____ |
| Crankshaft End Play | 0.038—0.380 mm (0.0015—0.0150 in.) | _____ |
| Crankshaft Main Bearing Journal O.D. | 95.201—95.227 mm (3.7480—3.7491 in.) | _____ |
| Main Bearing Assembled I.D. W/Bearing | 95.270—95.320 mm (3.7508—3.7528 in.) | _____ |
| Main Bearing-to-Journal Clearance | 0.030—0.107 mm (0.0012—0.0042 in.) | _____ |
| Crankshaft Connecting Rod Journal O.D. | 76.149—76.175 mm (2.9980—2.9990 in.) | _____ |
| Crankshaft Rear Oil Seal-to-Housing Maximum Runout | 0.152 mm (0.0060 in.) | _____ |
| Journal Taper per 25.4 mm (1.00 in.) Length | 0.0025 mm (0.0001 in.) | _____ |
| Journal Out-of-Roundness | 0.025 mm (0.0010 in.) | _____ |
| Undersized Main Bearings Available | 0.292, 0.552 mm (0.0115, 0.0217 in.) | _____ |
| Undersized Rod Bearings Available | 0.292 mm (0.0115 in.) | _____ |
| Oversize Thrust Washer Available | 0.18 mm (0.007 in.) | _____ |
| Main Bearing Cap Bore Specifications: | | |
| I.D. without Bearing Inserts | 101.651—101.677 mm (4.0020—4.0030 in.) | _____ |
| Maximum Bore Diameter Taper | 0.013 mm (0.0005 in.) | _____ |
| Maximum Bore Diameter Variation | 0.038 mm (0.0015 in.) | _____ |
| Maximum Straightness Variation (Any Bore-to-Adjacent Bores) | 0.038 mm (0.0015 in.) | _____ |
| Maximum Straightness Variation (5 Center Bores-to-End Bores) | 0.076 mm (0.0030 in.) | _____ |
| Centerline of Bore-to-Top Deck of Block | 352.35—352.50 mm (13.872—13.878 in.) | _____ |
| Main Bearing Cap Surface Width | 36.28—36.78 mm (1.428—1.448 in.) | _____ |

**Continued on next page**

| ITEM | SPECIFICATION | WEAR LIMIT |
|---|---|---|
| No. 5 Main (Thrust) Bearing: | | |
| Surface Width (Washer Clearance) | 37.44—37.54 mm (1.474—1.478 in.) | _____ |
| Overall Cap Width ( -1995) | 41.81—42.31 mm (1.646—1.666 in.) | _____ |
| Overall Cap Width (1995- ) | 39.16—39.66 mm (1.542—1.561 in.) | |
| Base Circle O.D. for Thrust Washer Clearance Base Circle[a] | 129.286—130.810 mm (5.09—5.15 in.) | _____ |
| Crankshaft O.D. for Front Pulley | 47.650—47.676 mm (1.8785—1876 in.) | _____ |
| Front Pulley I.D. | 47.594—47.630 mm (1.8738—1.8752 in.) | _____ |
| Damper Pulley Radial Runout (Maximum) | 1.02 mm (0.040 in.) | _____ |
| Front Oil Seal Installed Below Front Face of Seal Bore | 8.9 mm (0.35 in.) | _____ |
| Oil Pump Drive Gear-to-Crankshaft Clearance | 0.38 mm (0.015 in.) | _____ |
| Rear Oil Seal Housing-to-Oil Pan Rail | Recessed 0.000—0.050 mm (0.000—0.002 in.) | |
| Maximum Rear Oil Seal Housing Runout | 0.15 mm (0.006 in.) | _____ |
| Flywheel Housing Face Runout Maximum Variation | 0.20 mm (0.008 in.) | _____ |
| Flywheel Face Flatness Maximum Variation | 0.23 mm (0.009 in.) | _____ |
| 25 Maximum Variation per 25mm (1.0 in.) of travel | 0.013 mm (0.0005 in.) | _____ |
| Flywheel Bearing Bore Concentricity Maximum Variation | 0.127 mm (0.005 in.) | _____ |

[a]Thrust (washer) surfaces on bearing cap must be flat in respect to mating thrust (washer) surfaces in cylinder block.

**Continued on next page**

**TORQUES**

| | |
|---|---|
| Vibration Damper-to-Crankshaft | 230 N•m (170 lb-ft) |
| Crankshaft Pulley-to-Damper[a] | 70 N•m (52 lb-ft) |
| Main Bearing Caps | 230 N•m (170 lb-ft) |
| Rear Crankshaft Oil Seal Housing | 27 N•m (170 lb-ft) |
| Flywheel-to-Crankshaft | 115 N•m (85 lb-ft) |
| Flywheel Housing-to-Cylinder Block | 407 N•m (300 lb-ft) |
| Piston Cooling Orifices | 11 N•m (97 lb-in.) (8 lb-ft) |
| Injection Pump Gear Cover-to-Timing Gear Cover | 27 N•m (20 lb-ft) |
| Timing Gear Cover-to-Cylinder Block[b] | 27 N•m (20 lb-ft) |
| Water Pump Cover-to-Timing Gear Cover: | |
| 5/16-in. Cap Screws | 27 N•m (20 lb-ft) |
| 3/8-in. Cap Screws | 47 N•m (35 lb-ft) |
| Hub Drive-to-Flywheel | 115 N•m (85 lb-ft) |

[a]On single dampers used with generator set engines, torque pulley screws to 61 N•m (45 lb-ft).
[b]See INSTALL TIMING GEAR COVER, later in this group, for proper cap screw tightening sequence.

RG,RG34710,1148 –19–23OCT97–3/3

## 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.

RG,RG34710,1149 –19–23OCT97–1/1

## REMOVE CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE (WITH OIL SEAL HOUSING INSTALLED)

Using JDG719 Seal Puller Adapter along with JDE38-2 Shank and JDE38-3 Slide Handle is the preferred method for removing the crankshaft rear oil seal. If JDG719, JDE38-2, and JDE38-3 are not available, JDG22 Seal Remover can be used to remove the seal. Follow same procedure for both pullers.

**IMPORTANT: If rear oil seal is replaced, also replace rear wear sleeve (as a matched set).**

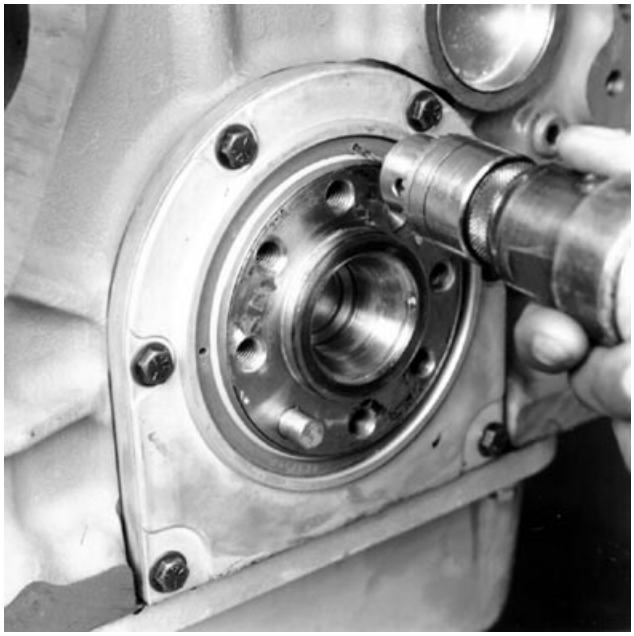
*NOTE: If oil seal housing is to be removed, remove seal and wear sleeve after housing is removed. See REMOVE REAR OIL SEAL HOUSING AND WEAR SLEEVE (with engine disassembled), later in this group.*

1. Remove rear drive hub (if equipped) and flywheel. See REMOVE FLYWHEEL later in this group.

2. Drill two small holes approximately 20° apart in bottom of seal casing. Install sheet metal screws in seal casing with JDG22 Seal Remover attached.

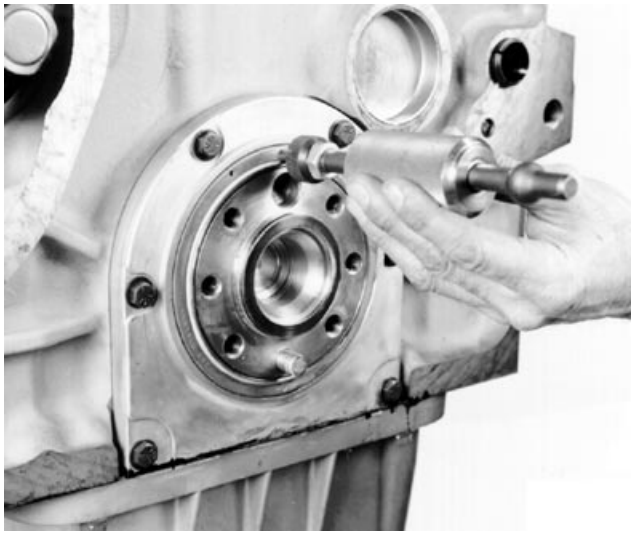
*NOTE: It may be necessary to drill a small hole in seal at one or two other locations to aid in removal.*

3. Cock seal at 6 o'clock position (180° opposite drilled hole) using a small punch and carefully pull seal from housing.



RG5819 –UN–05DEC97

*Drilling Holes in Rear Oil Seal Casing*

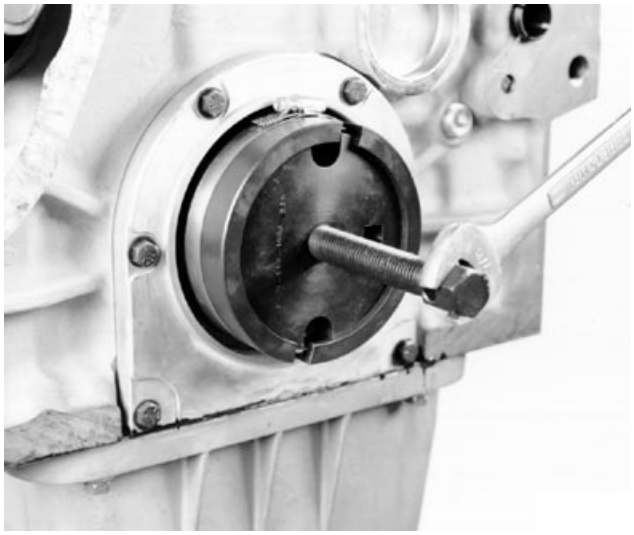


RG6467 –UN–05DEC97

*Removing Rear Oil Seal*

**Continued on next page**

4. Assemble JDG790 Rear Wear Sleeve Puller and position onto crankshaft flange with wear sleeve seated in jaws.
5. Securely tighten band clamp in groove on O.D. of jaws.
6. Tighten forcing screw with disc centered in crankshaft flange until wear sleeve is removed from crankshaft.



RG6468 –UN–05DEC97

*Removing Crankshaft Wear Sleeve*

RG,RG34710,1150 –19–23OCT97–2/3

Clean O.D. of crankshaft flange with cleaning solvent, acetone, or any other suitable cleaner that will remove sealant. (Brake Kleen or Ignition Cleaner and Drier are examples of commercially available solvents that will remove sealant from flange.)

Look for nicks or burrs on wear ring surface and bore in flywheel housing. If necessary, use a polishing cloth.

Finish cleaning by wiping flange with a clean rag. Any small nicks should be removed with 180-grit or finer polishing cloth.

Check oil seal housing runout as explained later in this group.

RG5822 –UN–05DEC97

*Cleaning Crankshaft Flange*

RG,RG34710,1150 –19–23OCT97–3/3

## CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE HANDLING PRECAUTIONS

Use the following precautions for handling seal and wear sleeve:

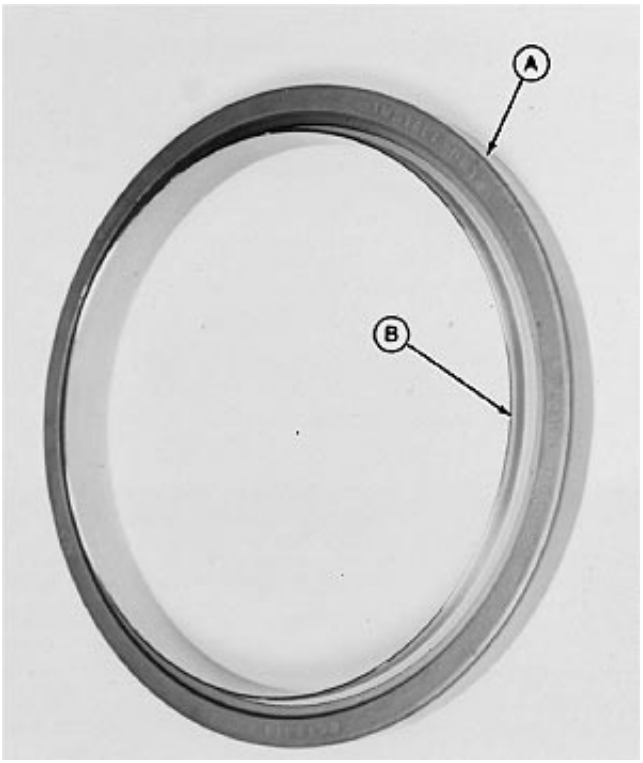
Seal (A) and wear sleeve (B) are assembled. DO NOT SEPARATE. If parts become separated, discard and replace with a new assembly. Attempts to reassemble will cause the wear sleeve to damage the seal allowing engine oil to leak past seal.

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 I.D. 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.

Oil seal/wear sleeve assembly MUST BE installed with the JDG476(85) Crankshaft Rear Oil Seal Installation Tool Set. Tool set consists of JDG477 (85) Pilot and JDG478 Driver.




RG5575 –UN–07JUL89

*Crankshaft Rear Oil Seal and Wear Sleeve*

RG,RG34710,1151 –19–23OCT97–1/1

## INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE (WITHOUT ENGINE DISASSEMBLY)

*NOTE: These instructions are for use when the oil seal housing and oil pan would not be removed. Refer to INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE (WITH ENGINE DISASSEMBLED), later in this group, for instructions with oil seal housing and oil pan removed.*

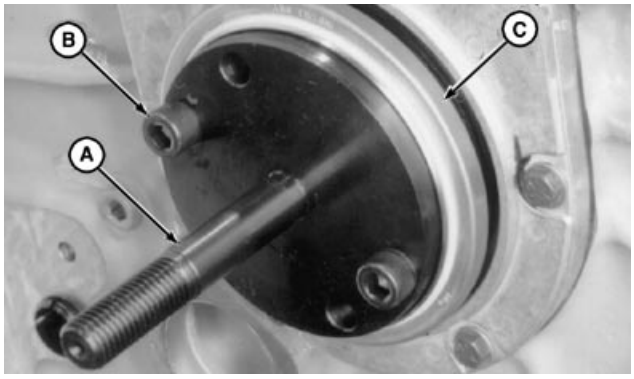
1. Apply a light coating of LOCTITE® 609 Retaining Compound, or equivalent, completely around the leading edge of crankshaft flange. Wipe away any sealant that may have gotten on I.D. of seal housing bore.

2. Install JDG477 (85) Pilot (A) on end of crankshaft using the Allen head cap screws (B) supplied with tool set. Tighten cap screws securely.

**IMPORTANT: Handle seal and wear sleeve assembly carefully. If assembly becomes separated, discard these parts and install a new assembly. (See CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE HANDLING PRECAUTIONS, later in this group.)**

**When installing the JDG478 Driver on JDG477 (85) Pilot and crankshaft flange to position oil seal/wear sleeve assembly, locate crossbar of installer at right angle (90°) to Allen head cap screws. This allows the crossbar to bottom on pilot, not head of cap screws, assuring correct installation.**

3. Carefully start oil seal/wear sleeve assembly (C) over JDG477 (85) Pilot and crankshaft with open side of seal toward engine.




RG4639 –UN–05DEC97

*Installing Crankshaft Rear Oil Seal/Wear Sleeve*

*LOCTITE is a trademark of Loctite Corp.*

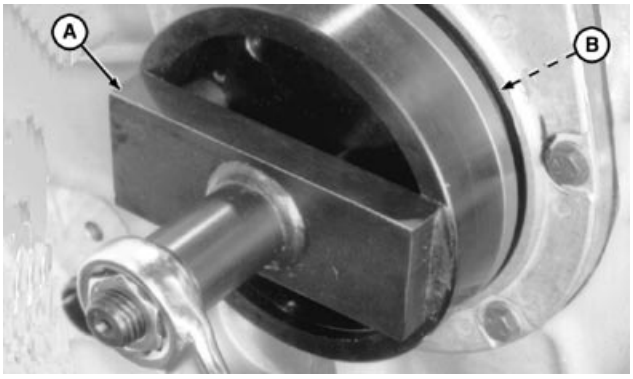
**Continued on next page**

RG,RG34710,1152 –19–23OCT97–1/2

4. Position JDG478 Driver (A) so that hole in the cross plate goes over threaded stud of pilot. Install washer and nut on stud.

5. Tighten nut to draw JDG478 Driver in until crossbar bottoms on JDG477 (58) Pilot. When the tool bottoms, seal and wear ring assembly (B) will be correctly positioned.

6. Remove JDG476 (85) Tool Set from engine.




*Crankshaft Rear Oil Seal/Wear Sleeve Installed*

RG,RG34710,1152 –19–23OCT97–2/2

## INSPECT VIBRATION DAMPER

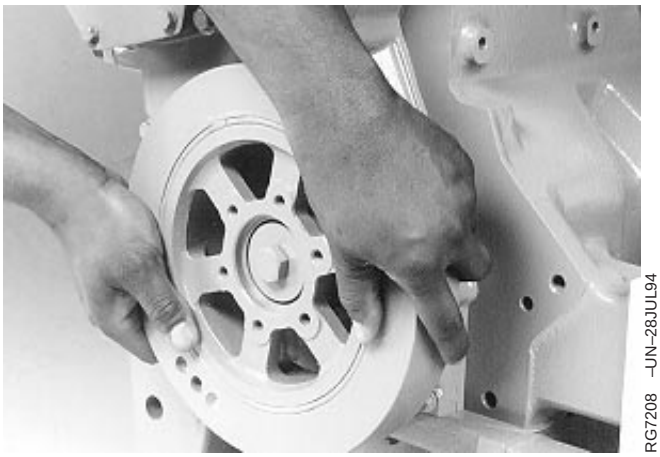
**IMPORTANT: The damper assembly is not repairable and should be replaced every 5 years or 4500 hours, whichever occurs first. Also, replace damper whenever crankshaft is replaced or major engine overhaul is performed. Dual dampers should always be replaced as a matched set.**

**Do not immerse the vibration damper or the damper pulley in cleaning solvent. Doing so may damage the rubber portions of this assembly.**

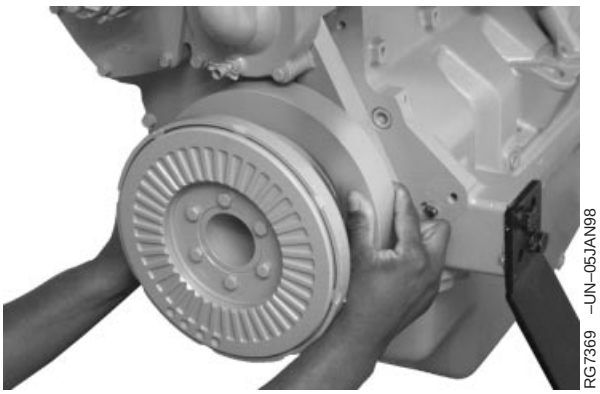
**Never apply thrust on outer ring of damper. Damper is sensitive to impact damage, such as being dropped or struck with a hammer.**

1. Relieve tension or remove V-belts (shown removed).

2. Grasp vibration damper with both hands and attempt to turn it in both directions. If rotation is felt, damper is defective and should be replaced.




*Single Damper*




*Dual Damper*

**Continued on next page**

DPSG,OUOE003,28 –19–17DEC98–1/2

3. Check vibration damper radial runout by positioning a dial indicator so preloaded probe (A) contacts damper O.D.

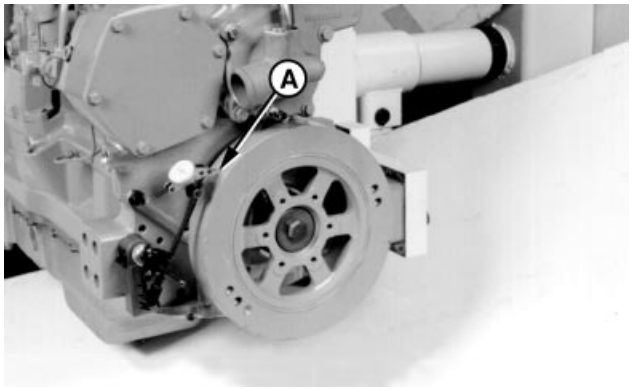
4. Rotate crankshaft using JDE81-1 or JDG820 Flywheel Turning Tool.

5. Note total dial indicator movement. Compare reading with specification below.

**Damper—Specification**

| | |
|---|---|
| Radial Runout | 1.02 mm (0.040 in.) |

If runout exceeds specifications, replace vibration damper. (See REMOVE DAMPER later in this group.)




RG7065 –UN–26NOV97

*Measuring Runout of Single Damper*

RG7370 –UN–05JAN98

*Measuring Runout of Dual Damper*

DPSG,OUOE003,28 –19–17DEC98–2/2

## CHECK CRANKSHAFT END PLAY

1. Completely engage then release the clutch lever.
2. Place a dial indicator on damper face.

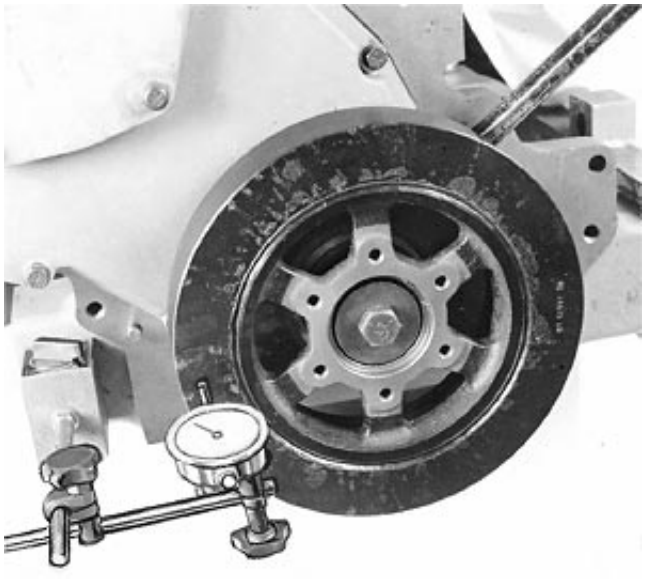
**IMPORTANT: Use care not to damage or distort the timing gear cover or bearing inserts when prying. Do not pry on outer inertia ring of damper.**

3. Pry with flat bar between the damper pulley and timing gear cover.

**Crankshaft—Specification**

| | |
|---|---|
| End Play | 0.038—0.380 mm (0.0015—0.0150 in.) |

*NOTE: New thrust bearings will usually restore proper end play.*



RG5934 –UN–28AUG91

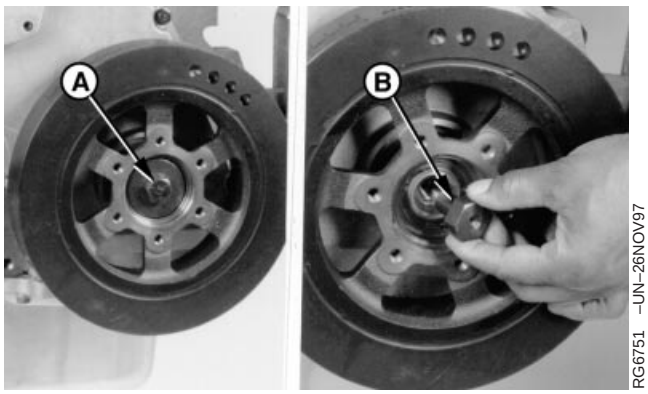
*Checking Crankshaft End Play*

RG,RG34710,1153 –19–23OCT97–1/1

## REMOVE CRANKSHAFT VIBRATION DAMPER

**IMPORTANT: DO NOT use a jaw-type puller to remove vibration damper. Damage could result to the damper. Never apply thrust on outer ring of damper. Do not drop or hammer on damper.**

1. Remove pulley from damper, if equipped (shown removed).
2. Remove cap screw (A) and washer securing damper to crankshaft.
3. Install JDG787 Thread Protector (B) in nose of crankshaft.




RG6751 –UN–26NOV97

*Preparing to Remove Crankshaft Vibration Damper*

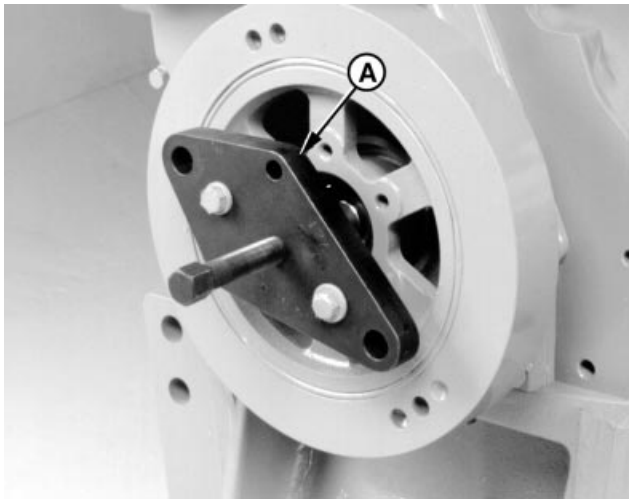
**Continued on next page**

RG,RG34710,1154 –19–23OCT97–1/2

**CAUTION: Plan a safe handling procedure to avoid personal injury or damage to damper.**

4. Remove damper from crankshaft using JDG721 Hub Puller (A).

*NOTE: D01207AA (OTC518) Puller Set (not shown) may also be used to remove damper.*




*Removing Crankshaft Vibration Damper*

RG,RG34710,1154 –19–23OCT97–2/2

## REPLACE CRANKSHAFT FRONT OIL SEAL AND WEAR SLEEVE (WITH TIMING GEAR COVER INSTALLED ON ENGINE)

**IMPORTANT: Whenever front oil seal is replaced, the wear sleeve must also be replaced.**

*NOTE: If timing gear cover is going to be removed from engine, remove front seal and wear sleeve after timing gear cover is removed.*

**TO REMOVE FRONT OIL SEAL:**

1. Check oil seal and wear sleeve for wear, damage, or leakage.

2. Center punch seal casing at 12 O'clock position.


*Center Punching Front Oil Seal Casing*

**Continued on next page**

RG,RG34710,1155 –19–23OCT97–1/7

3. Drill 3.175 mm (1/8 in.) hole in casing.


*Drilling Hole in Front Oil Seal Casing*

RG,RG34710,1155 –19–23OCT97–2/7

4. Using JDG719 Seal Puller along with JDE38-2 Shank, JDE38-3 Hammer, and metal screw, remove seal.

5. Remove keyway from keyslot of crankshaft.

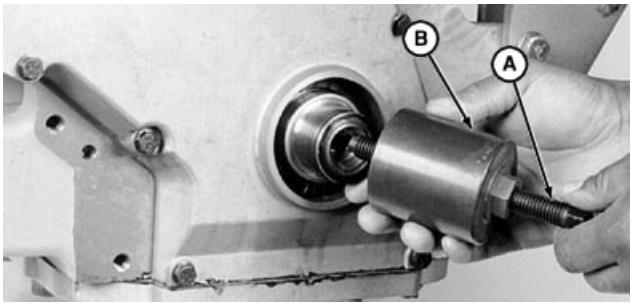

*Removing Front Oil Seal*

**Continued on next page**

RG,RG34710,1155 –19–23OCT97–3/7

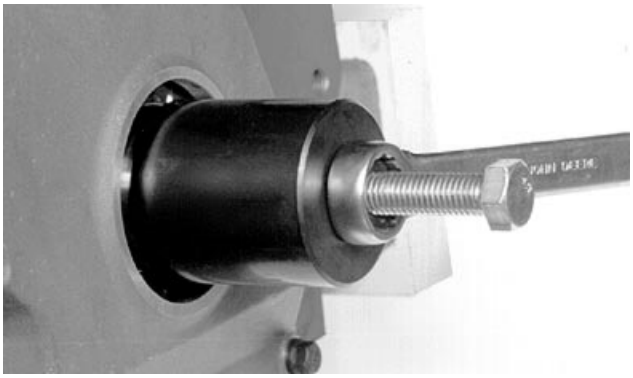
**TO REMOVE WEAR SLEEVE USING JDG786:**

1. Start fully threaded centering screw (A) through hex head end of puller (B) from JDG786 Front Wear Sleeve Puller until head of screw is approximately 1/2 in. from hex on puller.
2. Thread centering screw into nose of crankshaft until it bottoms. Back screw out one full turn after it bottoms.
3. Tighten puller until it is securely threaded onto wear sleeve. Back centering screw out one full turn and tighten threaded puller onto wear sleeve again.
4. Remove centering screw from nose of crankshaft and puller.




RG6753 –UN–05DEC97

*Assembling Puller to Remove Front Wear Sleeve*

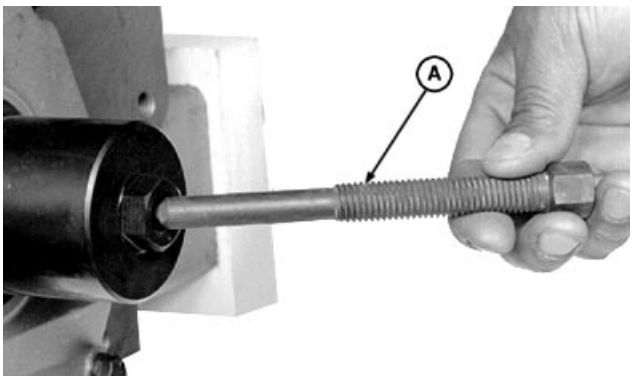


RG7728 –UN–05DEC97

*Installing Puller to Remove Front Wear Sleeve*

RG,RG34710,1155 –19–23OCT97–4/7

5. Install partially threaded forcing screw (A) into puller and tighten until bottoms in nose of crankshaft. There in no thread engagement in crankshaft; just with puller.
6. Continue to tighten forcing screw until puller and wear sleeve are free from crankshaft flange.
7. Inspect crankshaft flange for nicks or burrs. Clean up flange with a light file and emery cloth.
8. Measure front oil seal bore runout in timing gear cover. Maximum allowable runout is 0.254 mm (0.010 in.)




RG7729 –UN–05DEC97

*Removing Front Wear Sleeve*

**Continued on next page**

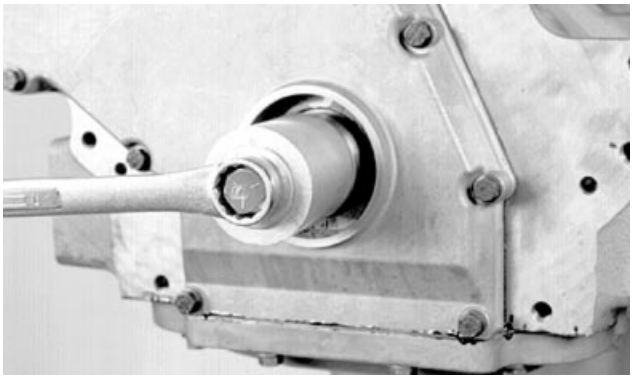
RG,RG34710,1155 –19–23OCT97–5/7

**TO INSTALL FRONT WEAR SLEEVE:**

1. Coat I.D. of new wear sleeve with LOCTITE 609 Retaining Compound.
2. Using JDG467 Driver from JDE3 Installer along with washer and 5/8-11 UNC x 3 in. cap screw that secures damper pulley assembly to crankshaft. TIghten cap screw until driver bottoms.
3. Remove installation tools and clean any sealant from O.D. of wear sleeve or I.D. of seal bore.

RG6476 –UN–05DEC97

*Tool for Installing Front Wear Sleeve*



RG6477 –UN–05DEC97

*Installing Front Wear Sleeve*

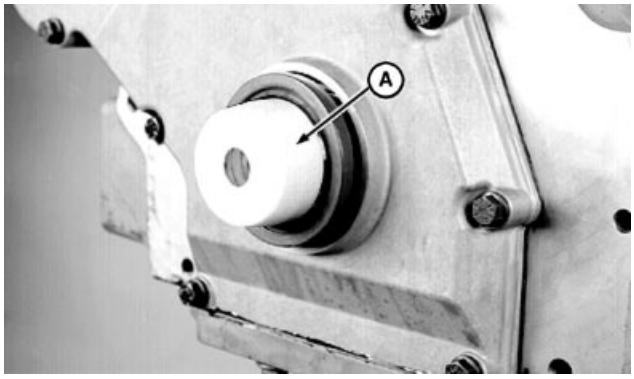
**Continued on next page**

RG,RG34710,1155 –19–23OCT97–6/7

**TO INSTALL FRONT OIL SEAL:**

1. Place JDG720-2 Seal Protector (A) on nose of crankshaft. Lubricate I.D. of front oil seal lips with clean engine oil. Slide seal with spring side of seal facing engine onto seal protector. Be careful not to roll oil seal lips.
2. Place JDG720-3A Seal Installer onto seal protector against seal. Do not use spacer ring provided with tool set.
3. With nut and washer installed onto JDG720-1 Forcing Screw, thread forcing screw into nose of crankshaft until it bottoms.
4. Tighten nut against crossplate of installer until installer bottoms onto front of timing gear cover.
5. Remove installation tools. Verify seal is installed square in bore and that seal lips are not rolled on wear sleeve.

   Oil seal should be 8.9 mm (0.35 in.) below front face of seal bore.




*Protector for Installing Front Oil Seal*


*Installing Front Oil Seal*

RG,RG34710,1155 –19–23OCT97–7/7

## REMOVE AND INSTALL TIMING GEAR COVER—ENGINE INSTALLED IN VEHICLE (8000 SERIES TRACTORS)

6081HRW Engines on 8100, 8200, 8300, and 8400 tractors are equipped with front frame/oil sump. Refer to TM1575 (8100, 8200, 8300, and 8400 Tractors—Repair) for access to front frame/oil sump-to-engine block cap screws. (For 8000T Tracks tractors, refer to TM1621.)

**TO REMOVE TIMING GEAR COVER:**

1. Remove viscous fan drive, drive housing, and coupler. (Refer to TM1575.)
2. Remove crankshaft vibration damper as detailed earlier in this group.
3. Disconnect water piping and remove water pump cover with water bypass tube. Remove and discard gaskets.
4. Back out all front frame/oil sump-to-engine block cap screws 9.5 mm (3.8 in.).
5. Disconnect engine speed sensor connector from sensor.
6. Remove injection pump drive gear cover.
7. Slowly lift engine block assembly approximately 6.4 mm (0.25 in.) using safety approved lifting equipment.

**IMPORTANT: The timing gear cover must not be "dragged" horizontally while in contact with front frame/oil sump gasket. Doing so may damage gasket sealing bead.**

8. Remove remaining cap screws and carefully remove timing gear cover with water pump. Remove and discard timing gear cover gasket.
9. Remove front oil seal from timing gear cover and discard seal.
10. Remove front wear sleeve from crankshaft flange and discard sleeve.

**TO INSTALL TIMING GEAR COVER:**

1. Thoroughly clean all timing gear cover gasket surfaces and front oil seal bore.

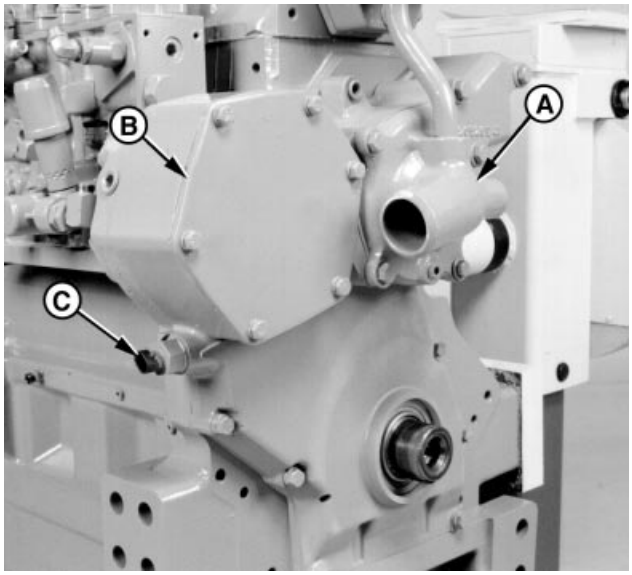
*NOTE: Front wear sleeve can be installed with timing gear cover removed or installed.*

2. Install a new front wear sleeve on crankshaft flange (See INSTALL FRONT WEAR SLEEVE, later in this group).
3. Install timing gear cover (See INSTALL CRANKSHAFT FRONT OIL SEAL WITH TIMING GEAR COVER INSTALLED ON ENGINE, later in this group).
4. Install front oil seal (See INSTALL CRANKSHAFT FRONT OIL SEAL WITH TIMING GEAR COVER INSTALLED ON ENGINE, later in this group).
5. Install vibration damper (See INSTALL VIBRATION DAMPER, later in this group).
6. Tighten front frame/oil sump cap screws as detailed in Group 20, Lubrication System of this manual (See TIGHTEN CAP SCREWS ON FRONT FRAME/OIL SUMP) or TM1575.
7. Complete final assembly as outlined in TM1575.

RG,RG34710,1156 –19–23OCT97–1/1

## REMOVE TIMING GEAR COVER—ENGINE REMOVED

1. Remove engine oil pan. Remove engine oil pump assembly if crankshaft is to be removed.
2. Disconnect engine speed sensor connector (shown disconnected) from sensor (C).
3. Remove injection pump drive gear cover (B).
4. Disconnect water piping and remove water pump cover (A) with water bypass tube. Remove and discard gaskets.
5. Remove remaining cap screws and remove timing gear cover with water pump. Remove and discard gasket.
6. Remove front oil seal from timing gear cover and discard seal.
7. Remove front wear sleeve from crankshaft flange and discard sleeve.




*Removing Timing Gear Cover*

RG,RG34710,1157 –19–23OCT97–1/1

## INSPECT AND MEASURE 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.

**IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel or housing face.**

3. Measure flywheel housing face run-out, flywheel face flatness, and pilot bearing bore concentricity, as outlined later in this group. Resurface flywheel face or replace as required.

RG,RG34710,1158 –19–23OCT97–1/1

## CHECK FLYWHEEL HOUSING FACE RUNOUT

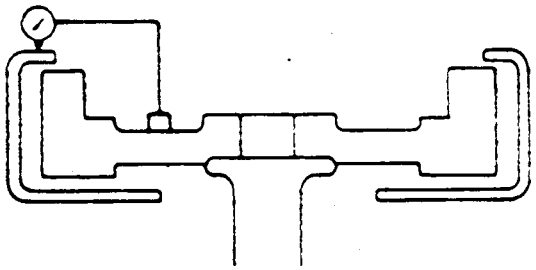
1. Mount dial indicator on flywheel. Set pointer to contact PTO mounting surface on flywheel housing at right angles. Pointer should not contact holes in flywheel housing.

**IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel housing face runout.**

2. Rotate flywheel by turning crankshaft. Read total dial indicator movement.

**Flywheel Housing Face—Specification**

| | |
|---|---|
| Runout | 0.20 mm (0.008 in.) maximum variation |



R22212 –UN–14DEC88

*Checking Flywheel Housing Face Runout*

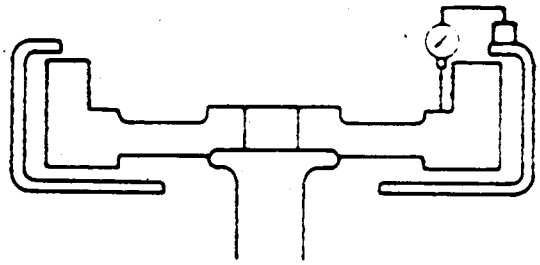
RG,RG34710,1159 –19–23OCT97–1/1

## CHECK FLYWHEEL FACE FLATNESS

1. Mount dial indicator base on flywheel housing. Position pointer to contact driving ring mounting surface. Do not allow pointer to contact driving ring mounting holes.

**IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel face runout.**

2. Rotate flywheel by turning crankshaft. Read total dial indicator movement. Resurface flywheel face or replace as required.



R22213 –UN–14DEC88

**Flywheel Face—Specification**

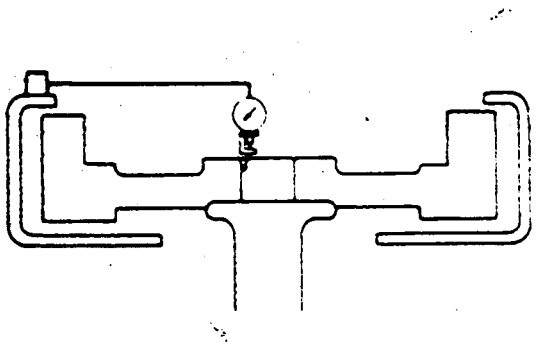
| | |
|---|---|
| Flatness | 0.23 mm (0.009 in.) maximum variation |
| Flatness | 0.013 mm (0.0005 in.) maximum variation per 25 mm (1.0 in.) of travel |

RG,RG34710,1160 –19–23OCT97–1/1

## 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.



R22214 –UN–14DEC88

*Checking Flywheel Pilot Bearing Bore*

**Flywheel Pilot Bearing—Specification**

| | |
|---|---|
| Bore Concentricity | 0.127 mm (0.005 in.) maximum variation |

RG,RG34710,1161 –19–23OCT97–1/1

## REMOVE FLYWHEEL

**CAUTION: Flywheel is heavy. Plan a proper lifting procedure to avoid injury.**

*NOTE: SAE 1 and SAE 2 flywheel housings MUST BE removed before flywheel can be removed from engine. See REMOVE SAE 1 AND SAE 2 FLYWHEEL HOUSING, later in this group.*

1. Remove two flywheel attaching cap screws (A), and install two pilot studs in their place.
2. Remove remaining cap screws, remove drive hub (if equipped), and carefully pull flywheel from crankshaft.
3. Check condition of dowel pin in crankshaft rear flange. Dowel pin must not be cracked or chipped. Measure protrusion of dowel pin from face of flange. If dowel pin is damaged, or protrusion is not within specifications, replace dowel pin.

*NOTE: When replacing dowel pin, crankshaft must be removed to prevent damage to crankshaft thrust bearings.*

**Dowel Pin—Specification**

| | |
|---|---|
| Protrusion | 13.5—14.5 mm (0.53—0.57 in.) from crankshaft rear flange |


RG7048 –UN–05DEC97

*Removing Flywheel*

RG,RG34710,1162 –19–23OCT97–1/1

## REMOVE SAE 1 AND SAE 2 FLYWHEEL HOUSING

**CAUTION: Flywheel housing is heavy. Plan a proper lifting procedure to avoid injury.**

1. Remove attaching cap screws.
2. Remove flywheel housing.
3. Inspect mounting holes in flywheel housing for thread damage.

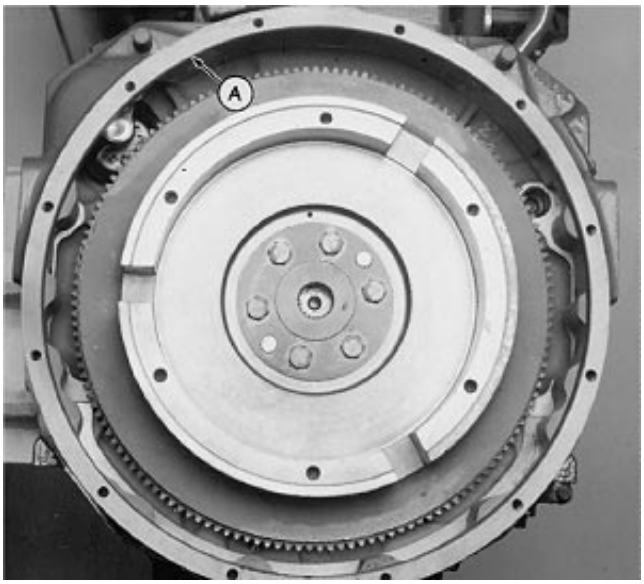
RG,RG34710,1163 –19–23OCT97–1/1

## REMOVE SAE 3 FLYWHEEL HOUSING

**CAUTION: Flywheel housing (A) is heavy. Plan a proper lifting procedure to avoid injury.**

*NOTE: The flywheel MUST be removed before removing the SAE 3 flywheel housing. See REMOVE FLYWHEEL earlier in this group.*

1. Remove flywheel housing attaching cap screws.
2. Remove flywheel housing.
3. Inspect mounting holes in flywheel housing for thread damage.




*Removing SAE 3 Flywheel Housing*

RG,RG34710,1164 –19–23OCT97–1/1

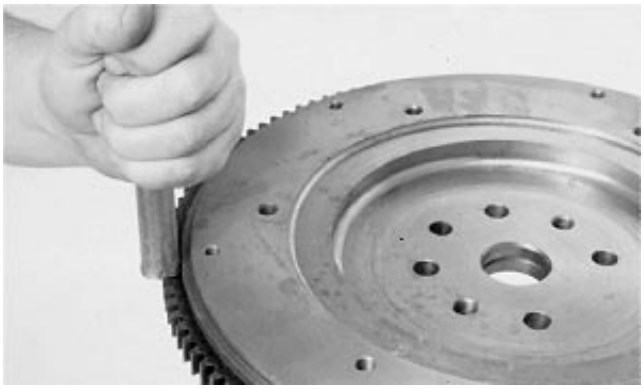
## REPLACE FLYWHEEL RING GEAR

**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.**

1. If ring gear is damaged, place the flywheel on a solid flat surface.
2. Remove ring gear with a brass drift and hammer.

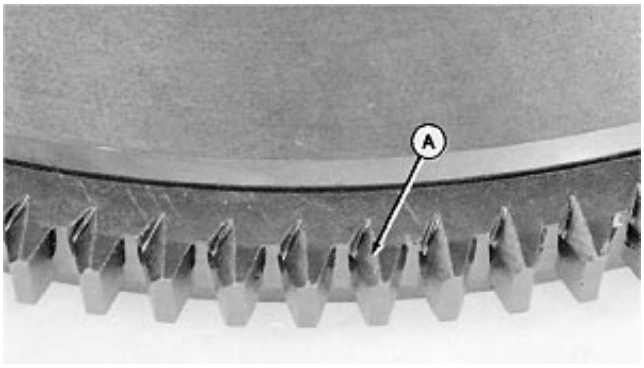
**IMPORTANT: If flame heat is used, be sure gear is heated uniformly around circumference. DO NOT OVERHEAT. Overheating may destroy original heat treatment of gear. SEE CAUTION.**

3. Heat new ring gear to 148°C (300°F) using either heated oil, oven heat, or flame heat.
4. Install ring gear against shoulder of flywheel so chamfered side (A) is on engine side of flywheel.



T90596 –UN–14OCT88

*Removing Flywheel Ring Gear*




RG3838 –UN–14OCT88

*Installing Flywheel Ring Gear*

RG,RG34710,1165 –19–23OCT97–1/1

## REMOVE AND INSTALL REAR OIL SEAL HOUSING—ENGINE INSTALLED IN VEHICLE (8000 SERIES TRACTORS)

**IMPORTANT: Remove rear oil seal housing for replacement purposes only. It is not necessary to remove seal housing for rear seal and wear sleeve replacement.**

6081HRW engines used in 8100, 8200, 8300 and 8400 tractors are equipped with front frame/oil sump. Refer to TM1575 (8100, 8200, 8300, and 8400 Tractors—Repair) for access to front frame/oil sump-to-engine block cap screws. (For 8000T Tracks tractors, refer to TM1621.)

**TO REMOVE REAR OIL SEAL HOUSING:**

*NOTE: Refer to TM1575 for access to rear crankshaft seal housing area.*

1. Remove flywheel cover.
2. Remove transmission input shaft coupler bolts and pry coupler rearward.

*NOTE: Use a set screw to separate damper from flywheel, if necessary.*

3. Remove torsional damper from flywheel.
4. Remove flywheel from right side of tractor.
5. Back out all front frame/oil sump-to-engine block cap screws 9.5 mm (0.38 in.).
6. Slowly lift engine block assembly approximately 6.4 mm (0.25 in.) using safety approved lifting equipment.

**IMPORTANT: The rear oil seal housing must not be “dragged” horizontally while in contact with front frame/oil sump gasket. Doing so may damage gasket sealing bead.**

7. Remove rear oil seal housing (A).
8. Remove rear wear sleeve from crankshaft flange with JDG790 Wear Sleeve Puller Kit as detailed earlier in this group. Clean flange with emery cloth.

**TO INSTALL REAR OIL SEAL HOUSING:**

1. Install rear oil seal housing and check runout. (See INSTALL CRANKSHAFT REAR OIL SEAL HOUSING AND CHECK OIL SEAL HOUSING RUNOUT, later in this group.)
2. Carefully lower engine onto locating dowels of front frame/oil sump.
3. Tighten front frame/oil sump cap screws as detailed in Group 20, Lubrication System of this manual (See TIGHTEN CAP SCREWS ON FRONT FRAME/OIL SUMP) or TM1575.
4. Install a new rear oil seal and wear sleeve assembly. (See INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE, WITHOUT ENGINE DISASSEMBLY, earlier in this group.)
5. Install flywheel. (See INSTALL FLYWHEEL, later in this group.)
6. Install torsional damper onto flywheel. (See TM1575.)
7. Pull transmission input shaft coupler forward, install cap screws and tighten to specified torque. (See TM1575.)
8. Install flywheel cover. (See TM1575.)
9. Start engine and check for leaks.

RG,RG34710,1166 –19–23OCT97–1/1

## REMOVE REAR OIL SEAL HOUSING—ENGINE REMOVED

1. Remove rear oil seal housing (A).

**IMPORTANT: Whenever rear oil seal is replaced, also replace rear wear sleeve as a matched assembly.**

2. Rear oil seal (B) will come off with housing. Use a small punch and hammer to remove oil seal from housing. Discard seal.

**IMPORTANT: The preferred method of removing the rear wear sleeve is with JDG790 Rear Wear Sleeve Puller. If removing wear sleeve with a chisel, DO NOT gouge crankshaft flange. Nicks or burrs should be removed with a medium-grit stone. A polishing cloth (180-grit or finer) may also be used when a stone is not available.**

3. Remove rear wear sleeve from crankshaft flange.

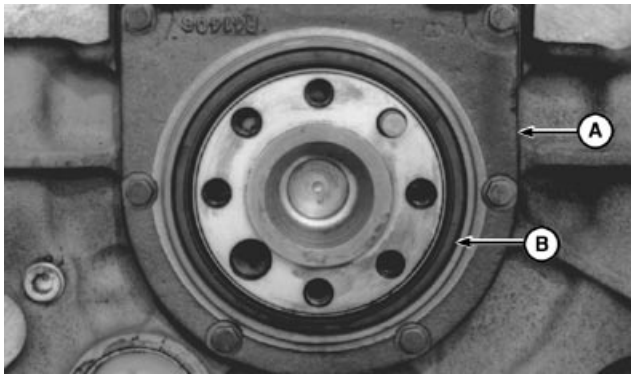
Crankshaft rear wear sleeve can be removed using one of the following procedures. However, the preferred method is using JDG790 Wear Sleeve Puller Kit.

Use JDG790 Wear Sleeve Puller to remove wear sleeve from crankshaft flange, as described earlier in this group. [See using REPLACE CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE (WITH OIL SEAL HOUSING INSTALLED.)]

Use the ball side of a ballpeen hammer and tap wear sleeve across its width in a straight line (to deform and stretch sleeve).

Score the wear sleeve in several places around O.D. (but do not cut) with a blunt chisel.

Remove wear sleeve from crankshaft flange. Clean flange with a light file and emery cloth.




*Removing Rear Oil Seal Housing*

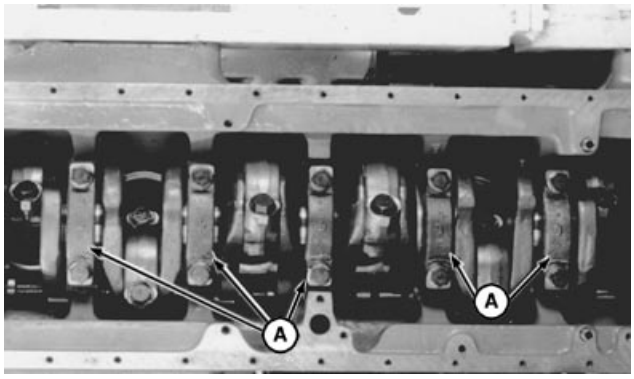
RG,RG34710,1167 –19–23OCT97–1/1

## REMOVE MAIN BEARING CAPS

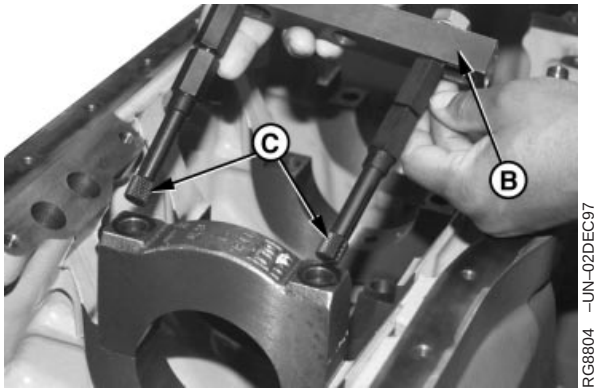
**IMPORTANT: Before removing main bearing caps (A), check for proper torque on all main bearings. Also, check each bearing cap to make sure they are numbered for reassembly on the same numbered main bearing bosses. Keep matched main bearings with their respective main bearing cap for comparison with crankshaft journal (surface wear) from which removed.**

*NOTE: When removing main bearings and caps, leave No. 1 and 7 main bearing caps installed until all of the connecting rod caps have been removed.*

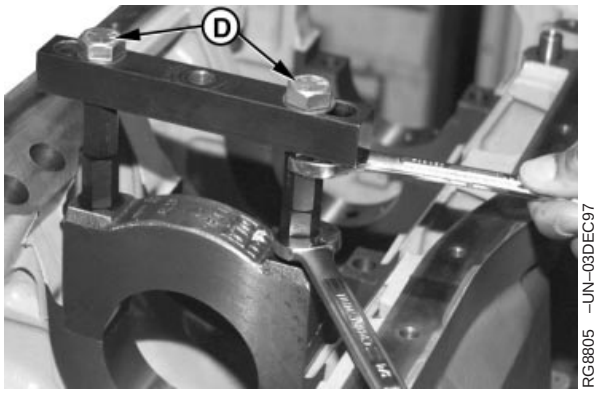
1. Remove main bearing cap screws.
2. Install JDG1069 Puller (B) so that tips (C) of blind hole puller legs are below bearing cap half.
3. Tighten hex of actuator pin securely while holding collet portion of puller leg with second wrench.
4. Tighten both cap screws (D) on cross block finger tight.




*Checking Torques Before Removing Main Bearing Caps*




*Installing Main Bearing Cap Puller*



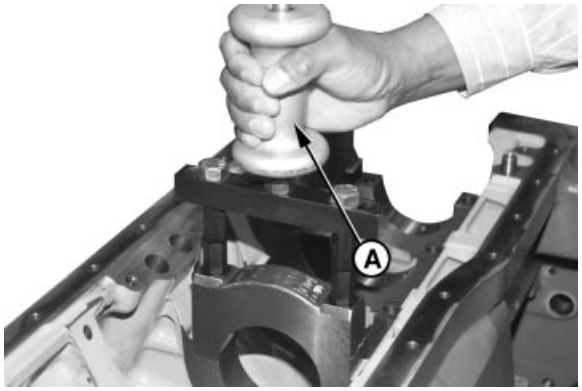

*Tightening Main Bearing Cap Puller*

**Continued on next page** RG,RG34710,1168 –19–23OCT97–1/2

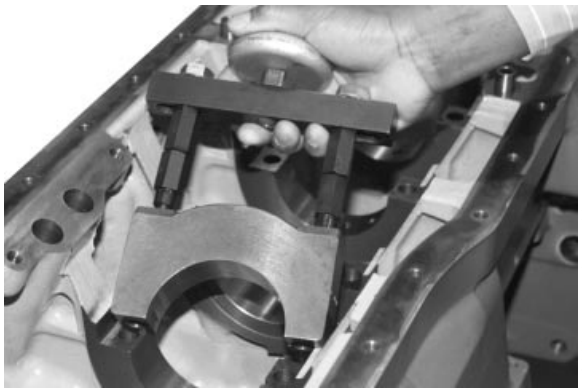
5. Attach D01300AA Slide Hammer (A) to cross block, tighten nut securely.

6. Remove main bearing cap by sliding up on hammer weight.

7. Use PLASTIGAGE® to measure journal-to-bearing oil clearance on each main bearing as they are removed. (See CHECK MAIN BEARING-TO-JOURNAL CLEARANCE, later in this group.)




*Using Slide Hammer to Loosen Bearing Cap*




*Removing Main Bearing Cap*

*PLASTIGAGE is a trademark of DANA Corp.*

RG,RG34710,1168 –19–23OCT97–2/2

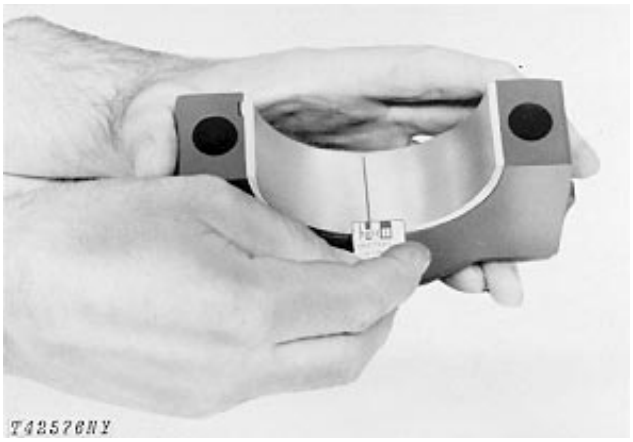
## CHECK MAIN BEARING OIL CLEARANCE

The use of PLASTIGAGE® will determine bearing-to-journal wear (oil clearance) but will not determine condition of the bearing or journal surfaces.

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.
2. Use oil (SAE30) on PLASTIGAGE® to prevent smearing.
3. Install cap and tighten to 230 N•m (170 lb-ft).
4. Remove cap and compare width of PLASTIGAGE® with scale provided on wrapper to determine oil clearance.

**Main Bearing-to-Journal—Specification**

| | |
|---|---|
| Clearance | 0.030—0.107 mm (0.0012—0.0042 in.) |

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*Checking Main Bearing Oil Clearance*

*PLASTIGAGE is a trademark of DANA Corp.*

RG,RG34710,1169 –19–23OCT97–1/1

## REMOVE CONNECTING ROD CAPS AND REMOVE CRANKSHAFT

1. Rotate crankshaft using JDG820 or JDE81-1 Flywheel Turning Tool until connecting rod caps can be removed easily. You will be able to remove rod caps at each position.

2. Remove all connecting rod caps (A) with bearings (B), then remove No. 1 and 7 main bearing caps and bearings. See REMOVE PISTONS AND CONNECTING RODS in Group 10.

**CAUTION: Crankshaft is very heavy. Plan a proper handling procedure to avoid injury.**

*NOTE: Install a screw on each end of crankshaft to aid in lifting crankshaft.*

3. Install a cap screw in each end of crankshaft and attach a lifting strap to crankshaft as shown. Using proper lifting equipment, carefully raise crankshaft out of cylinder block.

4. Clean crankshaft, especially oil passages, using solvent and compressed sir.

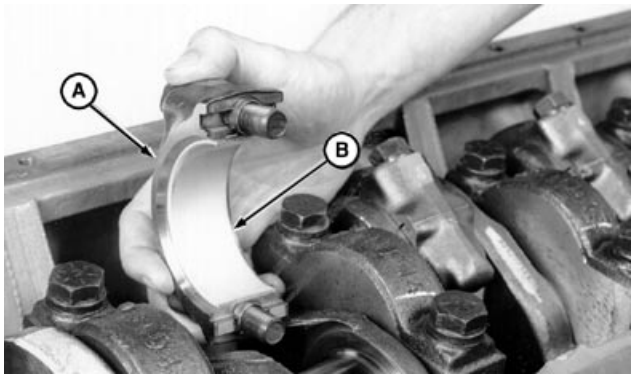
5. Put crankshaft on clean V-blocks.

6. Remove rear wear sleeve from crankshaft flange, if not previously done, using one of the following methods:

   Use JDG790 Wear Sleeve Puller to remove wear sleeve from crankshaft, as described earlier in this group. Position crankshaft rod journals in V-blocks so that crankshaft does not rotate while removing wear sleeve.

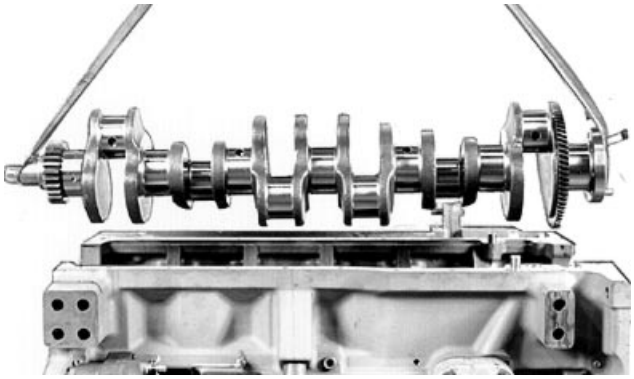
   Use the ball side of a ballpeen hammer and tap wear sleeve across its width in a straight line (to deform and stretch sleeve).

   Score (but do not cut) the wear sleeve in several places around O.D. with a blunt chisel.




RG5806 –UN–05DEC97

*Removing Connecting Rod Caps*



RG5834 –UN–05DEC97

*Removing Crankshaft*

RG,RG34710,1170 –19–23OCT97–1/1

## INSPECT CRANKSHAFT

*NOTE: If crankshaft damper damage was discovered during teardown, the crankshaft should be magna-fluxed. This will verify whether of not it has microscopic cracks or fissures. See INSPECT VIBRATION DAMPER, in this group.*

1. Thoroughly clean crankshaft. Clear restrictions from all oil passages.

2. Inspect crankshaft for signs of load stress, cracks, scratches on journals. Also check each journal for evidence of excessive overheating or discoloration. If either condition exists, replace crankshaft since heat treatment has probably been destroyed.

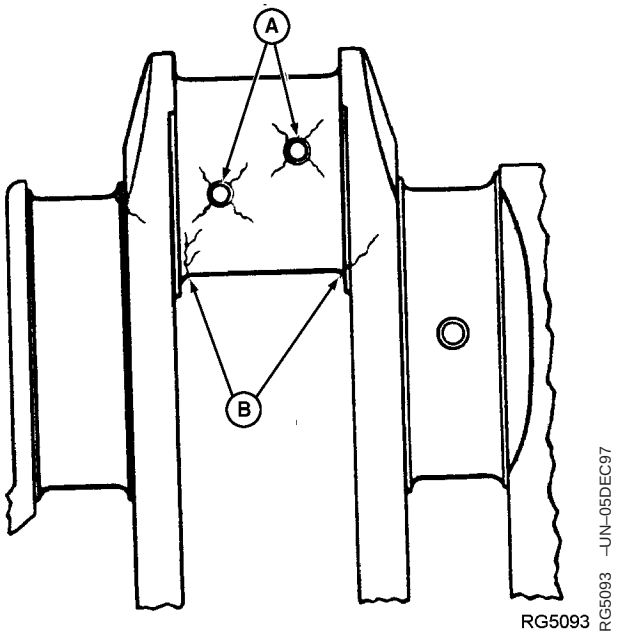
3. Inspect (front) crankshaft gear and (rear) oil pump drive gear for cracks, chipped teeth, or excessive wear. Replace gear(s) as required. (See REPLACE FRONT CRANKSHAFT GEAR and REPLACE CRANKSHAFT OIL PUMP DRIVE GEAR, later in this group.)

4. Inspect the keyway for evidence of cracks or wear. Replace crankshaft as necessary.

5. Carefully inspect rear hub of crankshaft in area of wear sleeve contact surface for evidence of rough or grooved condition. Any imperfections here will result in oil leaks. Slight ridges may be cleaned up with emery or crocus cloths.

6. Check each journal for evidence of excessive overheating or discoloration. If either condition exists, replace crankshaft since heat treatment has probably been destroyed.

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.




*Inspecting Crankshaft*

**Continued on next page**

RG,RG34710,1171 –19–23OCT97–1/2

**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, using magnetic particles which are fluorescent and glow under 'black light'. The crankshaft must be de-magnetized after inspection.**

RG,RG34710,1171 –19–23OCT97–2/2

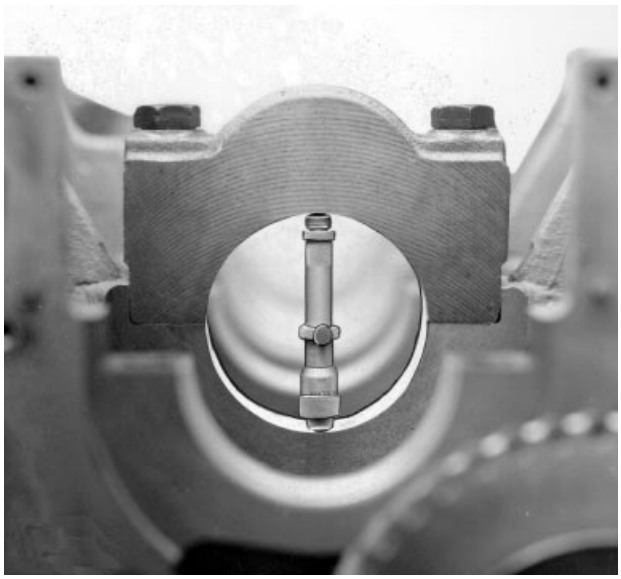
## MEASURE ASSEMBLED I.D. OF BEARINGS AND O.D. OF CRANKSHAFT JOURNALS

*NOTE: Also inspect and measure assembled I.D. of connecting rod bearings. Compare measurements with connecting rod journal O.D. on crankshaft. (See Group 10.)*

1. With crankshaft removed from engine, install main bearing caps with bearing inserts. Be sure inserts are installed correctly.
2. Tighten main bearing cap screws to 230 N•m (170 lb-ft).
3. Measure I.D. of all assembled bearings with an inside micrometer.

**Main Bearing—Specification**

| | |
|---|---|
| ID | 95.270—95.320 mm (3.7508—3.7528 in.) with bearing |
| ID | 101.651—101.677 mm (4.0020—4.0030 in.) without bearing |



RG8808 –UN–05JAN98

*Measuring Main Bearings*

**Continued on next page**

RG,RG34710,1172 –19–23OCT97–1/2

*NOTE: If engine has previously had a major overhaul and undersized bearing inserts were used, I.D. and O.D. dimensions may not be the same as those recorded. However, oil clearance must be 0.030—0.107 mm (0.0012-0.0042 in.). Replace bearings as needed.*

4. Measure O.D. of all respective crankshaft main journals at several points around journal.

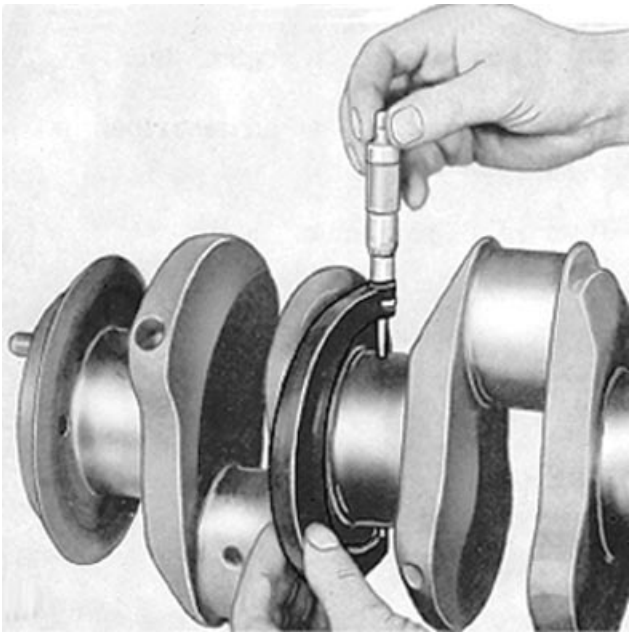
**Crankshaft Main Journal—Specification**

| | |
|---|---|
| OD | 95.201—95.227 mm (3.7480—3.7491 in.) |

Use crankshaft journal O.D. measurements to determine if journal is out-of-round or tapered.

**Crankshaft Journal Wear—Specification**

| | |
|---|---|
| Taper per 25.4 m (1.0 in.) length | 0.0025 mm (0.0001 in.) |
| Out-of-Roundness | 0.025 mm (0.0010 in.) |




*Measuring Crankshaft Main Journals*

RG,RG34710,1172 –19–23OCT97–2/2

## MAIN BEARING CAP LINE BORE SPECIFICATIONS

If any main bearing cap assembled I.D. is not within specification, blank (generic) bearing caps are available and must be line bored to specification. Replace individual bearing caps as needed.

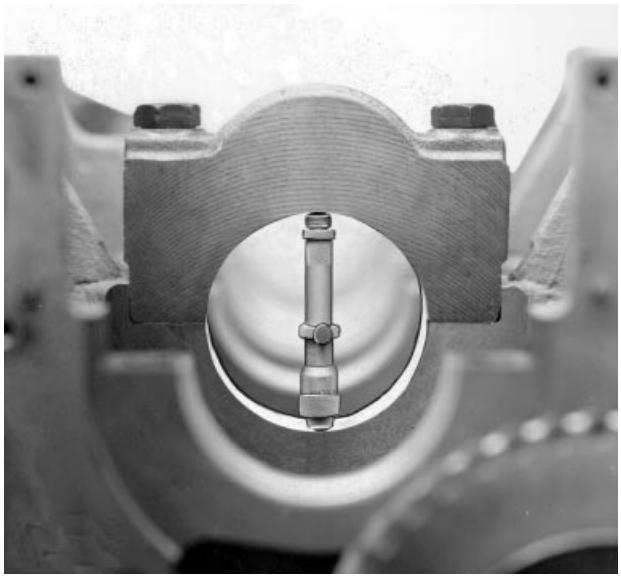
1. With crankshaft removed from cylinder block, install main bearing caps without bearing inserts.
2. Tighten main bearing cap screws to 230 N•m (170 lb-ft).
3. Measure I.D. of all bearing caps with an inside micrometer. Main bearing cap I.D. should be 95.270—95.320 mm (3.7508—3.7528 in.).

   If any main bearing cap assembled I.D. is not within specification, blank (generic) bearing caps are available and must be line bored to finished specification. Replace individual bearing caps as needed.

**IMPORTANT: Main bearing cap line boring should be done ONLY by experienced personnel on equipment capable of maintaining bore specifications.**

**Main Bearing Cap Bore—Specification**

| | |
|---|---|
| ID Without Bearings (Standard) | 101.651—101.677 mm (4.0020—4.0030 in.) |
| Diameter Variation | 0.013 mm (0.0005 in.) maximum |
| Diameter Taper | 0.008 mm (0.0003 in.) maximum |
| Straightness Variation (Any Bore-to-Adjacent Bore) | 0.038 mm (0.0015 in.) maximum |
| Straightness Variation (5 Center Bore-to-End Bore | 0.076 mm (0.0030 in.) maximum |
| Centerline of Bore-to-Top Deck | 352.35—352.50 mm (13.872—13.878 in.) |



RG8808 –UN–05JAN98

*Measuring Main Bearing Cap Bores*

RG,RG34710,1173 –19–23OCT97–1/1

## THRUST BEARING NEW PART SPECIFICATIONS

**IMPORTANT: Install thrust bearing in cylinder block and tighten to specification before regrinding or polishing thrust surfaces to assure that all surfaces on bearing and on block web are correctly aligned.**

**Thrust Washer Clearance Base Circle—Specification**

| | |
|---|---|
| Diameter | 129.286—130.810 mm (5.09—5.15 in.) |

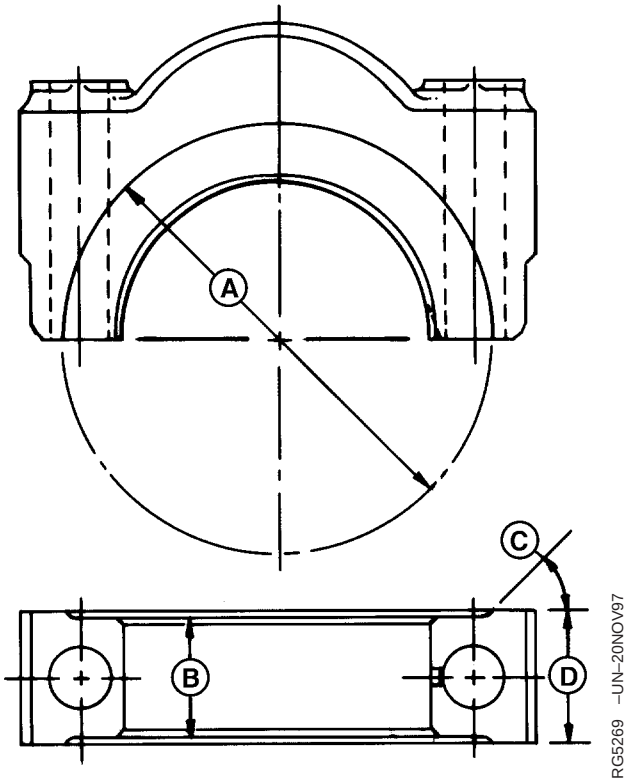
**Thrust Bearing—Specification**

| | |
|---|---|
| Thickness | 37.44—37.54 mm (1.474—1.478 in.) |
| Relief Angle | 45° |

**Thrust Bearing Cap—Specification**

| | |
|---|---|
| Overall Width ( —1995) | 41.81—42.31 mm (1.646—1.66 in.) |
| Overall Width (1995—) | 39.16—39.66 mm (1.542—1.561 in.) |

Maximum runout for thrust surface is 0.25 mm (0.0010 in.).




*Thrust Bearing Measurements*

RG,RG34710,1174 –19–23OCT97–1/1

## CRANKSHAFT GRINDING GUIDELINES

**IMPORTANT: Crankshaft grinding should be done ONLY be experienced personnel on equipment capable of maintaining crankshaft size and finish specifications.**

**Crankshaft rod (pin) journals have an undercut fillet radius. DO NOT grind within this undercut area when undersize bearings are used.**

In addition to the standard size main bearings, 0.292 mm (0.0115 in.) and 0.552 mm (0.0217 in.) undersize bearings are available for main bearing journals. Rod (pin) journals have only 0.292 mm (0.0115 in.) undersize bearings only. If journals are tapered, out-of-round, scored, or damaged, grind the crankshaft and install the proper undersize bearings.

**IMPORTANT: If undersize bearings are used, check bearing clearance after bearing caps have been tightened to specified torque. If undersize bearings are too tight and clearance is not within specifications, the journal and bearing will be wiped clean of all oil. This would result in premature wear of parts.**

If the crankshaft is to be reground, use the following recommended guidelines:

1. Compare the crankshaft journal measurements taken during inspection and determine the size to which the journals are to be reground.

2. Grind all main journals or all connecting rod journals to the same required size. (See CRANKSHAFT GRINDING SPECIFICATIONS next page.)

**IMPORTANT: All main journal (tangential) fillets radii must be free of any sharp grind marks or scratches. The fillet must blend smoothly into the journal and crank cheek. Check the radii with a fillet gauge.**

**Care must be taken to avoid localized heating which often produces grinding cracks. Cool the crankshaft while grinding by using coolant generously. 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 the ground surfaces to the specified finish to prevent excessive wear of the journals.

*NOTE: Production crankshafts are induction hardened and shotpeened at the factory. Field shotpeening is not recommended due to the equipment required and part geometry.*

4. If the thrust surfaces of the crankshaft are worn or grooved excessively, regrind and polish. Maintain the specified radius between each thrust surface and the bearing journal. An oversized thrust washer and two 0.18 mm (0.007 in.) oversized washers are available. (See THRUST BEARING NEW PART SPECIFICATIONS, earlier in this group.)

*NOTE: When thrust surfaces are reground and an oversized washer is used, crankshaft end play specification must be maintained to within 0.038—0.380 mm (0.0015—0.0150 in.). (See CHECK CRANKSHAFT END PLAY, earlier in this group.)*

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.).

**Continued on next page**

6. When finished grinding, inspect the crankshaft for cracks with the Fluorescent Magnetic Particle method, or similar method. De-magnetize crankshaft after inspection.
7. Thoroughly clean the crankshaft and oil passages with solvent. Dry with compressed air.

RG,RG34710,1175 –19–23OCT97–2/2

## CRANKSHAFT GRINDING SPECIFICATIONS

| Item | Specification |
|---|---|
| Engine Stroke | 128.5 mm (5.059 in.) |
| Main and Rod Journal Surface Finish | Lap 0.20 Um (8 AA) |
| Thrust Journal Surface Finish | Lap 0.40 Um (16 AA) |
| Rod Journal (Undercut) Fillet Radius | 4.10—4.37 mm (0.158—0.172 in. |
| Main Journal (Tangential) Fillet Radius | 3.94—4.44 mm (0.155—.0175 in.) |
| Thrust Journal (Tangential) Fillet Radius | 3.56—4.06 mm (0.140—0.160 in.) |
| Thrust Journal Width | 44.387—44.487 mm (1.7475—1.7515 in.) |

| Bearing Sizes Available | Crankshaft Main Journal O.D. | Crankshaft Rod Journal O.D. |
|---|---|---|
| Standard | 95.201—95.227 mm (3.7480—3.7491 in.) | 76.149—76.175 mm (2.9980—2.9990 in.) |
| 0.292 mm (0.0115 in.) Undersize | 94.909—94.935 mm (3.73666—3.7376 in.) | 75.857—75.883 mm (2.9865—2.9875 in.) |
| 0.552 mm (0.0217 in.) Undersize[a] | 94.649—94.675 mm (3.7263—3.7274 in.) | |

[a]Available for main journals only.

RG,RG34710,1176 –19–23OCT97–1/1

## REPLACE (CRANKSHAFT) OIL PUMP DRIVE GEAR

**IMPORTANT: Protect all machined surfaces of crankshaft from grinding debris and weld spatter when removing old gear and installing new gear. DO NOT use a cutting torch to remove failed gear.**

1. Using a rotary grinding wheel or parting disc, grind weld beads (A) until flush with crankshaft flange.
2. Remove gear (B) by alternately striking gear at each weld location using a brass drift and soft lead mallet.
3. After removal of gear, clean up O.D. of crankshaft flange and remove any burrs or remaining weld bead to eliminate interference when installing new gear.

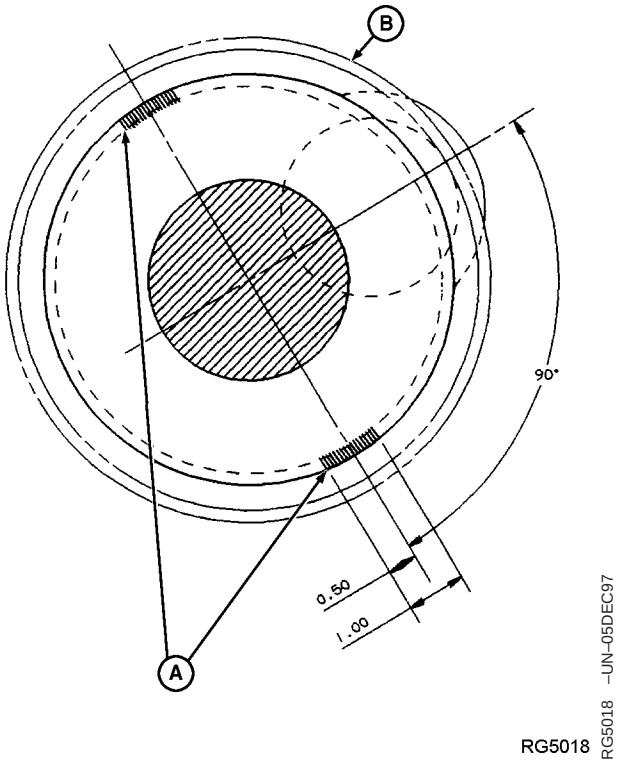
**CAUTION: Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer and do not exceed 182°C (360°F). Do not allow a heating element to be in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.**

**IMPORTANT: DO NOT OVERHEAT GEAR. SEE CAUTION. Overheating may also destroy original heat treatment of gear.**

4. Heat crankshaft gear to 148°C (300°F) using either heated oil or oven heat.
5. Drive gear onto crankshaft flange until flush against shoulder.

*NOTE: When driving oil pump onto crankshaft flange, the beveled edge of gear teeth should face the flywheel end of crankshaft.*

6. Weld two 25.4 mm (1 in.) beads according to illustration using 1/8 in. diameter 7018 welding rod. Grind away excess weld to eliminate the possibility of interference with cylinder block.




*Removing Crankshaft Oil Pump Drive Gear*

RG,RG34710,1177 –19–23OCT97–1/1

## REPLACE CRANKSHAFT GEAR

*NOTE: Remove crankshaft gear for replacement only; it is not necessary to remove gear for crankshaft removal.*

1. Install JDG787 Thread Protector in nose of crankshaft.
2. Protect crankshaft wear sleeve surface with masking tape.
3. Remove crankshaft gear using D01251AA[1] Puller or an equivalent puller.
4. Discard gear after removal.
5. Remove Woodruff key from crankshaft keyway.
6. Remove masking tape.

**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.**

**IMPORTANT: Crankshaft gear must be installed on crankshaft before crankshaft is installed in engine, otherwise damage to thrust bearings could occur.**

**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.**

7. Heat crankshaft gear (if removed) to 148°C (300°F), using either heated oil or oven heat.
8. Install Woodruff key in crankshaft.

[1]*Part of D01047AA 17-1/2 and 30-Ton Puller Set.*

**Continued on next page**

9. Place gear on crankshaft flange. Be sure key on crankshaft is properly aligned with keyway in gear.

**IMPORTANT: When installing gear, do not gouge or nick crankshaft flange.**

10. Use JDH7 Driver to firmly seat gear against crankshaft flange.

11. Once gear cools, reseat gear using JDH7 Driver.

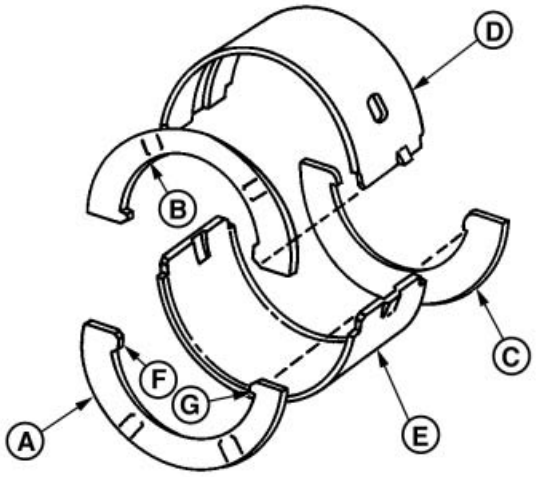
RG,RG34710,1178 –19–23OCT97–2/2

## INSPECT THRUST BEARINGS

Check thrust surfaces of the thrust bearing and the thrust bearing journal on crankshaft and replace as necessary.

Thrust bearing are available in each of the previously mentioned insert undersizes. An oversized thrust washer set containing one regular size washer and two 0.18 mm (0.007 in.) oversized washers is also available.

*NOTE: Thrust bearing must be installed with slots facing crankshaft flange. Two halves (A) and (C) go on cap side, not block.*




RGR24545N –UN–19NOV97

*Crankshaft Main Thrust Bearing Assembly*

**A—Lower Rear Thrust Washer**
**B—Upper Rear Thrust Washer**
**C—Lower Front Thrust Washer**
**D—Main Bearing Block Thrust Bearing**
**E—Main Bearing Cap Thrust Bearing**
**F—Large Tang**
**G—Small Tang**

RG,RG34710,1179 –19–23OCT97–1/1

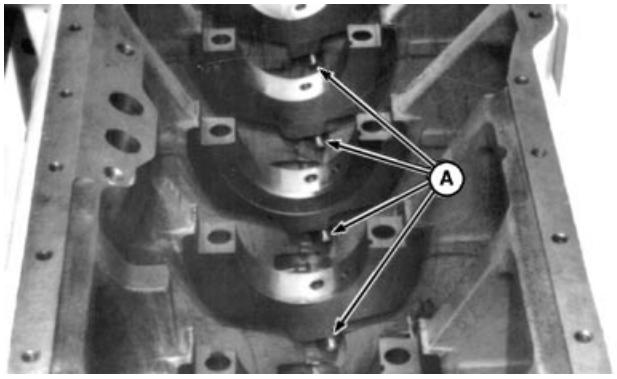
## REMOVE AND CLEAN PISTON COOLING ORIFICES

1. Remove all six (four shown) piston cooling orifices (A) and inspect each cooling orifice to make sure it is not plugged or damaged.

2. Use a soft wire and compressed air to clean orifice. Replace if condition is questionable.

**IMPORTANT: A piston cooling orifice failure could cause damage to pistons, piston pins, rod pin bushings, and liners. If a piston cooling orifice is left out, low or no oil pressure will result.**

3. Install orifices and tighten to 11 N•m (97 lb-in.).




RG3752 –UN–04DEC97

*Piston Cooling Orifices in Block*

RG,RG34710,1180 –19–23OCT97–1/1

## INSPECT MAIN BEARINGS AND CRANKSHAFT

**IMPORTANT: If new main or thrust bearing inserts or thrust washers are installed, they must be installed as a matched set.**

During assembly, apply a liberal coating of clean engine oil to:

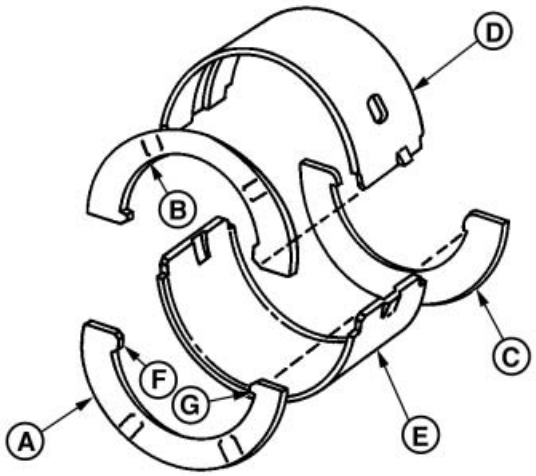
- All main bearing webs in block
- Both sides of main bearing inserts and thrust bearing inserts
- Entire O.D. of crankshaft main bearing journal

1. Install six main bearing inserts in block except No. 5 thrust bearing insert. Be sure locating tabs on inserts are properly positioned with slot in block web.

**IMPORTANT: Thrust washers (A, C) go on both sides of bearing cap. Thrust washer (B) goes on rear side of block web only with the slots facing the crankshaft.**

2. Install No. 5 main thrust bearing insert (D) in block. Install upper thrust washer on bearing insert at rear of block web. Be sure tangs on washer are properly positioned on thrust bearing insert.

3. Check to make sure that oil holes in main bearing web are properly aligned with oil holes in bearing inserts.




RGR24545N –UN–19NOV97

*No. 5 Main Thrust Bearing Assembly*

**A—Lower Rear Thrust Washer**
**B—Upper Rear Thrust Washer**
**C—Lower Front Thrust Washer**
**D—Main Bearing Block Thrust Bearing**
**E—Main Bearing Cap Thrust Bearing**
**F—Large Tang**
**G—Small Tang**

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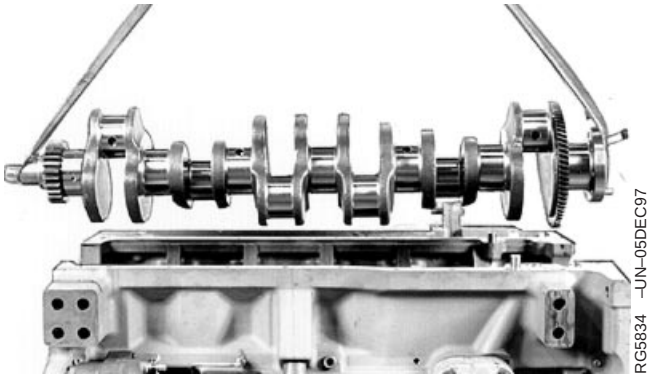
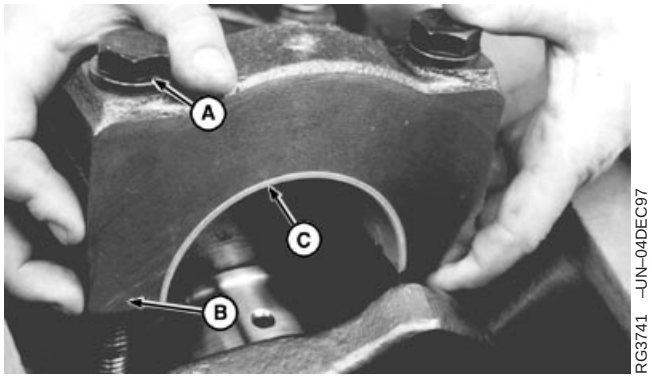
RG,RG34710,1181 –19–23OCT97–1/2




*Installing Crankshaft*




*Installing Main Bearing Caps*

**CAUTION: Crankshaft is heavy. Plan a proper lifting procedure to avoid injuries.**

4. Carefully position crankshaft onto main bearing inserts using a hoist and lift sling, as shown.

5. Dip entire main bearing cap screws in clean engine oil and position them in main bearing caps. Apply a liberal amount of oil to bearing inserts in caps.

6. Install each bearing cap (B), bearings (C), and cap screws with washer (A) with the recesses and tabs aligned in matching order. Make sure bearing tabs also match up before tightening cap screws.

*NOTE: Make sure main bearing caps are installed on the bearing bosses from which they were removed. The numbers stamped on the caps should be on the same side as the numbers on the block. If there is an arrow on cap, arrow must be on the camshaft side of the block pointing towards the front of the engine. If bearing caps have been rebored, make sure bearing caps have numbers stamped on them.*

**IMPORTANT: Do not use pneumatic wrench to install main bearing cap screws, as damage may occur to threads.**

7. Before tightening cap screws on main bearing caps, align upper and lower thrust flanges on main thrust bearings. Using a soft-face hammer, tap crankshaft to the rear and then to the front to line up thrust bearing flanges.

8. Tighten No.'s 1, 2, 3, 4, 6, and 7 main bearing cap screws to 68 N•m (50 lb-ft). Hand -tighten No. 5 main thrust bearing cap screws.

9. Gently pry crankshaft rearward and then forward to align thrust washers on No. 5 main thrust bearing.

*NOTE: DO NOT PRY crankshaft on No. 5 main thrust bearing.*

10. Tighten No. 5 main thrust bearing cap screws 68 N•m (50 lb-ft).

11. Tighten all main bearing cap screws (including No. 5) to final torque of 230 N•m (170 lb-ft).

12. Turn crankshaft by hand. If it does not turn easily, disassemble parts and determine the cause.

13. Install connecting rod bearings and connecting rods caps. See INSTALL PISTONS AND CONNECTING RODS in Group 10.

14. Check crankshaft for 0.038—0.380 mm (0.00150—0.0150 in.) end play.

15. Install oil pump and check drive gear-to-crankshaft clearance. See INSTALL ENGINE OIL PUMP in Group 20.

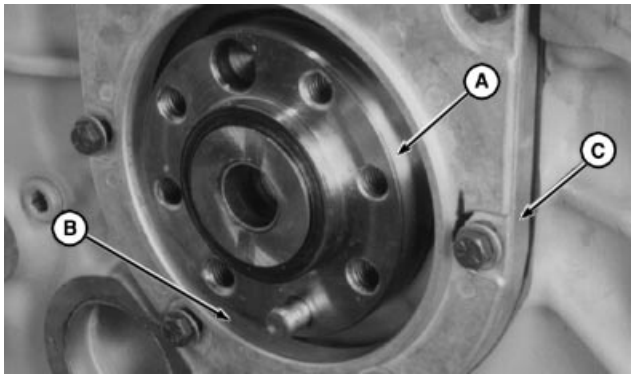
RG,RG34710,1181 –19–23OCT97–2/2

## INSTALL CRANKSHAFT REAR OIL SEAL HOUSING

These instructions are for when oil seal housing and oil pan have been removed from cylinder block.

1. Make sure the O.D. of crankshaft flange (A) and I.D. of seal housing (B) are free from nicks or burrs. Restore damaged surfaces with a fine file or emery cloth. Clean with compressed air.

2. Install oil seal housing (C) on cylinder block using a new gasket. Install all six cap screws with washers, using LOCTITE® 242 on threads. Tighten screws finger tight.




*Installing Crankshaft Rear Oil Seal Housing*

*LOCTITE is a trademark of Loctite Corp.*

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RG,RG34710,1182 –19–23OCT97–1/2

**IMPORTANT: Alignment and installation tools must be clean to hold runout within specification and to assure proper positioning on crankshaft flange so oil seal does not fail prematurely.**

3. Slip the JDG796 Alignment Tool (A) over crankshaft flange and into seal housing bore to center oil seal housing.

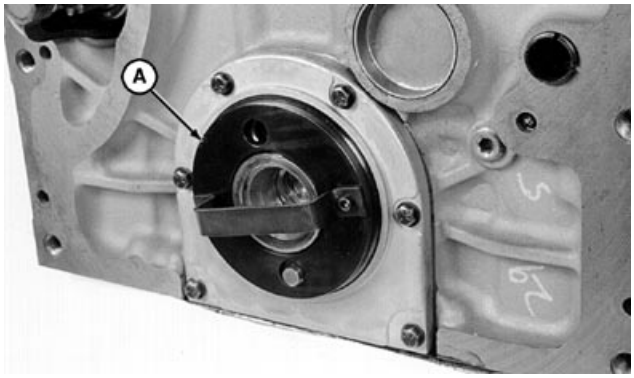
   The tool is designed to center the oil seal housing in relation to crankshaft flange. However, measuring the seal housing runout after installation with a magnetic base dial indicator is recommended. Runout should not exceed 0.15 mm (0.006 in.).

4. Position bottom of oil seal housing so it is recessed 0.000—0.050 mm (0.000—0.002 in.) inside cylinder block-oil pan rail. Tighten seal housing cap screws to 27 N•m (20 lb-ft), using sequence shown in bottom illustration, beginning with cap screw No. 1.

5. Remove alignment tool from end of crankshaft flange.

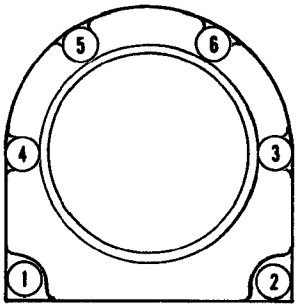
6. Check oil seal housing runout with a magnetic base dial indicator. (See CHECK OIL SEAL HOUSING RUNOUT, later in this group.)

7. Trim off excess gasket material extending below bottom of oil seal housing.




RG7049 –UN–05DEC97

*Centering Rear Oil Seal Housing*




RG6427 –UN–05DEC97

RG6427

*Cap Screw Tightening Sequence for Rear Oil Seal Housing*

RG,RG34710,1182 –19–23OCT97–2/2

## CHECK OIL SEAL HOUSING RUNOUT

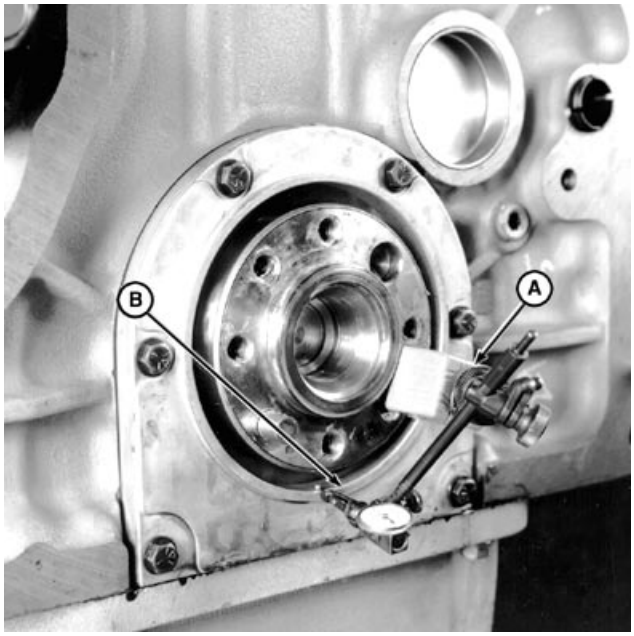
**IMPORTANT: On service “short block” assemblies, rear oil seal housing runout is preset at the factory. Do not remove housing from block.**

1. Position magnetic base dial indicator (A) on end of crankshaft flange as shown. Preset dial indicator tip on I.D. of oil seal housing bore (B).

2. Zero dial indicator and rotate crankshaft one full revolution, observe full indicator movement. The maximum oil seal housing bore runout is 0.15 mm (0.006 in.).

   If runout exceeds specification, loosen cap screws and adjust housing to obtain an acceptable runout while keeping bottom of seal housing flush with oil pan mating surface.

3. Recheck oil seal housing bore runout. If runout still exceeds specification, oil seal housing bore is possibly distorted and should be replaced. See INSTALL CRANKSHAFT REAR OIL SEAL HOUSING, earlier in this group.




RG5751 –UN–05DEC97

*Checking Rear Oil Housing Runout*

RG,RG34710,1183 –19–23OCT97–1/1

## CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE HANDLING PRECAUTIONS

Use the following precautions for handling seal and wear sleeve:

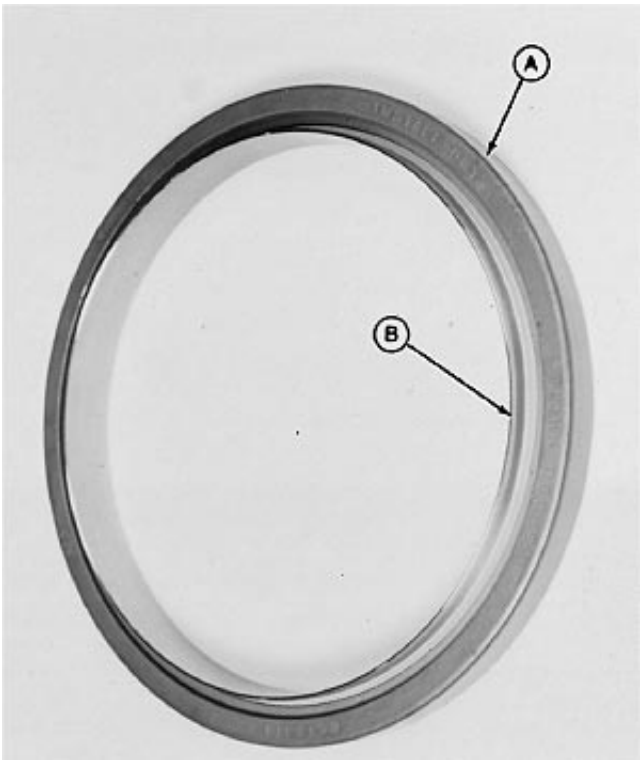
Seal (A) and wear sleeve (B) are assembled. DO NOT SEPARATE. If parts become separated, discard and replace with a new assembly. Attempts to reassemble will cause the wear sleeve to damage the seal allowing engine oil to leak past seal.

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 I.D. 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.

Oil seal/wear sleeve assembly MUST be installed with the JDG476(85) Crankshaft Rear Oil Seal Installation Tool Set. Tool set consists of JDG477 (85) Pilot and JDG478 Driver.




RG5575 –UN–07JUL89

*Crankshaft Rear Oil Seal and Wear Sleeve*

RG,RG34710,1184 –19–23OCT97–1/1

## INSTALL CRANKSHAFT REAR OIL SEAL AND WEAR SLEEVE ASSEMBLY

**IMPORTANT: DO NOT allow sealant to get on any part of wear sleeve O.D. or on oil seal.**

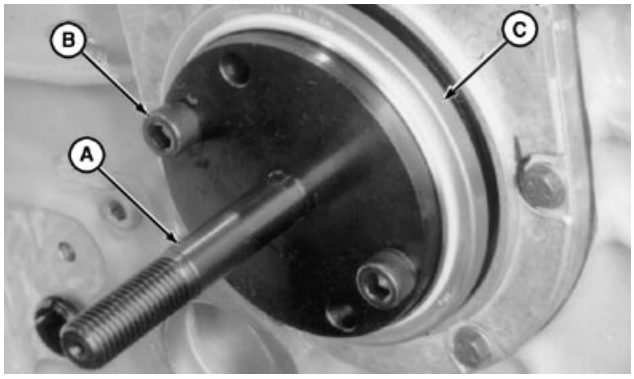
1. Apply a light coating of LOCTITE® 609 Retaining Compound, or equivalent, completely around the leading edge of crankshaft flange. Wipe away any sealant that may have gotten on I.D. of seal housing bore.

2. Install JDG477 (85) Pilot (A) on end of crankshaft using the Allen head cap screws (B) supplied with tool set. Tighten cap screws securely.

**IMPORTANT: Handle seal and wear sleeve assembly carefully. If assembly becomes separated, discard these parts and install a new assembly.**

**When installing the JDG478 Driver on JDG477 (85) Pilot and crankshaft flange to position oil seal/wear sleeve assembly, locate crossbar of installer at right angle (90°) to Allen head cap screws. This allows the crossbar to bottom on pilot, not head of cap screws, assuring correct installation.**

3. Carefully start oil seal/wear sleeve assembly (C) over JDG477 (85) Pilot and crankshaft with open side of seal toward engine.




RG4639 –UN–05DEC97

*Installing Rear Oil Seal and Wear Sleeve*

*LOCTITE is a trademark of Loctite Corp.*

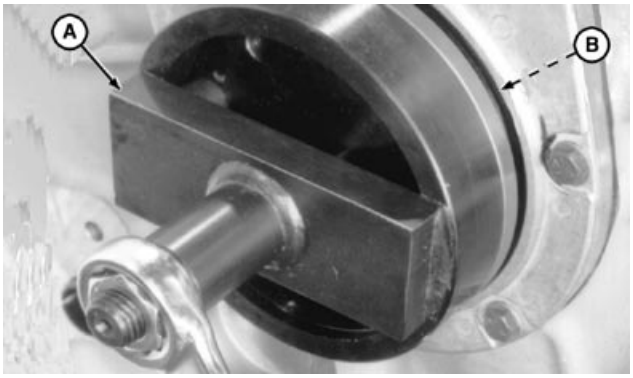
**Continued on next page**

RG,RG34710,1185 –19–23OCT97–1/2

4. Position JDG478 Driver (A) so that hole in the cross plate goes over threaded stud of pilot. Install washer and nut on stud.

5. Tighten nut to draw JDG478 Driver in until crossbar bottoms on JDG477 (58) Pilot. When the tool bottoms, seal and wear ring assembly (B) will be correctly positioned.

6. Remove JDG476 (85) Tool Set from engine.




*Rear Oil Seal and Wear Sleeve Installed*

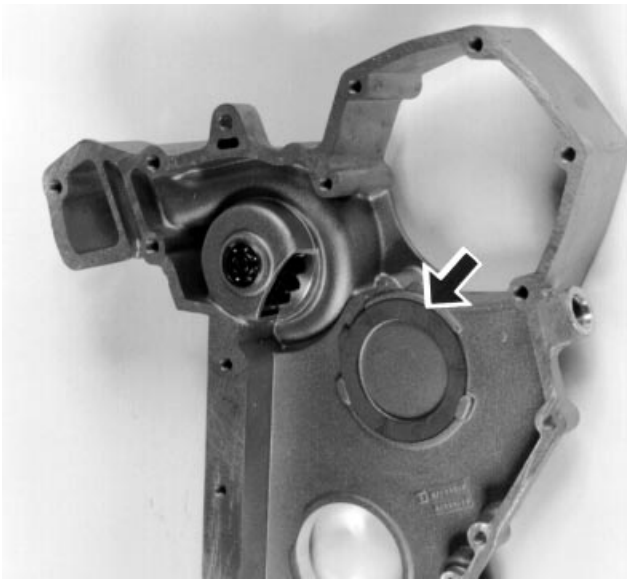
RG,RG34710,1185 –19–23OCT97–2/2

## INSTALL TIMING GEAR COVER

**IMPORTANT: Tightening the timing gear cover (A) cap screws one through six in numerical sequence controls the total runout of the crankshaft flange-to-oil seal bore.**

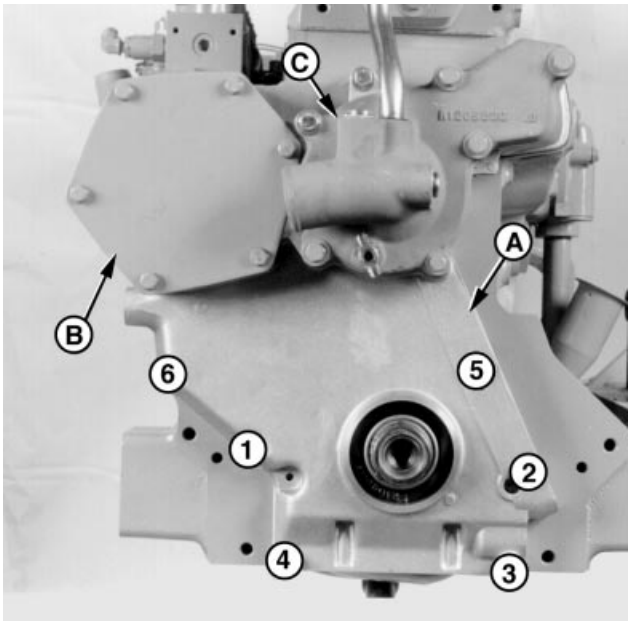
**On engines with auxiliary front drive, tighten those cap screws (Group 16) before tightening timing cover screws.**

1. Lubricate thrust washer (bold arrow) with TY6333 or TY6347 High Temperature Grease and install in timing gear cover tabs.
2. Install a new gasket on engine block. Apply a light film of grease to the gasket to hold it in place.
3. Install timing gear cover. Tighten cap screws one through six to 27 N•m (20 lb-ft) in numerical sequence, as shown.
4. Install injection pump drive gear cover (B) using a new gasket and tighten cap screws to 27 N•m (20 lb-ft).
5. Install water pump cover using a new gasket. Tighten 5/16-in. cap screws to 27 N•m (20 lb-ft) and 3/8-in. cap screws to 47 N•m (35 lb-ft).
6. Trim timing gear cover gasket flush with oil pan gasket rail.
7. Using a new O-ring, install magnetic speed sensor in timing gear cover, if removed.
8. Install crankshaft front wear sleeve and oil seal. (See INSTALL CRANK SHAFT FRONT OIL SEAL, later in this group.)



RG7060 –UN–26NOV97

*Thrust Washer in Timing Gear Cover*




RG7050 –UN–26NOV97

*1-6 Tightening Sequence for Cover Cap Screws*

RG,RG34710,1186 –19–23OCT97–1/1

## INSTALL FRONT WEAR SLEEVE

*NOTE: Front wear sleeve can be installed with timing gear cover removed or installed.*

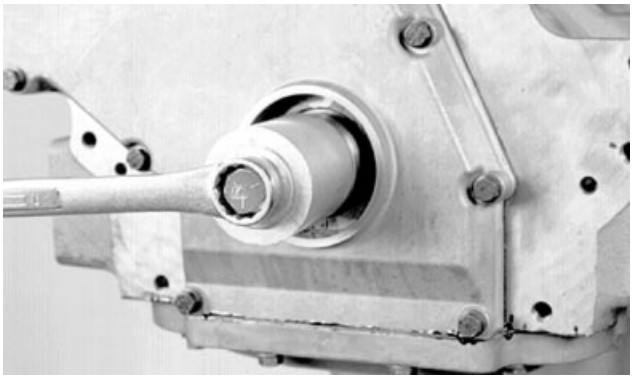
1. Coat I.D. of new wear sleeve with LOCTITE® 609 Retaining Compound or equivalent. Position wear sleeve on crankshaft flange.

2. Use the JDG467 Driver (from JDE3 Installer Set), along with large washer and cap screw that secures damper to crankshaft. Tighten cap screw until driver bottoms.

3. Remove installation tools. Clean any sealant from O.D. of wear sleeve and I.D. of seal bore.

RG6476 –UN–05DEC97

*Tool for Installing Front Wear Sleeve*



RG6477 –UN–05DEC97

*Installing Front Wear Sleeve*

*LOCTITE is a trademark of Loctite Corp.*

RG,RG34710,1187 –19–23OCT97–1/1

## INSTALL CRANKSHAFT FRONT OIL SEAL (WITH TIMING GEAR COVER INSTALLED ON ENGINE)

**IMPORTANT: Whenever front oil seal is replaced, the wear sleeve MUST also be replaced.**

1. Place JDG720-2 Seal Protector (A) on nose of crankshaft. Lubricate I.D. of front oil seal lips with clean engine oil. Slide seal with spring side of seal facing engine onto seal protector. Be careful not to roll oil seal lips.

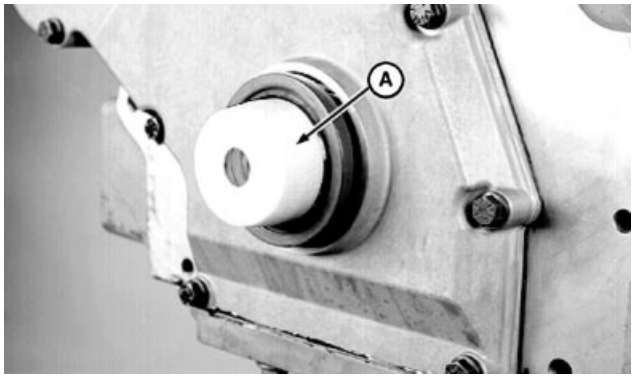
2. Place JDG720-5 Seal Installer onto seal protector against seal. Do not use spacer ring provided with tool set.

3. With nut and washer installed onto JDG720-1 Forcing Screw, thread forcing screw into nose of crankshaft until it bottoms.

4. Tighten nut against crossplate of installer until installer bottoms onto front face of timing gear cover.

5. Remove installation tools. Verify seal is installed square in bore and that seal lips are not rolled on wear sleeve.

   Oil seal should be 8.9 mm (0.35 in.) below front lip of seal bore.




RG6479 –UN–05DEC97

*Protector for Installing Front Oil Seal*

RG6480 –UN–05DEC97

*Installing Front Oil Seal*

RG,RG34710,1188 –19–23OCT97–1/1

## INSTALL VIBRATION DAMPER

*NOTE: On engines with dual dampers, ALWAYS replace both dampers as a matched set.*

1. Install crankshaft Woodruff key with tab facing toward front of engine and key firmly seated in keyway. Position damper (B) onto crankshaft.

**IMPORTANT: Always use new cap screws when installing damper.**

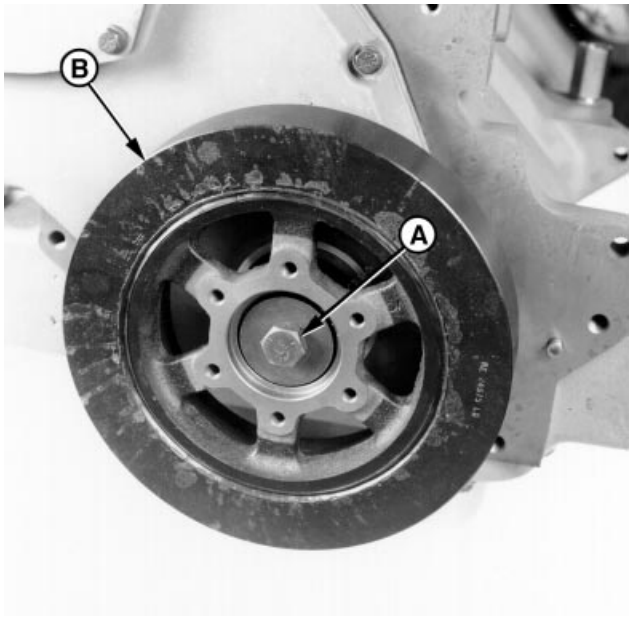
2. Use hardened washer (part of damper assembly) and insert a cap screw that is 25 mm (1 in.) longer than original cap screw (A). Tighten cap screw until it just bottoms out.

3. Remove cap screw and install original cap screw with same hardened washer.

4. Tighten cap screw to 230 N•m (170 lb-ft).

5. Install crankshaft pulley (if equipped) to damper. Tighten cap screws to 70 N•m (52 lb-ft). (On single dampers for gen-set engines, tighten cap screws to 61 N•m (45 lb-ft).

*NOTE: On later engines, damper and pulley are a one-piece unit.*




*Installing Vibration Damper*

RG,RG34710,1189 –19–23OCT97–1/1

## INSTALL SAE 3 FLYWHEEL HOUSING

On SAE 1 and SAE 2 and all aluminum flywheel housings, the flywheel housing is installed AFTER the flywheel.

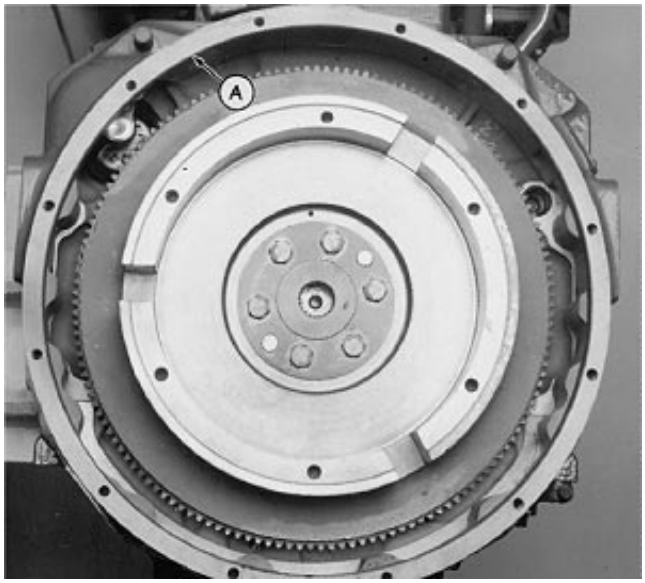
**CAUTION: Flywheel housing (A) is heavy. Plan a handling procedure to avoid personal injuries.**

1. On engines requiring a gasket between block and flywheel housing, inspect cylinder block and flywheel housing gasket surfaces to see that they are clean. Scrape off all old gasket material. Install a new gasket without sealant between block and flywheel housing.

2. Install flywheel housing on cylinder block.

*NOTE: Use new cap screws when installing flywheel housing.*

3. Dip threads of cap screw in engine oil before installing. Install and tighten cap screws to 407 N•m (300 lb-ft).




*Installing SAE 3 Flywheel Housing*

RG,RG34710,1190 –19–23OCT97–1/1

## INSTALL FLYWHEEL

**CAUTION: Flywheel is heavy. Plan a handling procedure to avoid personal injuries.**

Two guide studs may be used at cap screw locations (A) opposite each other to aid in flywheel installation.

*NOTE: ALWAYS use new cap screws when installing flywheel. Flywheel must be clean and free of oil before installing.*

1. Coat threads of flywheel attaching cap screws with LOCTITE® 242 or its equivalent.
2. Position flywheel over dowel pin and install drive hub (if equipped). Start four cap screws. Remove guide studs and install remaining cap screws.
3. Install remaining flywheel attaching cap screws.
4. Tighten flywheel attaching cap screws to 115 N•m (85 lb-ft).


RG7048 –UN–05DEC97

*Installing Flywheel*

*LOCTITE is a trademark of Loctite Corp.*

RG,RG34710,1191 –19–23OCT97–1/1

## INSTALL SAE 1 AND SAE 2 FLYWHEEL HOUSING

**CAUTION: Flywheel housing is heavy. Plan a handling procedure to avoid personal injuries.**

On SAE 3 cast-iron flywheel housings, the housing MUST be installed BEFORE installing flywheel.

1. Scrape off all old gasket material. Install a new gasket without sealant between block and flywheel housing.
2. Install flywheel housing on cylinder block.

*NOTE: ALWAYS use new cap screws when installing flywheel housing.*

3. Dip threads of cap screw in engine oil before installing. Install and tighten cap screws to 407 N•m (300 lb-ft).

RG,RG34710,1192 –19–23OCT97–1/1

## COMPLETE FINAL ASSEMBLY

1. Install oil pump assembly and oil pan (Group 20). Fill engine with clean engine oil.
2. Fill cooling system with proper coolant after engine installation and perform engine break-in. (See PERFORM ENGINE BREAK-IN at end of Group 05.)

RG,RG34710,1193 –19–23OCT97–1/1

# Camshaft and Timing Gear Train

## SPECIAL OR ESSENTIAL TOOLS

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

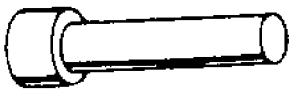
*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1194 –19–23OCT97–1/12

RG5068 –UN–05DEC97

Timing Pin . . . . . JDE81-4

Lock engine at TDC when timing valve train, adjusting valve clearance, and installing fuel injection pump. Use with JDG820 and JDE81-1 Flywheel Turning Tools.



RG5068

*JDE81-4*

RG,RG34710,1194 –19–23OCT97–2/12

RG5073 –UN–05DEC97

Magnetic Follower Holder Kit . . . . . D15001NU

Hold cam followers when removing or installing camshaft.

RG5073

*D15001NU*

RG,RG34710,1194 –19–23OCT97–3/12

Slide Hammer . . . . . D01299AA

Used with JDG405 Camshaft Bushing Service Set and JDG606 Camshaft Bushing Adapter Set to service camshaft bushings.

RG78104H1 –UN–15DEC88

*D01299AA*

**Continued on next page**

RG,RG34710,1194 –19–23OCT97–4/12

Hub Puller Kit . . . . . JDG721

Used with JDG787 Thread Protector to remove vibration damper pulley assembly on some engine applications.

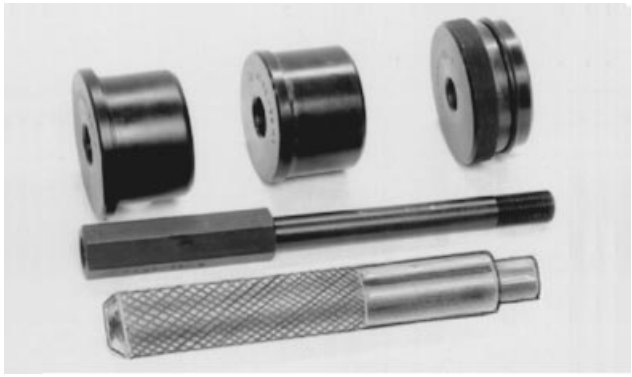
RG5763 –UN–05DEC97

*JDG721*

RG,RG34710,1194 –19–23OCT97–5/12

Camshaft Bushing Service Set . . . . . JDG405

Used with JDG606 Camshaft Bushing Adapter Set and D102999AA Slide Hammer to service camshaft bushings.



RG4228 –UN–05DEC97

*JDG405*

RG,RG34710,1194 –19–23OCT97–6/12

*NOTE: JDE6 Service Set may be used along with JDG602 Adapter Set if JDG405 is not available.*

**Continued on next page**

RG,RG34710,1194 –19–23OCT97–7/12

R26149N –UN–04DEC97

Camshaft Bushing Service Set. . . . . JDE6

Used with JDG602 Camshaft Bushing Adapter Set to service camshaft bushings.

*JDE6*

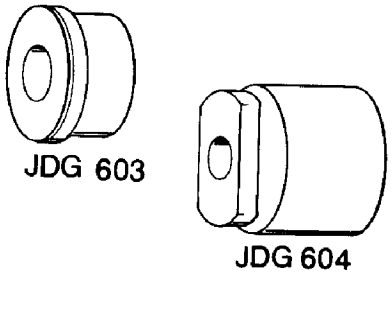
RG,RG34710,1194 –19–23OCT97–8/12

*NOTE: JDG405 Service Set may be used along with JDG606 Adapter Set if JDE6 is not available.*

RG,RG34710,1194 –19–23OCT97–9/12

Camshaft Bushing Adapter Set . . . . . JDG602

Used with JDE6 Camshaft Bushing Service Set to service camshaft bushings. JDG602 consists of JDG603 Driver and JDG604 Receiver Cup.



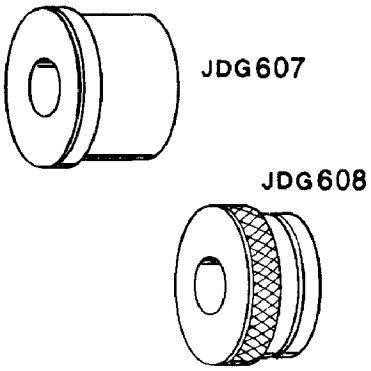

*JDG602*

**Continued on next page**

RG,RG34710,1194 –19–23OCT97–10/12

Camshaft Bushing Adapter Set . . . . . JDG606

Used with JDG405 Camshaft Bushing Service Set and D01299AA Slide Hammer to service camshaft bushings. JDG606 consists of JDG607 Driver and JDG608 Pilot.

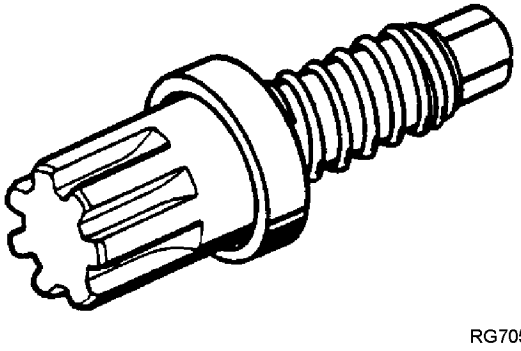



*JDG606*

RG,RG34710,1194 –19–23OCT97–11/12

Flywheel Turning Tool . . . . . JDG820

Used to rotate engine to check damper radial runout and time engine. JDE81-1 may be used also if JDG820 is not available.




*JDG820*

RG,RG34710,1194 –19–23OCT97–12/12

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| TY6333 or TY66347 (U.S.) | High Temperature Grease | Lubricate camshaft lobes and thrust washer before camshaft installation. |
| C-670 (U.S.) | Molybdenum Disulfide Paste | Lubricate camshaft nose to provide lubrication to aid in camshaft gear installation. |
| TY6299 (U.S.) | PERMATEX® AVIATION (Form-A-Gasket No. 3) | Lubricate camshaft bore steel cap plug. |

*FEL-PRO is a trademark of FEL-PRO.*
*PERMATEX is a trademark of Loctite Corp.*

RG,RG34710,1195 –19–23OCT97–1/1

## CAMSHAFT AND TIMING GEAR TRAIN SPECIFICATIONS

| ITEM | SPECIFICATION | WEAR LIMIT |
|---|---|---|
| Camshaft End Play | 0.0130—0.5000 mm (0.0005—0.0200 in.) | 0.65 mm (0.026 in.) |
| Camshaft Thrust Washer Thickness | 2.24—2.34 mm (0.088—0.092 in.) | _____ |
| Camshaft Journal O.D. | 66.987—67.013 mm (2.6373—2.6383 in.) | _____ |
| Camshaft Bushing I.D. | 67.076—67.102 mm (2.6408—2.6418 in.) | _____ |
| Camshaft Bushing-to-Journal Clearance | 0.063—0.115 mm (0.0025—0.0045 in.) | _____ |
| Camshaft Gear-to-Injection Pump Drive Gear Backlash | 0.051 mm (0.0020 in.) minimum | _____ |
| Camshaft Bushing Bore in Block (without bushings) | 69.987—70.013 mm (0.273—0.292 in.) | _____ |
| Maximum Runout of Camshaft Bore | 0.038 mm (0.0015 in.) | _____ |
| Maximum Runout of Camshaft Gear Thrust Surfaces | 0.10 mm (0.004 in.) | _____ |
| Camshaft Driver Gear-to-Crankshaft Gear Backlash | 0.076 mm (0.0030 in.) minimum | _____ |
| Camshaft Lobe Lift: | | |
| Intake | 7.69—7.79 mm (0.303—0.307 in.) | 7.19 mm (0.283 in.) |
| Exhaust | 8.25—8.35 mm (0.325—0.329 in.) | 7.75 mm (0.305 in.) |
| Cam Follower O.D. | 17.33—17.35 mm (0.682—0.683 in.) | _____ |
| Cam Follower Bore Diameter in Block | 17.384—17.440 mm (0.6845—0.6865 in.) | _____ |
| Valve Lift at 0.00 mm (in.) Clearance: | | |
| Intake | 13.53—13.71 mm (0.533—0.540 in.) | 12.65 mm (0.498 in.) |
| Exhaust | 14.52—14.70 mm (0.572—0.579 in.) | 13.64 mm (0.537 in.) |
| Crankshaft Front Oil Seal Bore Runout | 0.254 mm (0.010 in.) maximum | _____ |
| Crankshaft Front Oil Seal Installed Depth (below front face of cover) | 8.4 mm (0.33 in.) | _____ |

RG,RG34710,1196 –19–23OCT97–1/1

# CAMSHAFT AND TIMING GEAR TRAIN TORQUES

**TORQUES**

| | |
|---|---|
| Rocker Arm Shaft Clamps | 75 N•m (55 lb-ft) |
| Rocker Arm Cover-to-Cylinder Head | 8 N•m (6 lb-ft) (72 lb-in.) |
| Timing Gear Cover-to-Cylinder Block | 27 N•m (20 lb-ft) |
| Injection Pump Drive Gear Cover | 27 N•m (20 lb-ft) |
| Water Pump Cover-to-Timing Gear Cover: | |
| 5/16 in. Cap Screws | 27 N•m (20 lb-ft) |
| 3/8 in. Cap Screws | 47 N•m (35 lb-ft) |
| Auxiliary Drive Cover Cap Screws | 47 N•m (35 lb-ft) |

RG,RG34710,1197 –19–23OCT97–1/1

## CHECK VALVE LIFT

**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 bent push rods.*

1. Remove rocker arm cover. Loosen locknut on rocker arm and set valve clearance at 0.0 mm (in.). Tighten locknut.
2. Put dial indicator tip on valve rotator. Be sure that valve is fully closed.
3. Check pre-set on dial indicator. Set dial indicator pointer at zero.
4. Manually turn engine in running direction, using the engine rotation tool previously mentioned for checking valve clearance.
5. Observe dial indicator reading as valve is moved to fully open position. Valve lift must be no less than limits shown.

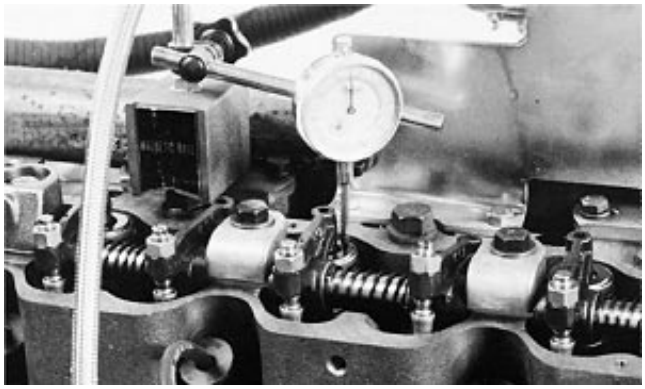
**Intake Valve—Specification**

| | |
|---|---|
| Lift | 13.53—13.71 mm (0.533—0.540 in.) at 0.00 mm (in.) clearance |
| Wear Limit | 12.65 mm (0.498 in.) at 0.00 mm (in.) clearance |

**Exhaust Valve—Specification**

| | |
|---|---|
| Lift | 14.52—14.70 mm (0.572—0.579 in.) at 0.00 mm (in.) clearance |
| Wear Limit | 13.64 mm (0.537 in.) at 0.00 mm (in.) clearance |

6. Follow same procedure for all remaining valves and adjust valve clearance to specification. (See CHECK AND ADJUST VALVE CLEARANCE in Group 05.)



RG6527 –UN–14DEC92

*Checking Valve Lift*

RG,RG34710,1198 –19–23OCT97–1/1

## CHECK CAMSHAFT END PLAY AND MEASURE GEAR BACKLASH

*NOTE: Camshaft end play must be measured before removing timing gear cover, as thrust washer in back side of timing gear cover limits camshaft end play.*

1. Remove injection pump drive gear cover (shown removed).

2. Install magnetic base dial indicator on front face of cylinder block and position dial indicator tip on front face of camshaft gear, as shown. Set dial indicator to zero.

3. Move camshaft gear back and forth and observe end play reading. Compare reading with specification given below.

**Camshaft—Specification**

| | |
|---|---|
| End Play | 0.013—0.500 mm (0.0005—0.0200 in.) new |
| End Play | 0.65 mm (0.0260 in.) maximum allowable |

If end play is excessive, remove timing gear cover and crankshaft and measure thickness of thrust washers.

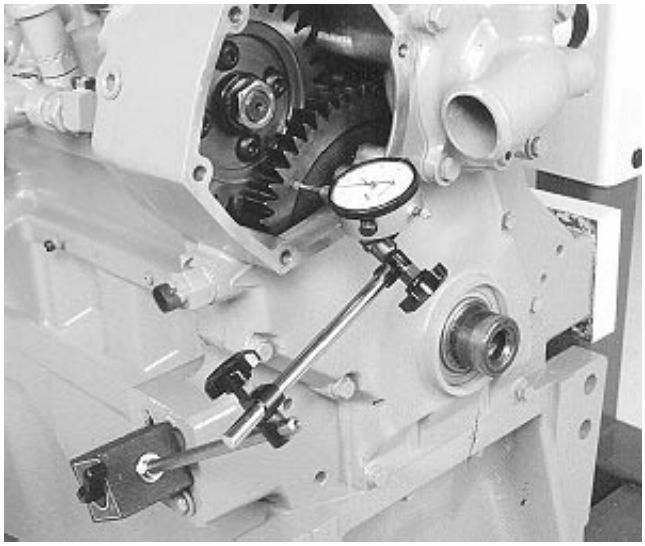
4. Position indicator plunger tip against camshaft gear tooth with a preload.

5. Measure backlash between camshaft drive gear and crankshaft gear in three (3) different positions around the camshaft gear. Compare readings with specifications given below.

**Camshaft Drive Gear Gear-to-Crankshaft Gear—Specification**

| | |
|---|---|
| Backlash | 0.076 mm (0.003 in.) min. |

Replace gear if backlash does not equal or exceed specification.



RG7211 –UN–28JUL94

*Measuring Camshaft End Play*

RG,RG34710,1199 –19–23OCT97–1/1

## REMOVE VIBRATION DAMPER AND TIMING GEAR COVER

For timing cover removal procedure with engine installed in vehicle (8000 Tractors), refer to REMOVE AND INSTALL TIMING GEAR COVER—ENGINE INSTALLED IN VEHICLE, in Group 15.

1. Drain oil (if not previously done), and remove oil pan. Remove oil pump if crankshaft is to be removed.

2. Remove cap screw and washer on damper pulley. Install JDG787 Thread Protector in nose of crankshaft.

**IMPORTANT: DO NOT use a jaw-type puller to remove vibration damper. Damage could result to the damper. Never apply thrust on outer ring of damper. Do not drop damper or strike with a hammer.**

3. Remove damper from crankshaft using JDG721 Hub Puller (A).

*NOTE: D01207AA (OTC518) Puller Set (not shown) may also be used to remove damper.*

4. Disconnect speed sensor wiring connector (C, shown disconnected) and remove injection pump drive gear cover (B).

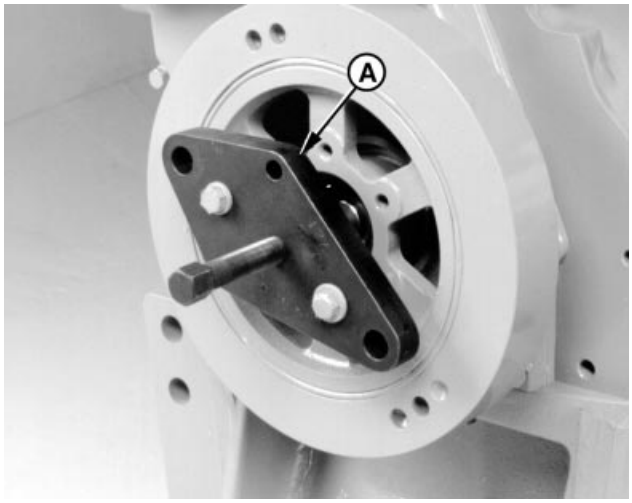
5. Check camshaft end play. (See CHECK CAMSHAFT END PLAY earlier in this group.)

**IMPORTANT: Whenever timing gear cover is removed, ALWAYS install a new front oil seal and wear sleeve.**

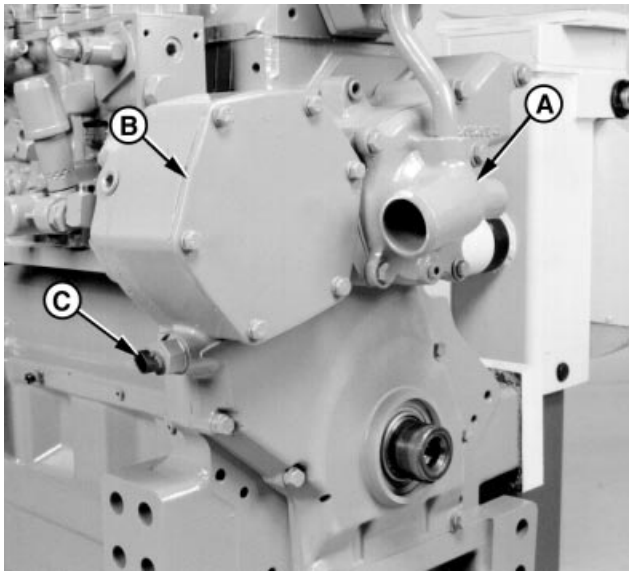
6. Remove water pump cover (A). Remove all remaining cap screws and remove timing gear cover.

7. Remove front oil seal from timing gear cover. Install a new seal after timing gear cover is installed. See INSTALL FRONT OIL SEAL (WITH TIMING GEAR COVER INSTALLED ON ENINGE) in Group 15.

8. Remove crankshaft front wear sleeve. (See Group 15.)




*Removing Crankshaft Vibration Damper*




*Removing Timing Gear Cover*

RG,RG34710,1200 –19–23OCT97–1/1

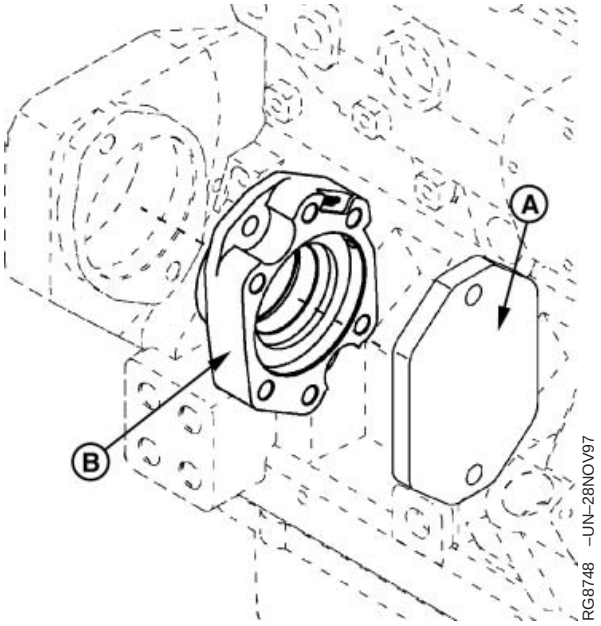
## REMOVE, INSPECT, AND INSTALL CAMSHAFT GEAR-DRIVEN AUXILIARY DRIVE—IF EQUIPPED

*NOTE: Various auxiliary drive options are available; removal and installation of all options are similar. The auxiliary drive is integrated into the engine front timing gear cover.*

1. Remove auxiliary drive gear cover (A).
2. Clean and inspect cover for cracks or damage.
3. Remove auxiliary drive assembly (B).
4. Inspect for cracked housing, worn or damaged bearings, damaged gear or spline.

*NOTE: Auxiliary drive assembly is not repairable; install a new assembly if damage is detected. Refer to CTM67 - OEM Accessories for additional service information.*

5. Replace auxiliary drive assembly as needed.
6. Install cover and tighten cap screws or nuts to 47 N•m (35 lb-ft).




*Auxiliary Drive*

RG,RG34710,1201 –19–23OCT97–1/1

## 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, it may be necessary to remove cylinder head for inspection of block, head, cam lobes and cam followers.*

1. Drain engine oil and coolant, if not previously done. Remove timing gear cover as detailed earlier in this group.

2. Rotate engine flywheel with JDE81-1 or JDG820 Flywheel Rotation Tool and lock engine at No. 1 cylinder's "TDC-Compression" stroke with JDE81-4 Timing Pin. Timing marks (A) on camshaft gear and crankshaft gear should be aligned.

   If timing marks are not aligned, remove timing pin and continue to rotate engine until marks align. Timing pin should enter hole in flywheel. Engine will be locked at No. 1 "TDC-Compression" stroke.

3. Remove rocker arm assembly and push rods. (See Group 05, Cylinder Head and Valves.)

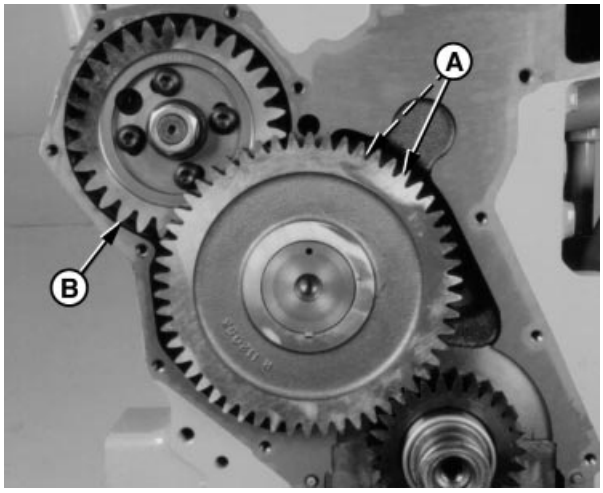
4. When removing camshaft with engine on rollover stand, roll engine to a position where followers fall away from camshaft lobes (oil pan side up) or hold cam followers away from lobes with D15001NU Magnetic Holding Set.


*Timing Marks—Camshaft and Crankshaft Gears*

**Continued on next page**

5. Examine both camshaft gears (A) and injection pump drive gear (B) for worn or damaged gear teeth. Gears should have a minimum backlash of 0.051 mm (0.0020 in.).

*NOTE: Timing marks on crankshaft and camshaft gear should be aligned and No. 1 cylinder locked at "TDC Compression" stroke when removing camshaft.*




*Camshaft Gears*

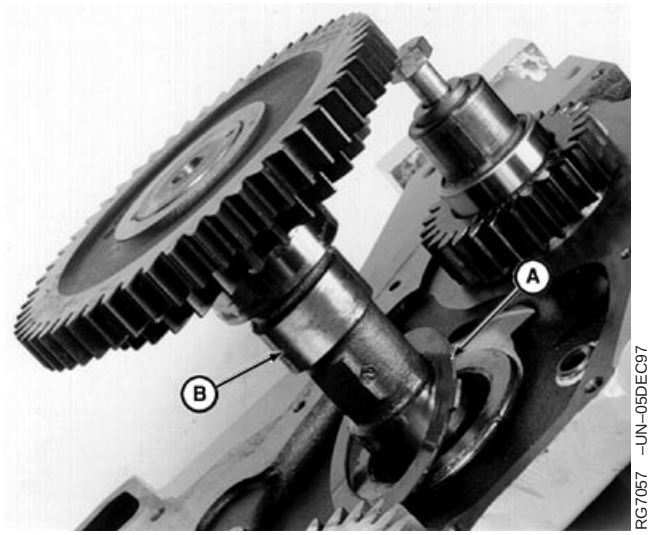
RG,RG34710,1202 –19–23OCT97–2/3

6. Carefully remove camshaft (B) from cylinder block so that camshaft lobes do not drag in bores.

*NOTE: Rotate camshaft carefully to aid in removing.*

7. Remove thrust washer (A) from behind cam gears.

8. Remove cam followers from cylinder block.




*Removing Camshaft*

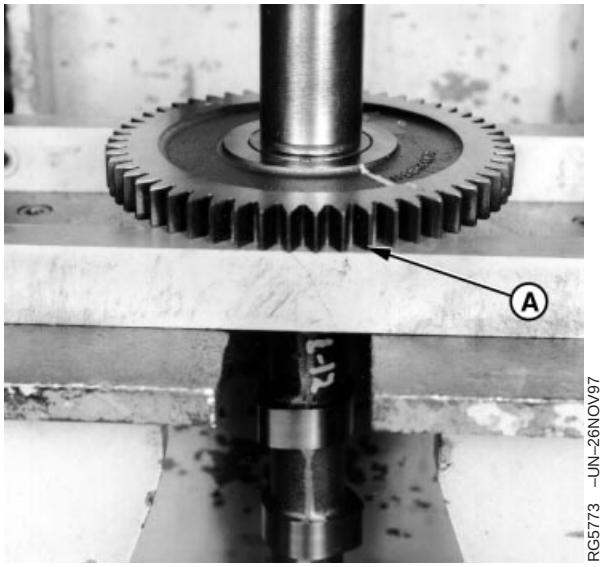
RG,RG34710,1202 –19–23OCT97–3/3

## REMOVE CAMSHAFT GEARS

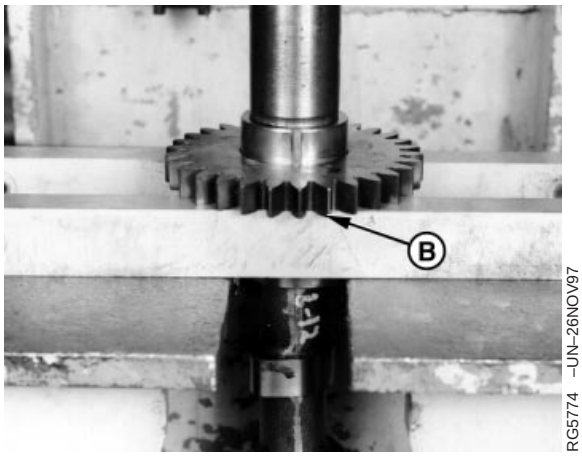
**IMPORTANT: Prevent camshaft from striking floor when pushing camshaft nose out of gear. Camshaft may be damaged if it is allowed to fall to the floor.**

*NOTE: Camshaft gears are pressed onto the camshaft. Removal of gears from camshaft will require approximately a 10-ton press.*

1. Support outer camshaft gear (A) in a press.
2. Remove outer gear from camshaft.
3. Support inner camshaft gear (B) in a press.
4. Remove inner gear from camshaft.
5. Clean camshaft and gears in solvent. Dry with compressed air.




*Removing Outer Camshaft Gear*




*Removing Inner Camshaft Gear*

RG,RG34710,1203 –19–23OCT97–1/1

## MEASURE THRUST WASHER THICKNESS

1. After removal of camshaft, check the two thrust washers individually for proper thickness.

**Thrust Washer—Specification**

Thickness..... 2.24—2.34 mm (0.088—0.092 in.)

2. Replace washers if worn or damaged.

RG5775 –UN–05DEC97

*Measuring Camshaft Thrust Washers*

RG,RG34710,1204 –19–23OCT97–1/1

## INSPECT AND MEASURE CAMSHAFT FOLLOWERS

1. Inspect camshaft followers for uneven wear or damage. Also inspect corresponding camshaft lobe for wear or damage. Replace as necessary.

2. Measure follower O.D. and follower bore I.D. in cylinder block.

**Camshaft Follower—Specification**

OD ..... 17.33—17.35 mm (0.682—0.683 in.)

**Camshaft Follower Bore in Block—Specification**

ID ..... 17.384—17.440 mm (0.6845—0.6865 in.)

Replace cam followers that are not within specification. Replace cylinder block if any one follower bore is not within specification.

RG2745 –UN–04DEC97

*Inspecting Camshaft Followers*

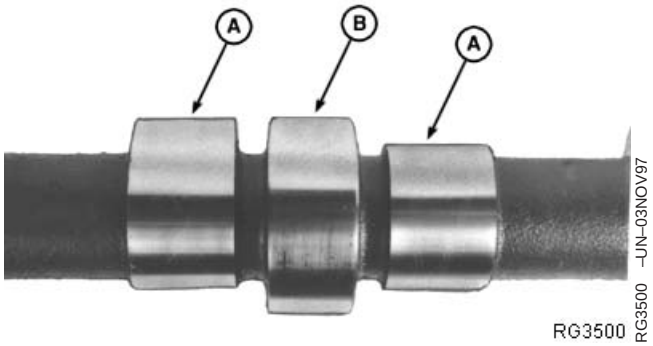
RG,RG34710,1205 –19–23OCT97–1/1

## VISUALLY INSPECT CAMSHAFT

1. Clean camshaft in solvent. Dry with compressed air.

2. Inspect all camshaft lobes (A) and journals (B) for wear or damage. Replace camshaft as necessary. New camshaft followers can be used with old camshaft (if camshaft is serviceable). DO NOT reuse old camshaft followers with a new camshaft.

*NOTE: Very light score marks may be found but are acceptable if valve lift is within specification. Pitting or galling dictates replacement. (See CHECK VALVE LIFT, earlier in this group.)*




*Inspecting Camshaft*

RG,RG34710,1206 –19–23OCT97–1/1

## MEASURE CAMSHAFT JOURNAL O.D. AND BUSHING I.D.

1. Measure each camshaft journal O.D. If camshaft journal O.D. is not within specification, install a new camshaft.

2. Measure each camshaft bushing I.D. when installed in cylinder block.

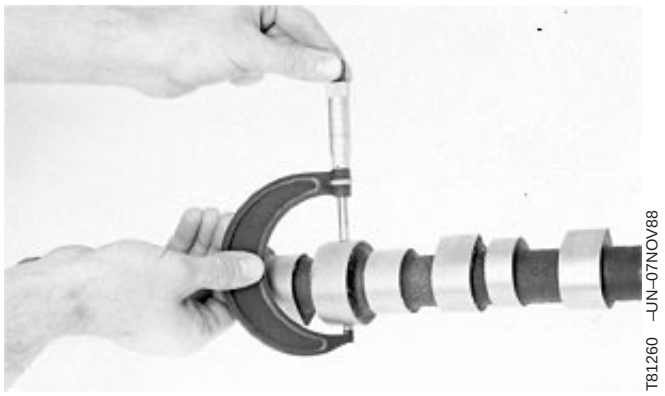
   Compare measurements with specs given below. Replace camshaft and bushings as needed.

**Camshaft Journal—Specification**

OD ..... 66.987—67.013 mm (2.6373—2.6383 in.) new

**Camshaft Bushing—Specification**

I.D. ..... 67.076—67.102 mm (2.6408—2.6418 in.) new




*Measuring Camshaft Journals*

RG,RG34710,1207 –19–23OCT97–1/1

## MEASURE CAMSHAFT LOBE LIFT

Measure each camshaft lobe at its highest point and at its narrowest point. Subtract narrowest dimension from highest dimension to find camshaft lobe lift.

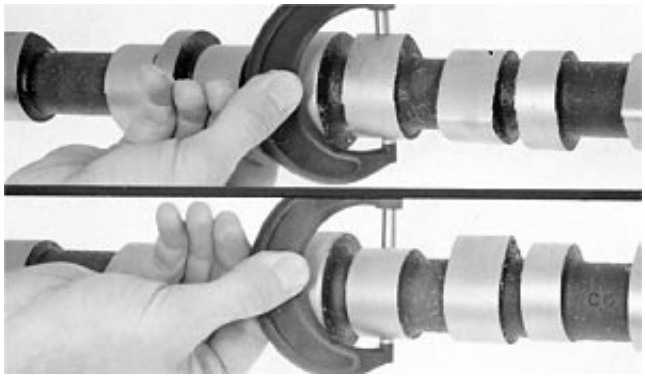
If camshaft lobe lift is not within the wear specification on any one lobe, install a new camshaft.

**Intake Camshaft Lobe—Specification**

Lift ..... 7.69—7.79 mm (0.303—0.307 in.)
Wear Limit ..... 7.19 mm (0.283 in.)

**Exhaust Camshaft Lobe—Specification**

Lift ..... 8.25—8.35 mm (0.325—0.329 in.)
Wear Limit ..... 7.75 mm (0.305 in.)



T81262 –UN–01NOV88

*Measuring Camshaft Lobes*

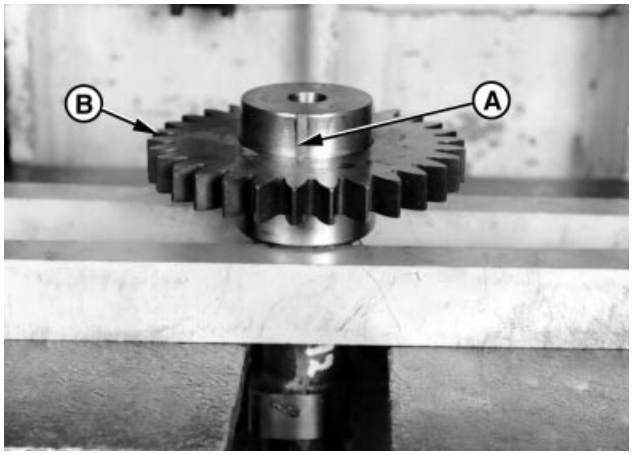
RG,RG34710,1208 –19–23OCT97–1/1

## INSTALL CAMSHAFT GEARS

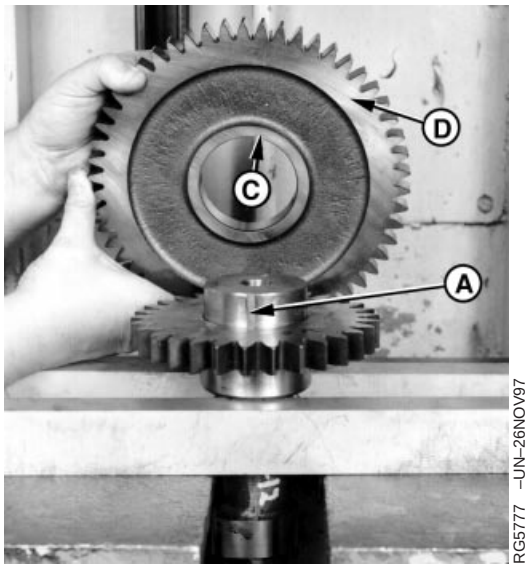
1. Support camshaft under first bearing journal in a hydraulic press.
2. Install Woodruff key (A). Lubricate camshaft nose with FEL-PRO® C-670 Molybdenum Disulfide Paste.
3. Set inner gear (B) on camshaft with thrust washer surface to the inside (toward the camshaft). Align Woodruff key and keyway.
4. Install gear onto nose of camshaft. Push inner gear on until tight against the camshaft bearing journal.
5. Set outer gear on camshaft with timing mark upward (away from the camshaft). Align Woodruff key and keyway (C) of outer gear (D).
6. Push outer gear onto camshaft nose until tight against inner gear.
7. Support each end of the camshaft on centers. Use a dial indicator with plunger resting on the thrust surface of the camshaft gears.
8. Check the runout of the inner and outer gear thrust surfaces.

**Camshaft Gear Surface—Specification**

| | |
|---|---|
| Runout | 0.10 mm (0.004 in.) |




*Installing Camshaft Inner Gear*




*Installing Camshaft Outer Gear*

**A—Woodruff Key**
**B—Inner Gear**
**C—Keyway**
**D—Outer Gear**

*FEL-PRO is a trademark of FEL-PRO.*

RG,RG34710,1209 –19–23OCT97–1/1

## SERVICE CAMSHAFT BUSHINGS USING JDG602 ADAPTER SET

1. Inspect camshaft journals and bushings for wear or damage. Measure cam journals and bushings to determine if proper oil clearance exists. Replace camshaft and/or bushings as necessary.

**Camshaft Bushing—Specification**

| | |
|---|---|
| ID | 67.076—67.102 mm (2.6408—2.6418 in.) |
| Bore in Block | 69.987—70.013 mm (2.7554—2.7564 in.) |

**Camshaft Journal—Specification**

| | |
|---|---|
| OD | 66.987—67.013 mm (2.6373—2.6383 in.) |

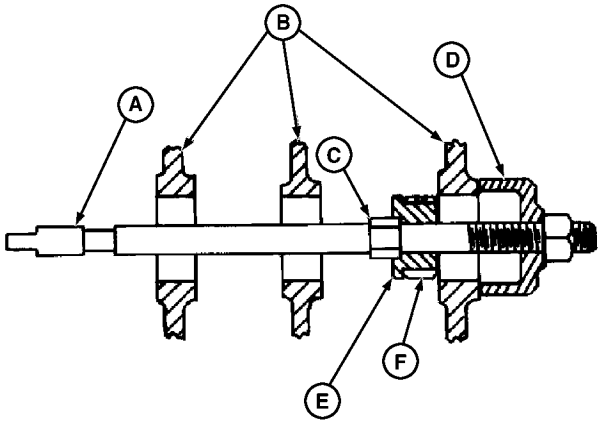
**Camshaft Journal and Bushing Oil—Specification**

| | |
|---|---|
| Clearance | 0.063—0.115 mm (0.0025—0.0045 in.) |

*NOTE: The front two bushings can be reached from the front of the engine. The flywheel and rear camshaft bore plug (G) must be removed to reach the other two bushings.*

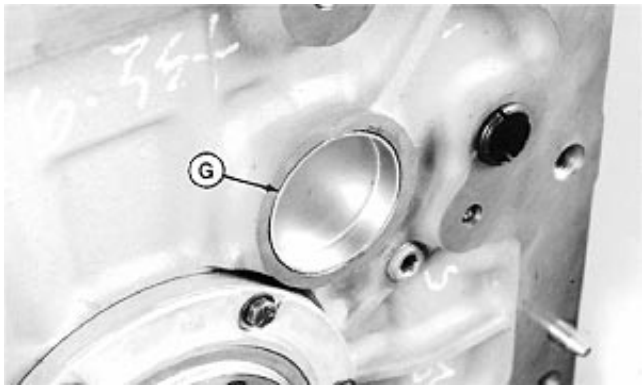
2. Remove camshaft bushings (F) using JDG603 Bushing Driver (E) and JDG604 Receiver Cup (D) along with the components shown from JDE6 Camshaft Bushing Replacement Set (A and C).

3. Tighten nut on end of bushing screw until bushing is pulled out of camshaft bushing bore. Inspect and measure camshaft bushing bore in block (B). Follow same procedure for remaining bushings to be replaced.




RG5272 –UN–07NOV97

*Removing Camshaft Bushings*




RG5949 –UN–30AUG91

*Camshaft Rear Bore Plug*

**A—Bushing Screw (JDE6-1)**
**B—Cylinder Block Web**
**C—Lock Bushing (No. 25916)**
**D—Receiver Cup (JDG604)**
**E—Bushing Driver (JDG603)**
**F—Camshaft Bushing**
**G—Camshaft Bore Plug**

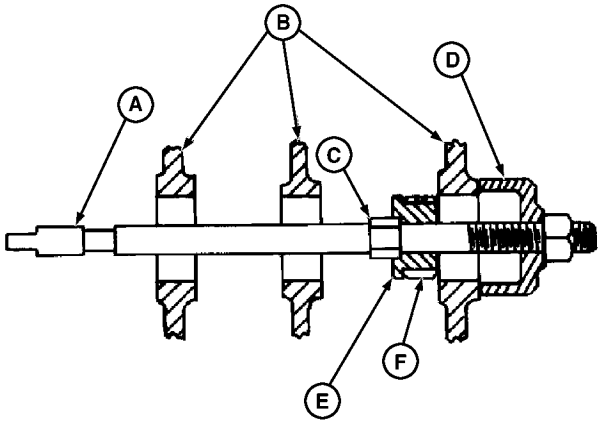
**Continued on next page**

**IMPORTANT: Oil holes in bushings and cylinder block must be aligned after installation or oil starvation will occur. The elongated hole in bushing must be toward the top. After installation, use a small mirror with extension to be sure oil holes are properly aligned.**

4. Slide a new camshaft bushing (F) onto JDG603 Bushing Driver (E). Assemble driver and JDGF604 Receiver Cup (D) along with components shown from JDE6 Camshaft Bushing Replacement Set (A and C).

5. Be sure bushing is started square in bore and oil holes are aligned with holes in block. Tighten nut to pull bushing in until it is properly positioned in bore.

6. Check bushing-to-cylinder block oil hole alignment using a small mirror with extension.




*Installing Camshaft Bushings*

**A—Bushing Screw (JDE6-1)**
**B—Cylinder Block Web**
**C—Lock Bushing (No. 25916)**
**D—Receiver Cup (JDG604)**
**E—Bushing Driver (JDG603)**
**F—Camshaft Bushing**

DPSG,OUOE003,29 –19–18DEC98–2/2

## SERVICE CAMSHAFT BUSHINGS USING JDG606 ADAPTER SET

1. Inspect camshaft journals and bushings for wear or damage. Measure cam journals and bushings to determine if proper oil clearance exists. Replace camshaft and/or bushings as necessary.

**Camshaft Bushing—Specification**

| | |
|---|---|
| ID | 67.076—67.102 mm (2.6408—2.6418 in.) |
| Bore in Block | 69.987—70.013 mm (2.7554—2.7564 in.) |

**Camshaft Journal—Specification**

| | |
|---|---|
| OD | 66.987—67.013 mm (2.6373—2.6383 in.) |

**Camshaft Journal and Bushing Oil—Specification**

| | |
|---|---|
| Clearance | 0.063—0.115 mm (0.0025—0.0045 in.) |

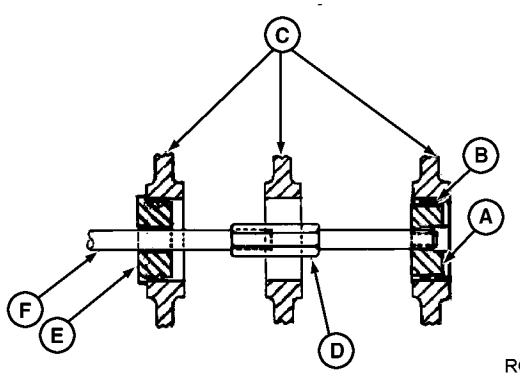
*NOTE: The front two bushings can be reached from the front to the engine. The flywheel and rear camshaft bore plug (G) must be removed to reach the other two bushings.*

*Lubricate O-ring on JDG608 Bushing Pilot with clean engine oil before installing in cylinder block web (C).*

2. Remove camshaft bushings (B) using JDG607 Bushing Driver (A) and JDG408 Slide Hammer Adapter (D) (from JDG405 camshaft Bushing Service Set). Also use JDG608 Bushing Pilot (E), and D01299AA Slide Hammer (F).

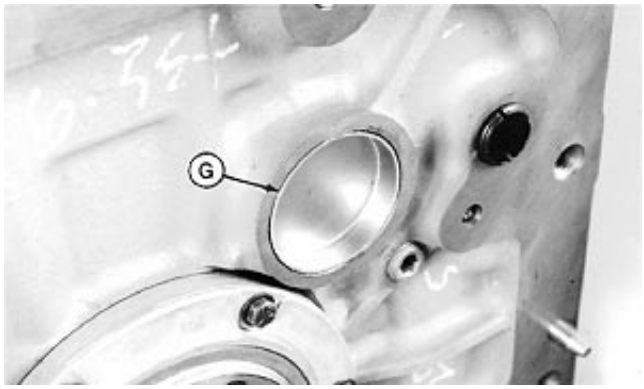
*NOTE: End bushing at front and rear of cylinder block may be removed with just JDG607 Bushing Driver and D01299AA Slide Hammer.*

3. Inspect and measure each camshaft bushing bore in block as bushings are removed.




RG5332 –UN–07NOV97

*Removing Camshaft Bushings*




RG5949 –UN–30AUG91

*Camshaft Rear Bore Plug*

**A—Bushing Driver (JDG607)**
**B—Camshaft Bushing**
**C—Cylinder Block Web**
**D—Slide Hammer Adapter (JDG408)**
**E—Bushing Pilot (JDG608)**
**F—Slide Hammer (D01299AA)**
**G—Camshaft Bore Plug**

**Continued on next page**

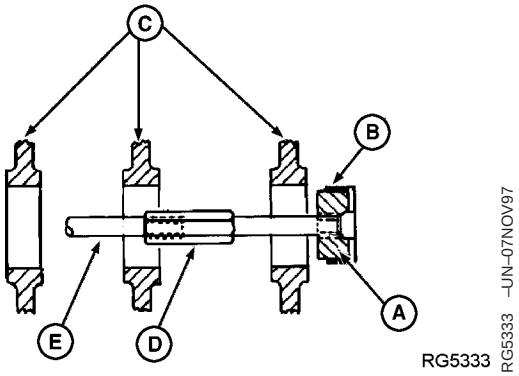
**IMPORTANT: Oil holes in bushings and cylinder block must be aligned after installation. The elongated hole in bushing must be toward the top. After installation, use a small mirror with extension to be sure oil holes are properly aligned.**

4. Slide a new camshaft bushing (B) onto JDG603 Bushing Driver (A). With JDG608 Bushing Pilot installed in outside cylinder block web (C), assemble D01299AA Slide Hammer (E) and JDG408 Slide Hammer Adapter (D) with bushing driver as shown.

5. Be sure bushing is started square in bore and oil holes are aligned with holes in block. Pull bushing into bore with slide hammer until properly positioned.

6. Check bushing-to-cylinder block oil hole alignment using a small mirror with extension.

7. Apply PERMATEX® AVIATION (Form-A-Gasket No. 3) to new camshaft bore steel cap plug and install plug in bore. Plug edge must be seated below edge of bore.




*Installing Camshaft Bushings*

**A—Bushing Driver (JDG607)**
**B—Camshaft Bushing**
**C—Cylinder Block Web**
**D—Slide Hammer Adapter (JDG408)**
**E—Slide Hammer (D01299AA)**

*PERMATEX is a trademark of Loctite Corp.*

DPSG,OUOE003,30 –19–18DEC98–2/2

## INSTALL CAMSHAFT

**IMPORTANT: Set engine at TDC of No. 1 piston's compression stroke before installing camshaft so timing marks on camshaft and crankshaft gears will be aligned.**

1. If camshaft followers were removed with engine on a rollover stand, reinstall followers but do not obstruct camshaft bore. Roll engine to an angle where followers fall away from camshaft bores.

*NOTE: If D15001NU Magnetic Holding Tool Set is used, hold camshaft followers away from camshaft bore until camshaft is installed.*

2. Lubricate thrust washer (A) with TY6333 or TY6347 High Temperature Grease and install on camshaft behind inner gear.

3. Lubricate camshaft lobes with TY6333 or TY6347 High Temperature Grease and bearing journals with clean engine oil.

4. Carefully install camshaft in cylinder block so that camshaft lobes do not drag in bores. Rotate camshaft during installation to avoid obstruction in any bore.


*Camshaft Thrust Washer*

RG,RG34710,1210 –19–23OCT97–1/2

5. With No. 1 piston on "TDC" compression, align timing marks (A) on camshaft and crankshaft gears. Check injection pump timing. (See Group 35.)


*Timing Marks—Camshaft and Crankshaft Gears*

RG,RG34710,1210 –19–23OCT97–2/2

## INSTALL THRUST WASHER AND TIMING GEAR COVER

1. Lubrication thrust washer (bold arrow) with TY6333 or TY6347 High Temperature Grease and install in timing gear cover (A) tabs.

2. Install a new gasket on engine block. Apply a light film of grease to the gasket to hold it in place.

**IMPORTANT: Tightening the timing gear cover cap screws in proper sequence controls the total runout of the crankshaft flange-to-oil seal bore.**

**On engines with auxiliary front drives, tighten those adapter cap screws BEFORE tightening the timing cover screws. (See earlier in this group.)**

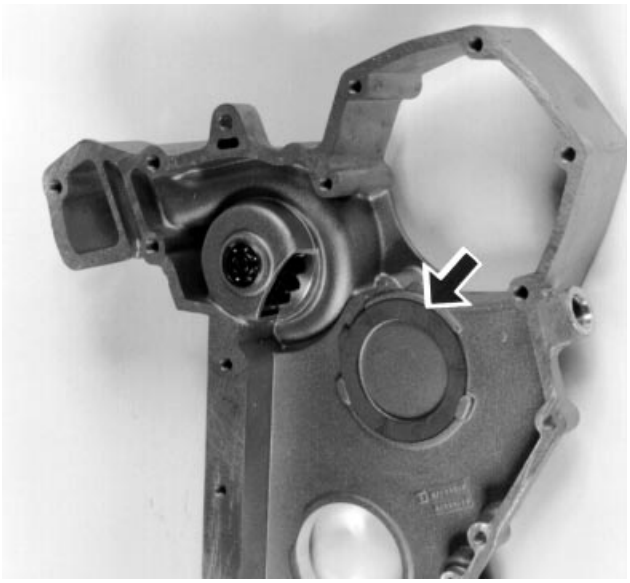
3. Install timing gear cover. Tighten cap screws one through six to 27 N•m (20 lb-ft).

4. Install water pump and cover assembly (C) using a new gasket. Tighten 5/16-in. cap screws to 27 N•m (20 lb-ft) and 3/8-in. cap screws to 47 N•m (35 lb-ft).

5. Check camshaft endplay. (See CHECK CAMSHAFT END PLAY earlier in this group.)

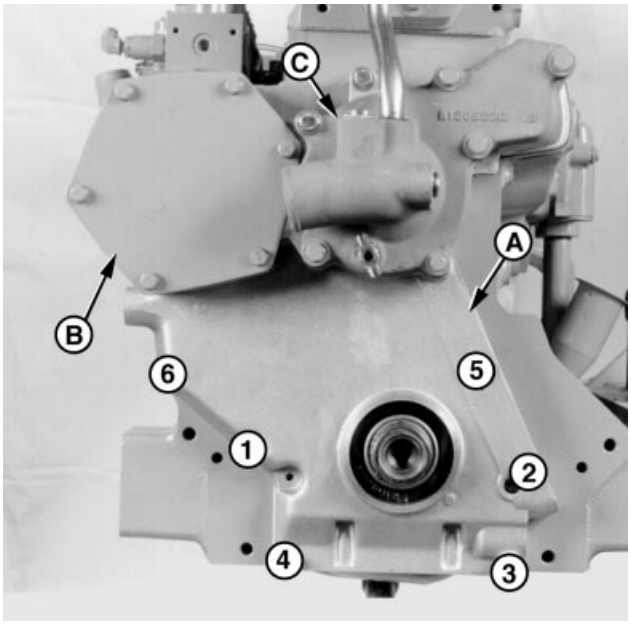
6. Install injection pump drive gear cover using a new gasket and tighten cap screws to 27 N•m (20 lb-ft).

7. Trim timing gear cover gasket flush with oil pan gasket rail.



RG7060 –UN–26NOV97

*Thrust Washer in Timing Gear Cover*




RG7050 –UN–26NOV97

*1-6 - Sequence for Tightening Cover Cap Screws*

RG,RG34710,1211 –19–23OCT97–1/1

## COMPLETE FINAL ASSEMBLY

1. Install a new crankshaft front wear sleeve and oil seal. (See INSTALL CRANKSHAFT FRONT OIL SEAL (WITH TIMING GEAR COVER INSTALLED ON ENGINE, in Group 15.)

2. Connect the magnetic speed sensor wiring lead.

3. Install crankshaft vibration damper. (See INSTALL VIBRATION DAMPER in Group 15.)

4. Install valve train and rocker arm assembly. (See Group 05, Cylinder Head Valves.)

5. Install oil pan using a new gasket or install engine into vehicle if equipped with a structural oil pan. (See Group 20, Lubrication System.) Fill engine with clean engine oil.

6. Perform engine break-in as required. (See PERFORM ENGINE BREAK-IN, Group 04.)

RG,RG34710,1212 –19–23OCT97–1/1

# Lubrication System

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| T43512 (U.S.)<br>TY9473 (Canadian)<br>242 (LOCTITE®) | Thread Lock and Sealer (Medium Strength) | Oil filter adapter. |
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | To seal oil pan elbow drain fitting. |
| AVIATION (TY6299) (U.S.) | Form-A-Gasket No. 3 | Oil pan gasket surfaces. |

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*PERMATEX is a trademark of Loctite Corp.*

RG,RG34710,1213 –19–23OCT97–1/1

## LUBRICATION SYSTEM SPECIFICATIONS

| ITEM | SPECIFICATION |
|---|---|
| Engine Oil Pressure[a] @ 1800—2000 RPM | 280—400 kPa (2.8—4.0 bar) (40—58 psi) |
| Oil Filter Bypass Valve Operating Pressure | 220 kPa (2.2 bar) (32 psi) |
| Oil Cooler Bypass Valve Operating Pressure | 220 kPa (2.2 bar) (32 psi) |
| Pressure Regulating Valve Starts to Operate | 340 kPa (3.4 bar) (49 psi) |
| Oil Pressure Regulating Valve Spring: | |
| Compressed Length | 43.0 mm @ 66–74 N (1.69 in. @ 15–17 lb-force) |
| Free Length | 85.0 mm (3.35 in.) |
| Oil Filter Bypass Valve Spring: | |
| Compressed Length | 30.0 mm @ 64–78 N (1.18 in. @ 14–18 lb-force) |
| Free Length | 44.0 mm (1.73 in.) |
| Oil Cooler Bypass Valve Spring: | |
| Compressed Length | 30.0 mm @ 64–78 N (1.18 in. @ 14–18 lb-force) |
| Free Length | 44.0 mm (1.73 in.) |
| Oil Pump: | |
| Crankshaft Gear-to-Oil Pump Drive Gear Minimum Backlash | 0.08 mm (0.003 in.) |
| Pump Gear Backlash | 0.33—2.00 mm (0.013—0.079 in.) |
| Oil Pump Drive Gear-to-Crankshaft Throw Minimum Clearance | 0.38 mm (0.0015 in.) |
| Maximum Drive Shaft End Play | 0.15 mm (0.006 in.) |
| Maximum Drive Shaft Side Movement | 0.17 mm (0.0065 in.) |
| Oil Filter Housing-to-Cylinder Block | 80 N•m (60 lb-ft) |
| Oil Cooler Cover-to-Cylinder Block[b] | 37 N•m (27 lb-ft) |
| Oil Pressure Regulating Valve Housing[c]-to-Cylinder Block (External) | 61 N•m (45 lb-ft) |
| Oil Pump Outlet and Oil Cooler Cross-Over Tube-to-Cylinder Block Adapter (Internal) | 54 N•m (40 lb-ft) |
| Valve Plugs | 100 N•m (74 lb-ft) |
| Oil Pump: | |
| Drive Gear-to-Pump Drive Shaft Nut | 54 N•m (40 lb-ft) |
| Pump Cover-to-Housing | 41 N•m (30 lb-ft) |
| Intake (Pickup) Tube-to-Cover | 41 N•m (30 lb-ft) |
| Pump Housing-to-Cylinder Block | 42 N•m (31 lb-ft) |

[a]Oil pressure with oil sump temperature at 105°C (220°F).
[b]Refer to REMOVE, INSPECT, AND INSTALL ENGINE OIL COOLER, later in this group for cap screw tightening sequence.
[c]Use new, stronger-grade cap screws when reinstalling oil pressure regulating valve housing.

**Continued on next page**

| ITEM | SPECIFICATION |
|---|---|
| Oil Pan:[a] | |
| 3/8 in. Cap Screws | 68 N•m (50 lb-ft) |
| 1/2 in. Cap Screws | 162 N•m (120 lb-ft) |
| Oil Pan Drain Plug: | |
| Aluminum Pans | 100 N•m (74 lb-ft) |
| Cast Iron Pans (Sumps) | 47 N•m (35 lb-ft) |
| Front Frame/Oil Sump (8000 Tractors):[b] | |
| 3/8 in. Cap Screws | 58 N•m (42 lb-ft) |
| 1/2 in. Cap Screws | 133 N•m (98 lb-ft) |

[a]For oil pans, initially tighten all 1/2-in. cap screws to 162 N•m (120 lb-ft), then,tighten all 3/8-in. cap screws to 68 N•m (50 lb-ft). Retighten all 3/8-in.cap screws to 68 N•m (50 lb-ft) and then all 1/2-in. cap screws to 162 N•m (120 lb-ft).
[b]For oil sumps on 8000 tractors, initially tighten all 1/2-inch, then all 3/8-inch screws to full torque. Finally, retighten 3/8-inch, then 1/2-inch screws to full torque.

RG,RG34710,1214 –19–23OCT97–2/2

## DIAGNOSING LUBRICATION SYSTEM MALFUNCTIONS

**LOW OIL PRESSURE:**

- Low oil level.
- Clogged cooler or filter.
- Excessive oil temperature.
- Incorrect oil.
- Oil pressure regulating valve failure.
- Excessive main or rod bearing clearance.
- Clogged oil pump screen.
- Excessive clearance between oil pump gears and cover.
- Piston cooling orifice not installed.

**HIGH OIL PRESSURE:**

- Improper oil classification.
- Clogged oil lines.
- Oil pressure regulating valve failure.

**OIL SLUDGE AND DILUTION:**

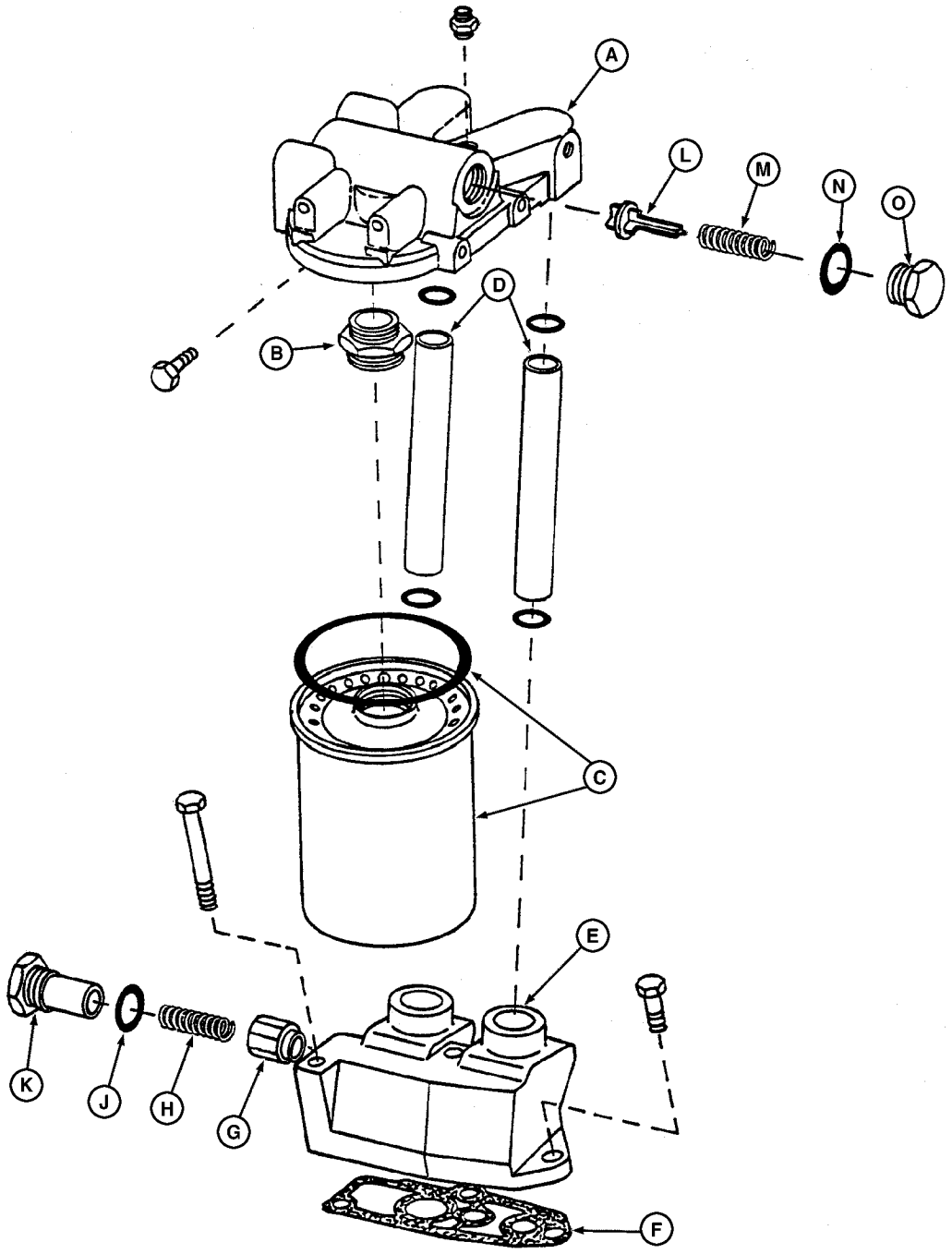
- Improper operation and servicing.
- Coolant leakage into lubrication system.
- Incomplete combustion.
- Excessive oil consumption.
- Defective injection pump (failed internal O-ring seals).

**LOW OIL PRESSURE AT SLOW IDLE:**

- Bypass oil check valve failure.

RG,RG34710,1215 –19–23OCT97–1/1

## OIL FILTER BASE AND OIL PRESSURE REGULATING VALVE HOUSING ASSEMBLY




*Oil Filter Base and Oil Pressure Regulating Valve Housing Assembly*

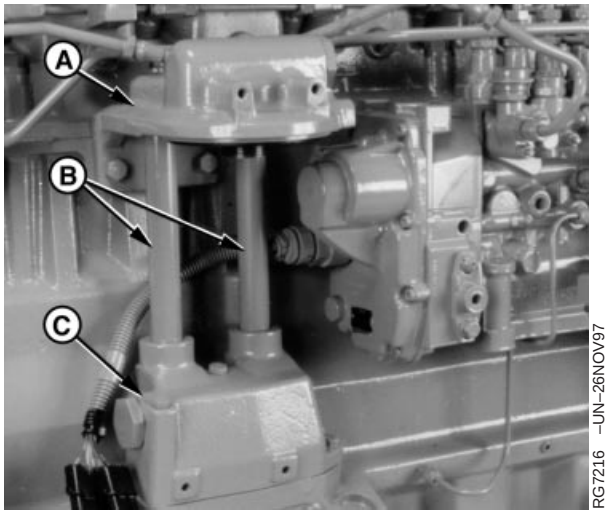
**A—Oil Filter Base**
**B—Oil Filter Adapter**
**C—Oil Filter With Packing**
**D—Oil Tubes**
**E—Oil Pressure Regulating Valve Housing**
**F—Gasket**
**G—Oil Pressure Regulating Valve**
**H—Spring**
**J—O-Ring**
**K—Plug**
**L—Oil Filter Bypass Valve**
**M—Spring**
**N—O-Ring**
**O—Plug**

RG,RG34710,1216 –19–23OCT97–1/1

## REMOVE AND INSTALL OIL FILTER BASE AND OIL PRESSURE REGULATING VALVE HOUSING

### REMOVE OIL FILTER BASE AND PRESSURE REGULATING VALVE HOUSING:

1. Disconnect turbocharger oil inlet line connector from top of oil filter base (A, shown disconnected).
2. Remove oil filter using a suitable filter wrench (shown removed).
3. Remove two cap screws securing oil filter base to cylinder block. Remove oil filter base and oil tubes (B). Remove and discard four O-rings.
4. Remove three cap screws securing oil pressure regulating valve housing (C) to cylinder block and remove housing. Clean all gasket material from both mating surfaces.




*Oil Filter Base and Regulating Valve Housing*

### INSTALL OIL FILTER BASE AND PRESSURE REGULATING VALVE HOUSING:

*NOTE: Refer to illustration on previous page.*

1. Install oil pressure regulating valve housing (E) using a new gasket. Install new, stronger-grade cap screws. Tighten new screws to 61 N•m (45 lb-ft).
2. Install new O-ring in housing O-ring bores, lubricate O-rings with clean engine oil, and install oil tubes.
3. Lubricate new O-rings with clean engine oil and install in oil filter base O-ring bores. Install base onto oil tubes.
4. Position filter base (A) on cylinder block, install cap screws, and tighten cap screws to 80 N•m (60 lb-ft).
5. Connect turbocharger oil line connector at top of filter base and tighten securely.
6. If removed, tighten valve plugs (K and O) to 100 N•m (74 lb-ft). Use new O-rings on plugs.

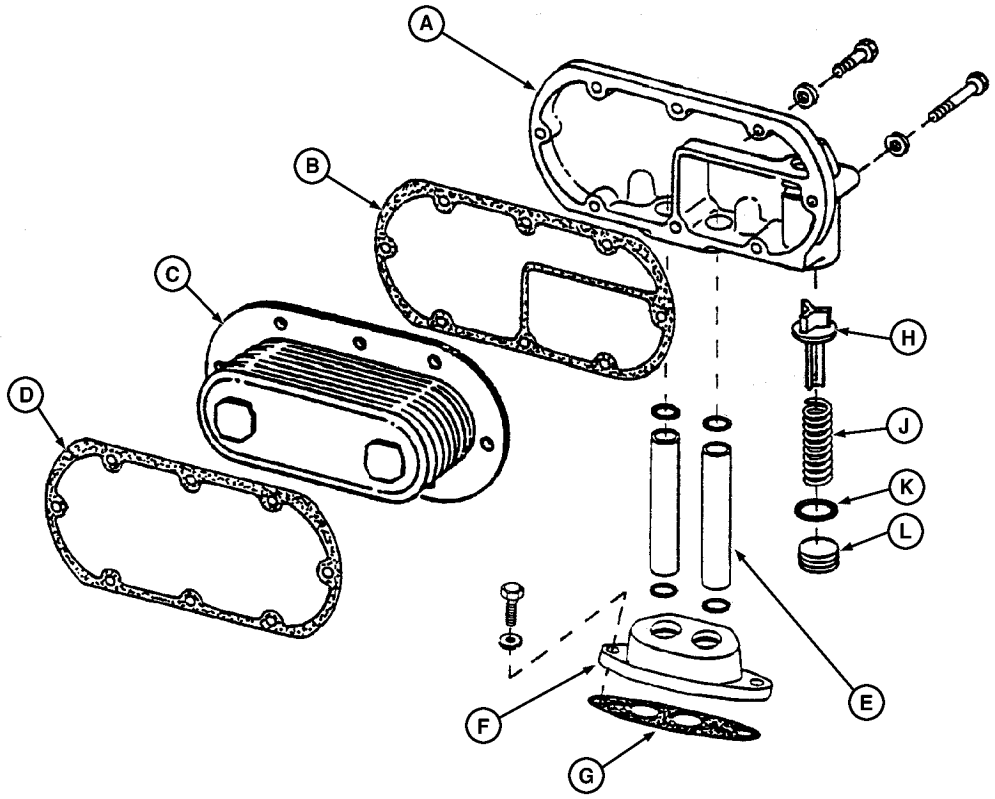
**Continued on next page**

RG,RG34710,1217 –19–23OCT97–1/2

7. Spread a layer of clean engine oil on new filter packing. Install filter and tighten until packing contacts filter base. Tighten an additional 1/2—3/4 turn after packing contacts base. DO NOT overtighten oil filter.

RG,RG34710,1217 –19–23OCT97–2/2

## ENGINE OIL COOLER ASSEMBLY




*Engine Oil Cooler Assembly*

**A—Oil Cooler Cover/Bypass Valve Housing**
**B—Cover-to-Cooler Gasket**
**C—Oil Cooler**
**D—Cooler-to-Block Gasket**
**E—Oil Cooler Tubes (2 used)**
**F—Tube Adapter**
**G—Adapter-to-Block Gasket**
**H—Oil Cooler Bypass Valve**
**J—Spring**
**K—O-Ring**
**L—Plug**

RG,RG34710,1218 –19–23OCT97–1/1

## REMOVE, INSPECT, AND INSTALL ENGINE OIL COOLER

Refer to ENGINE OIL COOLER ASSEMBLY, earlier in this group for exploded view of engine oil cooler assembly.

**REMOVE OIL COOLER ASSEMBLY:**

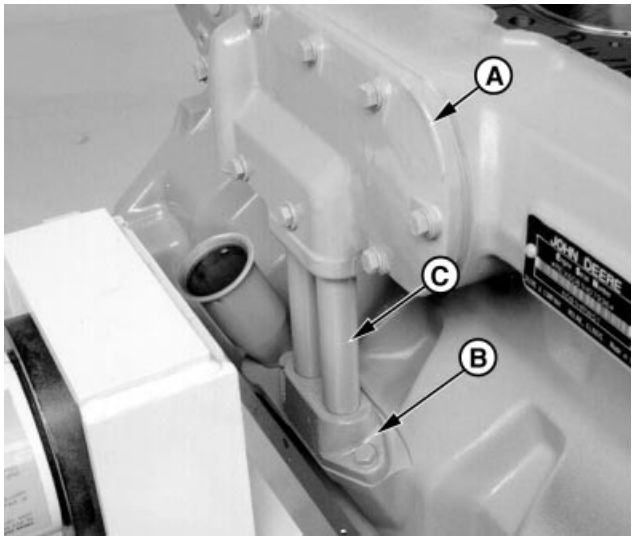
1. Remove eight cap screws securing oil cooler cover (A).
2. Remove two cap screws securing oil cooler tube adapter (B). Remove cover, tubes (C), and adapter as an assembly.
3. Remove oil cooler (D) from block bore. Clean all gasket material from mating surfaces.

**INSPECT OIL COOLER ASSEMBLY:**

1. Inspect oil cooler for physical damage, plugging, or leakage which may allow mixing of oil and coolant.
2. Back flush oil cooler to clean all debris from core.
3. Pressure test oil cooler in liquid and compressed air if mixing of oil and coolant is suspected.

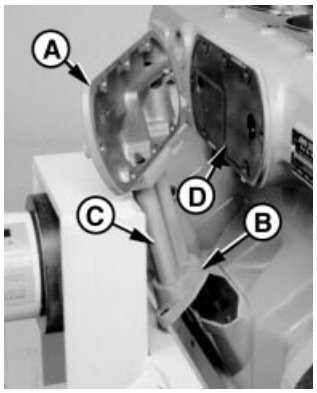
   Oil cooler should show no leakage when 140-170 kPa (1.4—1.7 bar) (20—25 psi) air pressure is applied for a minimum of 30 seconds.
4. Inspect all remaining parts of oil cooler assembly.

   Replace parts as needed. DO NOT attempt to repair oil cooler.

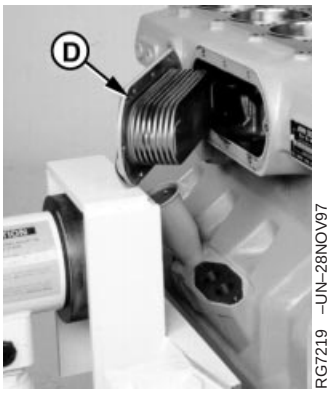



RG7217 –UN–12JAN98

*Removing Oil Cooler*




RG7218 –UN–26NOV97




RG7219 –UN–28NOV97

*Oil Cooler Removed*

**A—Oil Cooler Cover/Bypass Valve Housing**
**B—Oil Cooler Tube Adapter**
**C—Oil Cooler Tubes**
**D—Oil Cooler**

**Continued on next page**

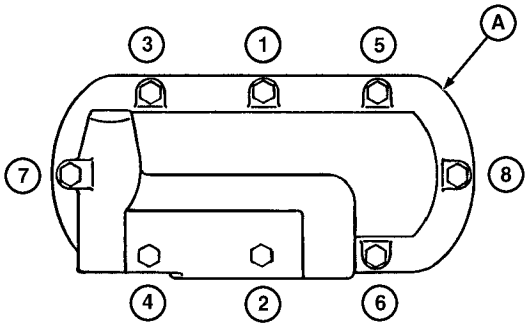
**INSTALL OIL COOLER ASSEMBLY:**

1. Install oil cooler using a new gasket on each side of cooler. Be sure gaskets are properly aligned with cap screw holes.

*NOTE: If cover, tubes, and adapter were disassembled, lubricate new O-rings with clean engine oil.*

2. Install a new gasket on cylinder block and install oil cooler cover, tubes, and adapter as an assembly. Tighten adapter cap screws to 47 N•m (35 lb-ft).

3. Tighten oil cooler cover cap screws in sequence shown (1-8). First tighten to 27 N•m (20 lb-ft). Then retighten in same sequence to final torque of 37 N•m (27 lb-ft).




*Sequence for Tightening Cover Screws*

RG,RG34710,1219 –19–23OCT97–2/2

## REMOVE, INSPECT, AND INSTALL OIL PRESSURE REGULATING VALVE, OIL FILTER BYPASS VALVE, AND OIL COOLER BYPASS VALVE

See OIL FILTER BASE AND OIL PRESSURE REGULATING VALVE HOUSING ASSEMBLY and ENGINE OIL COOLER ASSEMBLY, earlier in this group, for illustration of valves.

### OIL PRESSURE REGULATING VALVE:

1. Remove plug (K), O-ring (J), spring (H), oil pressure regulating valve (G) from housing (E). Discard O-ring.
2. Inspect valve and valve bore for damage. Replace if necessary.
3. Check spring for proper compression. Replace spring if not within specification.

**Pressure Regulating Valve Spring—Specification**

| | |
|---|---|
| Working Load | 66—74 N (15—17 lb-force) at 43.0 mm (1.69 in.) |
| Free Length | 85.0 mm (3.35 in.) |

4. Dip all parts in clean engine oil; insert valve and spring in housing.
5. Install plug (K) using a new O-ring and tighten to 100 N•m (74 lb-ft).

*NOTE: Pressure regulating valve starts to operate at 340 kPa (3.4 bar) (49 psi).*

### OIL FILTER BYPASS VALVE:

1. Remove plug (O) with O-ring (N), spring (M), and oil filter bypass valve (L) from oil filter base (A). Discard O-ring.
2. Inspect valve and housing bore for scoring or damage. Replace if necessary.
3. Check spring for proper compression. Replace spring if not within specification.

**Oil Filter Bypass Valve Spring—Specification**

| | |
|---|---|
| Working Load | 64—78 N (14—18 lb-force) at 30.0 mm (1.18 in.) |
| Free Length | 44.0 mm (1.73 in.) |

4. Dip all parts in clean engine oil; insert valve and spring in filter base.
5. Install new O-ring on plug (O). Install plug and tighten to 100 N•m (74 lb-ft).

*NOTE: Filter bypass valve operating pressure is 220 kPa (2.20 bar) (32 psi).*

### OIL COOLER BYPASS VALVE:

1. Remove plug (L), O-ring (K), spring (J), and oil cooler bypass valve (I) from oil cooler cover/bypass valve housing (A). Discard O-ring.
2. Check housing for clogged passages and all other parts for scale build-up.
3. Clean all parts with a stiff bristle brush and solvent, if necessary. Dry with compressed air.
4. Inspect bypass valve for damage. Replace if necessary.
5. Check bypass valve spring for proper specifications. Replace spring if not within specification.

**Oil Cooler Bypass Valve Spring—Specification**

| | |
|---|---|
| Working Load | 64—78 N (14—18 lb-force) at 30.0 mm (1.18 in.) |
| Free Length | 44.0 mm (1.73 in.) |

**Continued on next page**

6. Dip all parts in clean engine oil; insert valve (I) and spring (J) in housing bore.

7. Install new O-ring on plug (L) and tighten to 100 N•m (74 lb-ft).

*NOTE: Cooler bypass valve operating pressure is 220 kPa (2.20 bar) (32 psi).*

RG,RG34710,1220 –19–23OCT97–2/2

## REMOVE ENGINE FROM 8000 TRACTORS FOR ACCESS TO ENGINE OIL PUMP

6081HRW Engines used in 8000 Series Tractors are equipped with a front frame/oil sump which is also a structural member of the vehicle. For access to the engine oil pump, the engine must be removed from the vehicle. Refer to TM1575 (8100, 8200, 8300, and 8400 Tractors—Repair) for engine removal instructions. (For Tracks models, refer to TM1621.)

RG,RG34710,1221 –19–23OCT97–1/1

## REMOVE OIL PAN

Removing oil pan will allow access to engine oil pump.

1. Drain engine oil.

2. Remove oil pan and discard gasket.

3. Remove all gasket material from oil pan rail and cylinder block mounting surfaces.

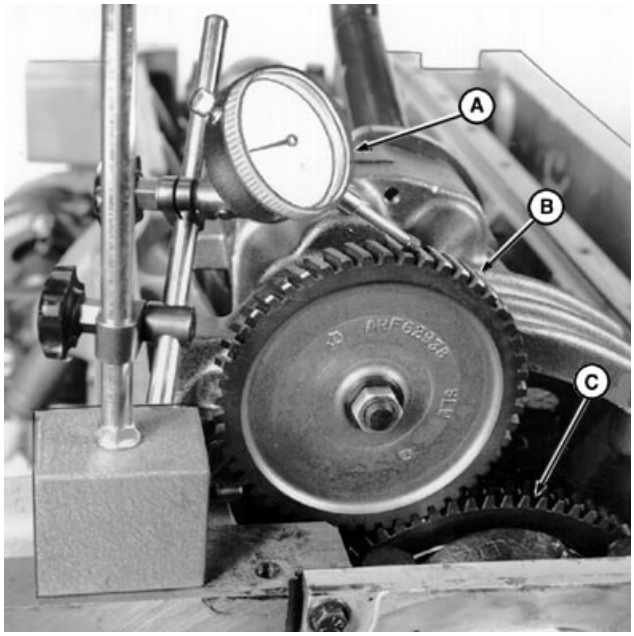
RG,RG34710,1222 –19–23OCT97–1/1

## CHECK CRANKSHAFT GEAR-TO-OIL PUMP DRIVE GEAR BACKLASH

**IMPORTANT: Backlash must be at least 0.08 mm (0.003 in.). If backlash is less than 0.08 mm (0.003 in.), replace the oil pump drive gear.**

Before removing oil pump, determine if there is adequate backlash between oil pump and crankshaft drive gears.

Mount dial indicator (A) and measure backlash between pump drive gear (B) and crankshaft gear (C).

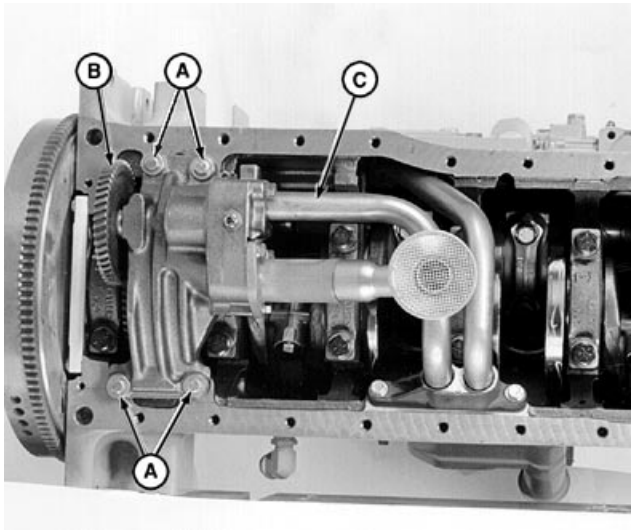



*Measuring Oil Pump Drive Gear Backlash*

RG,RG34710,1223 –19–23OCT97–1/1

## REMOVE ENGINE OIL PUMP

1. Remove four oil pump housing cap screws (A).
2. Remove oil pump assembly with drive gear (B) and oil pump outlet tube (C) attached.
3. Remove oil pump pickup tube, clean and inspect as detailed later.




*Removing Engine Oil Pump*

RG,RG34710,1224 –19–23OCT97–1/1

## INSPECT AND CLEAN OIL PUMP

1. Visually inspect oil pump for wear or damage.

**IMPORTANT: DO NOT disassemble engine oil pump for flushing, inspection, or performing wear checks. Individual components of oil pump are not available through service parts. Replace pump as a complete assembly.**

**Never hammer directly on oil pump housing as it could cause binding of gears.**

2. Flush pump assembly internally with clean solvent to remove oil. Spin pump gears to help remove solvent. *Pump gears should move freely*.

**IMPORTANT: To help insure accurate wear measurements, be sure the oil pump is clean and faces the same way as when mounted on the cylinder block.**

*NOTE: Leave pump drive gear installed when making checks.*

3. Place oil pump on a work bench with pump-to-cylinder block mounting surface facing upward (same as when mounted on engine).

RG,RG34710,1225 –19–23OCT97–1/1

## CHECK DRIVE SHAFT END PLAY

1. Mount dial indicator with indicator plunger resting against end of pump drive shaft.
2. Move shaft toward and away from indicator.

   If end play exceeds 0.15 mm (0.006 in.), there is excessive wear on pump cover and/or wear on end of pump drive gear.

   Replace oil pump if end play exceeds 0.15 mm (0.006 in.).

RG5916 –UN–05DEC97

*Checking Pump Shaft End Play*

RG,RG34710,1226 –19–23OCT97–1/1

## CHECK DRIVE SHAFT SIDE MOVEMENT

1. Mount dial indicator with indicator plunger resting on one of the hex nut flats.
2. Move shaft from side-to-side.

   If shaft side movement exceeds 0.17 mm (0.0065 in.). there is excessive wear in drive shaft bushing and/or drive shaft.

   Replace oil pump if shaft side movement exceeds 0.17 mm (0.0065 in.).

RG5917 –UN–05DEC97

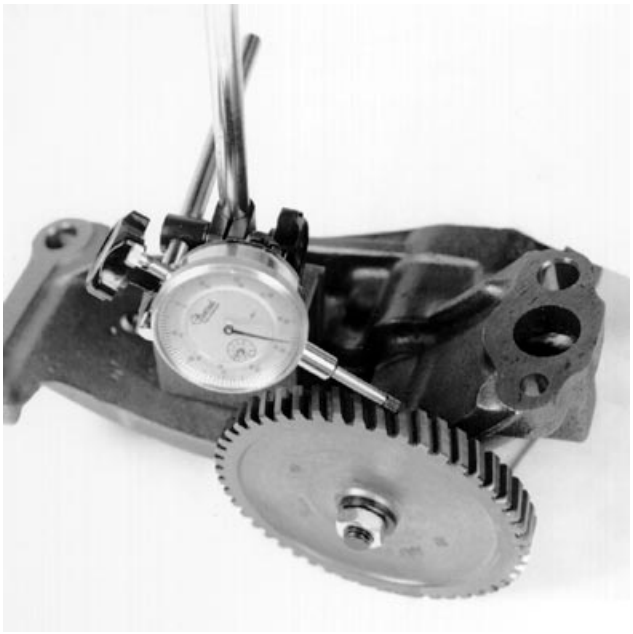
*Checking Pump Shaft Side Movement*

RG,RG34710,1227 –19–23OCT97–1/1

## CHECK PUMPING GEAR BACKLASH

1. Mount dial indicator with plunger resting against side of gear tooth.
2. Hold idler gear stationary. Slowly rotate drive gear back and forth until contact with idler gear is left.

   If backlash is not within 0.33—0.22 mm (0.013-0.079 in.) specification, there is excessive pumping gear wear and/or idler shaft and gear bushing wear. If there is less than 0.33 mm (0.013 in.) backlash, re-clean gears and check backlash again.
3. Replace oil pump if pumping gear backlash exceeds 2.00 mm (0.079 in.).



RG5918 –UN–05DEC97

*Checking Backlash of Pumping Gear*

RG,RG34710,1228 –19–23OCT97–1/1

## INSPECT OIL PUMP DRIVE GEAR

*NOTE: Oil pump does not need to be removed from engine, when inspecting drive gear.*

Inspect drive gear teeth for chips, cracks, or wear. Replace as necessary.

RG6435 –UN–05DEC97

*Inspecting Pump Drive Gear*

RG,RG34710,1229 –19–23OCT97–1/1

## ADJUST OIL PUMP SET SCREW (EARLY ENGINES)

**IMPORTANT: Normally the set screw (A) should NOT be adjusted; but if the set screw is altered, the following steps should be followed.**

1. Assemble drive gear and idler gear into pump housing.
2. Install oil pump cover (B) and tighten cover-to-housing cap screws to 41 N•m (30 lb-ft).
3. Tighten set screw until it contacts idler shaft.
4. Continue to hold set screw and tighten lock nut (C) to 8 N•m (6 lb-ft). Do not overtighten set screw or lock nut.
5. Spin drive gear by hand to assure shaft turns freely in housing. Readjust set screw if shaft does not turn freely.

RG6435 –UN–05DEC97

*Inspecting Pump Drive Gear*

RG,RG34710,1230 –19–23OCT97–1/1

## INSTALL ENGINE OIL PUMP

1. Clamp oil pump drive gear (B) in a soft-jawed vise and install drive gear onto oil pump, if removed. Tighten mounting nut to 54 N•m (40 lb-ft).

2. Using a new gasket, install oil pump intake (pickup) tube onto oil pump cover and tighten cap screws 41 N•m (30 lb-ft), if removed.

*NOTE: Lubricate new O-rings with clean engine oil when installing oil pump outlet tube (C) into oil pump and oil cooler (tube) adapter.*

3. Install oil pump-to-oil cooler adapter tube into oil cooler adapter.

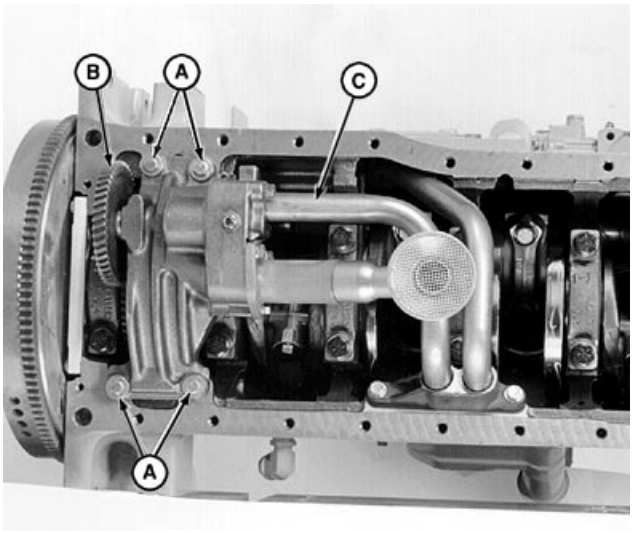
4. Install oil pump assembly on other end of oil pump-to-oil cooler adapter tube.

5. Rotate oil pump assembly into position over locating dowels in cylinder block.

**IMPORTANT: Do not hammer directly on pump housing as it could cause binding of gears.**

6. Seat pump onto dowels using a hard rubber hammer on the flanges; be sure drive gear is properly meshed with crankshaft gear and oil pump outlet tubes are properly positioned in O-ring bores.

7. Tighten oil pump housing-to-cylinder block cap screws (A) to 42 N•m (31 lb-ft).



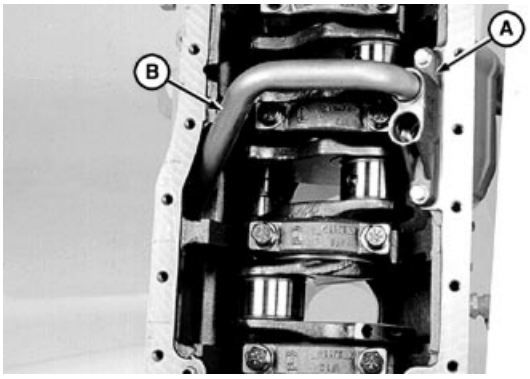

*Installing Engine Oil Pump*

RG,RG34710,1231 –19–23OCT97–1/1

## REMOVE AND INSTALL OIL PUMP OUTLET TUBE AND OIL COOLER CROSSOVER TUBE ADAPTER

**REMOVE ADAPTER:**

1. Remove oil pump (shown removed). (See REMOVE ENGINE OIL PUMP, earlier in this group.)
2. Remove two cap screws securing adapter (A) to cylinder block and remove adapter with oil cooler cross-over tube (B).
3. Clean all gasket material from mating surfaces and discard.




RG7221 –UN–05DEC97

*Oil Cooler Crossover Tube and Adapter*

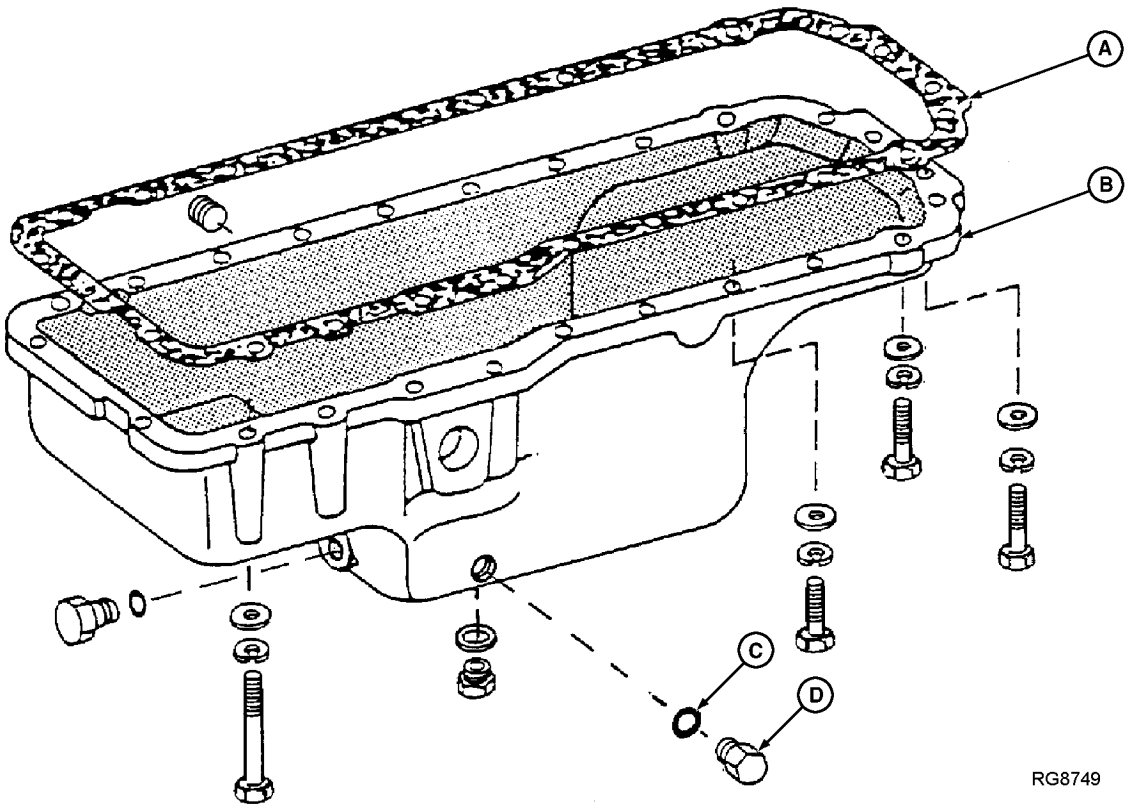
**INSTALL ADAPTER:**

*NOTE: Be sure gasket is positioned so that offset matches adapter to avoid blocking oil passages.*

1. Lubricate new O-ring with clean engine oil and install adapter (with cross-over tube) using a new gasket. Make sure tubes are properly positioned in each O-ring bore.
2. Tighten cap screws to 54 N•m (40 lb-ft).
3. Install engine oil pump assembly. (See INSTALL ENGINE OIL PUMP, earlier in this group.)

RG,RG34710,1232 –19–23OCT97–1/1

## INSTALL ENGINE OIL PAN




RG8749 –UN–08DEC97

*Installing Engine Oil Pan*

**A—Oil Pan Gasket** **B—Oil Pan** **C—O-Ring** **D—Drain Plug**

All oil pan and cylinder block (including timing gear cover and rear seal housing) gasket sealing surfaces MUST BE free of gasket material or oil, and dry.

1. Apply a thin layer of PERMATEX® Aviation (Form-A-Gasket No. 3, TY6299) at timing gear cover-to-cylinder block mating surfaces.

2. Apply a thin layer of PERMATEX® Aviation (Form-A-Gasket No. 3, TY6299) at rear oil seal housing-to-cylinder block mating surfaces.

3. Position new oil pan gasket (A) on cylinder block.

4. Apply a thin layer of PERMATEX® Aviation (Form-A-Gasket No. 3, TY6299) to gasket at same location as cylinder block in Step Nos. 1, 2 above.

*NOTE: Locate rear of oil pan flush to ± 0.05 mm (0.002 in.) with rear face of cylinder block.*

5. Carefully install oil pan (B) on cylinder block and tighten all oil pan-to-cylinder block cap screws as follows:

   a. First tighten 1/2-inch cap screws to 156 N•m (117 lb-ft).

   b. Next tighten 3/8-inch cap screws to 68 N•m (50 lb-ft).

6. Trim oil pan gasket flush at rear surface of cylinder block and oil pan.

7. Retighten all oil pan cap screws as follows:

*PERMATEX is a trademark of Loctite Corp.*

**Continued on next page**

a. First retighten 3/8-inch cap screws to 68 N•m (50 lb-ft).

b. Finally retighten all 1/2-inch cap screws to 156 N•m (117 lb-ft).

8. Install pan drain plug (D) using a new O-ring (C) and tighten to 100 N•m (74 lb-ft).

9. Some engine oil pans may be equipped with an elbow and drain hose.

*NOTE: On engines equipped with elbow fittings and drain hose, the threads and sealing surfaces must be free of any oil film to insure an effective seal. Apply a light coat of LOCTITE® 592 to fittings except for the leading one to three threads. Tighten fittings securely.*

*LOCTITE is a trademark of Loctite Corp.*

RG,RG34710,1233 –19–23OCT97–2/2

## TIGHTEN CAP SCREWS ON FRONT FRAME/OIL SUMP (8000 SERIES TRACTORS)

*NOTE: Refer to illustration on following page.*

1. Be sure all four sump-to-block locating dowels are in place.

**IMPORTANT: DO NOT apply gasket sealant to gasket, front frame/oil sump, trimmed edges of timing gear cover gasket, oil seal housing gasket, or cylinder block mating surfaces. Before installing engine, be sure mating surfaces of engine and front frame/oil sump are clean and dry.**

2. Install front frame/oil sump-to-cylinder block gasket.

3. Carefully lower engine block onto front frame/oil sump locating dowels.

4. Install all 3/8 in. and 1/2 in. cap screws in their appropriate locations as shown by A-F.

5. Tighten all 1/2 in. cap screws to 133 N•m (98 lb-ft). Tighten all 3/8 in. cap screws to 58 N•m (43 lb-ft).

6. Re-tighten all 3/8 in. cap screws to 58 N•m (43 lb-ft). Re-tighten all 1/2 in. cap screws to 133 N•m (98 lb-ft).

7. Apply clean engine oil to new O-ring for bottom drain plug and install drain plug, if removed. Tighten plug to 47 N•m (35 lb-ft).

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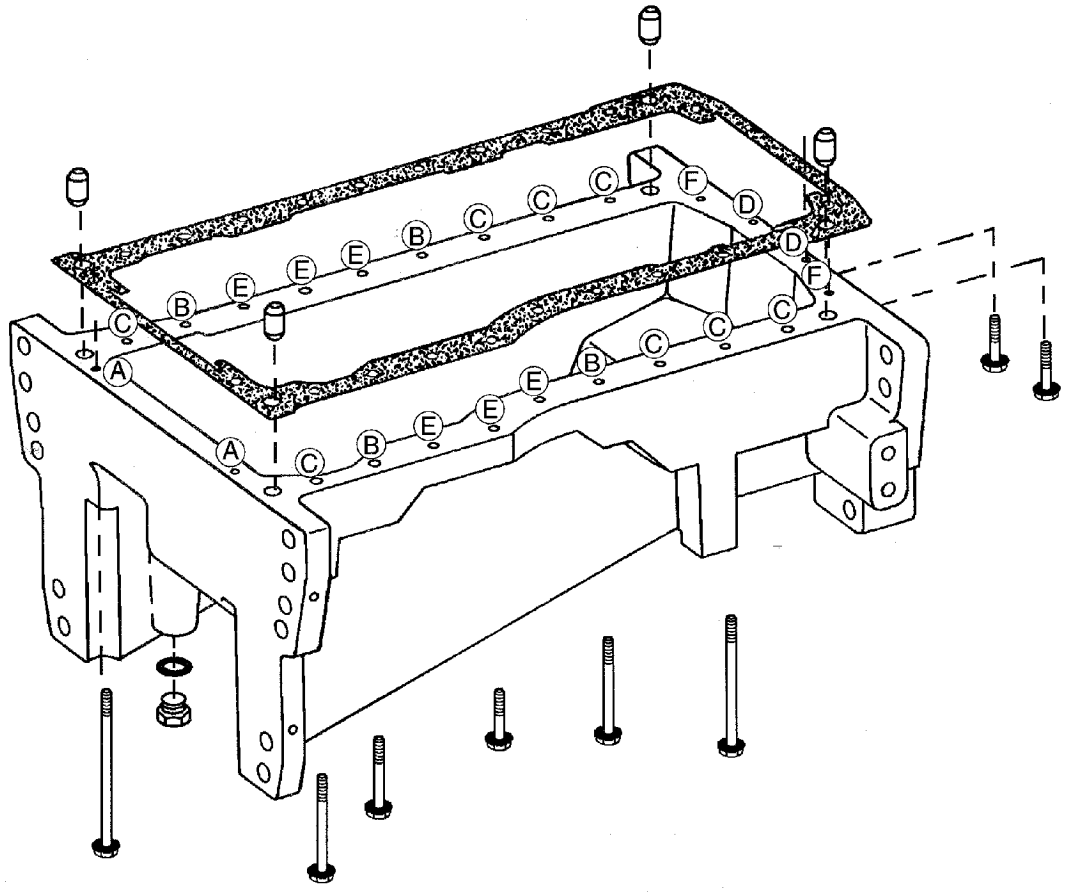



*Front Frame/Oil Pump for 8000 Tractors*

**A—0.3775 x 7.500 in. (2 used)**
**B—0.500 x 4.000 in. (4 used)**
**C—0.500 x 6.000 in. (8 used)**
**D—0.375 x 2.250 in. (2 used)**
**E—0.500 x 2.500 in. (6 used)**
**F—0.375 x 1.875 in. (2 used)**

*NOTE: Refer to TM1575 (8000 Tractors—Repair) for engine installation instructions after servicing engine oil pump assembly. (For Tracks models, refer to TM1621.)*

RG,RG34710,1234 –19–23OCT97–2/2

# Cooling System

## SPECIAL OR ESSENTIAL TOOLS

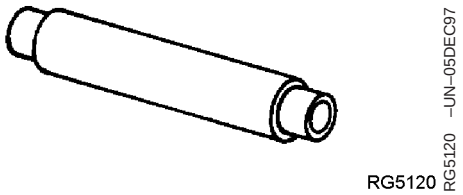
*NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC).*

*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1235 –19–23OCT97–1/2

Water Bypass Tube Seal Driver . . . . . JDG908

Used to install bypass tube seal in water pump cover.




*JDG908*

RG,RG34710,1235 –19–23OCT97–2/2

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| T43512 (U.S.)<br>TY9473 (Canadian)<br>242 (LOCTITE®) | Thread Lock and Sealer (Medium Strength) | Water manifold-to-cylinder head cap screws. |
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | Water pump and block drain valves. |
| TY6333 or TY6345 (U.S.) | High-Temperature Grease | Fan drive bearings. |

*LOCTITE is a trademark of Loctite Corp.*

RG,RG34710,1236 –19–23OCT97–1/1

## COOLING SYSTEM SPECIFICATIONS

| ITEM | SPECIFICATION |
|---|---|
| Thermostat Opening Temperature: | |
| 82°C (180°F) Thermostats (2 Used) | 80—84°C (175—182°F) |
| Adjustable Fan Drive Shaft End Play | 0.10 mm (0.004 in.) |
| Adjustable Fan Drive Housing Seal Depth | Flush-to-0.50 mm (0.020 in.) below housing face |
| Fixed Fan Drive Bearing Shaft Depth | 33.31—33.57 mm (1.311—1.322 in.) below manifold face |
| **TORQUES** | |
| Fan Hub/Pulley-to-Fan Shaft | 80 N•m (60 lb-ft) |
| Fan Hub/Pulley-to-Fan Spacer (If Equipped) | 60 N•m (45 lb-ft) |
| Fan-to-Fan Hub/Pulley | 47 N•m (35 lb-ft) |
| Fan Drive Support Plate-To-Engine: | |
| 5/16 in. Cap Screws | 27 N•m (20 lb-ft) |
| 3/8 in. Cap Screws | 47 N•m (35 lb-ft) |
| Water Manifold-to-Cylinder Head | 35 N•m (25 lb-ft) |
| Thermostat Cover-to-Water Manifold | 47 N•m (35 lb-ft) |
| Water Pump Cover-To-Timing Gear Cover: | |
| 5/16 in. Cap Screws | 27 N•m (20 lb-ft) |
| 3/8 in. Cap Screws | 47 N•m (35 lb-ft) |
| Water Pump Drain Valve-to-Water Pump Cover | 27 N•m (20 lb-ft) |

RG,RG34710,1237 –19–23OCT97–1/1

## DIAGNOSING COOLING SYSTEM MALFUNCTIONS

**ENGINE OVERHEATS:**

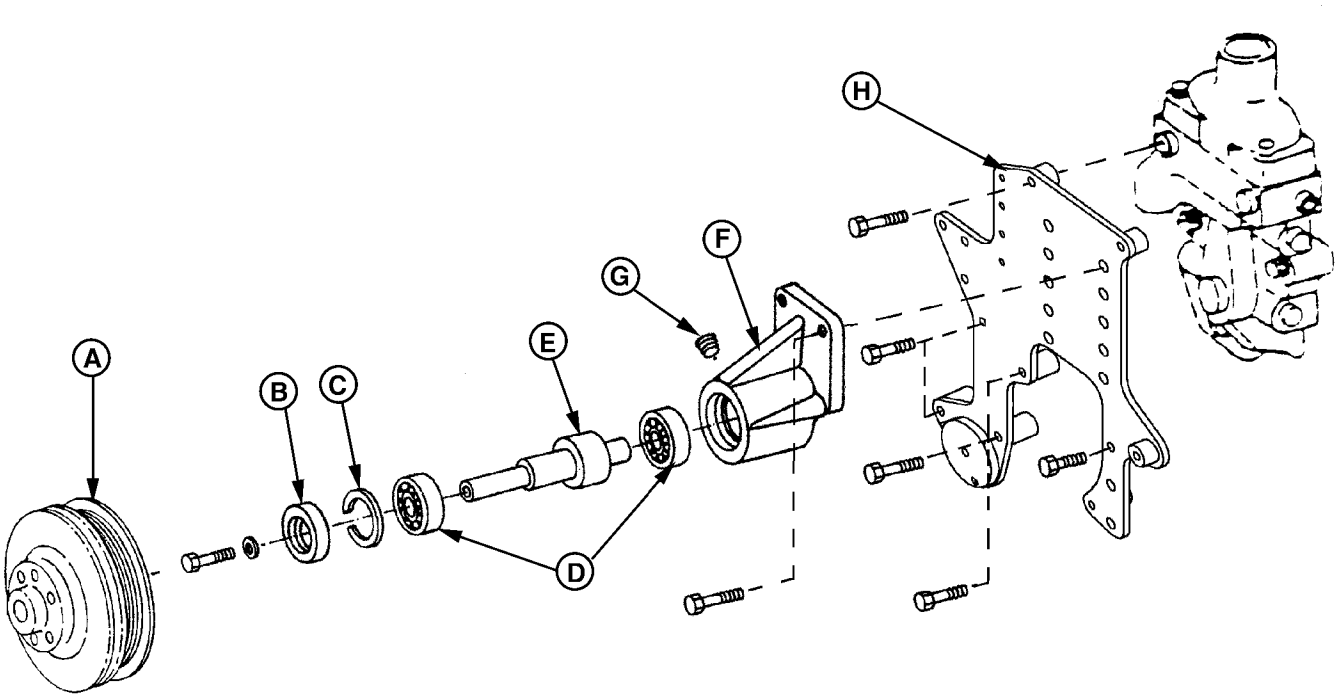
- Loose or broken fan belt
- Dirty radiator
- Low coolant level
- Low oil level
- Engine overloaded
- Defective head gasket
- Incorrect timing (engine/injection pump)
- Faulty thermostats
- Faulty water pump
- Corroded coolant passages
- Improper grade of fuel
- Excessive fuel delivery

**LOW COOLANT LEVEL:**

- Improper maintenance
- Improper operation
- Damaged radiator
- Water pump seal leakage
- Leakage
- Faulty radiator cap

RG,RG34710,1238 –19–23OCT97–1/1

## REPLACE BEARINGS IN HEAVY-DUTY, ADJUSTABLE FAN DRIVE ASSEMBLY




*Heavy-Duty Adjustable Fan Drive Assembly*

**A—Fan Hub/Pulley**
**B—Grease Seal**
**C—Snap Ring**
**D—Ball Bearing (2 Used)**
**E—Shaft**
**F—Bearing Housing**
**G—Pipe Plug**
**H—Support Plate**

**TO DISASSEMBLE FAN DRIVE:**

1. Remove belts and remove fan. Remove fan drive assembly from engine.
2. Clamp fan hub/pulley (A) in a soft-jawed vise. Support fan hub (so it does not fall to floor), and remove cap screw securing hub to shaft (E). Remove fan hub.
3. Remove pipe plug (G), grease seal (B), and snap ring (C). Discard seal and snap ring.
4. Remove shaft with bearings (D) by lightly tapping with a rubber mallet or brass hammer.
5. Remove bearings from shaft using a press and discard bearings.
6. Thoroughly clean and inspect shaft and bearing housing (F) for cracks or any other damage.

Measure parts and compare with specifications given below.

**Adjustable Fan Drive Housing—Specification**

| | |
|---|---|
| ID | 71.999—72.025 mm (2.8346—2.8356 in.) |

**Adjustable Fan Drive Shaft—Specification**

| | |
|---|---|
| OD | 35.001—35.017 mm (1.3780—1.3786 in.) |

**Adjustable Fan Drive Bearing—Specification**

| | |
|---|---|
| ID | 34.987—35.013 mm (1.3774—1.3785 in.) |
| OD | 71.987—72.013 mm (2.8341—2.8351 in.) |

**Continued on next page**

RG,RG34710,1239 –19–23OCT97–1/4

*Cooling System*

Replace parts that are cracked or not within specification.

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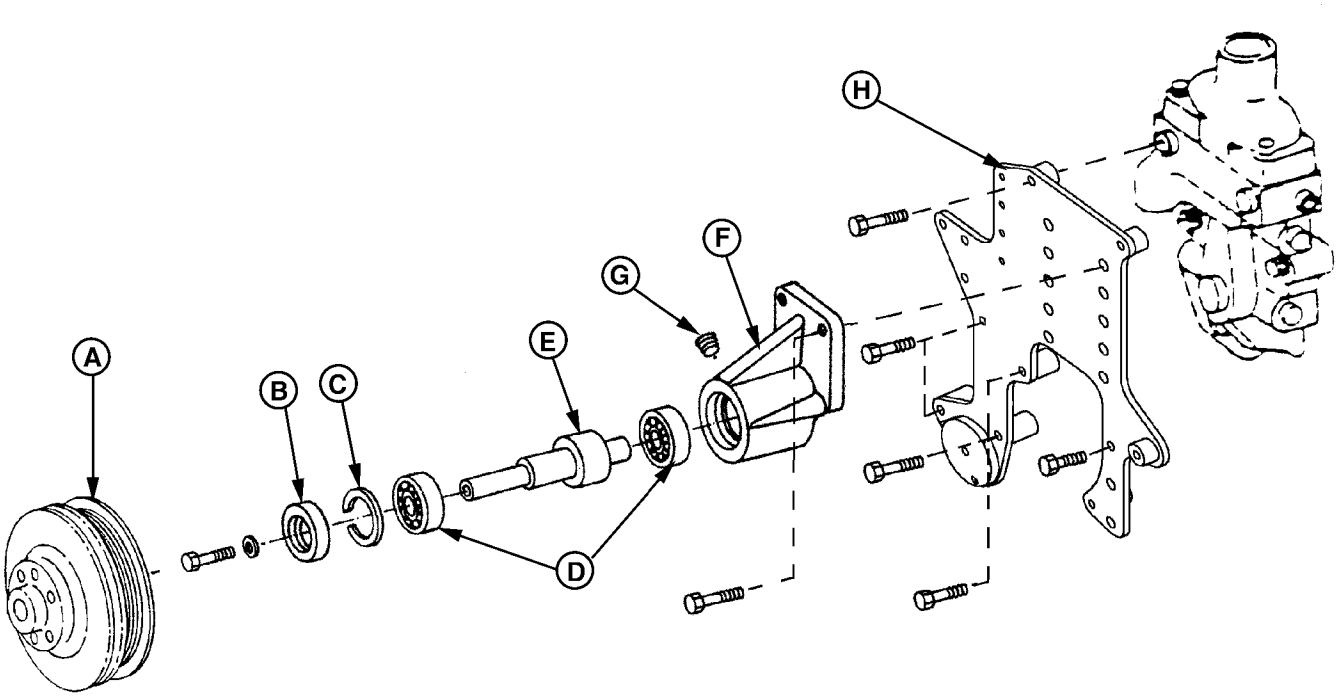
RG,RG34710,1239 –19–23OCT97–2/4




RG8754 –UN–02DEC97

*Heavy-Duty Adjustable Fan Drive Assembly*

**A—Fan Hub/Pulley**
**B—Grease Seal**
**C—Snap Ring**
**D—Ball Bearing (2 Used)**
**E—Shaft**
**F—Bearing Housing**
**G—Pipe Plug**
**H—Support Plate**

**TO ASSEMBLE FAN DRIVE:**

1. Pack inner and outer bearings (D) with TY6333 or TY6347 High Temperature Grease. Apply clean engine oil to bearing I.D. and shaft O.D.
2. Support end of shaft (E) and install bearings against shoulder. *Apply force to bearing inner race only*.
3. Support bearing housing (F) on a firm flat surface with bearing bore in the upward position.
4. Install bearing and shaft assembly into housing. Small end of shaft should extend through housing.
5. Determine proper snap ring (C) thickness needed to obtain 0.10 mm (0.004 in.) end play.
6. Install snap ring in housing groove. Visually inspect snap ring installation for proper seating in housing groove.
7. Apply a thin coat of clean engine oil to O.D. of seal casing (B) and to seal lips. Install seal in housing bore until metal casing is flush-to-0.50 mm (0.020 in.) below housing face.
8. Apply clean engine oil to I.D. of fan hub/pulley (A). Support end of shaft through pipe plug hole in bearing housing and push onto other end of shaft until it bottoms against shoulder.
9. Install washer and cap screw. Tighten cap screw to 80 N•m (60 lb-ft).

**Continued on next page**

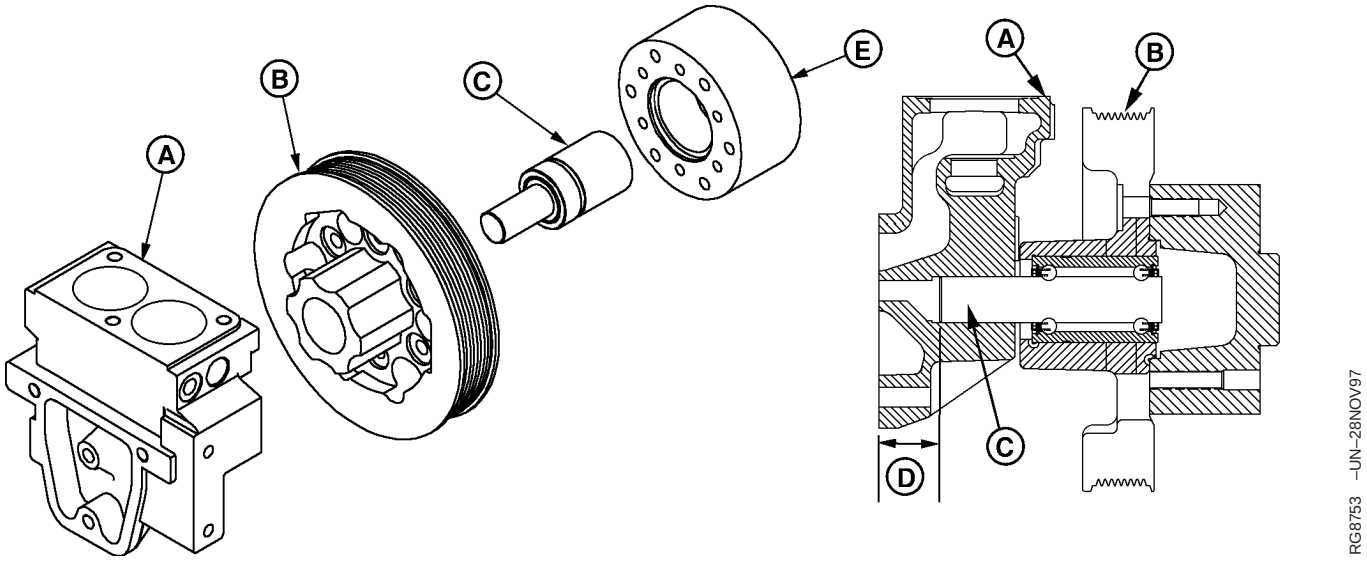
RG,RG34710,1239 –19–23OCT97–3/4

10. Apply LOCTITE® 592 Pipe Sealant to threads of pipe plug (G). Install and tighten plug in bearing housing.
11. Install fan drive assembly onto support plate (H).
12. Install support plate assembly onto engine and tighten 5/16-in. mounting cap screws to 27 N•m (20 lb-ft) and all 3/8-in. cap screws to 47 N•m (35 lb-ft).
13. Install fan and belts and adjust tension (see operator's manual).

*LOCTITE is a trademark of Loctite Corp.*

RG,RG34710,1239 –19–23OCT97–4/4

## REPLACE BEARINGS IN WATER MANIFOLD-MOUNTED, FIXED FAN DRIVE ASSEMBLY




*Fixed Fan Drive Assembly*

**A—Water Manifold**
**B—Fan Pulley**
**C—Bearing Shaft**
**D—Bearing Shaft Installed Dimension**
**E—Fan Spacer Hub[1]**

**TO DISASSEMBLE FAN DRIVE:**

1. Remove three water manifold-to-cylinder head cap screws. Remove water manifold (A) and fan pulley (B) assembly from cylinder head and lift to dislodge water bypass pipe from manifold.

2. Support front face of water manifold and use a press to push bearing (C) and pulley out of manifold.

3. Support front face of fan pulley and push bearing out of pulley, and fan spacer (if equipped). Discard bearing.

4. Thoroughly inspect water manifold and pulley for cracks or damage. Measure parts and compare readings with specifications shown. Replace parts as necessary.

**IMPORTANT: Support fan pulley on a flat, firm surface and press only on bearing outer race to prevent damage to the bearing.**

5. Install new bearing into pulley until outer race bottoms in bore of pulley. End of shaft will extend through bearing stop.

**Fixed Fan Drive Shaft—Specification**

| | |
|---|---|
| OD | 25.387—25.400 mm (0.9995—1.0000 in.) |

**Fixed Fan Drive Bearing—Specification**

| | |
|---|---|
| OD | 47.612—47.625 mm (1.8745—1.8750 in.) |

**Fixed Fan Drive Pulley (Bearing End)—Specification**

| | |
|---|---|
| ID | 47.576—47.612 mm (1.8731—1.8745 in.) |

*[1]In some applications, bearing is pressed into hub (E). The fan spacer and pulley are then bolted to hub. In some applications, the fan spacer is press-fit into the pulley. Dimension (D) is the same for all applications.*

**Continued on next page**

RG,RG34710,1240 –19–23OCT97–1/2

**Fixed Fan Drive Pulley (Fan Spacer End)[2]—Specification**

ID ..... 49.485—49.518 mm (1.9482—1.9495 in.)

**Fan Spacer[2]—Specification**

O.D..... 49.457—49.483 mm (1.9471—1.9481 in.)

**Fixed Fan Drive Manifold—Specification**

I.D. ..... 25.336—25.362 mm (0.9975—0.9985 in.)

**Fixed Fan Drive Shaft (Installed)—Specification**

Dimension ..... 33.31—33.57 mm (1.311—1.322 in.) from manifold mounting face-to-end of shaft

**TO ASSEMBLE FAN DRIVE:**

**IMPORTANT: Support water manifold on machined surface and press only on inner shaft to prevent damage to bearing.**

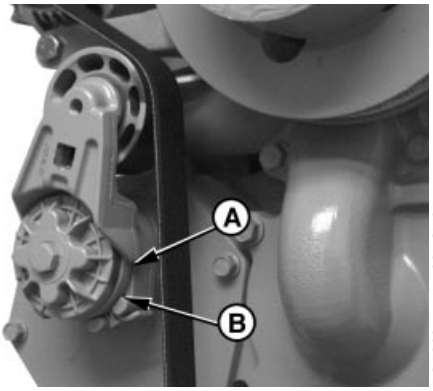
1. On units with a press-fit fan spacer, press spacer (E) into pulley (B) flush to 0.5 mm (0.020 in.) below front face of pulley.
2. Press bearing shaft (C) into water manifold (A). End of shaft should be 33.31—33.57 mm (1.311—1.322 in.) (D) from manifold mounting surface. Hold water manifold firmly and turn fan pulley by hand to be sure bearings rotate freely.
3. Install a new gasket and O-rings. Insert water bypass pipe in manifold and install assembly onto locating pin in front face of cylinder head. Tighten cap screws to 60 N•m 45 (lb-ft).
4. Install fan and belts. Refer to appropriate operator's manual for proper belt tensioning.

*[2]Units with press-fit fan spacer only.*

RG,RG34710,1240 –19–23OCT97–2/2

## CHECKING BELT TENSIONER SPRING TENSION AND BELT WEAR

Belt drive systems equipped with automatic (spring) belt tensioners cannot be adjusted or repaired. The automatic belt tensioner is designed to maintain proper belt tension over the life of the belt. If tensioner spring tension is not within specification, replace tensioner assembly.




*Belt Tensioner*

### CHECKING BELT WEAR

The belt tensioner is designed to operate within the limit of arm movement provided by the cast stops (A and B) when correct belt length and geometry is used.

Visually inspect cast stops (A and B) on belt tensioner assembly.

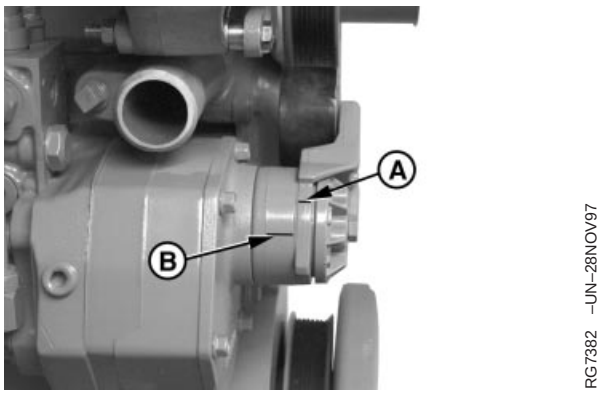
If the tensioner stop on swing arm (A) is hitting the fixed stop (B), check mounting brackets (alternator, belt tensioner, idler pulley, etc.) and the belt length. Replace belt as needed (see operator's manual).

RG,RG34710,1241 –19–23OCT97–1/3

### CHECKING TENSIONER SPRING TENSION:

A belt tension gauge will not give an accurate measure of the belt tension when automatic spring tensioner is used. Measure tensioner spring tension using a torque wrench and procedure outlined below:

1. Release tension on belt using a long-handle 1/2-in. breaker bar in tension arm. Remove belt from pulleys.
2. Release tension on tension arm and remove breaker bar.
3. Put a mark (A) on swing arm of tensioner as shown.
4. Measure 21 mm (0.83 in.) from (A) and put a mark (B) on tensioner mounting base.




*Checking Belt Tensioner*

**Continued on next page**

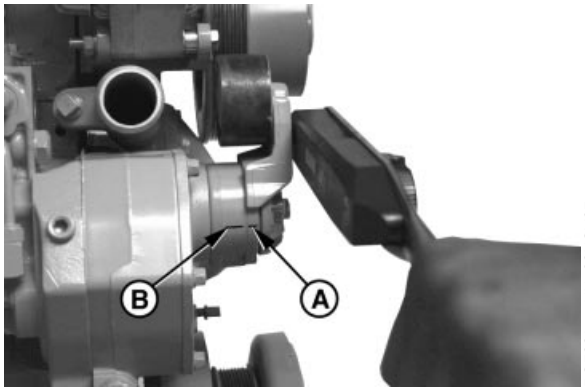
RG,RG34710,1241 –19–23OCT97–2/3

5. Rotate the swing arm using a torque wrench until marks (A and B) are aligned.

6. Record torque wrench measurement and compare with specification below. Replace tensioner assembly as required.

**Spring—Specification**

Tension ..... 24-28 N•m (17-21 lb-ft)




*Measuring Belt Tensioner*

RG,RG34710,1241 –19–23OCT97–3/3

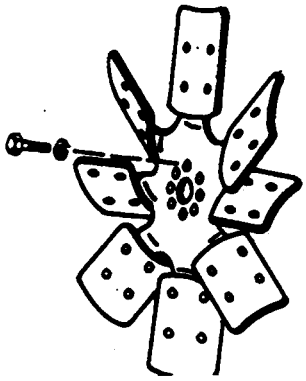
## INSPECT AND INSTALL FAN ASSEMBLY

Several fan drive ratios are available, allowing a closer matching of fan speed to application.

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 spacer hub. Tighten cap screws (with lock washers) to 47 N•m (35 lb-ft).




*Fan Assembly*

RG,RG34710,1242 –19–23OCT97–1/1

## VISUALLY INSPECT WATER PUMP

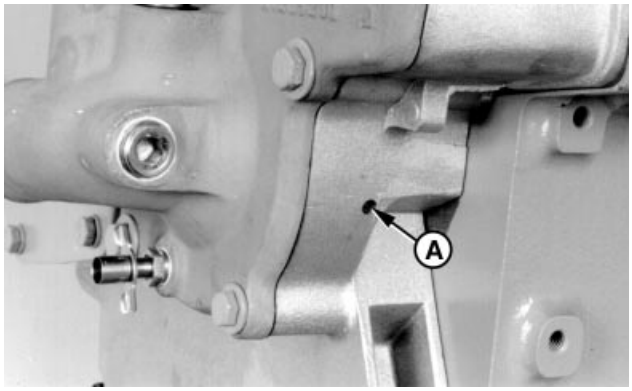
**INSPECT WEEP HOLE:**

Inspect water pump weep hole (A) in timing gear cover for oil or coolant leakage.

Oil leakage indicates a damaged rear seal.

Coolant leakage indicates a damaged front seal.

Replace complete water pump assembly if leakage is detected; individual repair parts are not available.




*Water Pump Weep Hole*

**INSPECT FOR IMPELLER CONTACT WITH COVER:**

1. Remove radiator-to-water pump hose from water pump inlet elbow.
2. Using a flashlight, inspect I.D. of water pump cover for internal impeller contact.

   Impeller contact with cover usually indicates that impeller has moved on shaft or there is a damaged bearing.

   Replace water pump assembly and cover as necessary if impeller contact is detected.

RG,RG34710,1243 –19–23OCT97–1/1

## REMOVE WATER PUMP ASSEMBLY

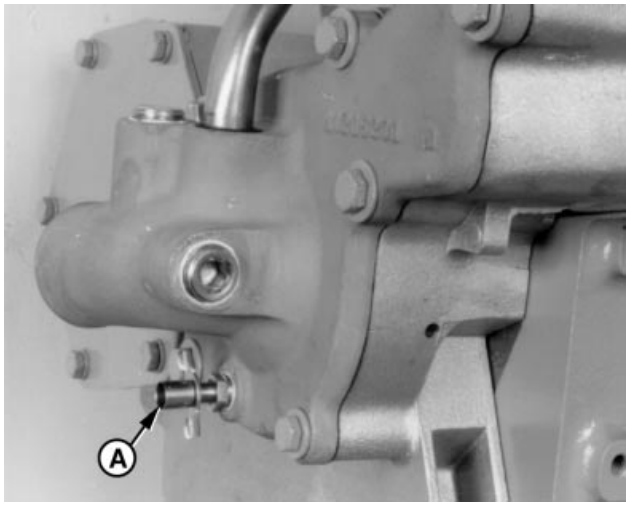
The water pump should be removed from the timing gear cover for replacement purpose only. There are no service parts available to repair water pump, replace as a complete assembly.

**Continued on next page**

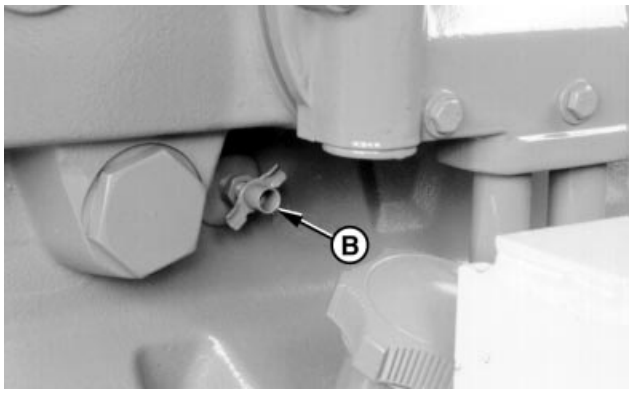
RG,RG34710,1244 –19–23OCT97–1/4

**CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Wait until engine coolant is cool enough to touch with bare hands before draining. Slowly loosen radiator cap to first stop to relieve pressure.**

1. Open water pump drain valve (A) and block drain valve (B) to drain coolant from engine.




*Water Pump Drain Valve*



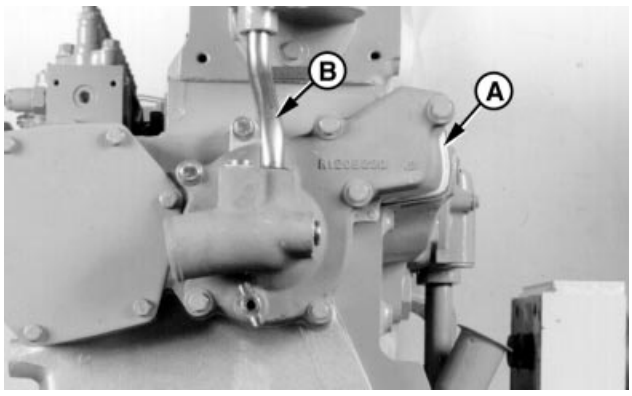

*Cylinder Block Drain Valve*

RG,RG34710,1244 –19–23OCT97–2/4

2. Remove hose from water pump cover inlet elbow, shown removed.

3. Remove six cap screws securing water pump cover (A) to timing gear cover and remove water pump cover with bypass tube (B).

4. Remove gasket from timing gear cover and discard. Remove bypass tube from cover. Inspect bypass tube seal in water pump cover, replace seal as needed. (See REPLACE BYPASS TUBE SEAL IN WATER PUMP COVER, later in this group.)



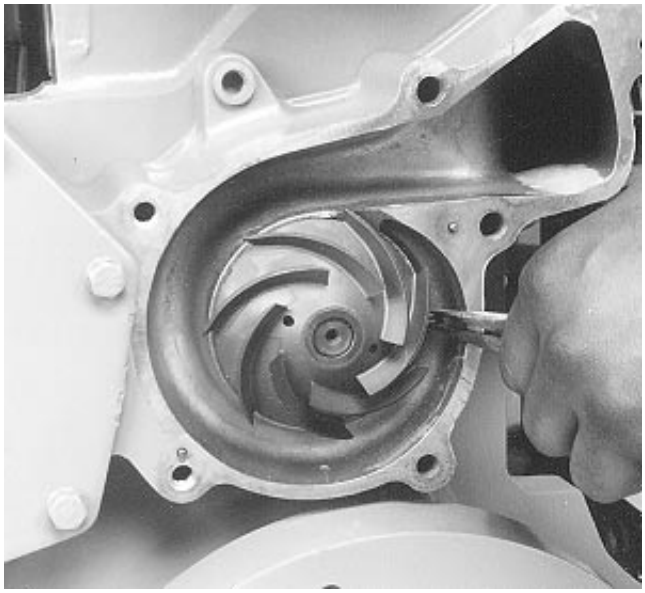

*Removing Water Pump Cover*

**Continued on next page**

RG,RG34710,1244 –19–23OCT97–3/4

5. Compress retaining ring ends with a small needle-nose pliers as shown.

6. Grasp impeller with a large pliers and pull water pump from timing gear cover using a slight rocking motion until assembly is removed from timing gear cover. Discard water pump assembly.




*Removing Water Pump*

RG,RG34710,1244 –19–23OCT97–4/4

## INSTALL WATER PUMP ASSEMBLY

1. Thoroughly clean and inspect water pump mounting bore in timing gear cover before installing pump assembly.

2. Install two new O-rings (A) in rear grooves of water pump housing and apply a light coat of clean engine oil to O-rings.

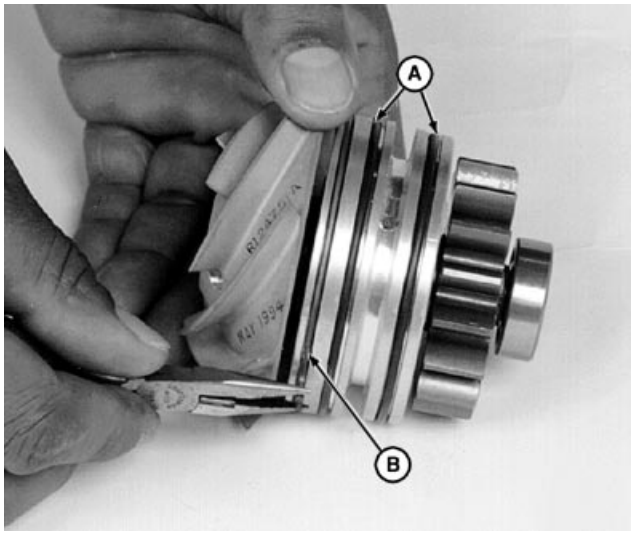
3. Install a new retaining ring (B) in front (smallest) groove of water pump housing and compress both ends of retaining ring together with a small needle-nose pliers.

*NOTE: Retaining ring ends should be at 3 o'clock position and water pump weep hole should align with hole in timing gear cover when installing water pump assembly.*

4. Compress retaining ring ends and install water pump assembly into pilot bore of timing gear cover. Make sure that pump drive gear properly meshes with crankshaft gear.

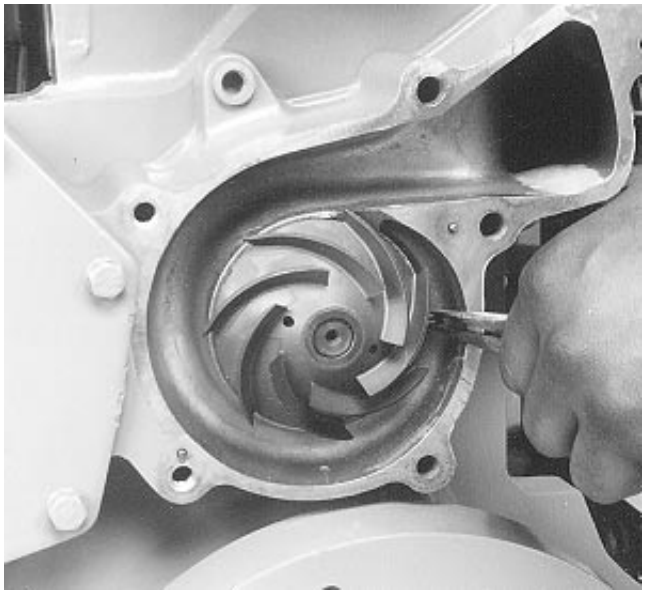
5. Release retaining ring ends and verify that retaining ring is firmly seated in groove of timing gear cover.

6. Install water pump cover with bypass tube using a new gasket. Tighten all 3/8-in. cap screws to 47 N•m (35 lb-ft) and all 5/16-in. cap screws to 27 N•m (20 lb-ft).




RG7227 –UN–05DEC97

*Assembling Water Pump*



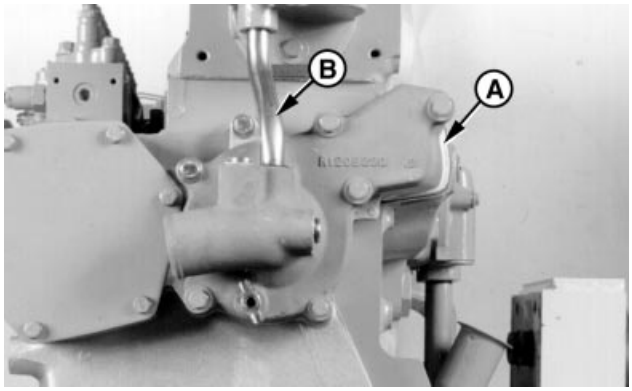
RG7062 –UN–07SEP94

*Installing Water Pump*

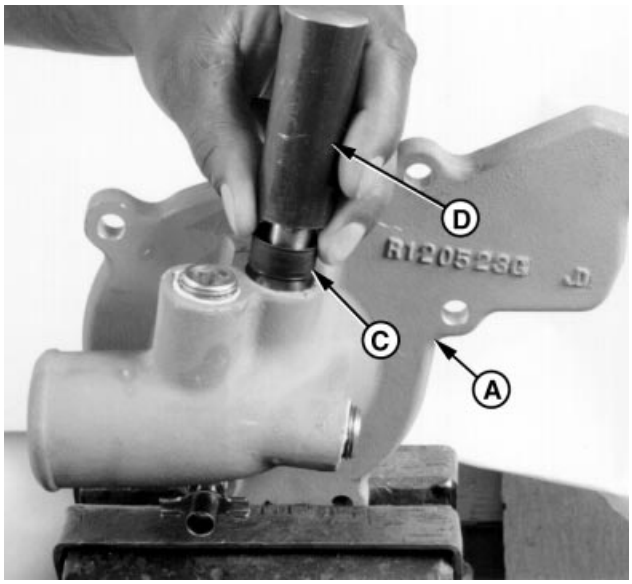
RG,RG34710,1245 –19–23OCT97–1/1

## REPLACE BYPASS TUBE SEAL IN WATER PUMP COVER

1. Drain cooling system and remove water pump cover (A) with bypass tube (B). Discard cover gasket.
2. Carefully clamp cover in a soft-jawed vise and remove bypass tube seal. Be careful not to damage machined gasket surface of cover.
3. Install new seal (C) using JDG908 Seal Driver (D). Drive seal into bore until driver bottoms.
4. Remove cover from vise and inspect seal installation and also machined gasket surfaces.




*Bypass Tube in Water Pump Cover*




*Installing Bypass Tube Seal*

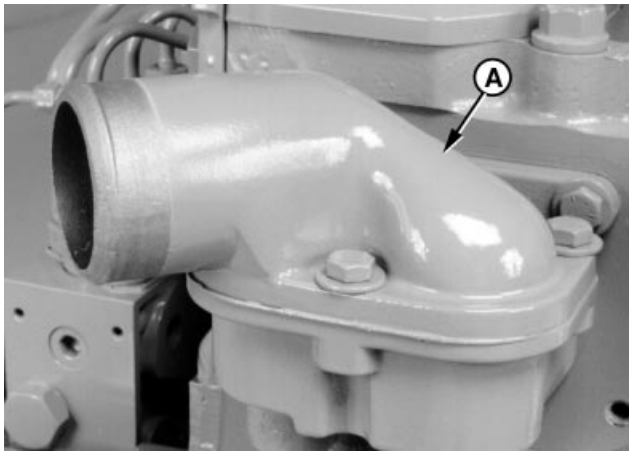
**A—Water Pump Cover**
**B—Bypass Tube**
**C—Bypass Tube Seal**
**D—JDG908 Seal Driver**

RG,RG34710,1246 –19–23OCT97–1/1

## REMOVE AND TEST 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 the area around the water manifold for leaks. Partially drain coolant from the cooling system.
2. Remove thermostat cover (A) with gasket. Remove and discard all gasket material.




*Removing Thermostat Cover*

RG,RG34710,1247 –19–23OCT97–1/2

3. Remove thermostats.
4. Inspect thermostats for debris or damage, and test each thermostat using an approved testing procedure. See INSPECT THERMOSTAT AND TEST THERMOSTAT OPENING TERMPERATURE in Group 105 for testing procedure. Thermostats should start to open within the range specified below.

**82°C (180°F) Thermostat—Specification**

| | |
|---|---|
| Opening Temperature | 80—84°C (175—182°F) |

If either thermostat fails to open within this range, replace both thermostats as a set.


*Removing Thermostats*

RG,RG34710,1247 –19–23OCT97–2/2

## INSTALL THERMOSTATS

**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 when all the air has been expelled.**

*NOTE: Install thermostats in groove in housing first. Then install gasket after thermostat is properly seated in grooves.*

1. Install thermostats. Install a new gasket on housing.
2. Install cover and tighten cap screws to 47 N•m (35 lb-ft).

RG6967 –UN–28JUL94

*Installing Thermostats*

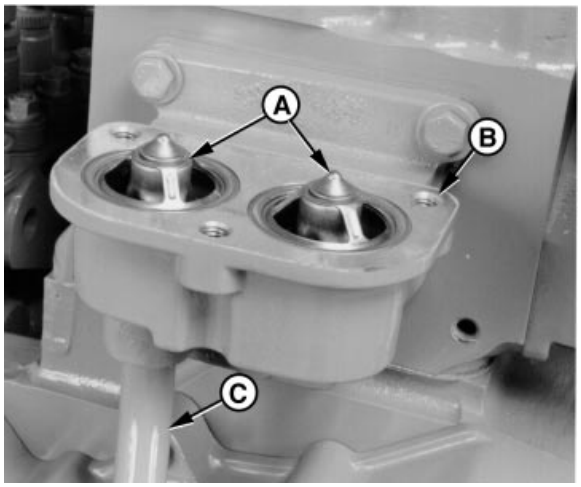
RG,RG34710,1248 –19–23OCT97–1/1

## REMOVE WATER MANIFOLD

1. Drain coolant and remove thermostat cover from water manifold (shown removed). Remove thermostats (A).
2. Remove three water manifold-to-cylinder head cap screw, remove water manifold (B) and dislodge water bypass tube as manifold is removed.

*NOTE: Pull water manifold straight out (toward front of engine) approximately 6.35 mm (0.25 in.) to disengage from locator (spring) pin, then lift straight up to disengage from bypass tube (C).*

3. Remove and discard O-ring from bore of water manifold.



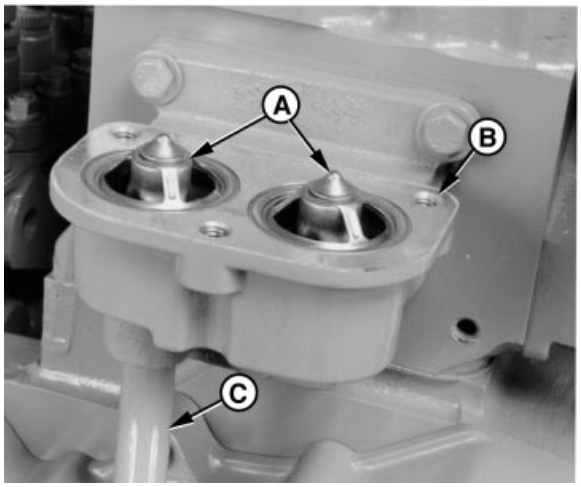

RG6968 –UN–26NOV97

*Removing Water Manifold*

RG,RG34710,1249 –19–23OCT97–1/1

## INSTALL WATER MANIFOLD

1. Install a new O-ring into water manifold O-ring bore. Lubricate O-ring with grease to ease bypass pipe installation. Install bypass pipe (C) into bore of water manifold (B). Be careful not to cut O-ring.
2. Install water manifold assembly. Be sure water manifold is properly positioned on spring pin (in front face of cylinder head) and that bypass pipe is fully seated in water manifold and water pump cover bores.
3. Apply LOCTITE® 242 Thread Sealer to water manifold-to-cylinder head cap screw threads 360 degrees (except for the leading one to three threads). Tighten water manifold cap screws to 35 N•m (25 lb-ft).
4. Install thermostats and cover. (See INSTALL THERMOSTATS, earlier in this group.)




*Installing Water Manifold*

*LOCTITE is a trademark of Loctite Corp.*

RG,RG34710,1250 –19–23OCT97–1/1

## SERVICING OF ENGINE COOLANT HEATER

Refer to CTM67, Engine Accessories, Group 25, for service of the block-type engine coolant heater.

RG,RG34710,1251 –19–23OCT97–1/1

## COMPLETE FINAL ASSEMBLY

*NOTE: Consult your engine operator's manual or see Group 02 of this CTM for coolant recommendations in your area.*

1. Fill cooling system to proper level with the proper coolant.
2. Start engine and run for several minutes to check for leaks in the cooling system.
3. After fan belts cool, check belt tension as detailed in your operator's manual.

RG,RG34710,1252 –19–23OCT97–1/1

# Air Intake and Exhaust System

## SPECIAL OR ESSENTIAL TOOLS

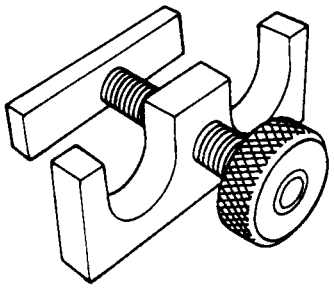
*NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC).*

*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1253 –19–23OCT97–1/2

Sealing Ring Compression Tool . . . . . JDG683

Used to compress aftercooler sealing ring for cover-to-intake manifold alignment during assembly (6081A engines).



RG5571 –UN–04JUL89

*JDG683*

RG,RG34710,1253 –19–23OCT97–2/2

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| PT569 (U.S.)<br>TY6332 (Canadian) | NEVER-SEEZ® Anti-Seize Lubricant | Turbocharger-to-exhaust manifold cap screws, and aftercooler cover-to-intake manifold cap screws. |
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | Turbocharger oil supply and drain lines. |

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

RG,RG34710,1254 –19–23OCT97–1/1

# AIR INTAKE AND EXHAUST SYSTEM SPECIFICATIONS

| ITEM | SPECIFICATION |
|---|---|
| Turbocharger Total Indicator Reading Limits: | |
| Radial Bearing Clearance | 0.13— 0.18 mm (0.005—0.007 in.) |
| Bearing/Shaft Axial End Play | 0.064—0.114 mm (0.0025—0.0045 in.) |
| **TORQUES** | |
| Compressor Housing-to-Backplate | 7—8 N•m (60—70 lb-in.) |
| Turbine Housing-to-Center Housing | 15—16 N•m (135—145 lb-in.) |
| Turbocharger-to-Exhaust Manifold | 24 N•m (18 lb-ft) |
| Turbocharger Oil Return Line | 34 N•m (25 lb-ft) |
| Exhaust Manifold-to-Cylinder Head | 47 N•m (35 lb-ft) |
| Intake Manifold-to-Cylinder Head | 47 N•m (35 lb-ft) |
| Aftercooler Cover-to-Intake Manifold | 34 N•m (25 lb-ft) |

RG,RG34710,1255 –19–23OCT97–1/1

## EXTENDING TURBOCHARGER LIFE

Turbochargers are designed to last the life of the engine, but, because they operate at such high speeds (100,000 rpm or more); a moment's carelessness can cause them to fail in seconds.

**The major causes of turbocharger failures are:**

- **Lack of Lube Oil (Quick Starts and Hot Shutdowns)**
- **Oil Contamination**
- **Ingestion of Foreign Objects**
- **Restricted Oil Drainage**
- **Low Oil Level**
- **Operation on Excessive Side Slopes**
- **Abnormally High Exhaust Temperatures**

### LACK OF LUBE OIL

Oil not only lubricates the turbocharger's spinning shaft and bearings, it also carries away heat. When oil flow stops or is reduced, heat is immediately transferred from the hot turbine wheel to the bearings, which are also heating up because of the increased friction due to the lack of oil. This combination causes the turbocharger shaft temperature to increase rapidly.

If oil flow does not increase and the process continues, bearings will fail. Once the bearings fail (which can happen in just seconds) seals, shaft, turbine and compressor wheels can also be damaged.

The principle causes of turbocharger bearing lubrication problems are low oil pressure, a bent, plugged or undersized oil lube supply line, plugged or restricted oil galleries in the turbocharger, or improper machine start-up and shutdown procedure.

Oil levels and pressure should always be closely monitored and all worn hoses and lines should be replaced. The turbocharger oil supply line should be checked frequently to make sure it is not kinked or bent and it should always be replaced with a line of equal size, length and strength.

The easiest way to damage a turbocharger is through improper start-up and shutdown procedures. Always idle the engine for at least 30 seconds (no load) after start-up and before shutdown. Warming the engine up before applying a load allows oil pressure to build up and lines to fill with oil.

Idling the engine before shutdown allows the engine and turbocharger to cool. "Hot" shutdowns can cause the turbocharger to fail because after high-speed operation the turbocharger will continue to rotate long after the engine has been shut off and oil pressure has dropped to zero. This will cause heat to build up and possibly damage bearing. It can also cause carbon and varnish deposits to form.

### OIL CONTAMINATION

A second cause of turbocharger failures is contaminated oil. It can be caused by a worn or damaged oil filter or not changing the lube oil at recommended intervals. Expecting the oil filter to remove dirt, sand, metal chips, etc. from the oil before they reach the engine or turbocharger can be a costly mistake because contaminated oil may completely bypass the engine oil filter if the oil filter or oil cooler is clogged, if the filter element is improperly installed, or if the oil is thick during cold weather.

Four good ways of avoiding oil contamination are:

Always inspect the engine thoroughly during major overhaul. Look especially for any sludge or debris left in lube oil galleries.

Change lube oil at recommended intervals. Analysis of oil samples at filter change periods can help identify potentially harmful contaminants in the oil.

Clean the area around the oil fill cap before adding oil.

Use a clean container when adding oil.

**Continued on next page**

**INGESTION OF FOREIGN OBJECTS**

The third cause of turbocharger damage is the ingestion of foreign objects. These particles can be ingested and cause damage to the turbocharger on both compressor and turbine sides. This is easy to avoid.

On the compressor side, foreign objects usually take the form of dust, sand, or shreds of air cleaner element that enter through improperly installed air cleaner elements. Leaky air inlet piping (loose clamps or torn rubber joints) or torn pleats in dry-type air cleaner elements also create problems.

The result is erosion of compressor blades that can cause the delicately balanced wheel to wobble.

**IMPORTANT: Whenever an internal engine failure (valve, valve seat, piston) occurs, a thorough inspection of the turbocharger MUST BE performed before returning engine to service.**

**RESTRICTED OIL DRAINAGE**

A fourth cause of turbocharger damage is restricted lube oil drainage. The lubricating oil carries away heat generated by friction of the bearings and from the hot exhaust gases. If drainage back to the sump is impeded, the bearings will overheat with damage that will ultimately lead to failure.

There are two primary reasons for restricted drainage. A blocked drain tube, due to either damage or a buildup of sludged oil, or high crankcase pressure, which can be due to restricted crankcase breather or excessive engine blowby.

Periodically check both the turbocharger oil drain tube and engine breather tube for damage or restriction. Correction of these conditions leads to longer turbocharger life.

**ABNORMALLY HIGH EXHAUST TEMPERATURES**

A fifth cause of turbocharger damage is abnormally high exhaust temperatures. Elevated exhaust temperatures cause coking of oil which can lead to bearing failure. Extreme over-temperature operation can cause wheel burst.

There are two basic causes of over-temperature. The first is restricted air flow and the second is overpowering the engine. In either case the engine has more fuel than available air for proper combustion; this overfueled condition leads to elevated exhaust temperatures.

Causes of restricted air flow can include damaged inlet piping, clogged air filters, excessive exhaust restriction, or operation at extreme altitudes. Overpowering generally is due to improper fuel delivery or injection timing. If overtemperature operation has been identified, an inspection of the air inlet and exhaust systems should be performed. Also, check the fuel delivery and timing.

RG,RG34710,1256 –19–23OCT97–2/2

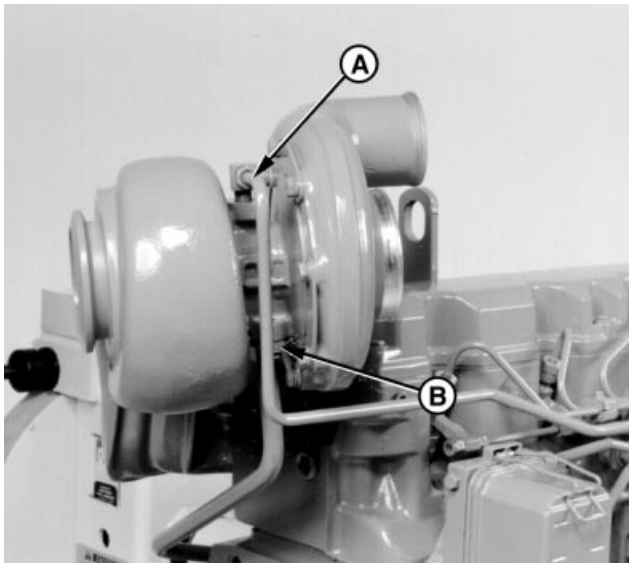
## REMOVE TURBOCHARGER

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

**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.)**

Thoroughly clean exterior of turbocharger and surrounding area to prevent entry of dirt into the air intake system during removal.

1. Disconnect air intake and exhaust piping from turbocharger (shown disconnected).
2. Disconnect turbocharger oil inlet line (A) from elbow adapter.
3. Disconnect turbocharger oil return (drain) tube (B). Remove and discard gasket.
4. If equipped, disconnect wastegate diaphragm hose.
5. Remove four turbocharger mounting cap screws with washers securing turbocharger to rear exhaust manifold and remove turbocharger.
6. Cap or plug all openings on engine (exhaust and intake manifold related) and place turbocharger on a clean flat table for inspection.
7. Perform turbocharger seven-step inspection, as described later, if failure mode has not been determined.




*Removing Turbocharger*

RG,RG34710,1257 –19–23OCT97–1/1

## TURBOCHARGER FAILURE ANALYSIS

The following is a guide for diagnosing the cause of turbocharger failures after removal from the engine.

**Continued on next page**

RG,RG34710,1258 –19–23OCT97–1/3

| Problem | Possible Cause | Suggested Remedy |
|---|---|---|
| **COMPRESSOR HOUSING INLET DEFECTS** | | |
| Foreign Object Damage | Objects left in intake system. | Disassemble and inspect intake system for foreign objects (this group).<br>Inspect engine for internal damage. |
| | Leaking and/or defective intake system. | Inspect air intake system connections including air filter; repair as required (this group).<br>Inspect air intake related engine components. |
| Compressor Wheel Rub | Bearing failure. | Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required. |
| | Manufacturing defects. | Correct as required. |
| **COMPRESSOR HOUSING OUTLET DEFECTS** | | |
| Oil and/or Dirt in Housing | Restricted air intake system. | 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** | | |
| 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.<br>Check engine for overfueling.<br>Check injection pump timing. |
| **TURBINE HOUSING OUTLET DEFECTS** | | |
| Turbine Wheel Rub | Bearing failure. | Determine if engine and/or operator contributed to lack of lubrication, contaminated lubrication, excessive temperature, or debris generating engine failure in progress. Correct as required. |
| | Manufacturing defect. | Correct as required (this group). |
| Foreign Object Damage | Internal engine failure. | Inspect and repair engine as required. |
| | Objects left in intake system. | Disassemble and inspect air intake system (this group). |
| | Leaking air intake system. | Correct as required (this group). |

**Continued on next page**

| Problem | Possible Cause | Suggested Remedy |
|---|---|---|
| Oil and/or Excessive Carbon | Internal engine failure.<br>Turbine seal failure. | Verified by oil in turbine housing. Correct as required.<br>Inspect for excessive heat from overfueling and/or restricted air intake. |
| | Prolonged periods of low rpm engine idling. | Ask operator to run engine under load or at a higher rpm (See Operator's Manual). |
| | Restricted oil drain line. | Inspect and clear oil drain line as required. |
| **EXTERNAL CENTER HOUSING AND JOINT DEFECTS** | | |
| Leaks from Casting | Defective casting.<br>Defective gasket. | Replace turbocharger (this group).<br>Verify if leaks are occurring at gasket joints. |
| Leaks from Joints | Loose attaching screws.<br>Defective gasket. | Tighten to specifications in CTM (this group).<br>Inspect and repair as required. |
| **INTERNAL CENTER HOUSING DEFECTS** | | |
| Excessive Carbon Build-Up in Housing or on Shaft | Hot engine shutdown. | Review proper operation with operator as shown in operator's manual. |
| | Excessive operating temperature. | Restricted air intake; overfueling or mistimed engine. |
| | Restricted oil drain line. | Inspect and clean oil drain lines as required. |
| | Operating engine at high speeds and loads immediately after start-up. | Idle engine for a few minutes to allow oil to reach bearings before applying heavy loads. |

RG,RG34710,1258 –19–23OCT97–3/3

## TURBOCHARGER SEVEN-STEP INSPECTION

The following inspection procedure is recommended for systematic failure analysis of a suspected failed turbocharger. This procedure will help to identify when a turbocharger has failed, and why it has failed so the primary cause of the failure can be corrected.

Proper diagnosis of a non-failed turbocharger is important for two reasons. First, identification of a non-failed turbocharger will lead to further investigation and repair of the cause of a performance complaint.

Second, proper diagnosis eliminates the unnecessary expense incurred when a non-failed turbocharger is replaced.

The seven recommended inspection steps, which are explained in detail on following pages, are:

- Compressor Housing Inlet and Compressor Wheel.
- Compressor Housing Outlet.
- Turbine Housing Inlet.
- Turbine Housing Outlet and Turbine Wheel.
- External Center Housing and Joints.
- Internal Center Housing.
- Turbocharger Bench Test.

**Continued on next page**

RG,RG34710,1259 –19–23OCT97–1/13

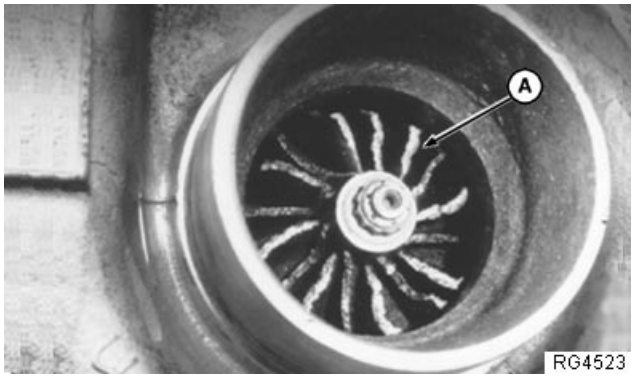
*NOTE: To enhance the turbocharger inspection, an inspection sheet (Form No. DF-2280 available from Distribution Service Center—English only) can be used that lists the inspection steps in the proper order and shows potential failure modes for each step. Check off each step as you complete the inspection 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 damage.*

2. Mark findings on your checklist and continue the inspection.

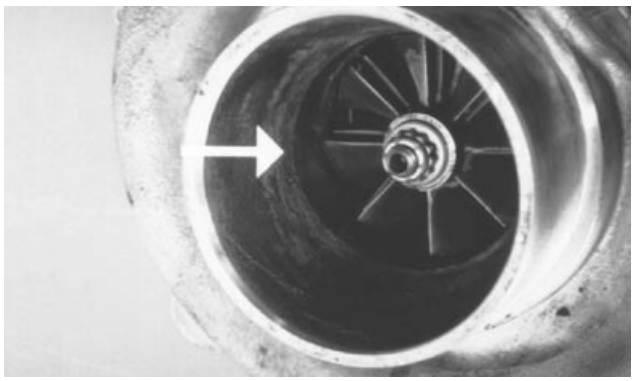



*Checking Inlet and Compressor Wheel*

RG,RG34710,1259 –19–23OCT97–2/13

*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.




*Checking Compressor Inlet*

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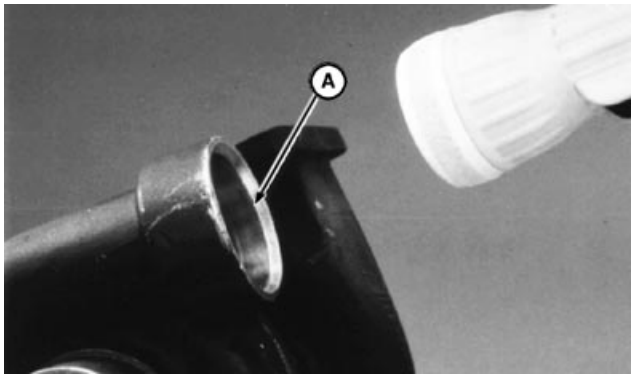
RG,RG34710,1259 –19–23OCT97–3/13

**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.



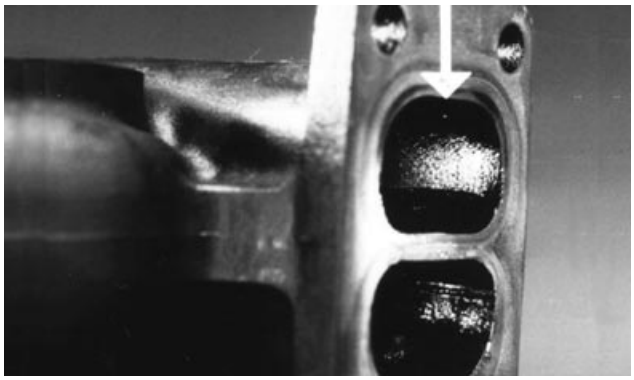

*Checking Compressor Outlet*

RG,RG34710,1259 –19–23OCT97–4/13

**TURBINE HOUSING INLET**

Check the turbine housing inlet ports (arrow) for oil in housing, excessive carbon deposit or erosion of center walls.

*NOTE: If the inlet is wet with oil, or has excessive carbon deposits, an engine problem is likely. Center wall erosion (cracking or missing pieces), indicate excessive exhaust temperature.*



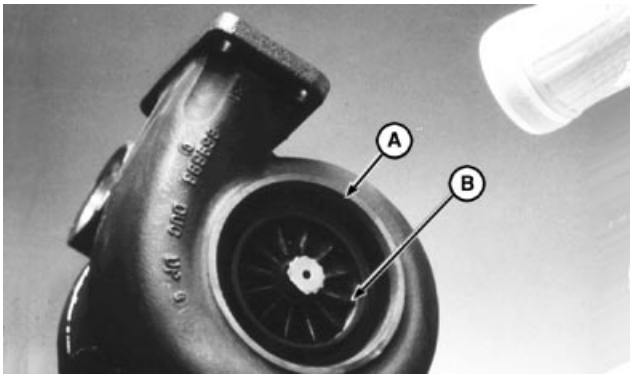

*Checking Turbine Housing Inlet Ports*

**Continued on next page**

RG,RG34710,1259 –19–23OCT97–5/13

**TURBINE HOUSING OUTLET AND TURBINE WHEEL**

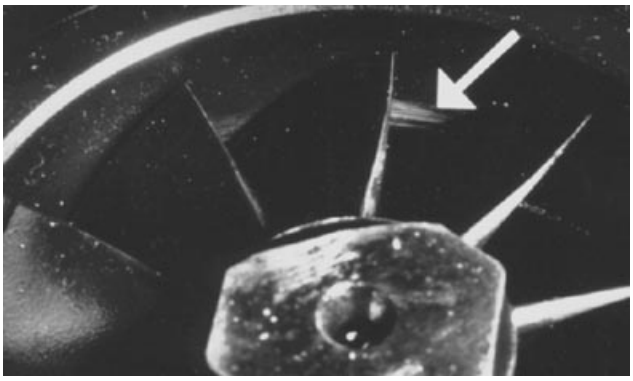
1. Use a flashlight to look up inside the turbine housing outlet (A) and check blades (B) for foreign object damage.




*Checking Turbine Wheel and Outlet*

RG,RG34710,1259 –19–23OCT97–6/13

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.




*Checking Turbine Wheel Blades*

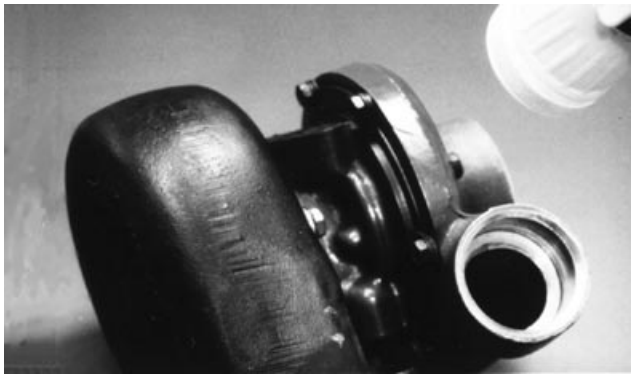
**Continued on next page**

RG,RG34710,1259 –19–23OCT97–7/13

## 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.*



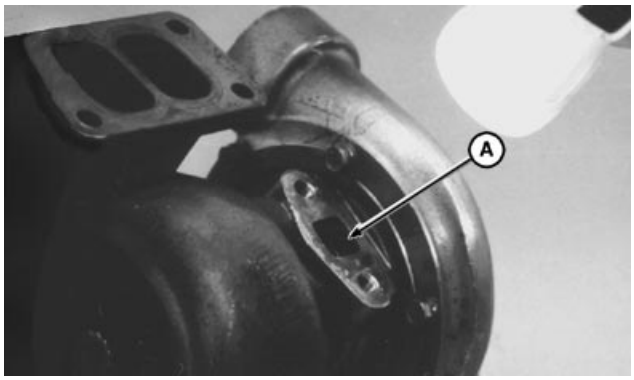
RG4529 –UN–05DEC97

*Checking Center Housing*

RG,RG34710,1259 –19–23OCT97–8/13

## 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.



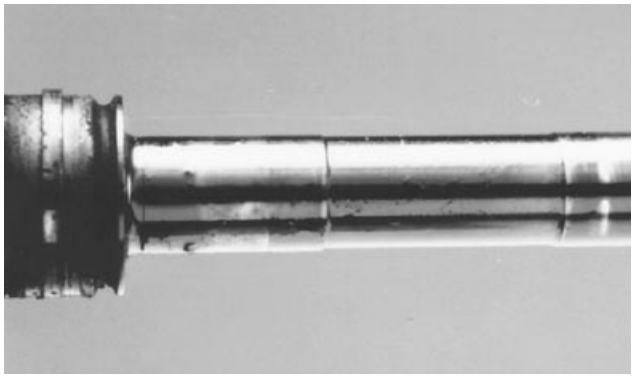

RG4530 –UN–05DEC97

*Checking Shaft and Bearings*

**Continued on next page**

RG,RG34710,1259 –19–23OCT97–9/13

2. Excessive “blueing” or “coking” of oil along the complete length of the shaft (A) indicates a possible lack of lubrication caused by an engine failure, or improper operation, such as hot shutdowns.



RG4531 –UN–05DEC97

*Checking for Oil “Coking” on Shaft*

RG,RG34710,1259 –19–23OCT97–10/13

**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

*Checking Shaft Rotation and Clearance*

**Continued on next page**

RG,RG34710,1259 –19–23OCT97–11/13

**IMPORTANT: Use only moderate hand force (3-4 pounds) on each end of shaft.**

3. Next, pull up on the compressor end of the shaft and press down on the turbine end while rotating shaft. Neither the compressor wheel nor the turbine wheel should contact the housing at any point.

*NOTE: There will be some "play" because the bearings inside the center housing are free floating.*

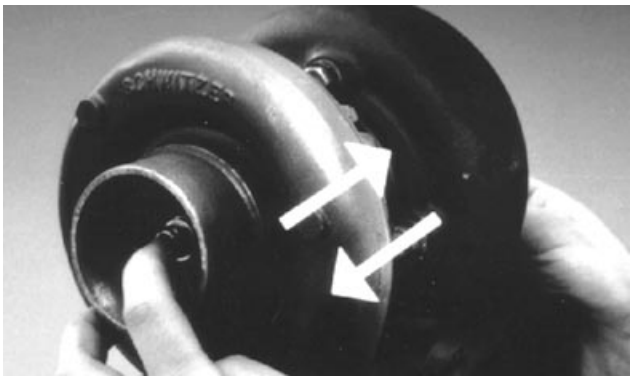

*Checking for Contact of Compressor and Turbine Wheels*

RG,RG34710,1259 –19–23OCT97–12/13

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.*




*Checking Shaft End Play*

RG,RG34710,1259 –19–23OCT97–13/13

## PERFORM RADIAL BEARING CLEARANCE TEST

This test will give an indication of the condition of the radial bearings within the center housing and rotating assembly.

1. Fasten a magnetic base (plunger-type) dial indicator to the turbocharger mounting base. Assemble an extension adapter and indicator extension rod onto dial indicator.

2. Position indicator tip (through center housing oil return) on center of shaft. Preload indicator tip and zero dial on indicator.

**IMPORTANT: Use only moderate hand force (3-4 pounds) on each end of shaft when checking clearance.**

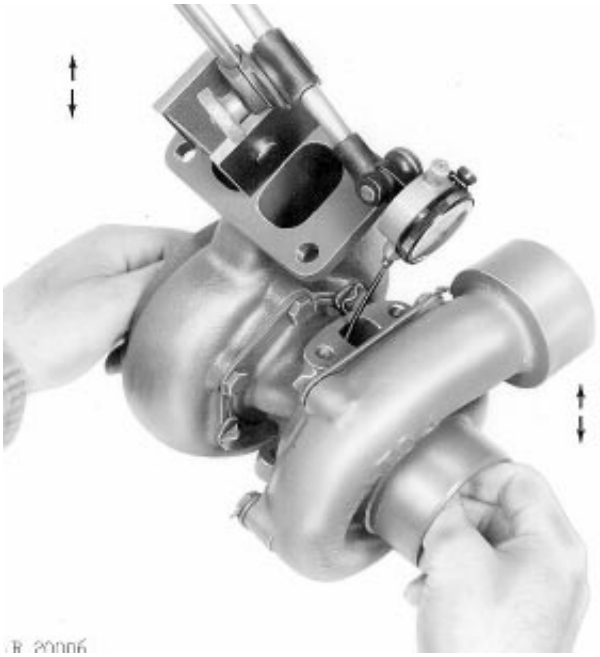
3. Grasp rotating shaft at both ends and move the shaft toward the indicator, then away from the indicator (arrows). Use care to move the shaft in the same direction as the dial indicator tip travels and apply equal pressure at both ends of the shaft.

4. Observe and record total indicator movement.

**Turbocharger Shaft Radial Bearing—Specification**

Clearance ..... 0.13—0.18 mm (0.005—0.007 in.)

If total indicator reading is not within specification, install a replacement turbocharger or replace center housing and rotating assembly. (See REPLACE CENTER HOUSING ASSEMBLY AND ASSEMBLE TURBOCHARGER, later in this group.)



R20006 –UN–20DEC88

*Checking Radial Bearing Clearance*

RG,RG34710,1260 –19–23OCT97–1/1

## PERFORM AXIAL BEARING END PLAY TEST

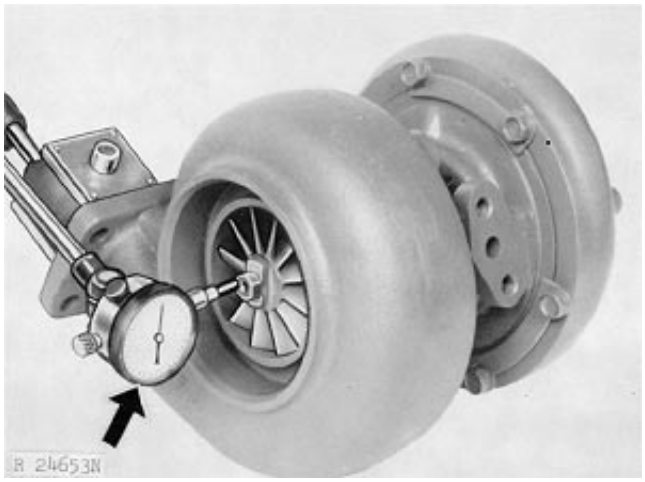
This test will give an indication of the condition of the thrust bearing within the center housing and rotating assembly.

1. Mount magnetic base dial indicator (arrow) so that indicator tip rests on flat surface on turbine end of shaft. Preload indicator tip and zero dial on indicator.
2. Move shaft axially back and forth by hand.
3. Observe and record total dial indicator movement.

**Turbocharger Shaft Axial Bearing—Specification**

End Play ..... 0.064—0.114 mm (0.0025—0.0045 in.)

If bearing end play is not within specification, install a replacement turbocharger or replace center housing and rotating assembly. See REPLACE CENTER HOUSING ASSEMBLY AND ASSEMBLE TURBOCHARGER, later in this group.)




R24653N –UN–20DEC88

*Checking Axial Bearing End Play*

RG,RG34710,1261 –19–23OCT97–1/1

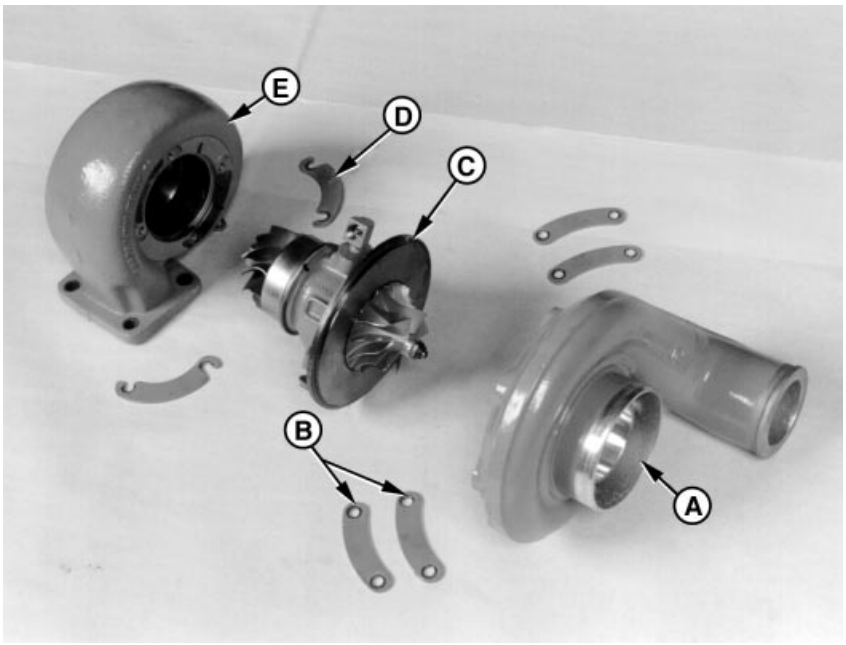
## REPAIR TURBOCHARGER

**IMPORTANT: Repairing a turbocharger center housing and rotating assembly requires specialized tooling and highly trained personnel. Therefore, complete disassembly of turbocharger is not recommended.**

Schwitzer turbochargers used on the engines covered in this manual are available through service parts as a complete remanufactured assembly only. When a new center housing and rotating assembly is being installed, thoroughly inspect turbine and compressor housing from existing turbocharger for serviceability. New mounting hardware MUST be used. (See CLEAN AND INSPECT TURBINE AND COMPRESSOR HOUSINGS, later in this group.)

RG,RG34710,1262 –19–23OCT97–1/1

## DISASSEMBLE TURBOCHARGER




*Turbocharger Disassembled*

**A—Compressor Housing**
**B—Compressor Housing Clamp Plates**
**C—Center Housing Assembly**
**D—Turbine Housing Clamp Plates**
**E—Turbine Housing**

**IMPORTANT: When cleaning turbocharger do not spray directly into compressor cover or turbine housing. Spinning rotor with high pressure spray may cause bearing damage.**

Cap or plug all openings (including exhaust and intake ports) and clean exterior of turbocharger with a pressurized cleaning solvent. Dry turbocharger with compressed air.

1. Place turbocharger on a clean flat surface.
2. Scribe a location mark on the turbine housing (E), center housing (C), and compressor housing (A) to assure proper indexing of housings when turbocharger is assembled.
3. Remove compressor housing cap screws and clamps (B).
4. Remove compressor housing. Gently tap compressor housing with a soft hammer, if necessary, to remove. Be careful not to damage compressor housing or compressor wheel.
5. Remove turbine housing cap screws and clamps (D).
6. Remove turbine housing. Gently tap turbine housing with a soft hammer, if necessary, to remove. Be careful not to damage turbine housing or turbine wheel.

RG,RG34710,1263 –19–23OCT97–1/1

## CLEAN AND INSPECT TURBINE AND COMPRESSOR HOUSING

1. Thoroughly clean compressor housing (A) and turbine housing (C) using a commercially approved solvent only. Caustic solutions may damage housings. Dry housings with compressed air after cleaning. 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 silicon carbide abrasive cloth.

   Nicks, dents or warpage that could prevent proper sealing between the turbine housing and center housing.

   Corroded or stripped threaded mounting holes.

   **Inspect Compressor Housing for:**

   Wheel rub damage within the contour area that cannot be polished out with 80-grit silicon carbide abrasive cloth.

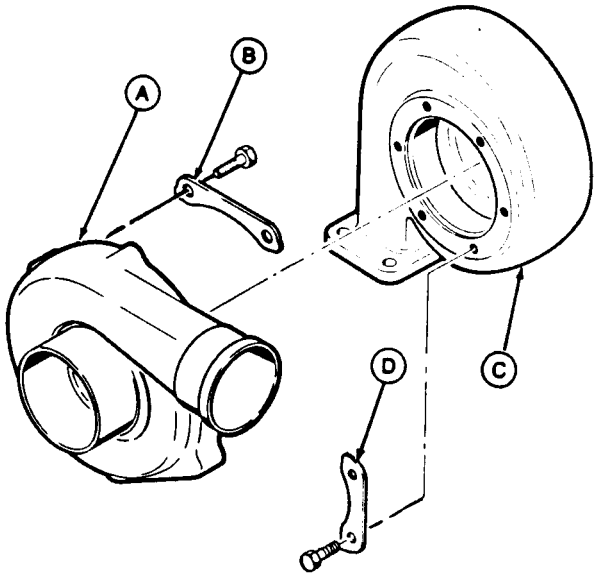
   Nicks, dents, or warpage that could prevent proper sealing between the compressor housing and center housing.

   Corroded or stripped threaded mounting holes.

2. Clean all threads in housings with a tap.

*NOTE: Use new mounting cap screws when turbocharger is reassembled.*

3. Replace either housing if any of the above defects are found.



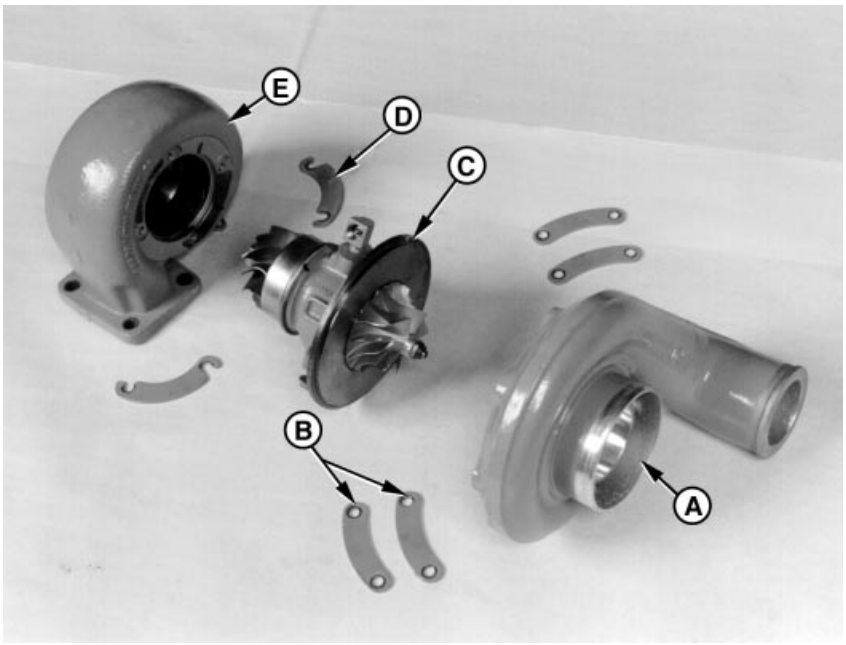

RG5747 –UN–05AUG91

*Inspecting Turbine and Compressor Housings*

**A—Compressor Housing**
**B—Compressor Clamp**
**C—Turbine Housing**
**D—Turbine Clamp**

RG,RG34710,1264 –19–23OCT97–1/1

## REPLACE CENTER HOUSING ASSEMBLY AND ASSEMBLE TURBOCHARGER




*Turbocharger Assembly*

**A—Compressor Housing**
**B—Compressor Housing Clamp Plates**
**C—Center Housing Assembly**
**D—Turbine Housing Clamp Plates**
**E—Turbine Housing**

**IMPORTANT: ALWAYS use new cap screws when installing compressor and turbine housings onto center housing assembly.**

**If reference index marks were not established during turbocharger disassembly, tighten clamp cap screws "finger-tight" until turbocharger is installed on engine and housings are properly indexed with air intake and exhaust piping.**

1. Carefully transfer the scribed marks from the original center housing (C) to the replacement assembly, if necessary. Use the same procedure for the turbine housing (E) and compressor housing (A), if they are also being replaced.
2. Lay turbine housing on outlet side and install center housing assembly into turbine housing. Align scribed reference marks (scribed during disassembly) on turbine housing and center housing.
3. Apply a coat of PT569 NEVER-SEEZ® Compound to new turbine housing cap screw. Install clamps (D) and cap screws. Tighten cap screws to specification.
4. Position compressor housing onto center housing assembly. Align scribed reference marks (scribed during disassembly) on compressor housing and center housing.

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**Continued on next page**

RG,RG34710,1265 –19–23OCT97–1/2

5. Apply a coat of PT569 NEVER-SEEZ® Compound to new compressor housing cap screws. Install clamps (B) and cap screws. Tighten cap screws to specification.

**Turbine Housing-to-Center Cap Screw—Specification**

Torque..... 15—16 N•m

**Compressor Housing-to-Backplate Cap Screw—Specification**

Torque..... (135—145 lb-in.)

6. Prelube turbocharger bearings (through oil inlet opening) with clean engine oil before putting turbocharger into service.

**IMPORTANT: DO NOT spin the rotor assembly with compressed air. Damage to bearings can occur with compressed air.**

7. After assembly, spin rotating assembly by hand to check for binding or wheel rub. If either condition exists, disassemble turbocharger and determine the cause.

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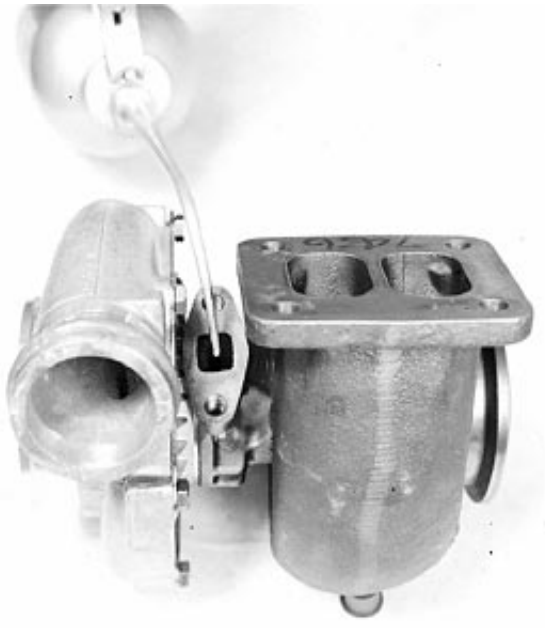
RG,RG34710,1265 –19–23OCT97–2/2

## PRELUBE TURBOCHARGER

**IMPORTANT: DO NOT spin the rotor assembly with compressed air. Damage to bearings can occur when using compressed air.**

Fill oil return (drain) port with clean engine oil and spin rotating assembly by hand to properly lubricate bearings.

If turbocharger is to be stored for an extended period of time, lubricate internally and install protective covers on all openings.



RG5858 –UN–13AUG91

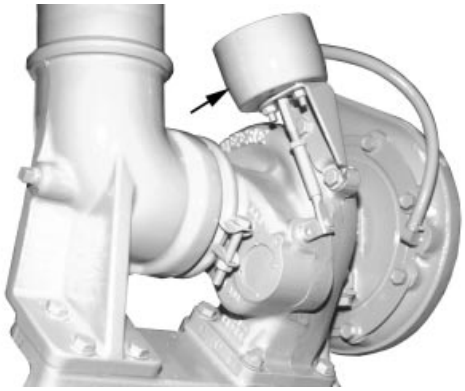
*Prelubing Turbocharger*

RG,RG34710,1266 –19–23OCT97–1/1

## TURBOCHARGER WASTEGATE (IF EQUIPPED)

Some 6081HDW engines have a wastegate actuator on their turbochargers to provide extra pressure boost.

Wastegate mechanism is not repairable. If it fails, replace complete assembly.



RG8775 –UN–02DEC97

*Turbocharger Wastegate Actuator*

RG,RG34710,1267 –19–23OCT97–1/1

## 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.**

**On 6081A engines, visually inspect the aftercooler and clean if necessary. Oil may have accumulated from the failed turbo.**

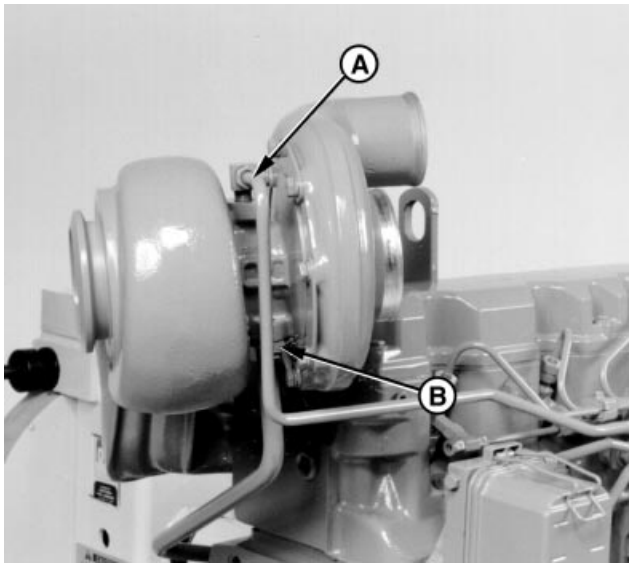
If not previously done, prime (prelube) turbocharger rotating assembly prior to installing turbocharger on engine. Prelube center housing with clean engine oil through oil return (drain) hole as shown. Turn rotating assembly by hand to lubricate bearings.

*NOTE: Two threaded guide studs may be used to hold turbocharger-to-exhaust manifold gasket in place and aid in turbocharger installation.*

1. Put a new gasket on turbocharger-to-exhaust manifold mounting surface (not shown).
2. Position turbocharger against gasket on exhaust manifold.
3. Apply PT569 NEVER-SEEZ® Compound to all turbocharger mounting cap screws. Install cap screws and tighten to 24 N•m (18 lb-in.)

*NOTE: Remove all caps or plugs from turbocharger openings.*

4. Install turbocharger oil return (drain) tube (B) using a new gasket. Tighten cap screws to 34 N•m (25 lb-ft).
5. Connect oil line (A) to elbow adapter and tighten securely.
6. If equipped, connect wastegate diaphragm hose. (If replacing hose, cut to length from roll furnished by Parts.)




*Installing Turbocharger*

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RG,RG34710,1268 –19–23OCT97–1/2

7. Connect air intake and exhaust piping to turbocharger. Tighten all connections securely. (For vehicle engines, refer to machine Technical Manual.)

**IMPORTANT: BEFORE STARTING an engine with a new or repaired turbocharger, crank the engine over (but do not start) for several seconds to allow engine oil to reach turbocharger bearings. DO NOT crank engine longer than 30 seconds at a time to avoid damaging starting motor.**

8. Start and run engine at low idle while checking oil inlet and air piping connections for leaks.

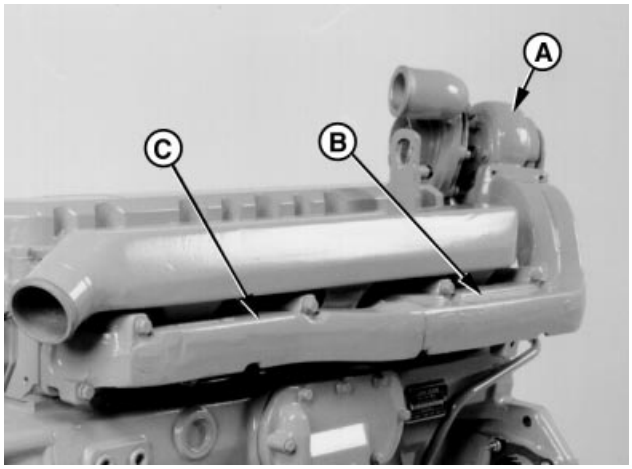
RG,RG34710,1268 –19–23OCT97–2/2

## REMOVE, INSPECT, AND INSTALL EXHAUST MANIFOLD

1. Remove turbocharger (A) from exhaust manifold. (See REMOVE TURBOCHARGER, earlier in this group.)
2. Remove cap screws and remove rear exhaust manifold (B) and front exhaust manifold (C). Remove manifold gaskets and discard.
3. Remove and discard front-to-rear exhaust manifold sealing ring (D).
4. Remove all residue and gasket material from gasket surfaces.
5. Thoroughly clean passages in exhaust manifold and exhaust below.
6. Inspect each exhaust manifold for cracks or damage. Inspect machined mounting surfaces for burrs or other defects which might prevent gaskets from sealing properly. Replace parts as needed.
7. To install exhaust manifold, reverse removal procedure and use new gaskets.

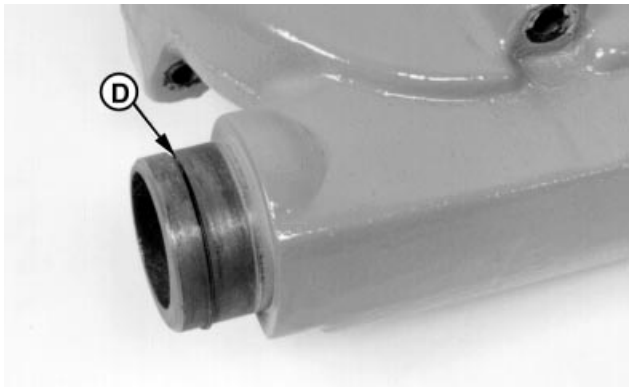
*NOTE: Exhaust manifold cap screws are stainless steel; it is not necessary to use an anti-seize compound during exhaust manifold installation.*

8. Tighten exhaust manifold mounting cap screws to 47 N•m (35 lb-ft).




RG7005 –UN–26NOV97

*Removing Exhaust Manifold*



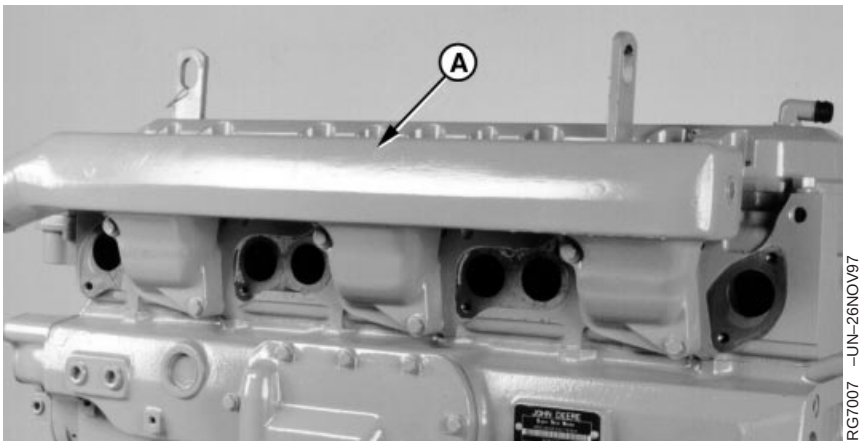

RG7006 –UN–26NOV97

*Sealing Ring for Front-to-Rear Exhaust Manifolds*

**A—Turbocharger**
**B—Rear Exhaust Manifold**
**C—Front Exhaust Manifold**
**D—Sealing Ring**

RG,RG34710,1269 –19–23OCT97–1/1

## REMOVE, INSPECT, AND INSTALL INTAKE MANIFOLD (6081T AND 6081H ENGINES)




*Removing Intake Manifold*

**IMPORTANT: All intake manifold connections at the turbocharger and engine cylinder head must be tight to prevent loss of power resulting from lack of intake manifold pressure.**

Intake manifold hose and cap screw connections should be inspected periodically for tightness.

Whenever a tune-up has been performed on the engine, or whenever it is suspected that the horsepower output might be low, the intake manifold pressure (turbo-boost) should be checked. (See CTM134, Group 110.)

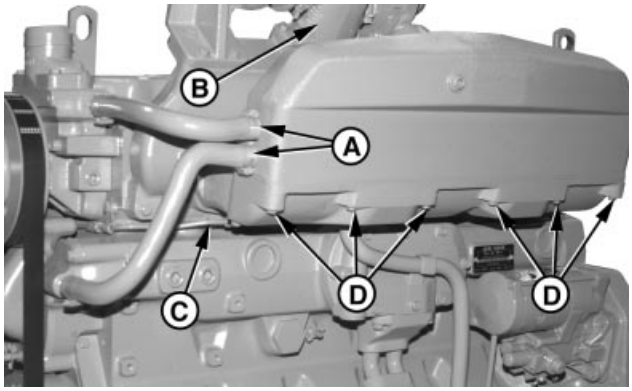
1. Remove exhaust manifold, shown removed. (See REMOVE, INSPECT, AND INSTALL EXHAUST MANIFOLD, earlier in this group.)
2. Remove air intake connections from intake manifold (A) as detailed in machine Technical Manual.
3. Disconnect air heater wire from manifold, if equipped.
4. Remove six cap screws and remove intake manifold from cylinder head. Remove and discard manifold gaskets.
5. Inspect the intake manifold for serviceability. Replace if it is cracked or otherwise damaged.
6. Inspect the machined mating surfaces of cylinder head and intake manifold. Clean, as required, by using a scraper and/or wire brush, and compressed air.
7. To install intake manifold, reverse removal procedures and use new gaskets.
8. Tighten intake manifold cap screws to 47 N•m (35 lb-ft).
9. Install exhaust manifold assembly and turbocharger as detailed earlier in this group.
10. Connect all air intake and exhaust piping. (For vehicle engines, refer to machine Technical Manual.)

RG,RG34710,1270 –19–23OCT97–1/1

## REMOVE VERTICALLY-MOUNTED AFTERCOOLER AND INTAKE MANIFOLD (6081A ENGINES)

**CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Wait until engine coolant is cool enough to touch with bare hands before draining. Slowly loosen radiator cap to first stop to relieve pressure.**

1. Open water pump and block drain valves to completely drain engine coolant.
2. Thoroughly clean exterior of turbocharger (B), intake manifold and adjacent areas to prevent entry of dirt into the engine when parts are removed.
3. Remove turbocharger as described earlier in this group.
4. Loosen clamps (A) on inlet and outlet hose. Remove coolant hoses from aftercooler.
5. Remove aneroid-to-intake manifold connector (C), if equipped.
6. Remove air intake cover cap screws (D).



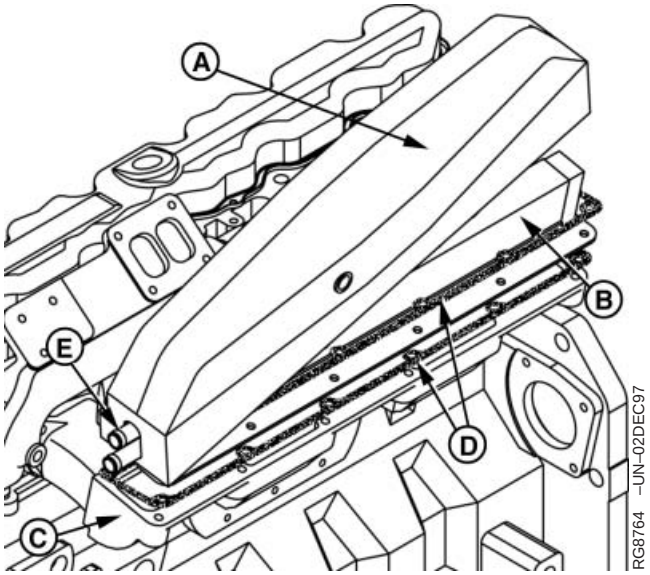

*Removing Aftercooler and Intake Manifold*

**A—Clamps**
**B—Turbocharger**
**C—Aneroid-to-Intake Manifold Connector**
**D—Air Intake Cover Cap Screws**

**Continued on next page**

RG,RG34710,1271 –19–23OCT97–1/3

7. Carefully lift air intake cover (A) from intake manifold (C).
8. Remove aftercooler (B).
9. Remove and discard gasket (D).
10. Inspect aftercooler end seal (E) and replace as needed.

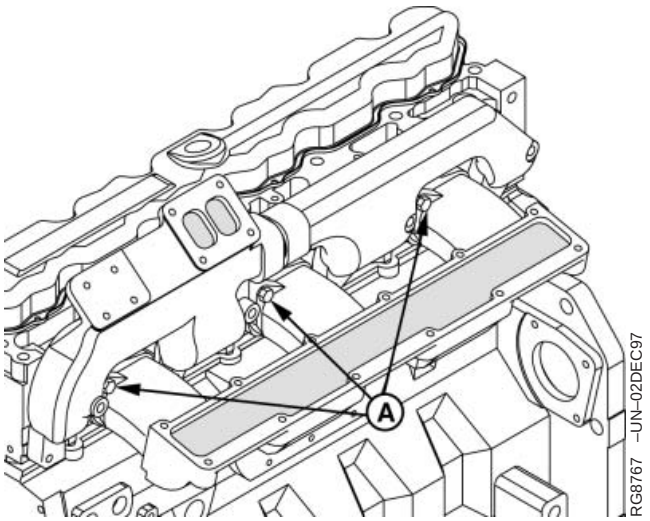



*Removing Aftercooler*

**A—Air Intake Cover**
**B—Aftercooler**
**C—Intake Manifold**
**D—Gaskets**
**E—Aftercooler End Seal**

RG,RG34710,1271 –19–23OCT97–2/3

11. Remove the six intake manifold-to-cylinder head caps screws (A) and remove intake manifold. Remove and discard all manifold gaskets.
12. Inspect and repair aftercooler. See INSPECT AND REPAIR AFTERCOOLER (6081A ENGINES), later in this group.

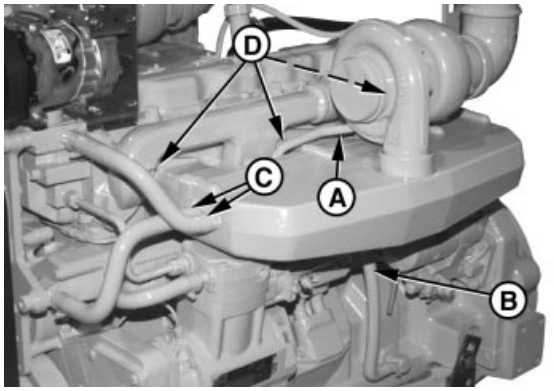



*Removing Intake Manifold*

RG,RG34710,1271 –19–23OCT97–3/3

## REMOVE AND DISASSEMBLE HORIZONTALLY-MOUNTED AFTERCOOLER (6081A ENGINES)

1. Completely drain engine coolant from aftercooler.
2. Disconnect turbocharger oil inlet line (A) and return line (B).
3. Remove four turbocharger-to-exhaust manifold cap screws.
4. Remove coolant inlet and outlet hoses (C) from aftercooler.
5. Remove top three intake manifold cap screws (D). Install guide studs at the three locations. Remove remaining cap screws.
6. Remove intake manifold and aftercooler as an assembly.
7. Remove and discard intake manifold gaskets.
8. Remove turbocharger from aftercooler.



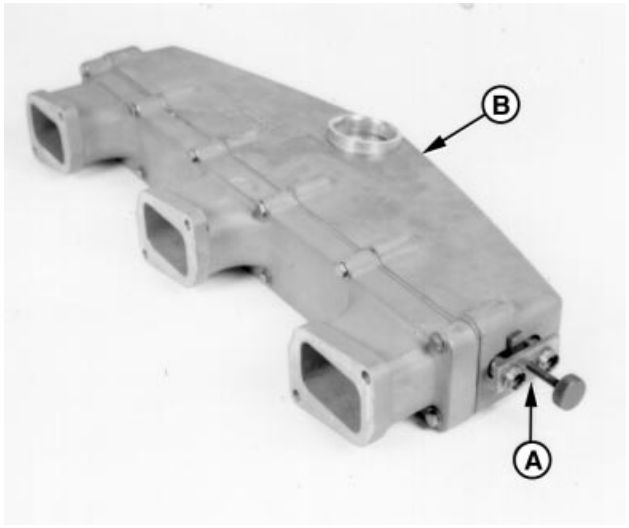

RG8763 –UN–02DEC97

*Removing Aftercooler*

**A—Turbocharger Oil Inlet Line**
**B—Turbocharger Oil Return Line**
**C—Coolant Inlet and Outlet Hoses**
**D—Intake Manifold Cap Screws**

RG,RG34710,1272 –19–23OCT97–1/2

9. Install JDG683 Sealing Ring Compression Tool (A) onto aftercooler coolant tubes with cross bar across slot.
10. Remove intake manifold cover (B).
11. Remove JDG683 tool.
12. Remove aftercooler core from intake manifold.
13. Inspect aftercooler end seal and replace as needed.
14. Inspect and repair aftercooler. See INSPECT AND REPAIR AFTERCOOLER (6081A ENGINES), as described next in this group.




RG6488 –UN–26NOV97

*Removing Aftercooler Cover and Core*

RG,RG34710,1272 –19–23OCT97–2/2

## INSPECT AND REPAIR AFTERCOOLER (6081A ENGINES)

1. Inspect aftercooler for overall condition. The fins should be reasonably straight, and cross straps should be free of cracks.

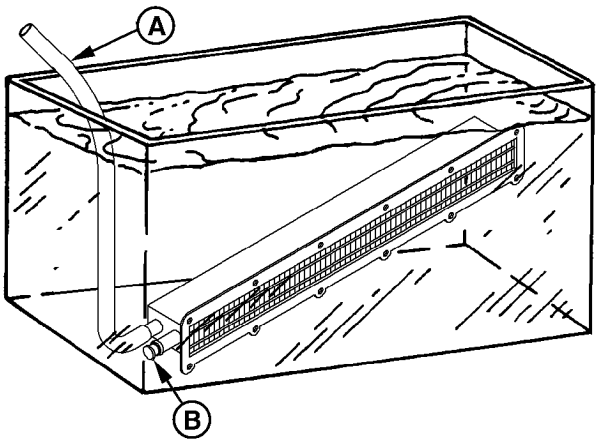
2. Inspect aftercooler inlet and outlet hoses. Replace either hose if cracked or damaged.

3. Test the aftercooler for leaks by plugging one of the tubes (A).

4. Apply compressed air (B) to the other tube while unit is submerged under water. Use 140—170 kPa (1.4—1.7 bar) (20-25 psi) air pressure for testing.

**IMPORTANT: Coolant leakage from the aftercooler may cause severe engine damage.**

A minor leak that is accessible may be repaired. However, if the condition of the core is questionable, replace the aftercooler.




RG8755 –UN–28NOV97

*Testing Aftercooler Core for Leaks*

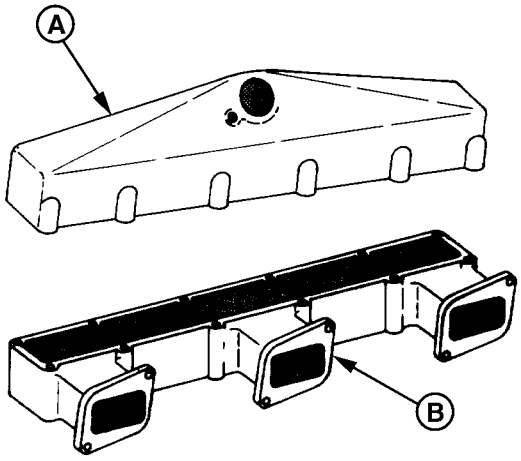
RG,RG34710,1273 –19–23OCT97–1/1

## INSPECT AND REPAIR INTAKE MANIFOLD AND AIR INTAKE COVER (6081A ENGINES)

1. Inspect air intake cover (A) for cracks or damage. Replace as necessary.
2. Check intake manifold (B) for damage. Inspect machined mounting surfaces for burrs or other defects which might prevent gaskets from sealing properly. Repair as required.
3. Thoroughly steam clean interior of intake manifold and covers.

**IMPORTANT: Do not use a hot tank to clean aluminum parts as damage and severe deterioration can occur.**

4. Scrape all gasket material from cylinder head and intake manifold mounting surfaces.

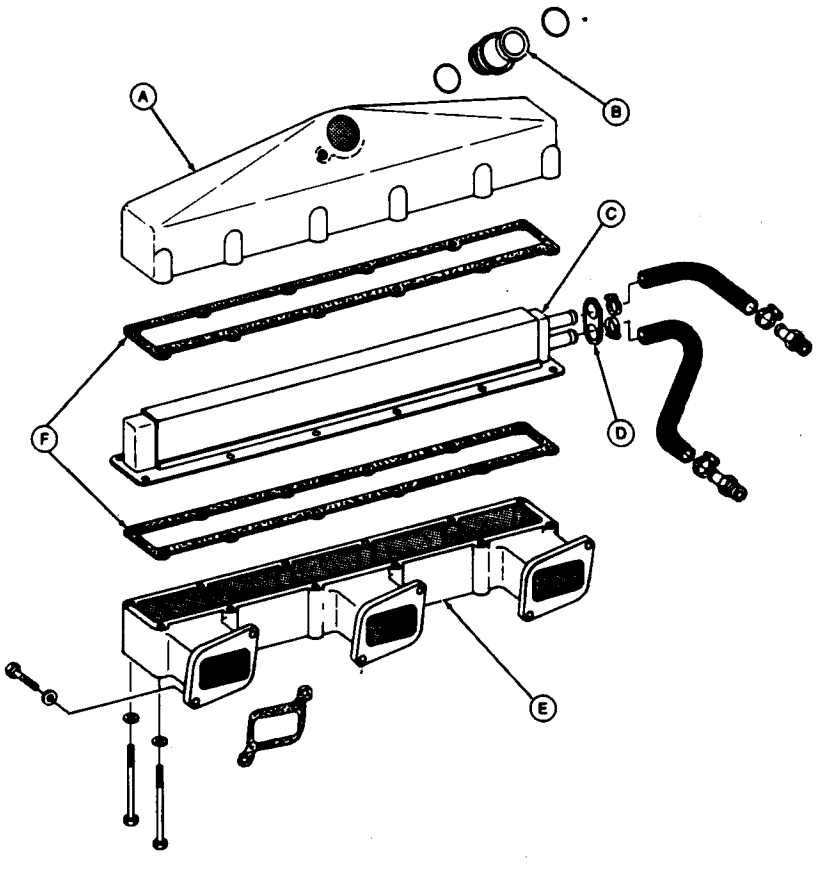



RG5750 –UN–22NOV97

*Inspecting Intake Manifold and Cover*

RG,RG34710,1274 –19–23OCT97–1/1

## INSTALL INTAKE MANIFOLD AND VERTICALLY-MOUNTED AFTERCOOLER (6081A ENGINES)




*Vertically-Mounted Aftercooler—6081A Engines*

**A—Air Intake Cover**
**B—Intake Coupling**
**C—Aftercooler**
**D—End Seal**
**E—Intake Manifold**
**F—Gasket (2 Used)**

**IMPORTANT: Debris left in intake manifold can cause engine damage. Make sure that the inside of manifold is clean before assembly.**

1. Install the intake manifold on cylinder head using new gaskets.

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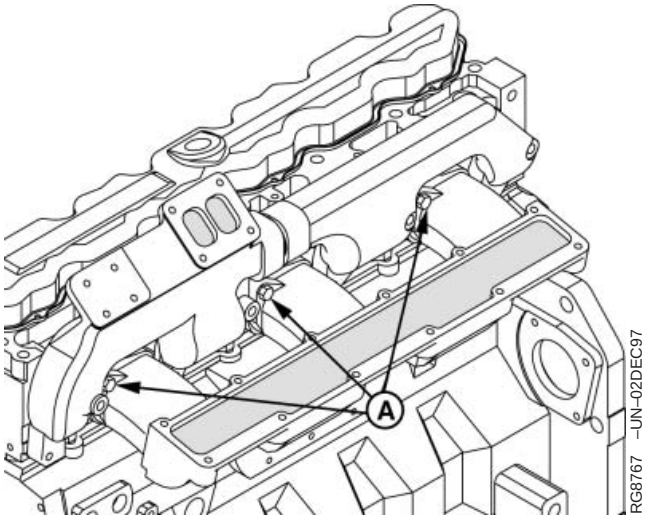
RG,RG34710,1275 –19–23OCT97–1/4

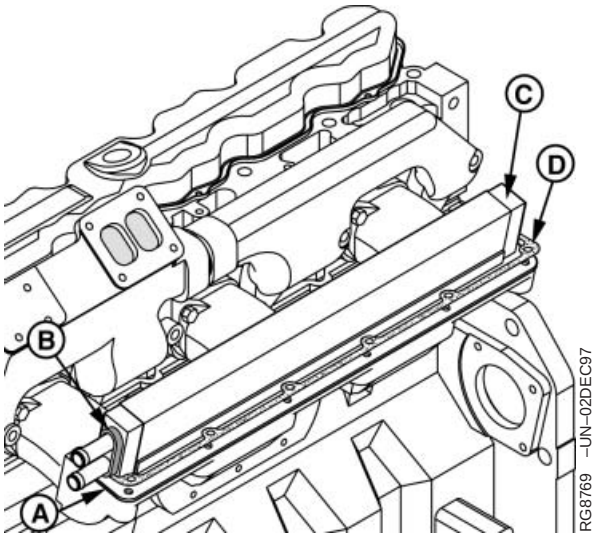
2. Tighten the six cap screws (A) to 47 N•m (35 lb-ft).




*Installing Intake Manifold*

RG,RG34710,1275 –19–23OCT97–2/4

3. Install a new gaskets (A) on top of intake manifold.
4. Install aftercooler end seal (B) on inlet and outlet tubes.
5. Install aftercooler (C) on top of intake manifold. Put a new gasket (D) on top of aftercooler. Carefully align cap screw holes in aftercooler, intake manifold, and gaskets.




*Installing Aftercooler*

**A—Gaskets**
**B—End Seal**
**C—Aftercooler**
**D—Gasket**

**Continued on next page**

RG,RG34710,1275 –19–23OCT97–3/4

6. Install air intake cover (A) cover aftercooler so inlet and outlet tubes are protruding through hole in cover.

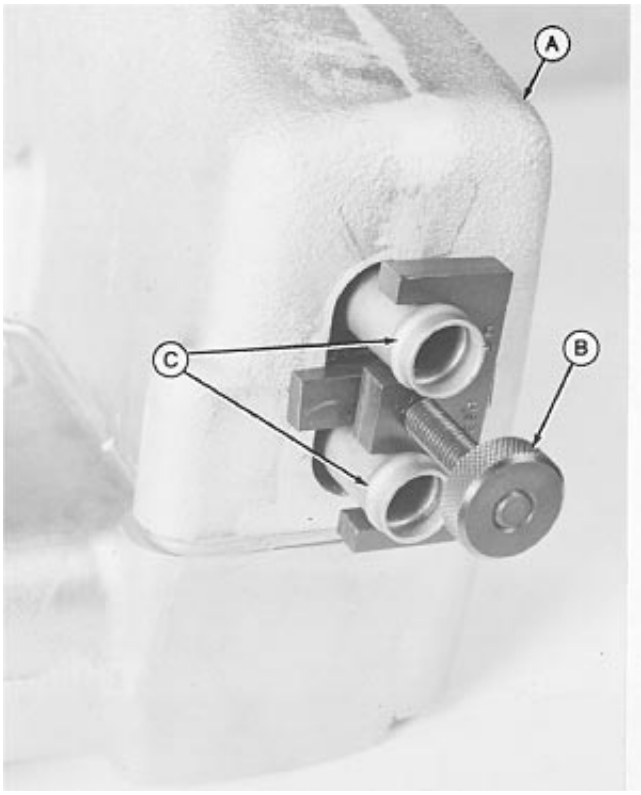
**IMPORTANT: Improperly seated or crimped end seal can result in loss of power and possible engine damage. Make sure end seal is properly seated.**

7. Install JDG683 Sealing Ring Compression Tool (B) onto aftercooler coolant tubes (C) with crossbar across slot as shown.

8. Tighten tool until air intake cover cap screw holes are aligned with holes in gaskets, aftercooler, and intake manifold.

**IMPORTANT: All intake manifold and aftercooler connections at the turbocharger and engine cylinder head must be tight to prevent loss of power resulting from lower manifold pressure, and possible engine damage.**

9. Apply PT569 NEVER-SEEZ® to all intake manifold-to-aftercooler cover cap screws. Install cap screws and tighten to 34 N•m (25 lb-ft). Remove seal compression tool.




RG5570 –UN–09JAN90

*Aligning Aftercooler Parts*

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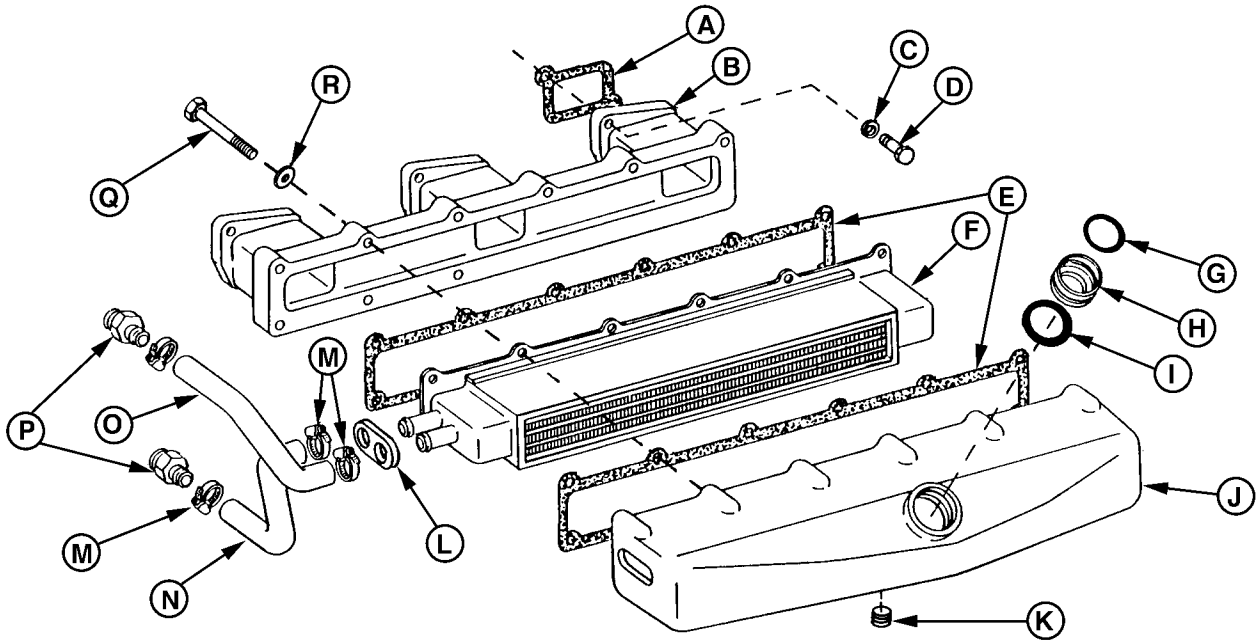
RG,RG34710,1275 –19–23OCT97–4/4

## ASSEMBLE AND INSTALL HORIZONTALLY-MOUNTED AFTERCOOLER ASSEMBLY (6081A ENGINES)




*Horizontally-Mounted Aftercooler—6081A Engines*

**A—Gasket (3 Used)**
**B—Intake Manifold**
**C—Washer (6 Used)**
**D—Cap Screw (6 Used)**
**E—Gasket (2 Used)**
**F—Aftercooler Core**
**G—O-Ring**
**H—Intake Coupler**
**I—O-Ring**
**J—Aftercooler Cover**
**K—Pipe Plug**
**L—End Seal**
**M—Clamps (4 Used)**
**N—Hose**
**O—Hose**
**P—Nipple (2 Used)**
**Q—Cap Screw (12 Used)**
**R—Washer (12 Used)**

**IMPORTANT: Improperly seated or crimped aftercooler end seal can result in loss of power and possible engine damage. Make sure end seal is properly seated.**

1. Install aftercooler end seal on coolant tubes.

**IMPORTANT: Debris left in intake manifold can cause engine damage. Make sure that inside of manifold is clean before assembly.**

2. Position aftercooler core into intake manifold using new gaskets.
3. Install JDG683 Sealing Ring Compression Tool onto aftercooler coolant tubes with cross bar across slot (See illustration on preceding page).
4. Tighten tool until intake manifold cover cap screw holes are aligned with holes in gaskets, aftercooler, and intake manifold. Use guide studs as needed to hold alignment.
5. Apply PT569 NEVER-SEEZ® Compound to all aftercooler cover-to intake cap screws. Tighten cap screws to 34 N•m (25 lb-ft). Remove seal compression tool.

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

**Continued on next page**

RG,RG34710,1276 –19–23OCT97–1/3

6. Install turbocharger (See INSTALL TURBOCHARGER earlier in this group).

RG,RG34710,1276 –19–23OCT97–2/3

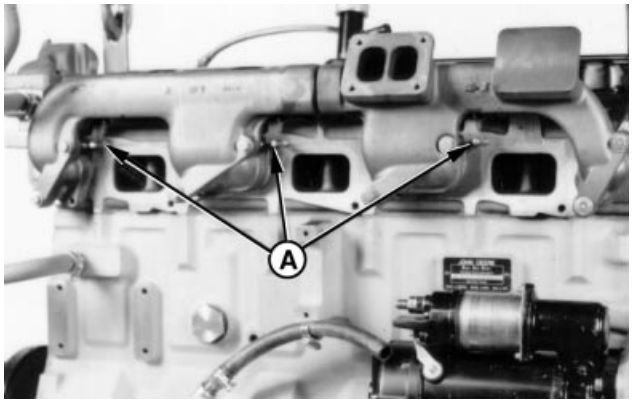
7. Install three guide studs (A) in locations shown.

**IMPORTANT: All intake manifold connections must be tight to prevent loss of power resulting from lower manifold pressure, and possible engine damage.**

8. Using new gaskets, install aftercooler assembly to cylinder head. Tighten cap screws to 47 N•m (35 lb-ft).

9. Connect coolant inlet and outlet hoses to aftercooler and tighten clamps.

10. Connect turbocharger oil inlet and return lines.




*Installing Aftercooler*

RG,RG34710,1276 –19–23OCT97–3/3

# Fuel System

## SPECIAL OR ESSENTIAL TOOLS

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

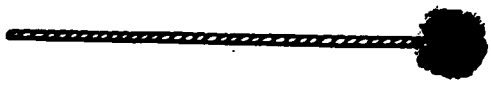
*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1277 –19–23OCT97–1/14

RG5099 –UN–23AUG88

Nozzle Thread Cleaning Brush. . . . . D17030BR

Used to clean nozzle threads in cylinder head.



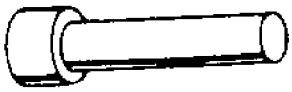
*D17030BR*

RG,RG34710,1277 –19–23OCT97–2/14

RG5068 –UN–05DEC97

Timing Pin . . . . . JDE81-4

Lock engine at TDC when timing valve train, adjusting valve clearance, and installing fuel injection pump. Use with JDG820 and JDE81-1 Flywheel Turning Tools.



RG5068

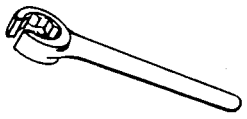
*JDE81-4*

RG,RG34710,1277 –19–23OCT97–3/14

RG5290 –UN–15OCT92

Serrated Wrench. . . . . JDE90

Use to hold injection pump fuel outlet fittings on Bosch “P” pump from turning when loosening and tightening fuel pipe connections.



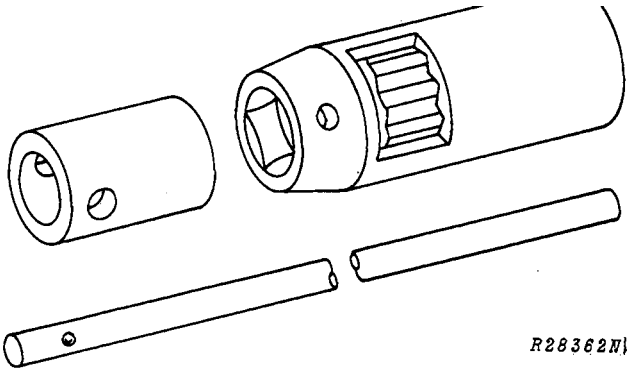
*JDE90*

**Continued on next page**

RG,RG34710,1277 –19–23OCT97–4/14

Nozzle Socket . . . . . JDE92

Used to remove and install 21 mm injection nozzles.



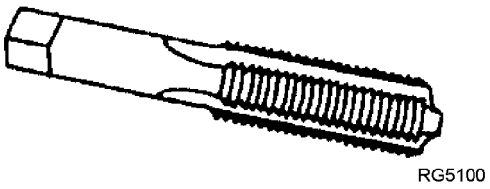

*JDE92*

RG,RG34710,1277 –19–23OCT97–5/14

RG5100 –UN–05DEC97

Tap . . . . . JDF5

Used to restore nozzle threads in cylinder head.

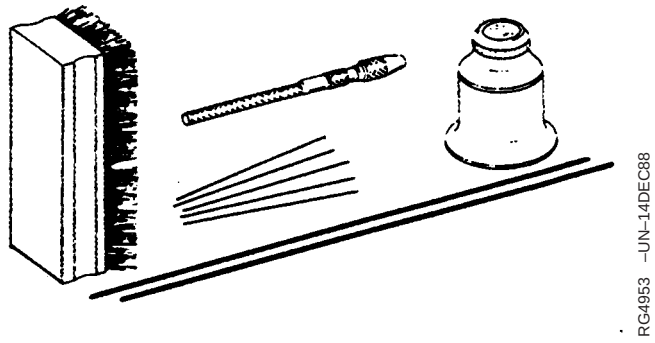



*JDF5*

RG,RG34710,1277 –19–23OCT97–6/14

Nozzle Cleaning Kit . . . . . JDF13 (JDE105)

Used to clean injection nozzles.



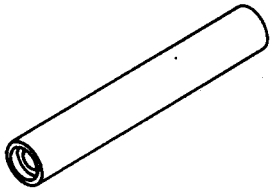

*JDF13 (JDE105)*

**Continued on next page**

RG,RG34710,1277 –19–23OCT97–7/14

Driver . . . . . JDF15

Used to install spindle seals in fuel supply pumps.



RG2017

RG2017 –UN–30NOV88

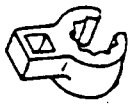
*JDF15*

RG,RG34710,1277 –19–23OCT97–8/14

RG5288 –UN–23AUG88

Crowsfoot Wrench. . . . . JDF22

Used to loosen and tighten fuel pipes at injection nozzles and at injection pump.



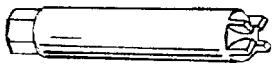
*JDF22*

RG,RG34710,1277 –19–23OCT97–9/14

RG5289 –UN–07NOV97

Nozzle Seat Reamer . . . . . JDG609

Used to clean carbon from nozzle seats in cylinder head.



RG5289

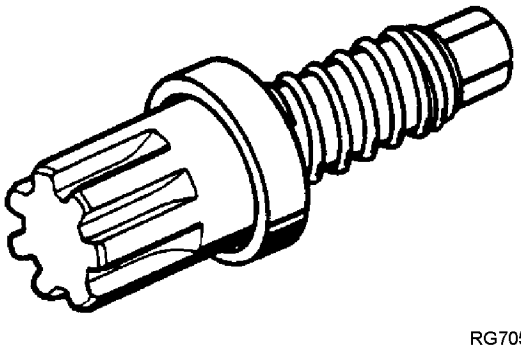
*JDG609*

**Continued on next page**

RG,RG34710,1277 –19–23OCT97–10/14

Flywheel Turning Tool . . . . . JDG820

Used to rotate flywheel on engine to check damper radial runout and time engine. JDE81-1 may be used also if JDG820 is not available.



RG7056 –UN–05DEC97

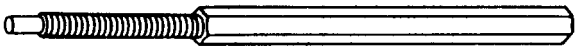
*JDG820*

RG,RG34710,1277 –19–23OCT97–11/14

RG7212 –UN–23NOV97

Injection Pump Timing Pin. . . . . JDG886

Used to set in-line fuel injection pump timing prior to removal of pump.

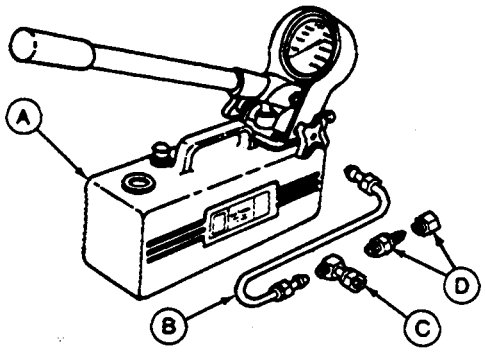


*JDG886*

RG,RG34710,1277 –19–23OCT97–12/14

Fuel Injection Nozzle Tester . . . . . D01109AA (Y900)

Used to test operational performance and opening pressure of nozzles.




RG4954 –UN–14DEC88

*D01109AA (Y900)*

**Continued on next page**

RG,RG34710,1277 –19–23OCT97–13/14

Testing Equipment:

A—Fuel Injection Nozzle Tester ..... D01109AA (Y900)
B—Fuel Injection Line Assembly ..... Y900-2A[a]
C—Adapter Nut ..... Y900-21[b]
D—Straight Adapters ..... Y900-7 and Y900-15
[a]Included in D01110AA (Y910A) Adapter Set.
[b]May be used instead of Y900-7 and Y900-15.

RG,RG34710,1277 –19–23OCT97–14/14

## SERVICE EQUIPMENT AND TOOLS

*NOTE: Order tools from 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.*

RG,RG34710,1278 –19–23OCT97–1/2

Adapter . . . . . .TORX® T45

Injection pump drive gear-to-hub cap screws.

*TORX is a trademark of Camcar/Textron.*

RG,RG34710,1278 –19–23OCT97–2/2

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| AR54749 (U.S.) | Soap Lubricant | Injection pump mounting flange O-ring. |
| PT569 (U.S.)<br>TY6332 (Canadian) | NEVER-SEEZ® Anti-Seize Lubricant | Injection nozzle gland nut threads and barrel. |
| T43512 (U.S.)<br>TY9473 (Canadian)<br>242 (LOCTITE®) | Thread Lock and Sealer (Medium Strength) | Injection pump timing hole plug. |
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | Fuel filter drain plug and bleed plug. |

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

RG,RG34710,1279 –19–23OCT97–1/1

## FUEL SYSTEM SPECIFICATIONS

| ITEM | SPECIFICATION |
|---|---|
| Injection Pump Types | Bosch P3000 In-line with Std. or Electronic Governor<br>Bosch P7100 In-line with Std. or Electronic Governor<br>Nippondenso A2500 with Std. Governor (6081T option) |
| Engine Operating Speeds | OEM engines (see Group 01)<br>Vehicle engines (See machine TM) |
| Injection Pump Timing-to-Engine | No. 1 engine cylinder at TDC, compression stroke, pump hub marks and pointer aligned |
| Overflow Valve Opening Pressure | 130—180 kPa (1.3—1.8 bar) (19—26 psi) |
| Fuel Supply Pump Minimum Output Pressure | 200 kPa (2.0 bar) (29 psi) |
| Fuel Injection Nozzle Type | 21 mm with 7 mm tip (Bosch or Nippondenso) |
| Nozzle Tip Hole Sizes | 7 Hole x 0.208—0.255[a] mm ID x 148° Spray Angle |
| New Nozzle Opening Pressure | 29 000 kPa (290 bar) (4200 psi) |
| Used Nozzle Minimum Opening Pressure | 26 200 kPa (262 bar) (3800 psi) |
| Injection Pump-to-Cylinder Block Stud Nuts | 47 N•m (35 lb-ft) |
| Injection Pump Drive Gear-to-Pump Hub Cap Screws | 61 N•m (45 lb-ft) |
| Fuel Delivery Line Connectors @ Delivery Valves and Nozzles | 27 N•m (20 lb-ft) |
| Nozzle Gland Nut-to-Cylinder Head | 88 N•m (65 lb-ft) |
| Nozzle Retaining Nut | 60—80 N•m (44—59 lb-ft) |
| Supply Pump Mounting Stud Nuts | 5—7 N•m (4—5 lb-ft) (45—60 lb-in.) |
| Leak-off Line-to-Connectors | 17 N•m (12 lb-ft) (150 lb-in.) maximum |
| Leak-off Connector-to-Nozzle | 8 N•m (6 lb-ft) |
| Fuel Filter Base-to-Cylinder Block | 34—54 N•m (25—40 lb-ft) |
| Fuel Pipe Connections at Filter Base | 17 N•m (12 lb-ft) (150 lb-in.) Maximum |
| Injection Pump Drive Gear Cover Cap Screws | 27 N•m (20 lb-ft) |
| Injection Pump Housing Oil Fill Plug | 25 N•m (18 lb-ft) |
| Injection Pump Governor Housing Oil Fill Plug | 40 N•m (30 lb-ft) |

[a]Nozzle tips available in various I.D. hole sizes: 0.208, 0.220, 0.236, 0.240, 0.244, and 0.255 mm.

RG,RG34710,1280 –19–23OCT97–1/1

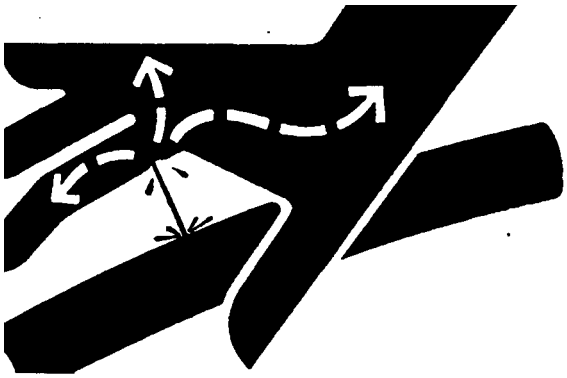
## DIAGNOSING FUEL SYSTEM MALFUNCTIONS

Refer to Group 105 of CTM134, Operation and Diagnostics, to diagnose the fuel system components.

For diagnosis of electronic controls, refer to the following: CTM68 for BOSCH controls or CTM134 for later John Deere controls.

RG,RG34710,1281 –19–23OCT97–1/1

## RELIEVE FUEL SYSTEM PRESSURE



X9811 –UN–23AUG88

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

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

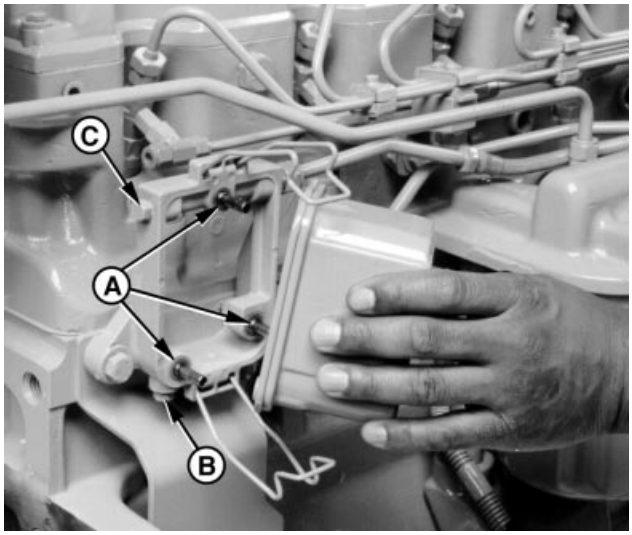
Any time the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system. (See BLEED FUEL SYSTEM in Group 105 of CTM134.)

RG,RG34710,1282 –19–23OCT97–1/1

## REPLACE RECTANGULAR FUEL FILTER ELEMENT

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

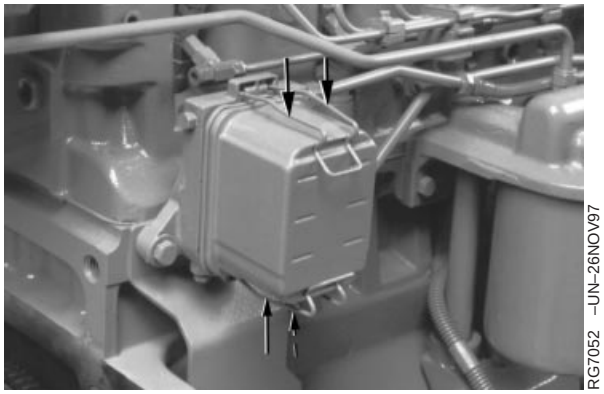
1. Close fuel shut-off valve at bottom of fuel tank (not illustrated).
2. Loosen bleed plug (C) and remove drain plug (B). Drain fuel from filter.
3. With fuel filter held firmly against base, lift up on top retaining spring and pull down on bottom retaining spring. Pull fuel filter off guide pins (A)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




*Replacing Rectangular Fuel Filter Element*

RG,RG34710,1283 –19–23OCT97–1/2

4. Install fuel filter onto guide pins on fuel filter base. Hold filter against base.
5. Secure bottom retaining spring first, then secure top retaining spring. (See arrows.)
6. Install drain plug, shown installed. Tighten bleed plug and drain plug securely. Do not overtighten.
7. Open fuel shut-off valve and bleed fuel system. (See BLEED THE FUEL SYSTEM, in Group 105 of CTM134.)

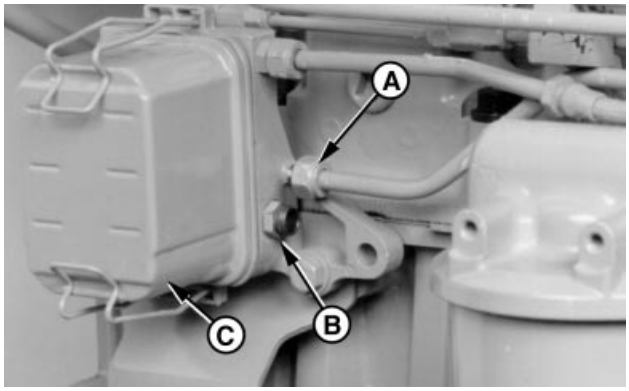



*Installing Fuel Filter Element*

RG,RG34710,1283 –19–23OCT97–2/2

## REPLACE FUEL FILTER CHECK VALVE

1. Drain and remove fuel filter (C) as described earlier in this group.
2. Remove fuel filter inlet line (A), (shown removed).
3. Inspect and clean fuel filter base (if needed).
4. Remove check valve assembly (B) from fuel filter base and discard.
5. Install new check valve assembly and tighten securely.
6. Install fuel inlet line and tighten connection to 17 N•m (12 lb-ft) (150 lb-in.) maximum. DO NOT overtighten.
7. Install fuel filter and bleed fuel system. (See BLEED THE FUEL SYSTEM, in Group 105 of CTM134.)




*Replacing Fuel Filter Check Valve*

RG,RG34710,1284 –19–23OCT97–1/1

## REPLACE PRIMARY (ROUND) FUEL FILTER/WATER SEPARATOR

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

1. Thoroughly clean exterior of filter element (E) and mounting base (A). Also clean around filter mounting area.

*NOTE: Lifting up on ring as it is rotated helps to get it past retaining detent.*

2. Rotate retaining ring (F) counterclockwise (left) 1/4 turn. Remove ring with filter element.

3. Remove water separator (B) from filter element. Drain and clean water separator, dry with compressed air.

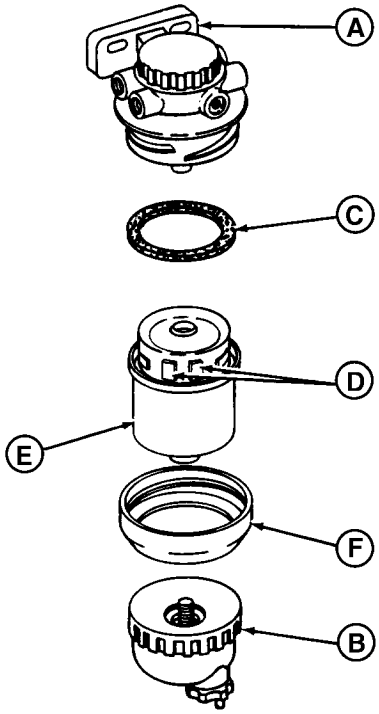
*NOTE: Note indexing keys (D) on filter element. These keys insure proper alignment of filter element to mounting base.*

4. Install water separator onto new filter element.

5. Index filter element until longer, vertical keys are oriented away from engine. Insert filter element into mounting base securely. It may be necessary to rotate filter for correct alignment.

6. Install retaining ring (F) to mounting base, making certain dust seal (C) is in place on filter base. Tighten retaining ring until it locks into detent position and a 'click' sound can be heard.

7. Bleed fuel system. See BLEED THE FUEL SYSTEM in Group 105 of CTM134.




RG7076 –UN–26NOV97

*Fuel Filter/Water Separator*

**A—Mounting Base**
**B—Water Separator**
**C—Dust Seal**
**D—Indexing Keys**
**E—Filter Element**
**F—Retaining Ring**

RG,RG34710,1285 –19–23OCT97–1/1

## IDENTIFICATION OF FUEL SUPPLY PUMPS

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

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

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

RG,RG34710,1286 –19–23OCT97–1/1

## REMOVE FUEL SUPPLY PUMP

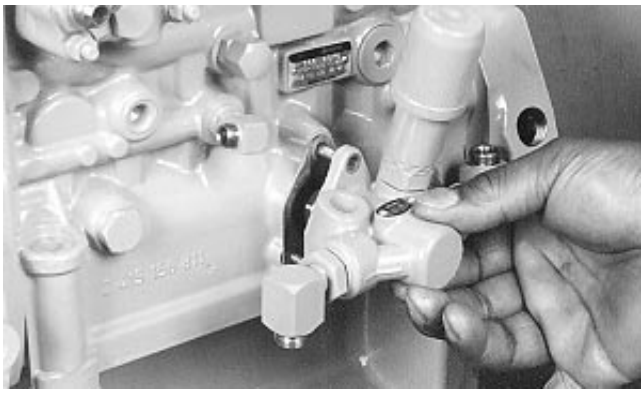
*NOTE: To diagnose fuel supply pump malfunctions, refer to Group 115 of CTM134.*

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

1. Disconnect fuel inlet line and outlet line, shown disconnected. Cap all line openings so contaminants do not enter fuel system.

2. Remove three supply pump mounting nuts and pull fuel supply pump straight out from mounting studs as shown.

3. Cover supply pump mounting bore so debris cannot enter injection pump housing.



RG7053 –UN–10AUG94

*Removing Fuel Supply Pump*

RG,RG34710,1287 –19–23OCT97–1/1

## TEST FUEL SUPPLY PUMP FOR LEAKS

Fuel delivery pressure should be checked before removing supply pump from injection pump. See CHECK SUPPLY PUMP OPERATION in Group 115 CTM134.

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

*NOTE: If bubbles appear, it is an indication that either the seal is defective or that the plunger or roller tappet is worn.*

**IMPORTANT: If enough diesel fuel leaks past the supply pump seal, serious damage to the injection pump or engine (or both) could occur. Fuel leakage past plunger or roller tappet dilutes engine oil.**

5. If pump leaks, replace complete pump assembly.


RG5894 –UN–03NOV97

*Testing Fuel Supply Pump for Leaks*

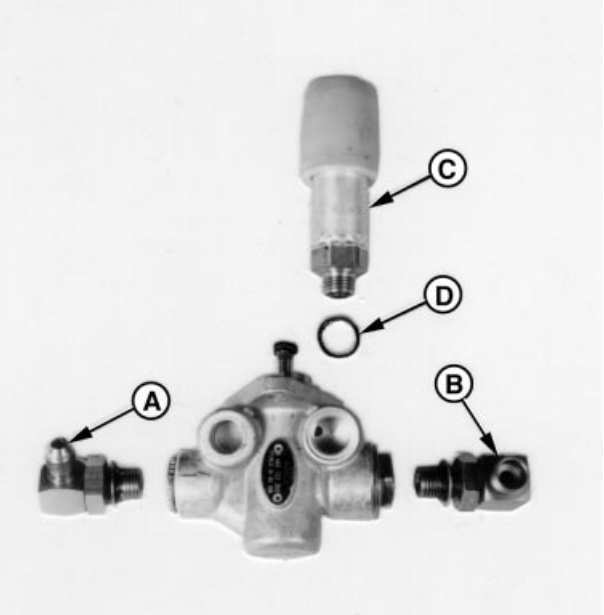
RG,RG34710,1288 –19–23OCT97–1/1

## INSPECT FUEL SUPPLY PUMP

1. Inspect supply pump housing (E) for cracks and wear. Be sure plunger or roller tappet bore is not worn or sored. Check condition of threads for inlet and outlet fittings (A and B), hand primer pump (C) and spindle guide plug.

2. Inspect plunger (F) or roller tappet for wear, scoring on O.D. and burrs. Check lands that contact plunger and fuel pump cam lobe to be sure they are flat and undamaged, or that roller tappet is not worn. Remove any deposits with a suitable solvent.

3. If pump housing or plunger/roller tappet mechanism is worn or damaged, replace pump assembly (E). Use new O-rings on fittings and new copper washer (D) on primer.




RG5909 –UN–26NOV97

*Fuel Supply Pump (Bosch Shown)*

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

RG,RG34710,1289 –19–23OCT97–1/1

## INSTALL FUEL SUPPLY PUMP

**IMPORTANT: Before installing supply pump, test pump to make sure fuel will not leak around plunger (or roller tappet) and seal. (See TEST FUEL SUPPLY PUMP FOR LEAKS, earlier in this group.)**

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

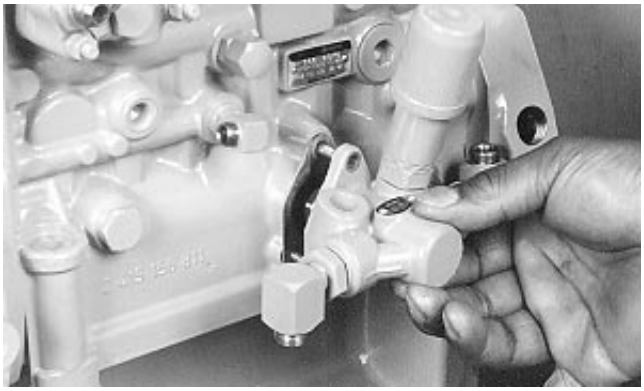
   On Nippondenso pumps, place a new O-ring in counterbore of injection pump housing at supply pump mounting face.

2. Position supply pump on mounting studs as shown.

3. Tighten mounting stud nuts 5—7 N•m (4—5 lb-ft) (45—60 lb-in.).

4. Install fuel inlet and outlet lines and tighten all connections securely.

5. Bleed fuel system. (See BLEED THE FUEL SYSTEM, in Group 105 of CTM134.)



RG7053 –UN–10AUG94

*Installing Fuel Supply Pump*

RG,RG34710,1290 –19–23OCT97–1/1

## REPAIR INJECTION PUMP ANEROID—IF EQUIPPED

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

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

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

RG,RG34710,1291 –19–23OCT97–1/1

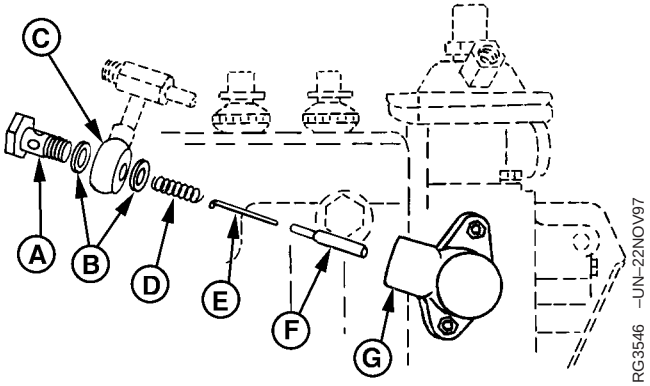
## REMOVE HYDRAULIC ANEROID ACTIVATOR—IF EQUIPPED

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

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

*NOTE: Do not bend restricter wire or other activator parts.*

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



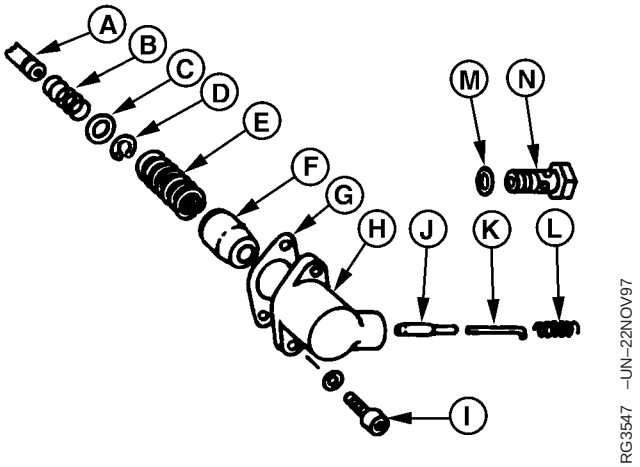

*Removing Hydraulic Aneroid Activator*

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

RG,RG34710,1292 –19–23OCT97–1/1

## DISASSEMBLE AND CLEAN HYDRAULIC ANEROID ACTIVATOR PARTS—IF EQUIPPED

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




*Inspecting Hydraulic Aneroid Activator*

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

RG,RG34710,1293 –19–23OCT97–1/1

## ASSEMBLE AND INSTALL HYDRAULIC ANEROID ACTIVATOR—IF EQUIPPED

*NOTE: Refer to previous illustration.*

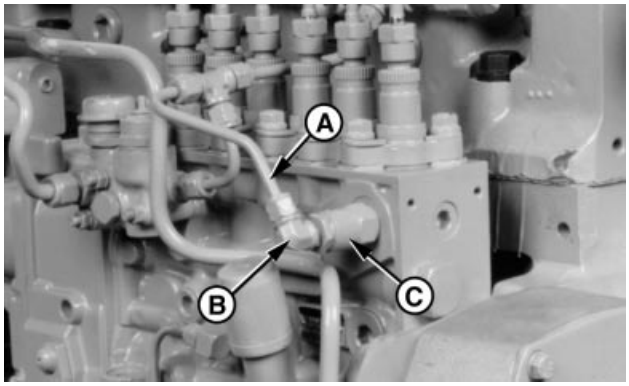
To assemble and install activator, reverse disassembly procedure using new gaskets.

RG,RG34710,1294 –19–23OCT97–1/1

## SERVICE INJECTION PUMP OVERFLOW VALVE

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

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




RG7075 –UN–26NOV97

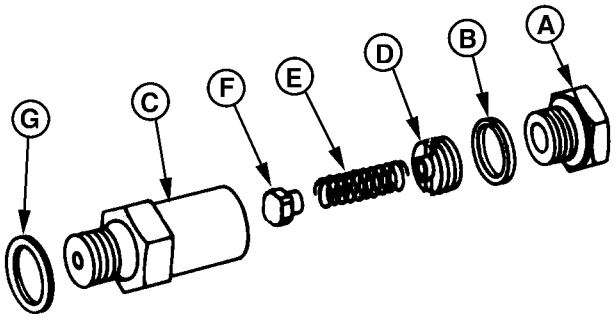
*Removing Injection Pump Overflow Valve*

RG,RG34710,1295 –19–23OCT97–1/2

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

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

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



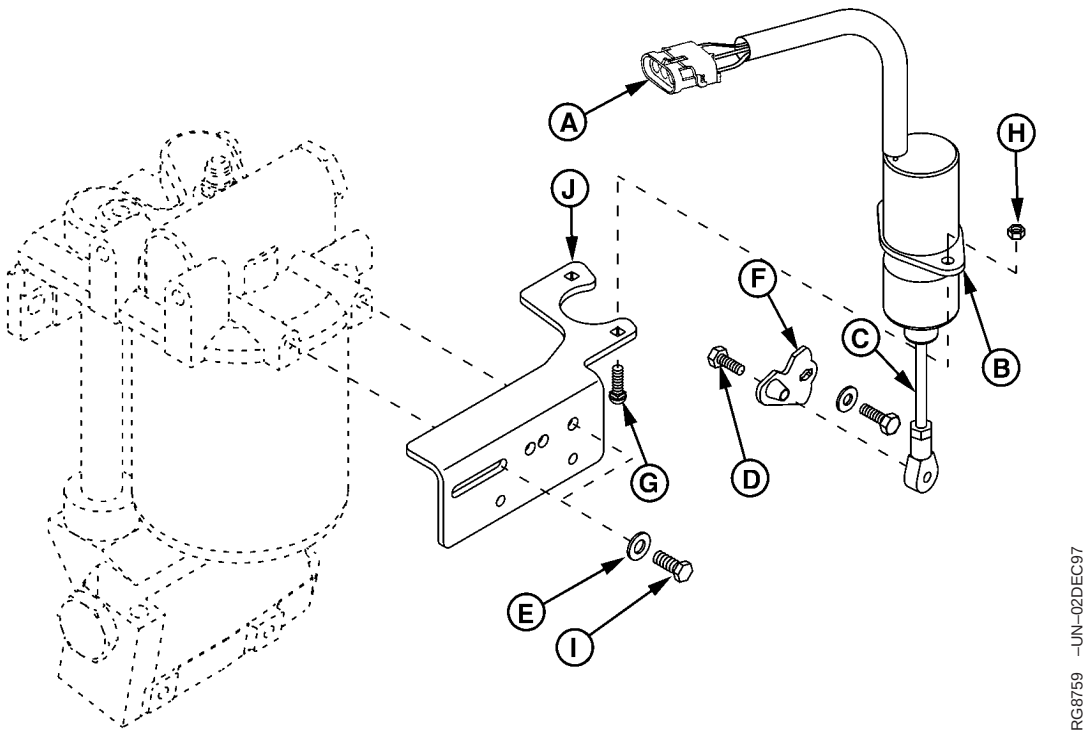

RG3549 –UN–22NOV97

*Inspecting Injection Pump Overflow Valve*

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

RG,RG34710,1295 –19–23OCT97–2/2

## REMOVE AND INSTALL FUEL SHUTOFF SOLENOID—IF EQUIPPED




*Fuel Shutoff Solenoid*

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

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

**IMPORTANT: Fuel shutoff solenoid linkage should move freely back and forth. On "A" pumps if linkage is binding, check pump for proper alignment. (See INSTALL FUEL INJECTION PUMP, later in this group.)**

*NOTE: Electric fuel shutoff solenoids are factory adjusted to a specified length and should not require additional adjustment. See CTM134 for diagnosis of fuel shutoff solenoid.*

6. To install fuel shutoff solenoid, reverse removal procedure. Tighten cap screws (I) to 23 N•m (17 lb-ft) and hex nuts (H) to 7 N•m (5 lb-ft).

RG,RG34710,1296 –19–23OCT97–1/1

## IDENTIFICATION OF IN-LINE FUEL INJECTION PUMPS

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


*Fuel Injection Pump Identification Plate (Bosch Shown)*

**INJECTION PUMP IDENTIFICATION NUMBER (BOSCH SHOWN)**

**A–76417 00136 B**

| | |
|---|---|
| 00000 00000 0 | Pump Serial Number |

**B–0 402 796 813**

| | |
|---|---|
| 0 000 000 000 | Bosch Part Number |

**C–PES6P120A720RS7356**

| | |
|---|---|
| PES | Injection Pump With Housing Flange |
| 6 | Number of plungers |
| P | Type or Size of Pump |
| 120 | Plunger Diameter in mm (120 is 12 mm) |
| A | Letter Designating Design Change |
| 000 | Three Numbers Denoting an Assembly |
| R | Right-Hand Rotation (Viewed From Drive End) |
| S | Production Pump |
| 0000 | Pump Identification Number |

**D–RE 61 658**

| | |
|---|---|
| 00 00 000 | John Deere Part Number |

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

To summarize pump applications:

P–Series Bosch Pumps ..... P3000 optional 6081T and A; P7100 optional on 6081A, standard on 6081H.

A–Series Nippondenso Pumps ..... A2500 optional on 6081T only.

RG,RG34710,1297 –19–23OCT97–1/1

## SERVICE OF FUEL INJECTION PUMPS

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

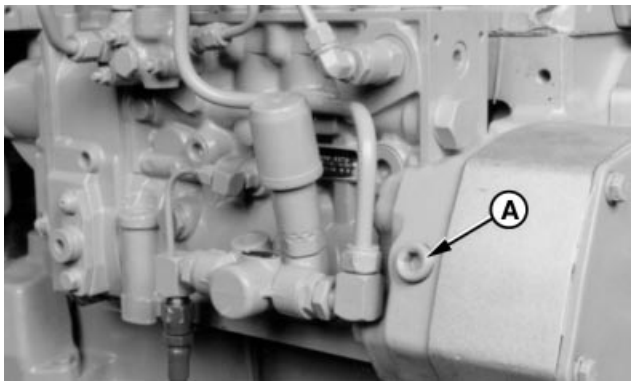
For diagnostics and tests of electronic control systems, refer to the following: For older Bosch ECU controls, see CTM68. For newer John Deere ECU controls, see CTM134.

RG,RG34710,1298 –19–23OCT97–1/1

## REMOVE FUEL INJECTION PUMP

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

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




*Injection Pump Timing Access Hole*

**Continued on next page**

RG,RG34710,1299 –19–23OCT97–1/4

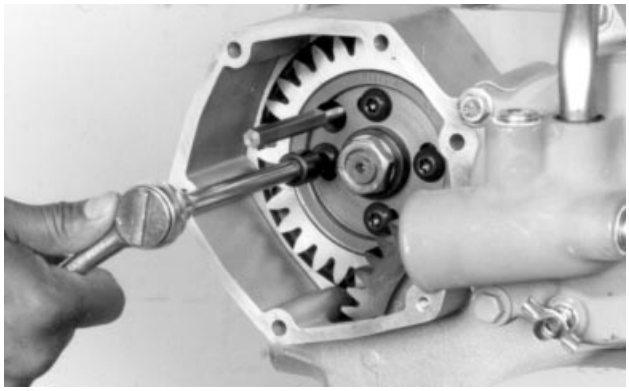
**IMPORTANT: To assure that accurate injection pump timing is maintained when pump is removed and reinstalled, is it recommended that JDG886 Injection Pump Timing Pin (A) is used prior to removal and installation of injection pump. If injection pump will be serviced at an authorized repair station, remove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

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

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

6. Install JDG886 Timing Pin (A) through hole in injection pump drive gear. Thread timing pin into injection pump hub until it bottoms.

7. Remove four injection pump drive gear cap screws using a T45 TORX® adapter (B) and remove drive gear from pump drive hub.



RG7740 –UN–04DEC98

*Installing Timing Pin and Removing Pump Gear*

*TORX is a trademark of Camcar/Textron*

**Continued on next page**

RG,RG34710,1299 –19–23OCT97–2/4

8. Remove engine oil filter (B) from filter base.

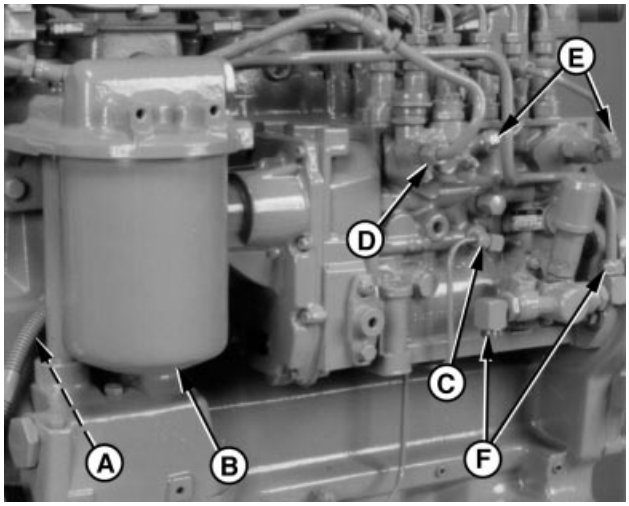
9. Disconnect governor pigtail connectors (A) from main wiring harness. Disconnect fuel shut-off solenoid wiring lead (shown disconnected and capped).

10. Remove injection pump lube line (C) from elbow fitting.

11. Remove fuel inlet (D) from shut-off solenoid. Remove fuel leak-off line assembly (E).

12. Disconnect fuel supply pump lines (F). (Photo shows outlet line only.)

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




*Removing Injection Pump*

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

**Continued on next page**

RG,RG34710,1299 –19–23OCT97–3/4

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

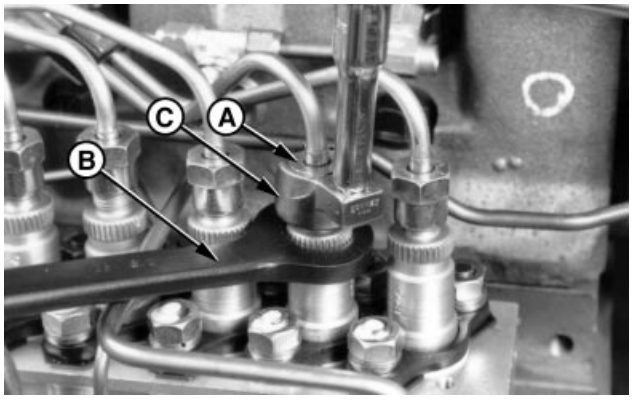
13. Remove injection line nuts (A) from injection pump delivery valves. On Bosch "P" pumps, use JDE90 Serrated Wrench (B) along with either JDF22 Crowsfoot Wrench (C) or a standard 3/4-in. line wrench. (On Nippondenso "A" pumps, use JDF22 Crowsfoot Wrench or equivalent to hold valve fittings.)

14. Disconnect throttle linkage from pump.

15. Remove four injection pump mounting stud nuts.

16. Carefully remove injection pump and place it on a clean flat surface.

17. Cap all delivery valve fittings.




*Removing Lines (Bosch "P" Pump Shown)*

RG,RG34710,1299 –19–23OCT97–4/4

## INSTALL FUEL INJECTION PUMP

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

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

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

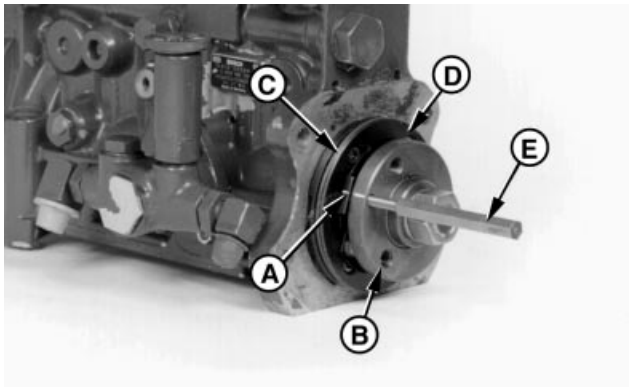
*NOTE: When No.1 cylinder is at “TDC” compression stroke, intake and exhaust valves for No. 1 cylinder will be closed and both rocker arms will be loose.*

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

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

3. Thread JDG886 Timing Pin (E) into drive hub, as shown, and tighten until it bottoms against bearing plate (D).

4. Install a new O-ring (C) on pump mounting hub. Lightly lubricate O-ring with AR54749 Soap Lubricant to aid in pump installation and prevent O-ring damage.




RG7741 –UN–28NOV97

*Preparing Injection Pump for Installation*

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

**Continued on next page**

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

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

6. Install mounting stud nuts and tighten to 47 N•m (35 lb-ft).

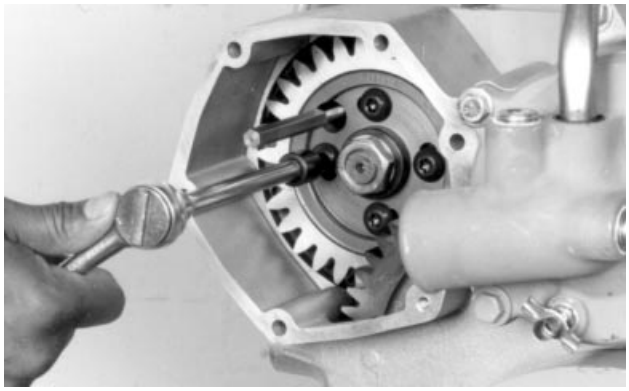
7. Carefully install drive gear on pump drive hub, position gear so mounting cap screws are approximately centered in mounting slots. This will allow for minor adjustment of pump timing, should the need arise.

8. Install four drive gear-to-pump hub cap screws and tighten to 61 N•m (45 lb-ft) using a T45 TORX® adapter (B).

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

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

10. Install injection pump drive gear cover using a new gasket or O-ring. Tighten cap screws to 27 N•m (20 lb-ft).



RG7740 –UN–04DEC98

*Installing Pump Drive Gear*

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

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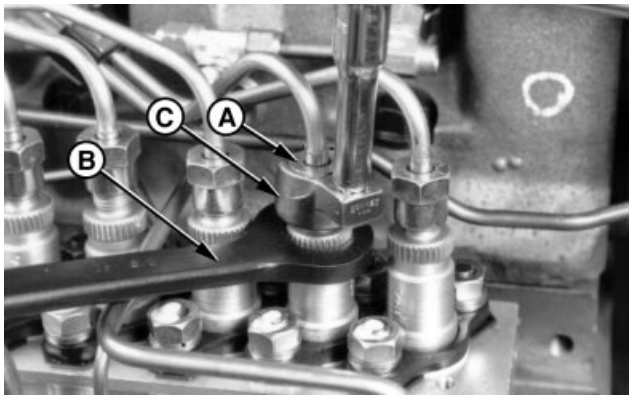
RG,RG34710,1300 –19–23OCT97–2/5

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

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

11. Connect fuel delivery line nuts (A) to injection pump delivery valve fittings using two wrenches as shown. On Bosch “P” pumps, use JDE90 Serrated Wrench (B) and JDF22 Crowsfoot Wrench (C). (On Nippondenso “A” pumps, use JDF22 Crowsfoot Wrench or equivalent to hold valve fittings.) Tighten line nuts to 27 N•m (20 lb-ft).




*Installing Lines (Bosch “P” Pump Shown)*

RG,RG34710,1300 –19–23OCT97–3/5

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

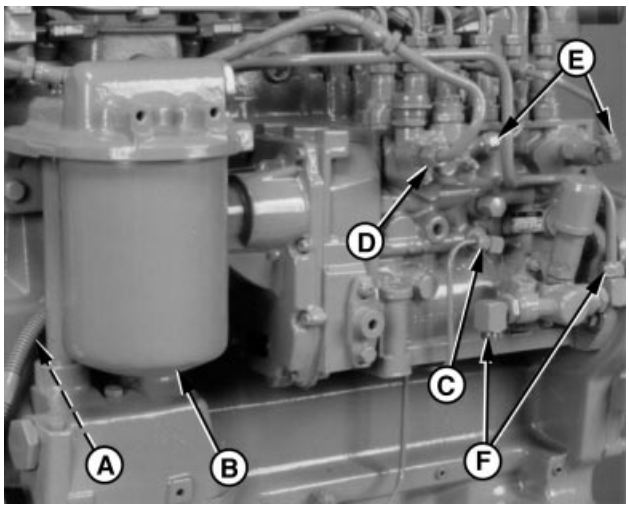
12. Install fuel leak-off line assembly (E) onto pump connectors and tighten all connections securely.

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

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

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

16. Install engine oil filter (B).




*Installing Injection Pump*

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

**Continued on next page**

RG,RG34710,1300 –19–23OCT97–4/5

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

17. Remove oil fill plug (A) and add enough clean engine oil until oil comes out fill hole. Engine should be level when checking oil level. Tighten plug to 25 N•m (18 lb-ft).

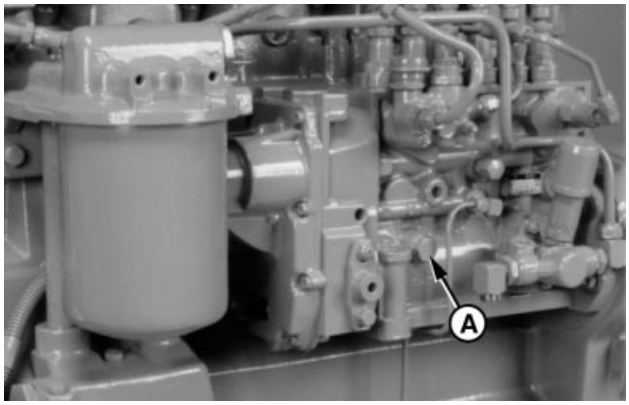
*NOTE: On Nippondenso "A" pumps, oil fill plug is on top of pump housing. Add 1/2 pint of clean engine oil.*

18. Also add clean engine oil to pump rear governor housing by removing plug (B) at top. Add 0.1 Liter (1/5 quart). Tighten plug to 40 N•m (30 lb-ft).

19. Service fuel filter and water separator as needed.

20. Bleed fuel system. (See BLEED THE FUEL SYSTEM, in Group 105 of CTM134.)

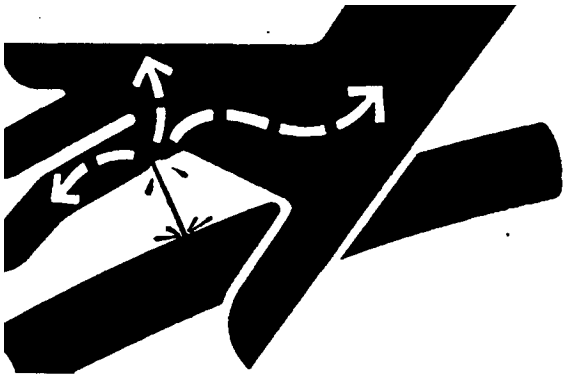
21. Connect throttle linkage to pump. To check fast and slow idle speeds, refer to Group 105 of CTM134.



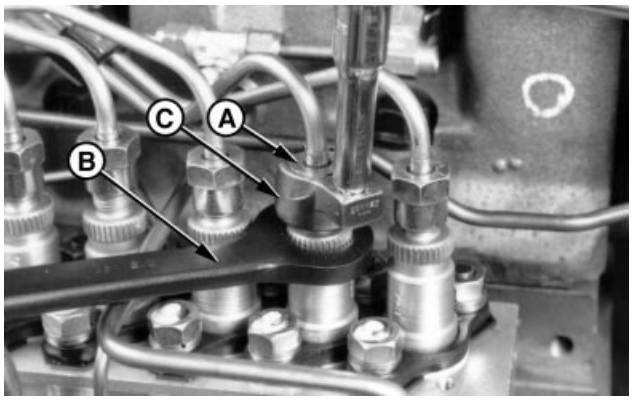

*Adding Oil to Pump Housings*

RG,RG34710,1300 –19–23OCT97–5/5

## REMOVE FUEL INJECTION NOZZLES



X9811 –UN–23AUG88




RG5877 –UN–26NOV97

*Disconnecting Injection Nozzle Line (Bosch "P" Pump Shown)*

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

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

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

Injection nozzles on 6081 engines may be either Bosch or Nippondenso. Both nozzles are of same basic design and procedures are combined on the following pages.

To test injection nozzles before removal, see Group 105 of CTM134.

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

**IMPORTANT: On Bosch "P" pumps, JDE90 Serrated Wrench (B) MUST BE used to keep delivery valve fittings stationary while loosening line nuts. If a delivery valve and barrel housing rotates while loosening or tightening a fuel line nut, injection pump must be recalibrated on a test stand. (On Nippondenso "A" pumps, use JDF22 Crowsfoot Wrench to avoid turning valve fittings.)**

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

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

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

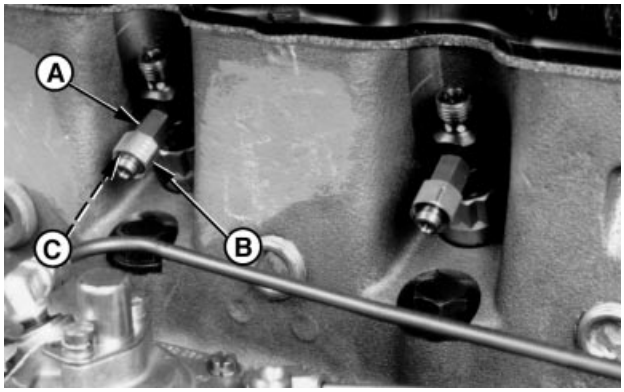
**Continued on next page**

RG,RG34710,1301 –19–23OCT97–1/4

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

RG,RG34710,1301 –19–23OCT97–2/4

5. Remove packing (C) and line nuts (B) from each leak-off connector. Discard packing.
6. Remove leak-off connector (A) with O-ring from each injection nozzle.

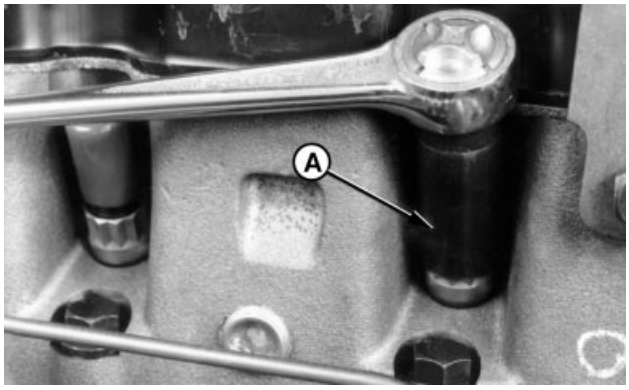



*Removing Nozzle Leak-off Connectors*

RG,RG34710,1301 –19–23OCT97–3/4

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

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




*Removing Injection Nozzles*

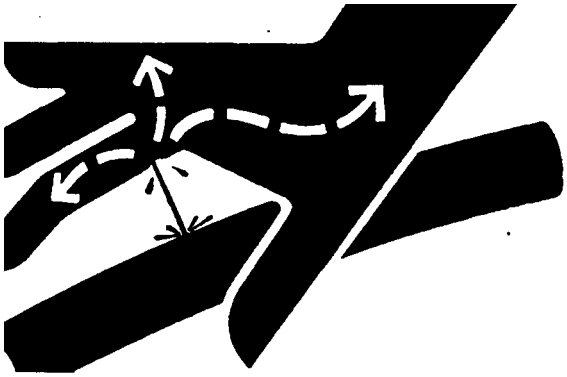
RG,RG34710,1301 –19–23OCT97–4/4

## DIAGNOSE INJECTION NOZZLE MALFUNCTION

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

RG,RG34710,1302 –19–23OCT97–1/1

## TEST FUEL INJECTION NOZZLES



X9811 –UN–23AUG88

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

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

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

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

Test for:

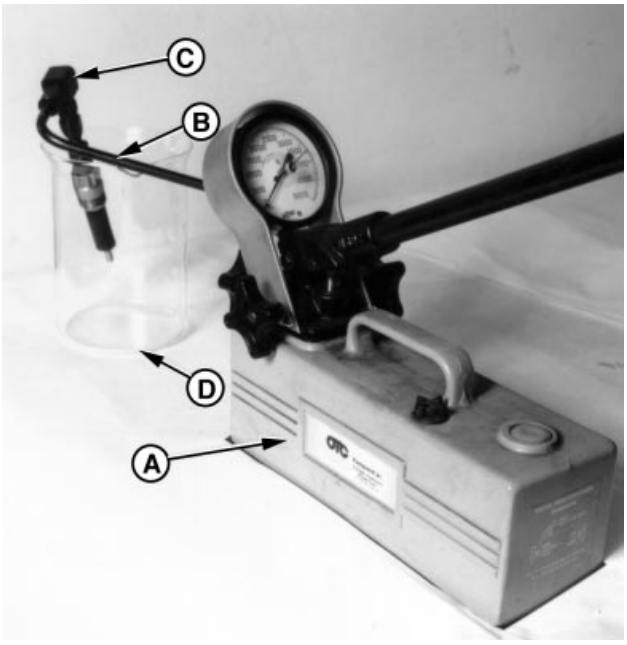
- Opening Pressure
- Leakage
- Chatter
- Spray Pattern

RG,RG34710,1303 –19–23OCT97–1/1

## PERFORM OPENING PRESSURE TEST

1. Connect injection nozzle to D01109AA Nozzle Tester (Y900) (A), using No. Y900-2A Fuel Line (B) and Y900-7 and Y90-15 Straight Adapters (C). Y900-21 90° Adapter may also be used. Place a glass beaker (D) around nozzle.
2. Pump handle several times to flush out nozzle fittings. Tighten fittings.
3. Expel air from nozzle by operating pump handle several strokes. Then raise pressure until valve opens.
4. Recheck by completely releasing pressure, then gradually building pressure until valve opens.

**IMPORTANT: Nozzle tester should be checked periodically for accuracy.**




*Testing Nozzle Opening Pressure*

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

RG,RG34710,1304 –19–23OCT97–1/1

## INJECTION NOZZLE OPENING PRESSURE SPECIFICATIONS

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

**New Injection Nozzle (All Tip Sizes)—Specification**

Opening Pressure ..... 29 000 kPa (290 bar) (4200 psi) minimum

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

**Used Injection Nozzle (All Tip Sizes)—Specification**

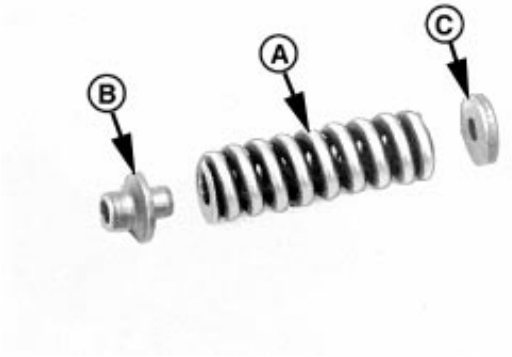
Opening Pressure ..... 26 200 kPa (262 bar) (3800 psi) minimum

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

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

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

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

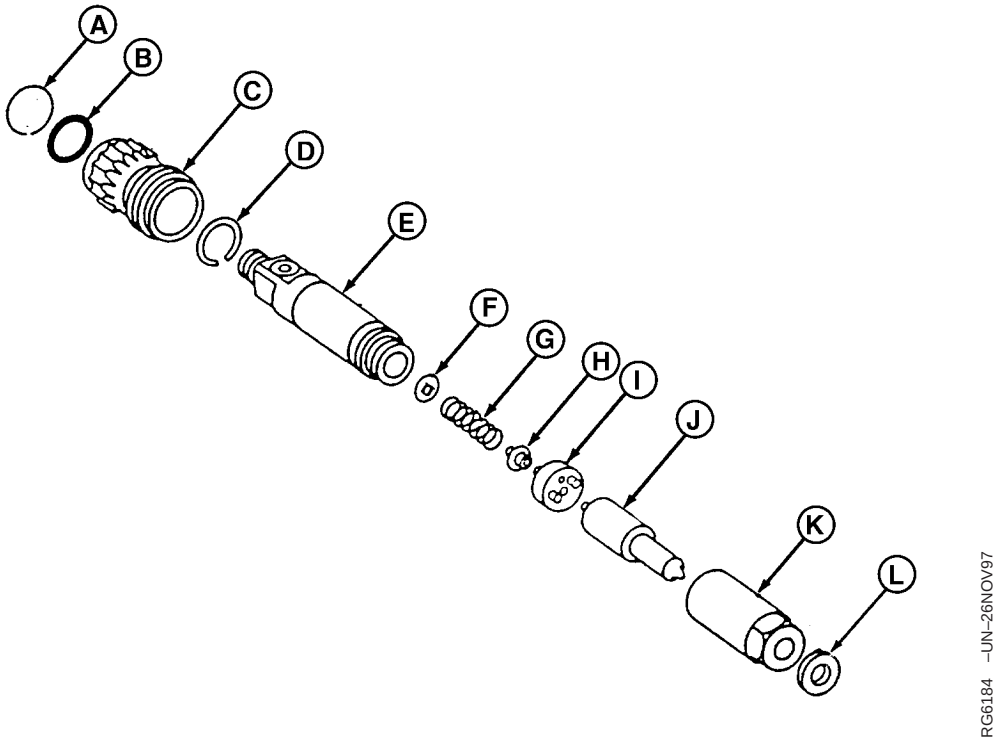



RG3410 –UN–22NOV97

*Injection Nozzle Spring and Pressure Adjusting Shims*

RG,RG34710,1305 –19–23OCT97–1/1

## PERFORM NOZZLE LEAKAGE TEST




*Bosch Injection Nozzle (Nippondenso Similar)*

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

1. Wipe nozzle dry.

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

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

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

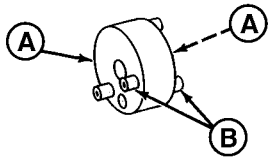
   Leakage indicates a bad seat either between nozzle and intermediate plate (I) or between nozzle holder and intermediate plate.

**Continued on next page**

RG,RG34710,1306 –19–23OCT97–1/2

RG2248 –UN–22NOV97

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




*Nozzle Intermediate Plate*

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

RG,RG34710,1306 –19–23OCT97–2/2

## PERFORM CHATTER AND SPRAY PATTERN TEST

1. Injection nozzle should chatter very softly, and only when hand lever movement is very rapid (four to six downward movements per second). Failure to chatter may be caused by a binding or bent nozzle valve.

2. Until chattering range is reached, the test oil emerges as non-atomized streams. When lever movement is accelerated, sprays should be very broad and finely atomized.

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

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

RG,RG34710,1307 –19–23OCT97–1/1

## DISASSEMBLE FUEL INJECTION NOZZLE

**General Nozzle Repair Notes:**

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

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

Cover workbench with clean paper before disassembly of injection nozzles.

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

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

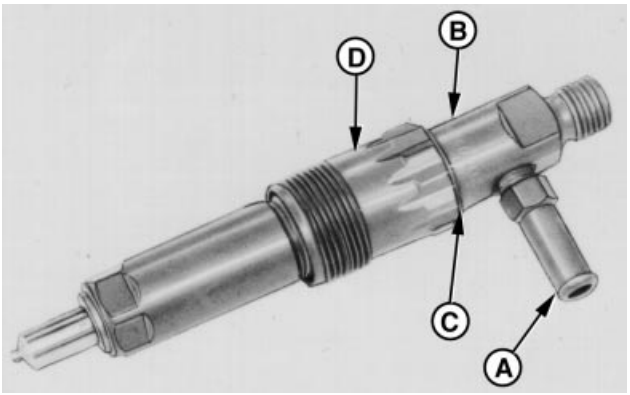
*NOTE: Bosch KDEL and Nippondenso KDAL injection nozzles are metric design. Use only metric tools to service nozzles.*

1. Use an 11 mm box or open-ended wrench and unscrew leak-off connector (A) (if not removed previously) out of nozzle holder (B).

2. Clamp flats of nozzle holder in a soft-jawed vise. Remove upper snap ring (C) from nozzle holder.

3. Slip gland nut (D) off nozzle holder.

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

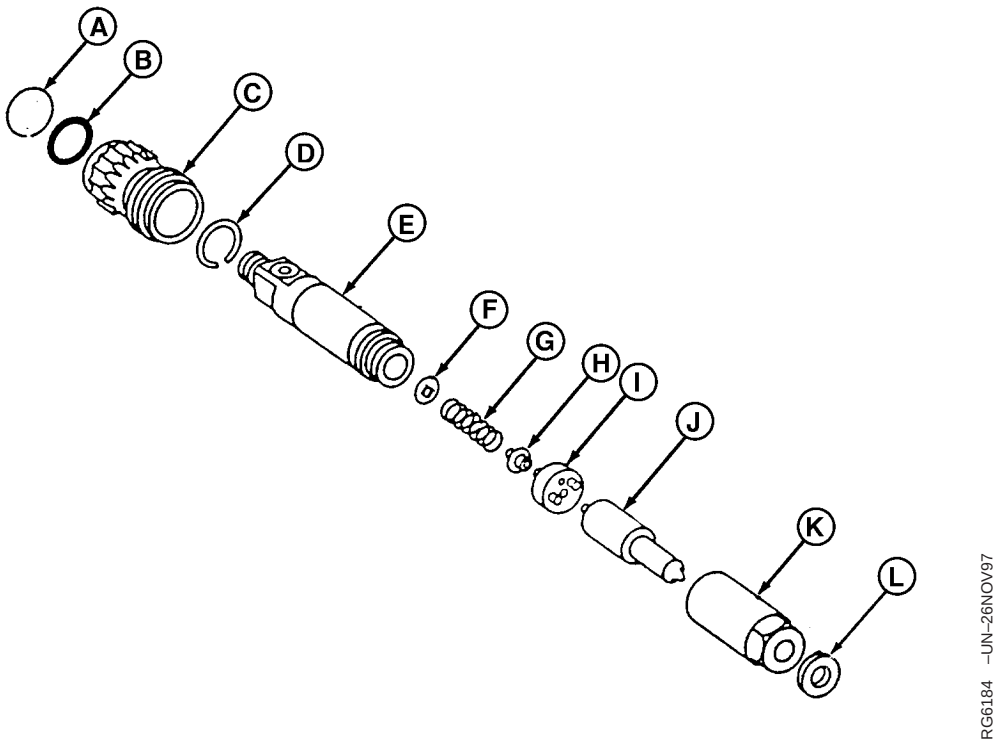



*Disassembly of Injection Nozzle*

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

**Continued on next page**

RG,RG34710,1308 –19–23OCT97–1/2




*Bosch Injection Nozzle (Nippondenso Similar)*

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

4. Remove lower snap ring (D).

5. Clamp the two flats of the nozzle holder (fuel inlet end) in a soft-jawed vise and remove nozzle retaining nut (K), using a 12-point 19 mm wrench.

6. Remove nozzle and valve assembly (J).

7. Pull off intermediate plate (I).

8. Remove spring seat (H), spring (G), and shims (F).

9. Remove gland nut O-ring (B).

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

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

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

RG,RG34710,1308 –19–23OCT97–2/2

## CLEAN AND INSPECT FUEL INJECTION NOZZLE ASSEMBLY

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

1. Remove anti-corrosive coating from new or reconditioned nozzles by washing them thoroughly with diesel fuel.

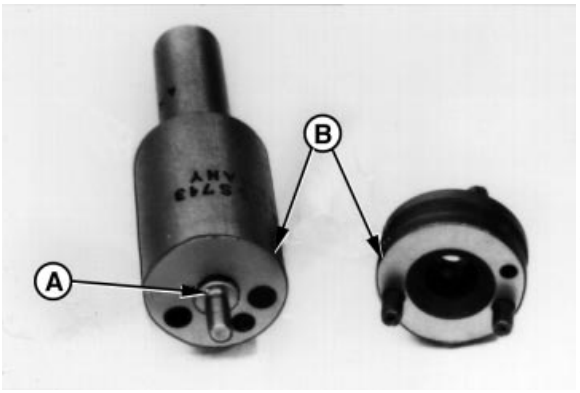
2. Remove carbon from used nozzles and clean by washing them in diesel fuel. If parts are coated with hardened carbon or lacquer, it may be necessary to use a brass wire brush.

3. After removing carbon or lacquer from nozzle exterior, inspect lapped surface for nicks or scratches. Replace if not in good condition.

4. Inspect piston part of nozzle valve (A) to see that it is not scratched or scored. If any of these conditions are present, replace nozzle assembly.

5. Inspect nozzle valve seat, nozzle, and intermediate plate. Contact area of parts (B) must be scored or pitted. Use inspection magnifier in JDF13 (JDE105) Nozzle Cleaning Kit to aid inspection.

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



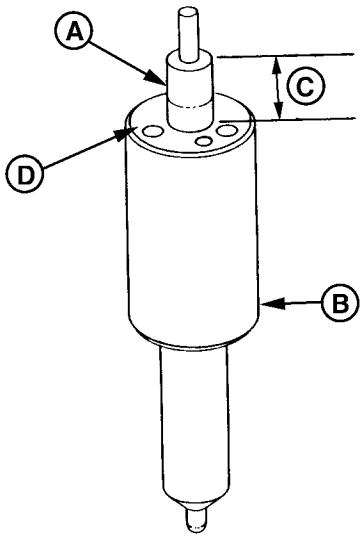

*Inspecting Nozzle Parts*

RG,RG34710,1309 –19–23OCT97–1/1

## PERFORM NOZZLE SLIDE TEST

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

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




RG2233 –UN–21NOV97

*Performing Nozzle Slide Test*

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

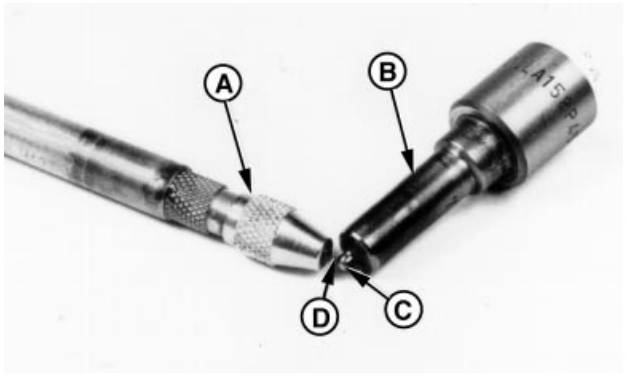
RG,RG34710,1310 –19–23OCT97–1/1

## CLEAN SPRAY ORIFICES

1. Begin with cleaning wire (D) 0.07—0.10 mm (0.003—0.004 in.) from JDF105 Nozzle Cleaning Kit.

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

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



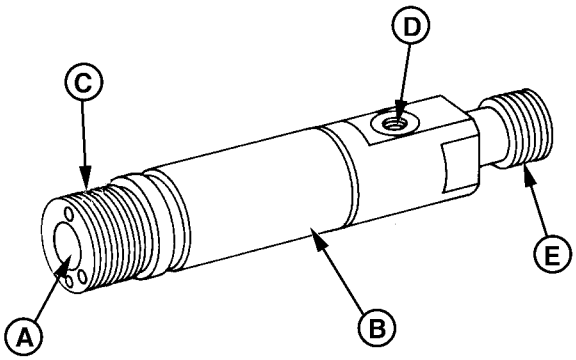

RG5954 –UN–26NOV97

*Cleaning Nozzle Spray Orifices*

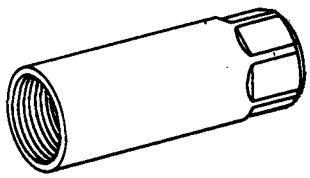
RG,RG34710,1311 –19–23OCT97–1/1

## INSPECT NOZZLE HOLDER

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




RG3413 –UN–22NOV97



RG2247 –UN–20DEC88

RG2247

*Inspecting Nozzle Holder*

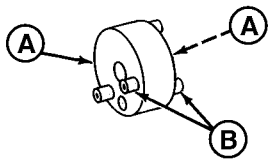
**A—Lapped Surface**
**B—Nozzle Holder**
**C—M19 x 0.75**
**D—M6 x 1.0**
**E—M14 x 1.5**

**Continued on next page**

RG,RG34710,1312 –19–23OCT97–1/3

RG2248 –UN–22NOV97

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




*Inspecting Nozzle Intermediate Plate*

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

RG2249 –UN–20APR89

RG2249

*Inspecting Nozzle Spring Seat*

7. Replace intermediate plate if lapped surfaces are worn or damaged.

8. Inspect spring seat for splitting, cracking, or excessive wear.

   Replace seat if any of these conditions are evident.

**Continued on next page**

RG,RG34710,1312 –19–23OCT97–2/3

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

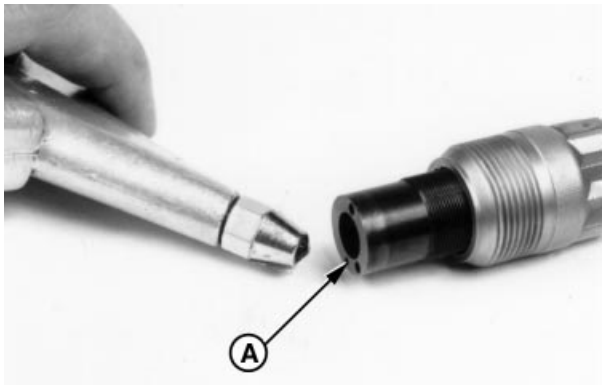
   Replace as necessary.

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

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

RG5955 –UN–30AUG91

*Inspecting Nozzle Spring and Shims*




RG5962 –UN–26NOV97

*Cleaning Nozzle Filter*

RG,RG34710,1312 –19–23OCT97–3/3

## INSPECT GLAND NUT

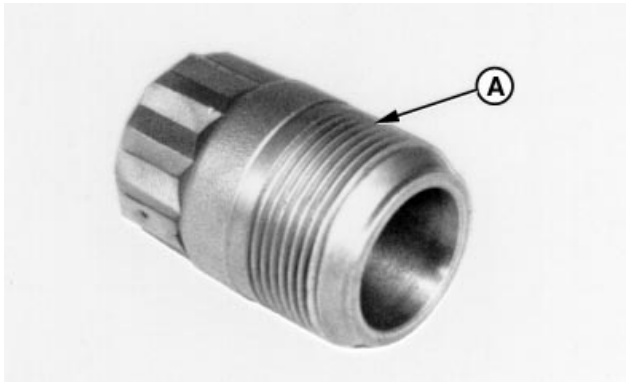
1. Inspect nozzle holder gland nut for general condition; be sure that it is not cracked or split.

2. Inspect M28 x 1.5 threads (A) for general condition. Threads which are slightly nicked or damaged may be “dressed up”.

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

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

4. Blow through connector passage with compressed air.




RG5956 –UN–26NOV97

*Inspecting Nozzle Gland Nut*

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RG,RG34710,1313 –19–23OCT97–1/2

5. Inspect the M6 x1 threads (A) for general condition. Replace connector if threads are damaged and cannot be restored to a serviceable condition.


*Inspecting Leak-off Connector*

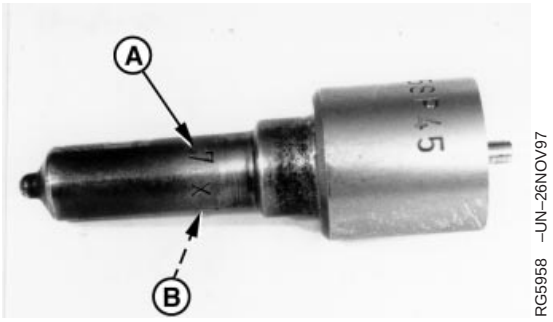
RG,RG34710,1313 –19–23OCT97–2/2

## ASSEMBLE FUEL INJECTION NOZZLE

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

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

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




*Markings on Nozzle Tip*

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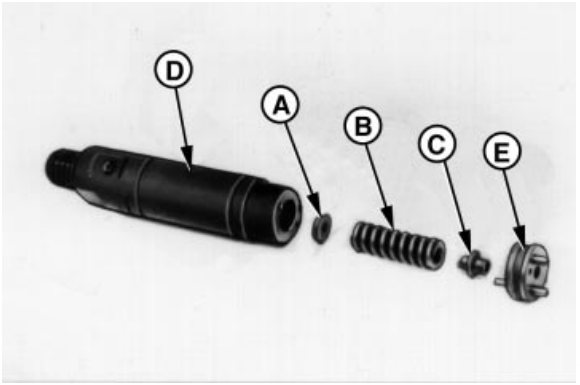
RG,RG34710,1314 –19–23OCT97–1/4

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

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

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



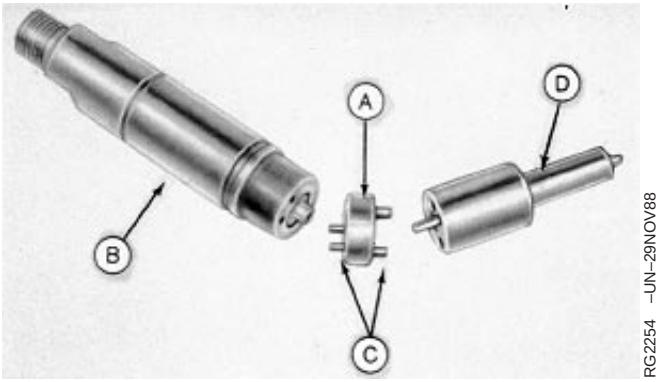

*Assembling Nozzle Holder Parts*

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

RG,RG34710,1314 –19–23OCT97–2/4

2. Position intermediate plate (A) on nozzle holder (B). Dowel pins (C) in plate will permit installation only one way.

3. Insert nozzle valve into nozzle (D) while holding parts below diesel fuel level in pan.




*Assembling Nozzle Valve Parts*

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

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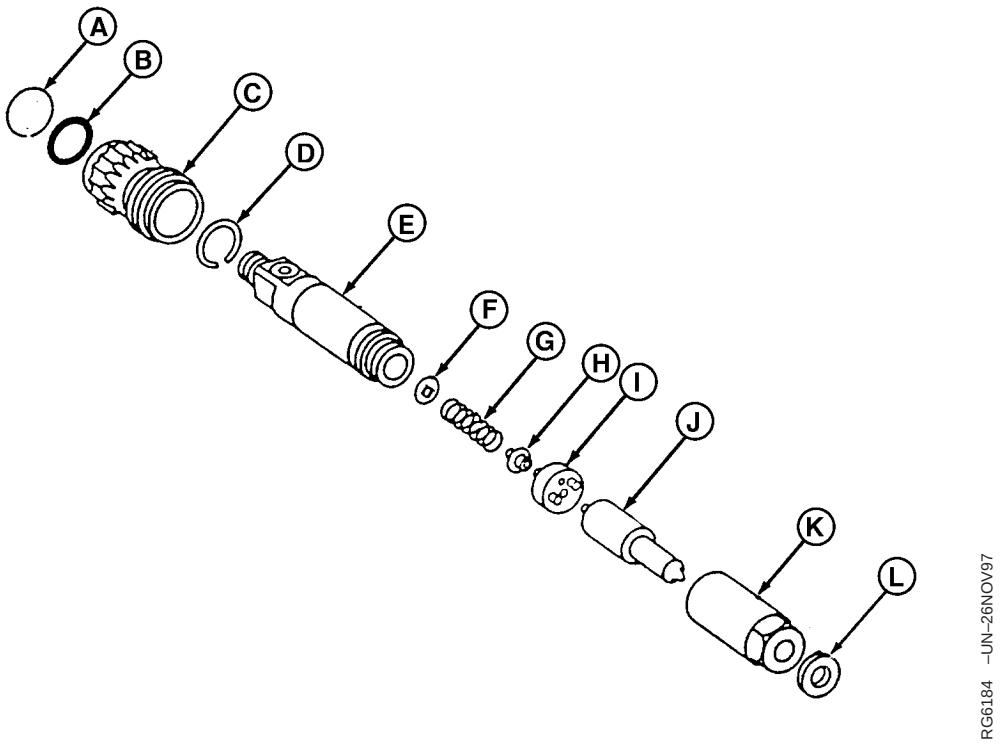
RG,RG34710,1314 –19–23OCT97–3/4




*Bosch Injection Nozzle (Nippondenso Similar)*

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

4. Install nozzle assembly on nozzle holder (E) and secure with nozzle retaining nut (K).

5. Clamp nozzle holder in a soft-jawed vise. Tighten nozzle retaining nut to 60– 80 N•m (44–59 lb-ft).

6. Install lower snap ring (D) on nozzle holder.

7. Coat bore of gland nut (C) liberally with PT569 NEVER-SEEZ compound to prevent gland nut from seizing on holder body.

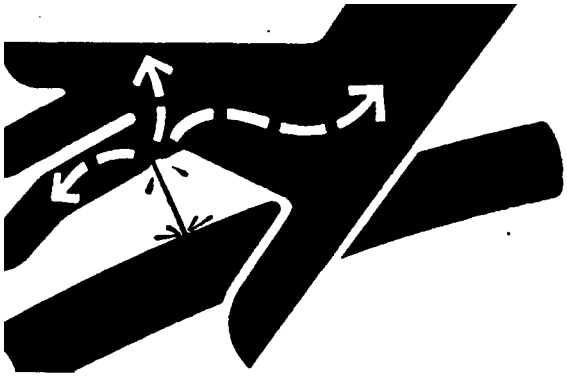
8. Install upper snap ring (A) on nozzle holder (Bosch only) and position O-ring (B) against gland nut.

9. Install leak-off connector on nozzle holder (E) using a new washer.

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

RG,RG34710,1314 –19–23OCT97–4/4

## TEST AND ADJUST INJECTION NOZZLE OPENING PRESSURE



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

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

RG,RG34710,1315 –19–23OCT97–1/1

## INSPECT AND CLEAN CYLINDER HEAD NOZZLE BORE

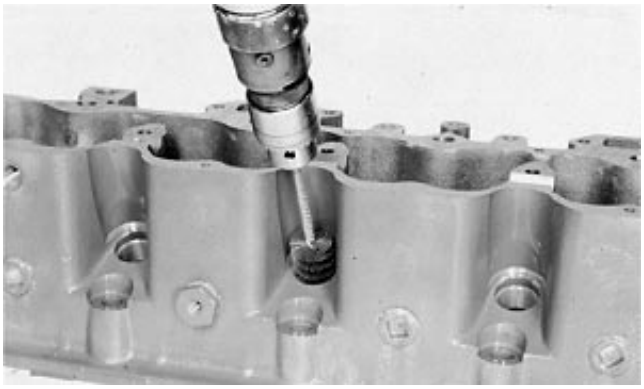
1. Inspect condition of threads for gland nut. Threads are metric (M28 x 1.5).

2. Inspect condition of nozzle seating in cylinder head.

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

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

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



RG5251 –UN–14DEC88

*Cleaning Nozzle Bores in Cylinder Head*

RG,RG34710,1316 –19–23OCT97–1/2

4. Clean threads with heavy foreign deposits or clean up damaged threads by using JDF5 Tap (M28 X 1.5 mm). Be sure to start tap straight to avoid possible cross-threading. A light coat of grease on tap will help collect foreign deposits on tap and prevent them from falling into nozzle bore.

5. After cleaning threads, insert a 13 mm (1/2 in.) tapered hardwood dowel to plug nozzle tip bore.

6. Blow out debris from nozzle cavity with compressed air; then remove wood dowel.

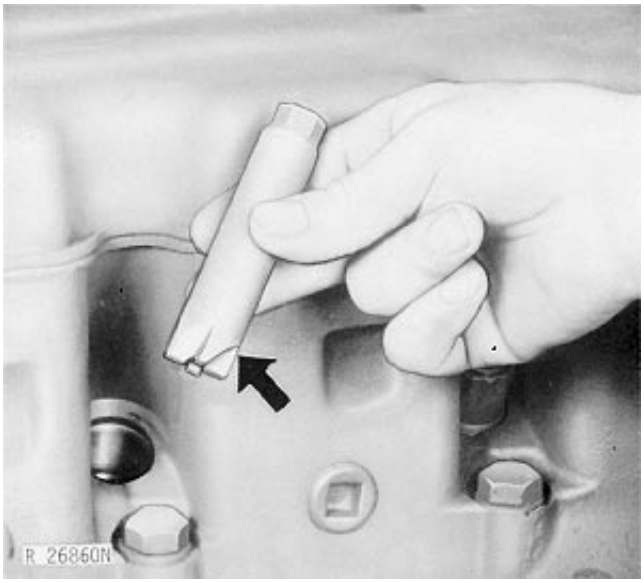

R28263N –UN–20DEC88

*Using Tap to Clean Threads in Nozzle Bores*

RG,RG34710,1316 –19–23OCT97–2/2

## INSPECT AND CLEAN NOZZLE SEATING SURFACE

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




R26860N –UN–20DEC88

*Cleaning Nozzle Seats in Head*

RG,RG34710,1317 –19–23OCT97–1/1

## INSTALL FUEL INJECTION NOZZLES

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

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

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

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


RG5888 –UN–26NOV97

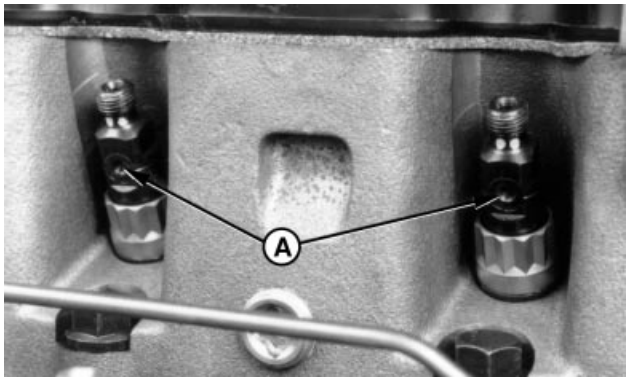
*Preparing Nozzle for Installation*

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

**Continued on next page**

RG,RG34710,1318 –19–23OCT97–1/7

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

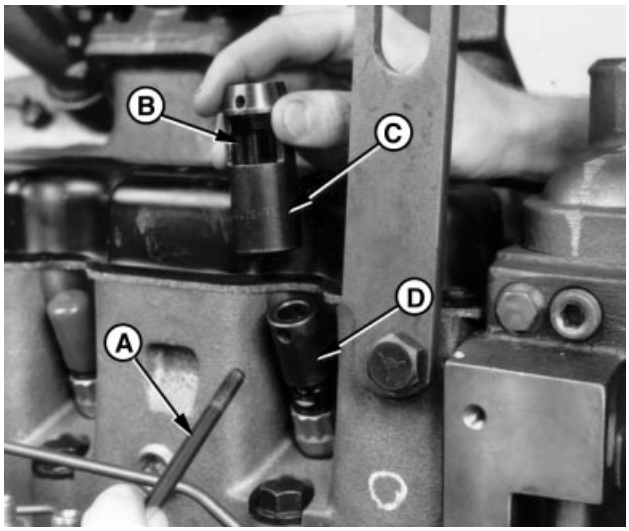



*Installing Injection Nozzles in Cylinder Head*

RG,RG34710,1318 –19–23OCT97–2/7

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

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




*Indexing of Injection Nozzle*

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

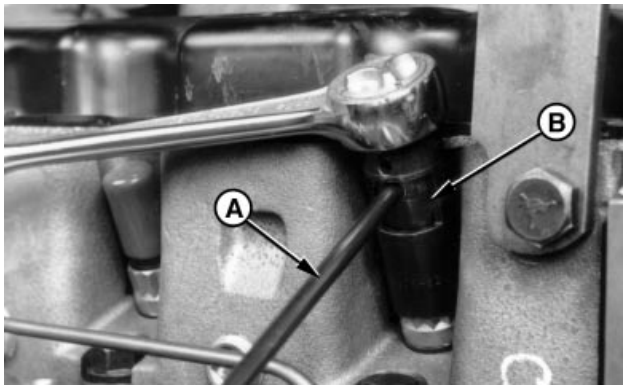
**Continued on next page**

RG,RG34710,1318 –19–23OCT97–3/7

9. Tighten injection nozzle gland nut to 88 N•m (65 lb-ft). Keep handle (A) pointing straight out while tightening.

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

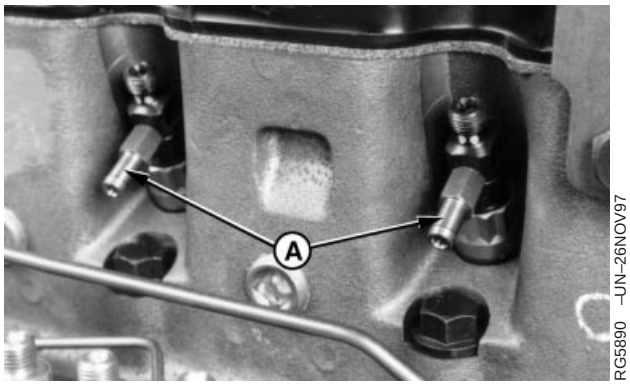
10. Be sure O-ring is positioned against injection nozzle gland nut.




*Torquing Nozzle Gland Nut*

RG,RG34710,1318 –19–23OCT97–4/7

11. Install leak-off connectors (A) with O-rings on injection nozzles. Tighten securely.




*Installing Nozzle Leak-off Connectors*

**Continued on next page**

RG,RG34710,1318 –19–23OCT97–5/7

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

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

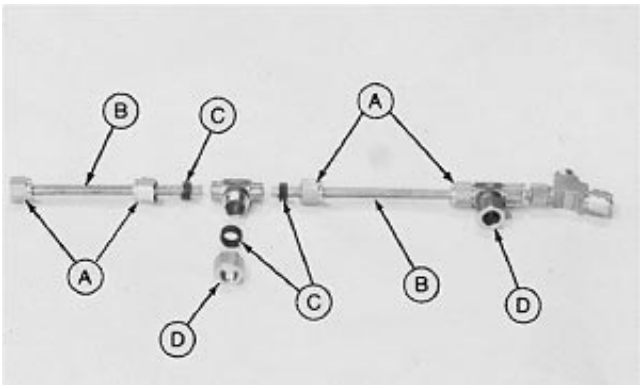
13. Check all pipes and fittings for wear or damage and replace as necessary.

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

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

16. Tighten all leak-off line connections securely at each injection nozzle.

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




RG5091 –UN–14DEC88

*Installing Nozzle Leak-off Lines*

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

**Continued on next page**

RG,RG34710,1318 –19–23OCT97–6/7

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

**IMPORTANT: On Bosch “P” pumps, use JDE90 Serrated Wrench (B) to keep delivery valve fittings stationary while tightening fuel line nuts. If a delivery valve and barrel housing rotates while tightening a fuel line nut, injection pump fuel delivery will be altered, and pump will have to be recalibrated on a test stand. (On Nippondenso “A” pumps, use JDF22 Crowsfoot Wrench to avoid turning valve fittings.)**

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

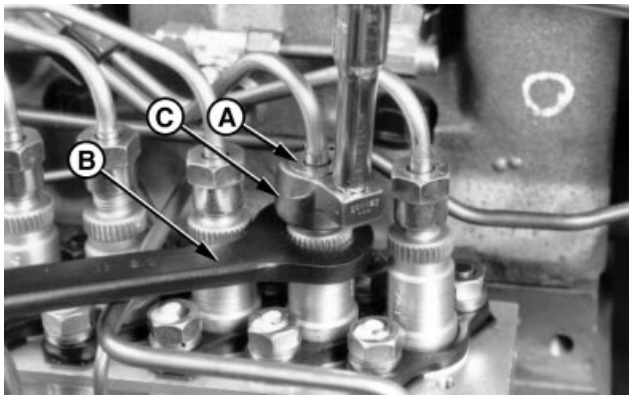
20. Tighten fuel injection line nozzle nuts (A) to 27 N•m (20 lb-ft).

21. Tighten line nuts at delivery valves to 27 N•m (20 lb-ft) as follows:

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

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

22. Bleed the fuel system. (See BLEED THE FUEL SYSTEM, in Group 105 of CTM134.)




RG5877 –UN–26NOV97

*Connecting Injection Lines (Bosch “P” Pump Shown )*

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

RG,RG34710,1318 –19–23OCT97–7/7

## SPECIAL OR ESSENTIAL TOOLS

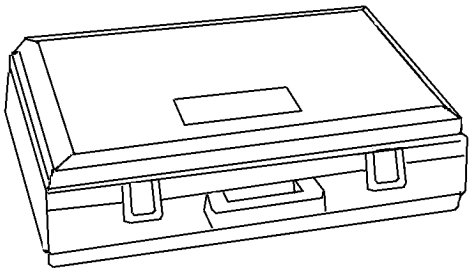
*NOTE: Order tools from the U.S. SERVICEGARD™ or European Microfiche Tool Catalogs.*

*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,1319 –19–23OCT97–1/11

Electrical Repair Tool Kit. . . . . JDG155

Remove and install wires into connectors



RW25558 –UN–29AUG96

*JDG155*

RG,RG34710,1319 –19–23OCT97–2/11

JDG155 Electrical Repair Tool Kit includes:

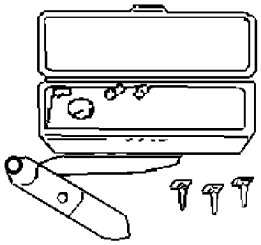
- JDG107 Holding Plate
- JDG139 Contact Insertion Tool
- JDG140 Contact Extraction Tool
- JDG141 Contact Extraction Tool
- JDG142 Contact Extraction Tool
- JDG143 Contact Extraction Tool
- JDG144 Crimping Pliers
- JDG145 Electrician's Pliers
- JDG146 Carrying Case

**Continued on next page**

RG,RG34710,1319 –19–23OCT97–3/11

DEUTSCH™ Electrical Repair Tool Kit. . . . . JDG359

Repair Deutsch electrical connector bodies



RW25540 –UN–06SEP96

*JDG359*

*DEUTSCH is a trademark of Deutsch Co.*

RG,RG34710,1319 –19–23OCT97–4/11

JDG359 DEUTSCH™ Electrical Repair Tool Kit includes:

- JDG360 Crimper
- JDG361 12—14 Gauge Extractor (Set of Two)
- JDG361 16—18 Gauge Extractor (Set of Two)
- JDG363 20—24 Gauge Extractor (Set of Two)

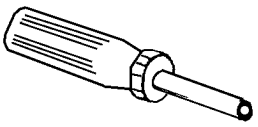
*DEUTSCH is a trademark of Deutsch Co.*

RG,RG34710,1319 –19–23OCT97–5/11

RW25539 –UN–28AUG96

WEATHER PACK™ Extraction Tool . . . . . .JDG364[1]

Remove wires from connectors



*JDG364*

*WEATHER PACK is a trademark of Packard Electric.*

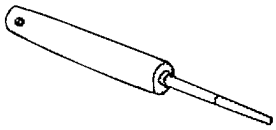
*[1]Included in JT07195A Electrical Repair Kit.*

RG,RG34710,1319 –19–23OCT97–6/11

RW25541 –UN–20AUG96

WEATHER PACK™ Extractor (Wide). . . . . .JDG776[1]

Remove terminals from METRI-PACK™ connectors



*JDG776*

*WEATHER PACK is a trademark of Packard Electric.*
*METRI-PACK is a trademark of Packard Electric.*

*[1]Included in JT07195A Electrical Repair Kit*

**Continued on next page**

RG,RG34710,1319 –19–23OCT97–7/11

WEATHER PACK™ Extractor (Narrow) . . . . . .JDG777[1]

Remove terminals from METRI-PACK™ connectors

*WEATHER PACK is a trademark of Packard Electric.*
*METRI-PACK is a trademark of Packard Electric.*

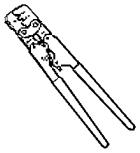
*[1]Included in JT07195A Electrical Repair kit*

RG,RG34710,1319 –19–23OCT97–8/11

RW25542 –UN–20AUG96

WEATHER PACK™ Crimping Tool . . . . . JDG783

Crimp contacts to wires



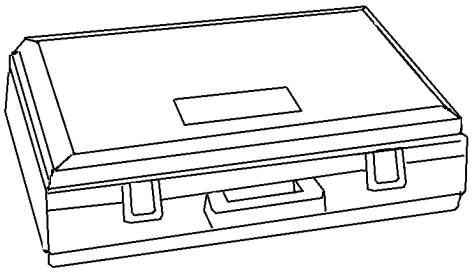
*JDG783*

*WEATHER PACK is a trademark of Packard Electric.*

RG,RG34710,1319 –19–23OCT97–9/11

Technician's Electrical Repair Kit . . . . . .JT07195A

Remove and install wires into connectors



RW25558 –UN–29AUG96

*JT07195A*

**Continued on next page**

RG,RG34710,1319 –19–23OCT97–10/11

Technician's Electrical Repair Kit includes:

- JDG140 Contact Extraction Tool
- JDG141 Contact Extraction Tool
- JDG361 12—14 Gauge Extractor
- JDG362 16—18 Gauge Extractor
- JDG364 Weather Pack Extractor
- JDG776 Metripack Extractor
- JDG777 Weather Pack/Metripack Narrow Extractor
- JDG785 6–8 Gauge Deutsch Extractor
- 307382 Carrying Case

RG,RG34710,1319 –19–23OCT97–11/11

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| JDT405 (U.S.) | High Temperature Grease | Sensor O-rings. |
| AT66865 (U.S.) | Lubricant | Insulate electrical connectors |

RG,RG34710,1320 –19–23OCT97–1/1

## TORQUES

| ITEM | TORQUE |
|---|---|
| Alternator Mounting Hardware | 27 N•m (20 lb-ft) (upper)<br>80 N•m (60 lb-ft) (lower) |
| Alternator Mounting Bracket and Strap Hardware | 61 N•m (45 lb-ft) |
| Starting Motor Mounting Hardware | 44 N•m (33 lb-ft) (upper)<br>27 N•m (20 lb-ft) (lower) |
| Coolant Temperature Sensor | 14 N•m (10 lb-ft) |
| Fuel Shutoff Solenoid | 50 N•m (37 lb-ft) |

RG,RG34710,1321 –19–23OCT97–1/1

## REMOVE AND INSTALL ALTERNATOR (OEM ENGINES)

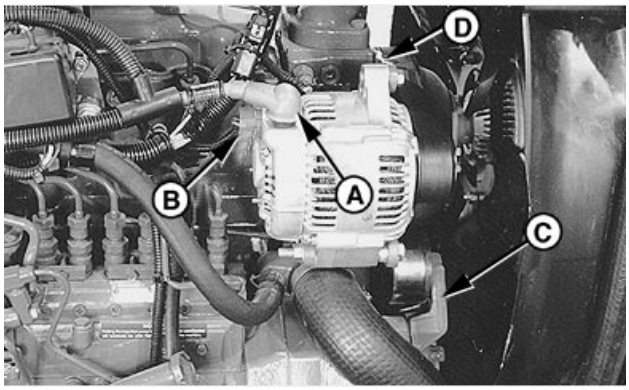
**IMPORTANT: The alternator is designed with a Transient Voltage Protector (TVP) to protect the engine electronics. A regular alternator without the TVP could cause extensive damage to the electronics.**

*NOTE: For test and repair of alternator, refer to Electrical system Repair chapter.*

1. Disconnect battery ground (-) cable.
2. Disconnect positive (+) red wire (A) and regulator connector (B).
3. Remove alternator belt using a 1/2 in. drive ratchet on the belt tensioner (C).
4. Remove mounting cap screws from bracket (D) and remove alternator.
5. Install alternator in reverse order.
6. Torque alternator mounting hardware as follows: Upper cap screw nut: 27 N•m (20 lb-ft). Lower (bracket) cap screw nut: 80 N•m (60 lb-ft).

*NOTE: If alternator mounting bracket or strap are removed and reinstalled, torque cap screws to 61 N•m (45 lb-ft).*

7. Inspect alternator belt for cracks and wear. To adjust belt tension, refer to operator's manual.




*Alternator*

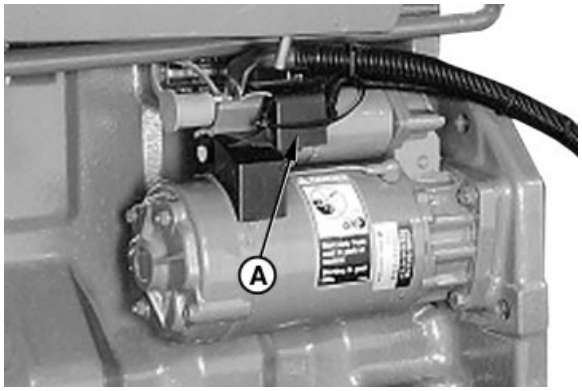
**A—Positive Wire**
**B—Regulator Connector**
**C—Belt Tensioner**
**D—Alternator Bracket**

RG,RG34710,1322 –19–23OCT97–1/1

## REMOVE AND INSTALL STARTING MOTOR (OEM ENGINES)

*NOTE: For test and repair of starting motor, refer to Electrical system Repair chapter.*

1. Disconnect battery ground (-) cable.
2. Disconnect all cables and wires from starter solenoid (A).
3. Remove starting motor using JDG725 Starter Wrench.
4. Install starting motor in reverse order.
5. Torque motor mounting hardware as follows:
   - Upper stud nut: 44 N•m (33 lb-ft).
   - Lower cap screws: 27 N•m (20 lb-ft).

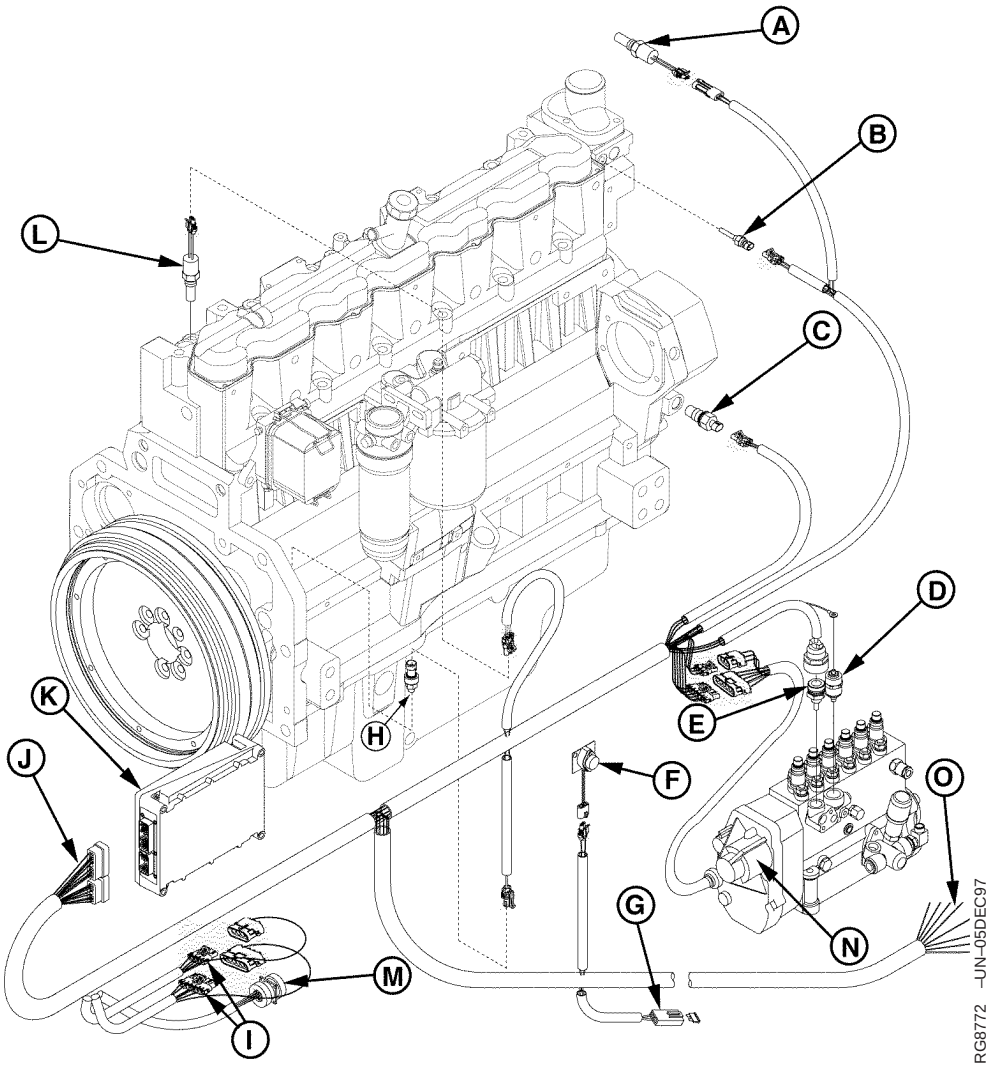



RG8768 –UN–02DEC97

*Starting Motor*

RG,RG34710,1323 –19–23OCT97–1/1

## ELECTRONIC ENGINE CONTROL SYSTEM AND SENSORS (DEERE ECU SHOWN)




*Electronic Engine Control System and Sensors (John Deere ECU Shown)*

**A—Manifold Air Temperature (MAT) Switch**
**B—Engine Coolant Temperature Sensor**
**C—Auxiliary Engine Speed Sensor**
**D—Fuel Shutoff Solenoid**
**E—Fuel Temperature Sensor**
**F—Transient Voltage Protection (TVP) Module**
**G—Fuse**
**H—Engine Oil Pressure Sensor**
**I—Diagnostic and Service Connectors**
**J—Electronic Wiring Harness**
**K—Engine Control Unit (ECU)**
**L—Loss of Coolant Sensor**
**M—CAN Bus Connector**
**N—Rack Actuator Assembly**
**O—Taped Wires[1]**

**IMPORTANT: DO NOT pressure wash the Engine Control Unit (ECU).**

*NOTE: For diagnosis and testing of the electronic engine control and sensors, refer to the following manuals: Earlier Bosch ECU systems—CTM68. Later John Deere ECU systems—CTM134.*

*[1]These wires do not have terminal ends attached. They are to be spliced and used per application requirements.*

RG,RG34710,1324 –19–23OCT97–1/1

## REMOVE AND INSTALL SENSORS

Refer to the diagram on previous page to identify and locate the various sensors on the engine which feed signals to the electronic control system.

1. Disconnect sensor wiring connector.
2. Remove sensor from bore.
3. Coat sensor O-ring with JDT405 High Temperature Grease and install sensor in its bore.
4. Tighten sensors securely, or to following torques:

**Coolant Temperature Sensor—Specification**

Torque ..... 14 N•m (10 lb-ft)

**Fuel Shutoff Solenoid (on Injection Pump)—Specification**

Torque ..... 50 N•m (37 lb-ft)

5. Install sensor wire connector.

RG,RG34710,1325 –19–23OCT97–1/1

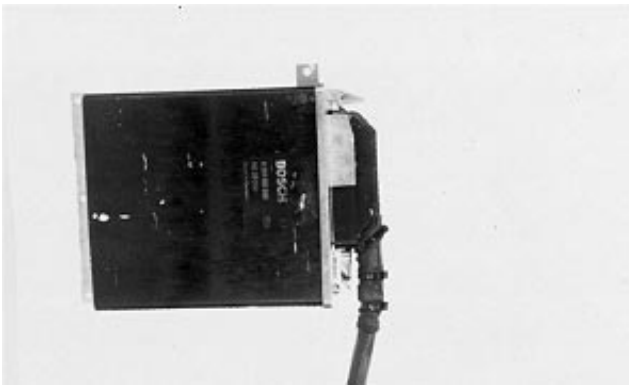
## ENGINE CONTROL UNIT (ECU)

**IMPORTANT: DO NOT OPEN ENGINE CONTROL UNIT.**

The Engine Control Unit is not repairable. If it is found to be defective, replace it as a unit.

**IMPORTANT: If an Engine Control Unit (ECU) is not programmed identically with the original (failed) Control Unit, misleading diagnostic messages, poor performance, or engine damage can occur.**

The wiring connector for the Engine Control Unit is repairable. For later Deere ECUs, see REPLACE (Pull Type) METRI-PACK™ CONNECTORS later in this group. For earlier Bosch ECU's, refer to CTM68, Electronic Fuel Injection Systems.




RG5350 –UN–09JAN90

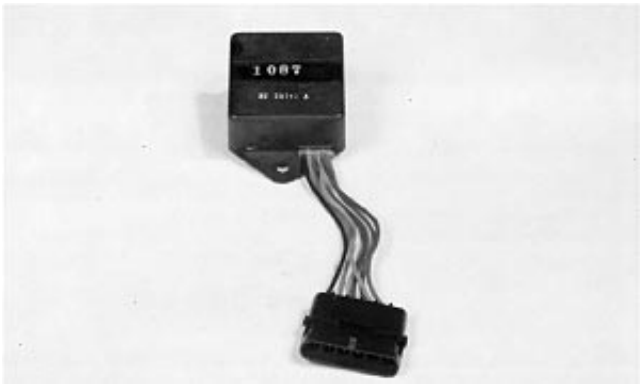
*Engine Control Unit (ECU) - Bosch shown*

*METRI-PACK is a trademark of Packard Electric.*

RG,RG34710,1326 –19–23OCT97–1/1

## TRANSIENT VOLTAGE PROTECTION (TVP) MODULE

The TVP module is not repairable. If the TVP module is defective, the unit must be replaced. The connector on the TVP module wiring harness is repairable. Refer to REPLACE WEATHER PACK™ CONNECTOR later in this group.



RG5374 –UN–09JAN90

*Transient Voltage Protection (TVP module)*

*WEATHER PACK is a trademark of Packard Electric*

RG,RG34710,1327 –19–23OCT97–1/1

## CONNECTORS

Connectors are devices that provide for assembly and disassembly of systems. Connectors should always be serviced using tools designed for that type of connector. A good crimp is important to mechanical and electrical soundness. Repaired connectors should be physically tested by pulling to be sure the contact is firmly attached to the conductor.

**IMPORTANT: If for some reason the connectors are not connected, such as when the fuel injection pump is removed, it is important to protect the connectors from debris.**

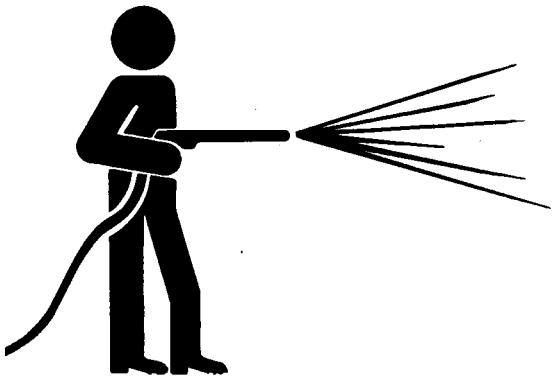
*NOTE: See earlier in this group for a diagram showing location of all sensor connectors. For vehicle engines, refer to machine Operation and Tests manual for complete wiring diagrams, including connectors.*

Refer to the procedures which follow for repair of various type of connectors.

RG,RG34710,1328 –19–23OCT97–1/1

## USING HIGH-PRESSURE WASHER

**IMPORTANT: Reduce pressure when directing pressurized water at electronic or electrical components and connectors as this may cause the components to malfunction. Always reduce pressure, and spray at a 45 to 90 degree angle.**



T6642EJ –UN–18OCT88

*Using High-Pressure Washer*

RG,RG34710,1329 –19–23OCT97–1/1

## REPLACE WEATHER PACK™ CONNECTOR

**IMPORTANT: Identify wire color locations with connector terminal letters.**

Open connector body.

Insert JDG364 Extraction Tool[1] over terminal contact in connector body.

Hold extractor tool fully seated and pull wire from connector body.

TS0128 –UN–23AUG88

*Removing Wire from WEATHER PACK™ Connector*

*WEATHER PACK is a trademark of Packard Electric.*

*[1]Included in JT07195A Electrical Repair Kit*

RG,RG34710,1330 –19–23OCT97–1/4

*NOTE: If terminal cannot be removed, insert wire or nail through extractor tool handle and push terminal contact from connector.*

Insert JDG364 Extraction Tool over terminal contact in connector body.

TS0128 –UN–23AUG88

*Inserting JDG364 Extraction Tool*

RG,RG34710,1330 –19–23OCT97–2/4

Hold extractor tool fully seated and pull wire from connector body.

TS0129 –UN–23AUG88

*Pulling Wire from Connector Body*

**Continued on next page**

RG,RG34710,1330 –19–23OCT97–3/4

*NOTE: If terminal cannot be removed, insert wire or nail through extractor tool handle and push terminal contact from connector.*

**IMPORTANT: Carefully spread contact lances to assure good seating on connector body.**

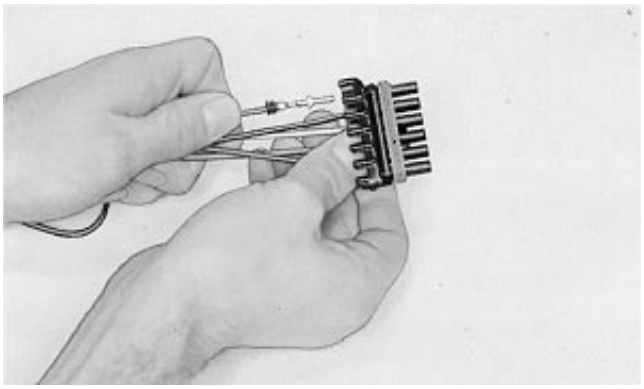
*NOTE: Connector bodies are "keyed" for correct contact. Be sure contacts are correctly aligned.*

Push contact into new connector body until fully seated.

Pull on wire slightly to insure contact is locked in position.

Transfer remaining wires to correct terminal in new connector.

Close connector body.



TS0130 –UN–23AUG88

*Pushing Contact into Connector Body*

RG,RG34710,1330 –19–23OCT97–4/4

## INSTALL WEATHER PACK™ CONTACT

*NOTE: Cable seals are color coded for three sizes of wire:*

- *Green - 18 to 20 gauge wire*
- *Gray - 14 to 16 gauge wire*
- *Blue - 10 to 12 gauge wire*

Push correct size cable seal on wire.

**IMPORTANT: The seal must fit snug over the cable insulation, without a gap between the cable seal and the insulation.**

Strip insulation from wire to expose 6 mm (1/4 in.) and align cable seal with edge of insulation.

TS0136 –UN–23AUG88

*WEATHER PACK™ Contact*

*WEATHER PACK is a trademark of Packard Electric.*

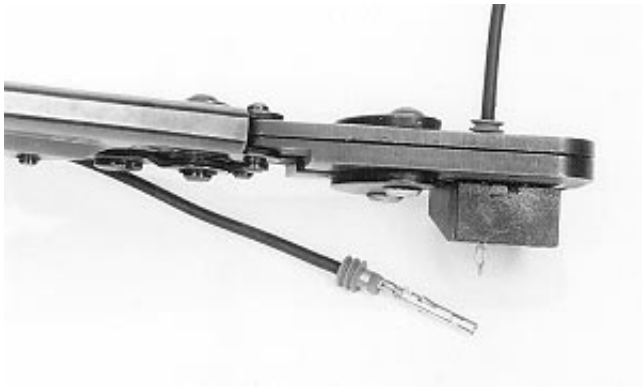
**Continued on next page**

RG,RG34710,1331 –19–23OCT97–1/4

*NOTE: Contacts have numbered identification for two sizes of wire:*

- *#15 for 14 to 16 gauge wire*
- *#19 for 18 to 20 gauge wire*

Put correct size contact on wire and crimp in place with a W-type crimp using a JDG783 WEATHER PACK™ Crimping Tool.



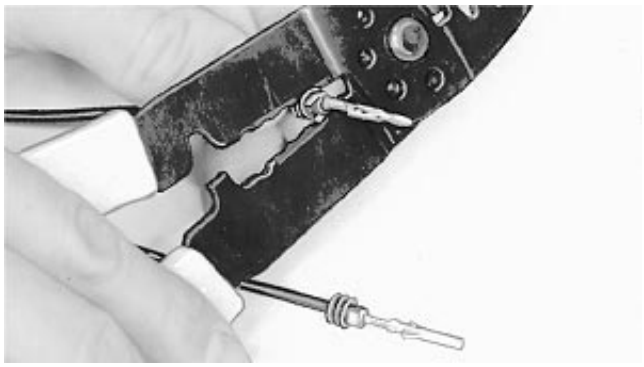
TS1623 –UN–02NOV94

*Crimping WEATHER PACK™ Connector to Wire*

*WEATHER PACK is a trademark of Packard Electric*

RG,RG34710,1331 –19–23OCT97–2/4

Secure cable seal to contact using a JDG783 WEATHER PACK™ Crimping Tool.



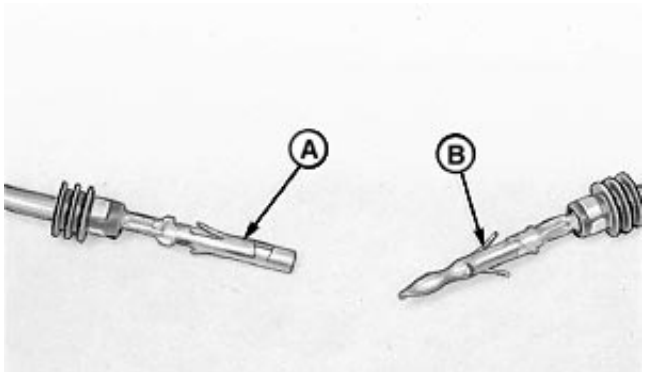
TS0138 –UN–23AUG88

*Securing Cable Seal to Contact*

*WEATHER PACK is a trademark of Packard Electric.*

RG,RG34710,1331 –19–23OCT97–3/4

**IMPORTANT: Correct contact installation for sleeve (A) and pin (B) is illustrated.**




RGTS0139 –UN–12JAN98

*Correct WEATHER PACK™ Installation*

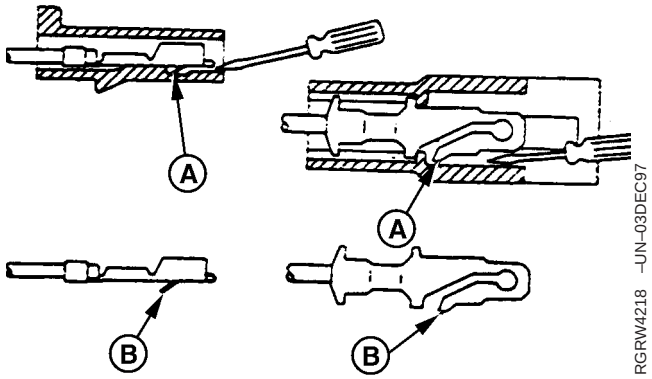
*WEATHER PACK is a trademark of Packard Electric.*

RG,RG34710,1331 –19–23OCT97–4/4

## REMOVE CONNECTOR BODY FROM BLADE TERMINALS

Depress locking tang (A) in terminal using a small screw driver. Remove connector body.

Bend locking tang back to the original position (B) before installing connector body.




*Removing Connector Body from Blade Terminals*

RG,RG34710,1332 –19–23OCT97–1/1

## REPLACE (PULL TYPE) METRI-PACK™ CONNECTORS

*NOTE: The Deere Engine Control Unit (ECU) has this type of connector.*

Disconnect the METRI-PACK™ connector (A). Remove tie bands and tape.

Insert a “T” pin (B) 6.4 mm (1/4 in.) into connector body socket (C).

*NOTE: Use JDG777 Terminal Extraction Tool[1] or “T” pin to remove terminals.*

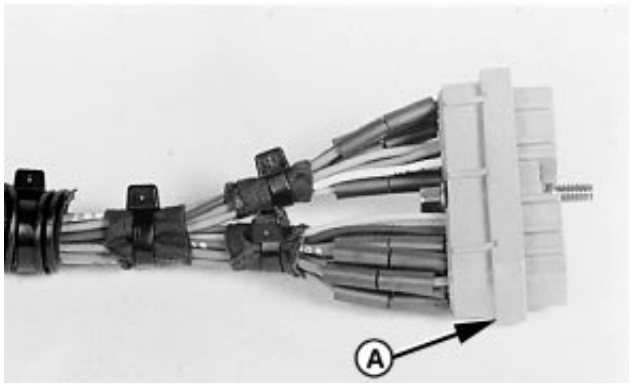
Angle “T” pin so pin tip slides close to the plastic socket edge pushing terminal locking tab (D) inward.

Remove “T” pin and push terminal (E) out of socket.

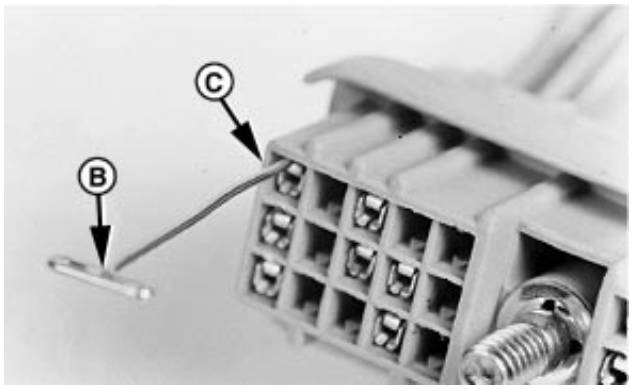
Remove terminal, cut, strip and crimp wire through connector.

Check to make sure locking tab on new terminal is in outward position, then pull on wire until terminal locks in connector body socket.

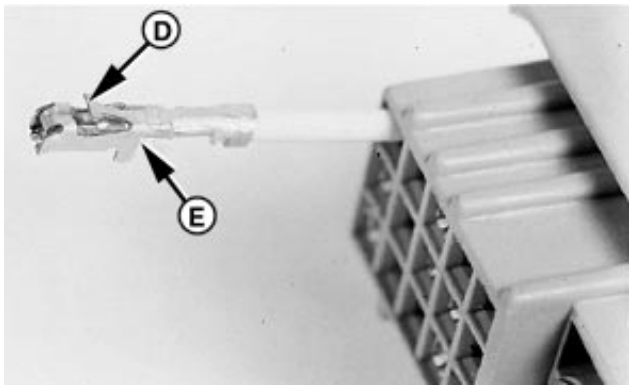
*NOTE: Terminal will seat only one way. If terminal does not pull into the connector body socket, check to make sure terminal is aligned correctly.*




*Disconnecting (Pull Type) METRI-PACK™ Connector*




*Inserting T-Pin into Socket*




*Removing Terminal from Socket*

**A—Connector**
**B—“T” Pin**
**C—Body Socket**
**D—Locking Tab**
**E—Push Terminal**

*METRI-PACK is a trademark of Packard Electric.*

*[1]Included in JT07195A Electrical Repair Kit*

RG,RG34710,1333 –19–23OCT97–1/1

## REPLACE (PUSH TYPE) METRI-PACK™ CONNECTORS

Disconnect the METRI-PACK™ connector. Remove the tie bands and tape.

Remove the connector lock (A), and mark wire colors for identification.

Identify wire color locations with connector terminal letters.

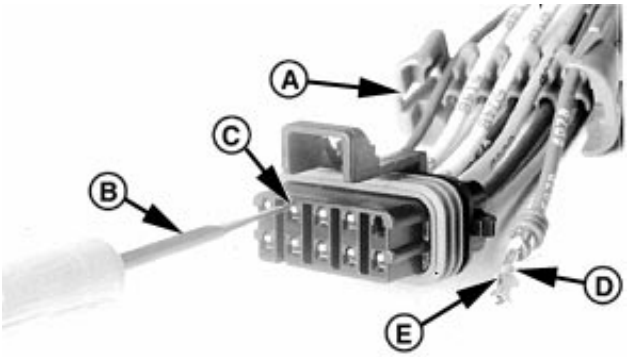
Insert JDG776 or JDG777 Terminal Extraction Tool (B) into connector body socket (C) pushing the terminal locking tab inward.

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

Remove extraction tool and pull terminal (D) out of the socket.

Replace terminal. Make sure locking tab (E) on the new terminal is in the outward position.

Push terminal into connector body socket until terminal locks.




RGRW21325 –UN–03DEC97

*Replacing (Push Type) METRI-PACK™ Connectors*

**A—Connector Lock**
**B—Extraction Tool JDG77[1]**
**C—Connector Body Socket**
**D—Terminal**
**E—Locking Tab**

*METRI-PACK is a trademark of Packard Electric.*

*[1]Included in JT07195A Electrical Repair Kit*

RG,RG34710,1334 –19–23OCT97–1/1

## USE ELECTRICAL INSULATING COMPOUND

Apply AT66865 Compound directly to the terminals between the wire seal and connector body. This provides a moisture barrier, especially in wet and humid conditions.

RG,RG34710,1335 –19–23OCT97–1/1

## REPLACE DEUTSCH™ CONNECTORS

Select correct size extractor tool for size of wire to be removed:

- JDG361 Extractor Tool[1] for 12 to 14 gauge wire
- JDG362 Extractor Tool[1] for 16 to 18 gauge wire
- JDG363 Extractor Tool[1] for 20 gauge wire

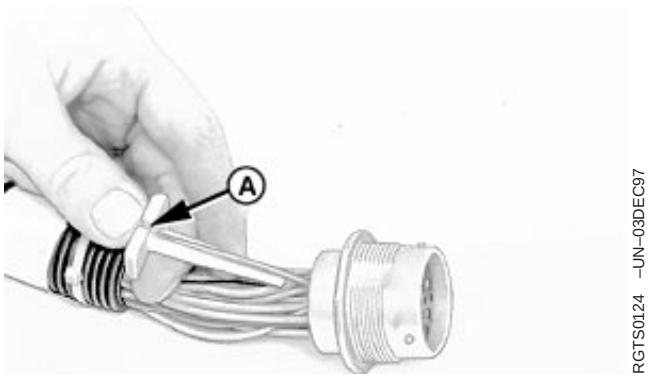
Start correct size extractor tool over wire at handle (A).

Slide extractor tool rearward along wire until tool tip snaps onto wire.

**IMPORTANT: DO NOT twist tool when inserting in connector.**

Slide extractor tool along wire into connector body until tool is positioned over terminal contact.

Pull wire from connector body using extractor tool.



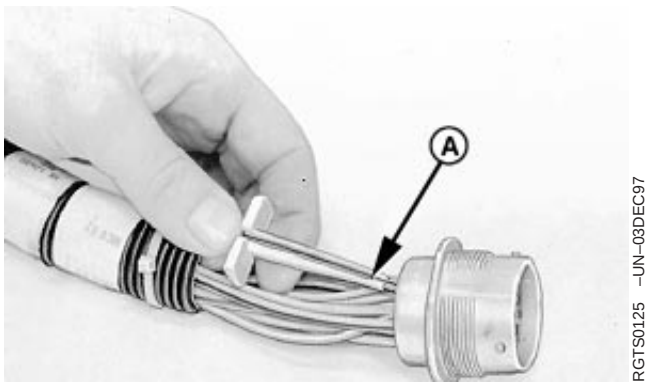

*Extractor Tool for DEUTSCH™ Connectors*

*DEUTSCH is a trademark of Deutsch Co.*

*[1]Included in JDG359 DEUTSCH Electrical Repair Kit*

RG,RG34710,1336 –19–23OCT97–1/5

Slide extractor tool rearward along wire until tool tip (A) snaps onto wire.



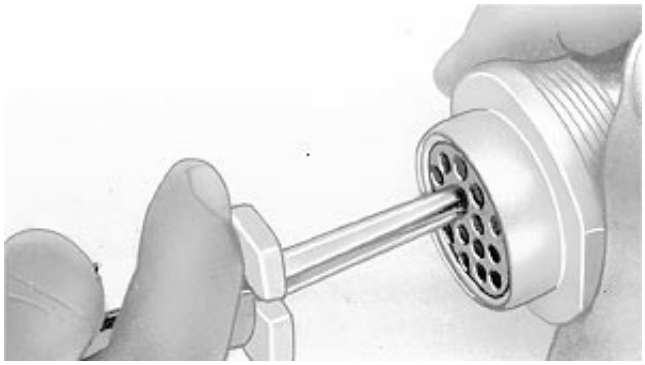

*Sliding Extractor Tool Along Wires*

**Continued on next page**

RG,RG34710,1336 –19–23OCT97–2/5

**IMPORTANT: DO NOT twist tool when inserting on connector.**

Slide extractor tool along wire into connector body until tool is positioned over terminal contact.



TS120 –UN–23AUG88

*Extractor Tool Positioned Over Terminal Contact*

RG,RG34710,1336 –19–23OCT97–3/5

Pull wire, with extractor tool, from connector body.

TS0126 –UN–23AUG88

*Removing Wire From Connector Body*

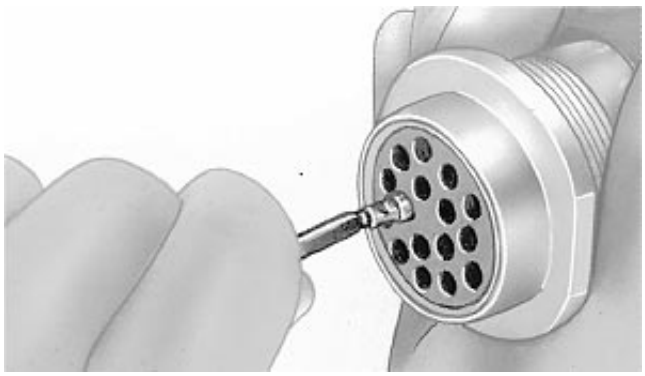
RG,RG34710,1336 –19–23OCT97–4/5

**IMPORTANT: Install contact in correct location using correct size grommet.**

Push contact straight into connector body until positive stop is felt.

Pull on wire slightly to insure contact is locked in position.

Transfer remaining wires to correct terminal in new connector.



TS122 –UN–23AUG88

*Installing Contact in DEUTSCH™ Connector*

*DEUTSCH is a trademark of Deutsch Co.*

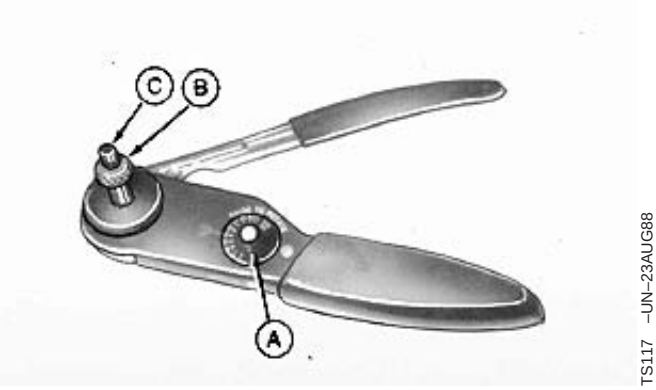
RG,RG34710,1336 –19–23OCT97–5/5

## INSTALL DEUTSCH™ CONTACT

Strip 6 mm (1/4 in.) insulation from wire.

Adjust selector (A) on JDG360 Crimper[1] for correct wire size.

Loosen lock nut (B) and turn adjusting screw (C) in until screw stops.




*Crimping DEUTSCH™ Contact*

*DEUTSCH is a trademark of Deutsch Co.*

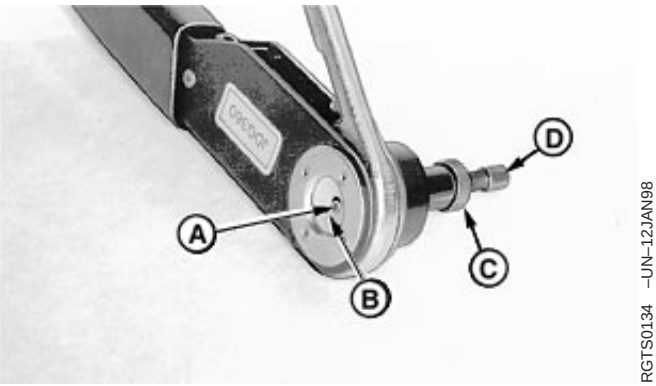
*[1]Included in JDG359 DEUTSCH Electrical Repair Kit*

RG,RG34710,1337 –19–23OCT97–1/4

**IMPORTANT: Select correct size contact sleeve or pin to fit connector body.**

Insert contact (A) and turn adjusting screw (D) until contact is flush with cover (B).

Tighten lock nut (C).




*Inserting Contact into Crimping Tool*

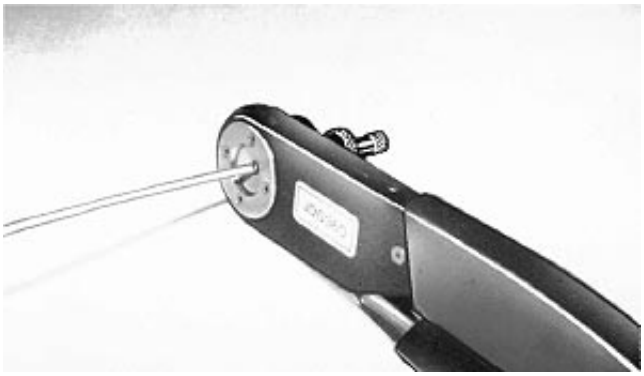
**Continued on next page**

RG,RG34710,1337 –19–23OCT97–2/4

**IMPORTANT: Contact must remain centered between indentors while crimping.**

Insert wire in contact and crimp until handle touches stop.

Release handle and remove contact.



TS1118 –UN–23AUG88

*Crimping DEUTSCH™ Contact*

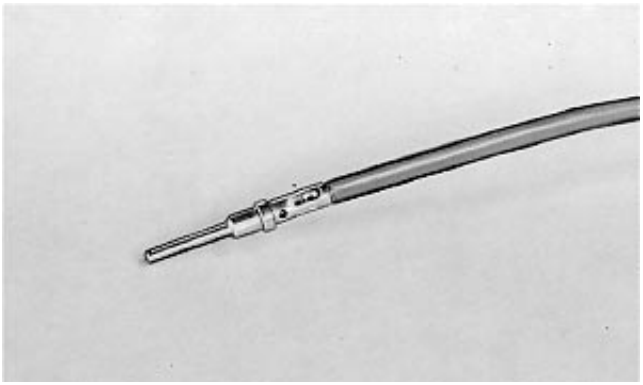
*DEUTSCH is a trademark of Deutsch Co.*

RG,RG34710,1337 –19–23OCT97–3/4

**IMPORTANT: If all wire strands are not crimped into contact, cut off wire at contact and repeat contact installation procedures.**

*NOTE: Readjust crimping tool for each crimping procedure.*

Insert contact to be certain all wires are in crimped barrel.



TS0135 –UN–23AUG88

*DEUTSCH™ Connector Replaced*

*DEUTSCH is a trademark of Deutsch Co.*

RG,RG34710,1337 –19–23OCT97–4/4

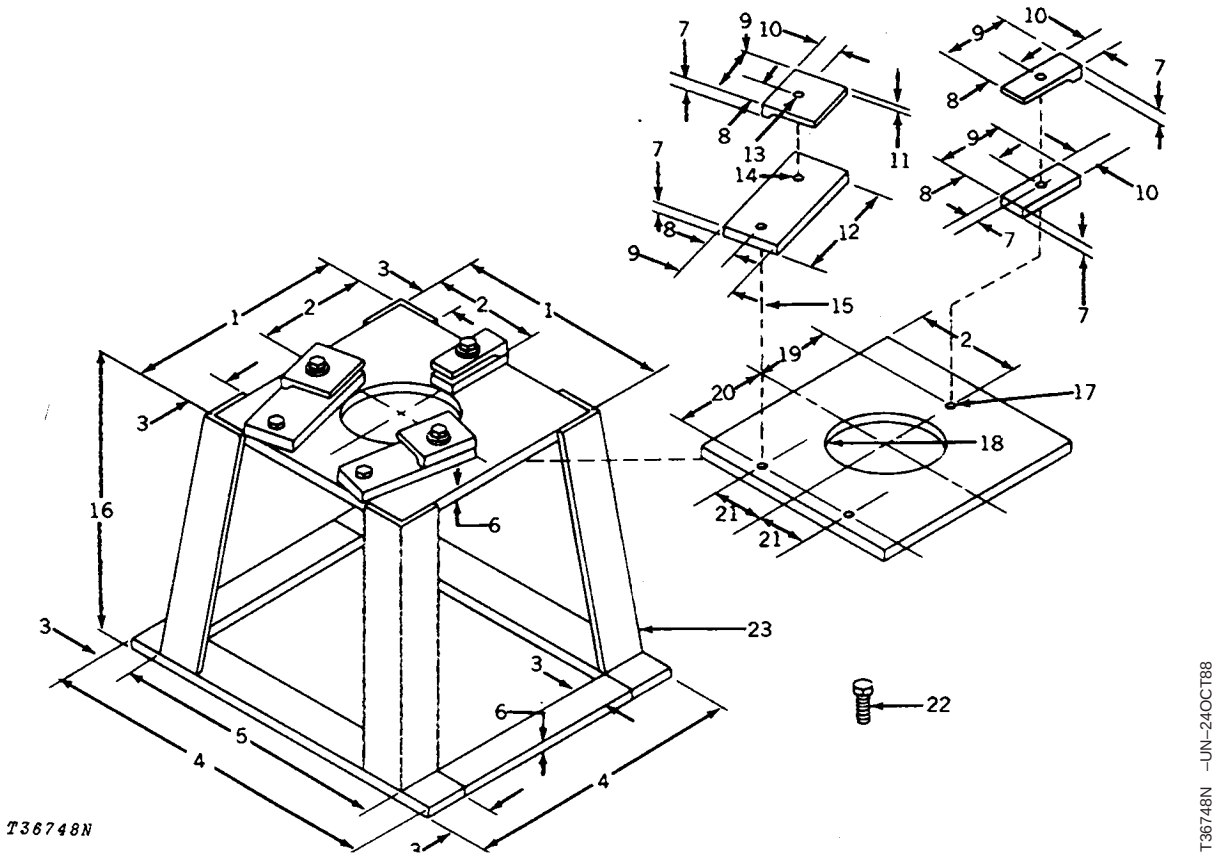
# Dealer Fabricated Tools

## HOW TO MAKE TOOLS

This tool can be made in a service shop using common shop tools and locally obtained materials.

RG,RG34710,1338 –19–23OCT97–1/1

## DFRG3—CYLINDER LINER HOLDING FIXTURE




*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**

RG,RG34710,1339 –19–23OCT97–1/1

BLANK

# CHAPTER 12

# SECTION 05

# ENGINE AUXILIARY SYSTEMS REPAIR

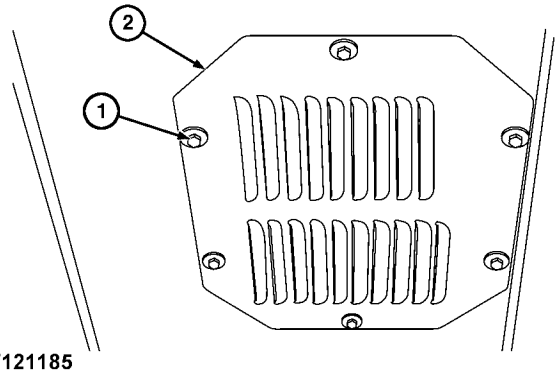
**BLANK**

## REMOVE AND INSTALL ENGINE COOLANT HEATER

1. Remove cap screws (1) and remove cover (2).

*NOTE: Cap screws holding injection pump lever were installed with LOCTITE® 242. Use heat in order to soften the LOCTITE®.*

2. Disconnect injection pump lever.




T121185

T121185 –UN–20APR99

**1—Cap Screw (6 used)**
**2—Cover**

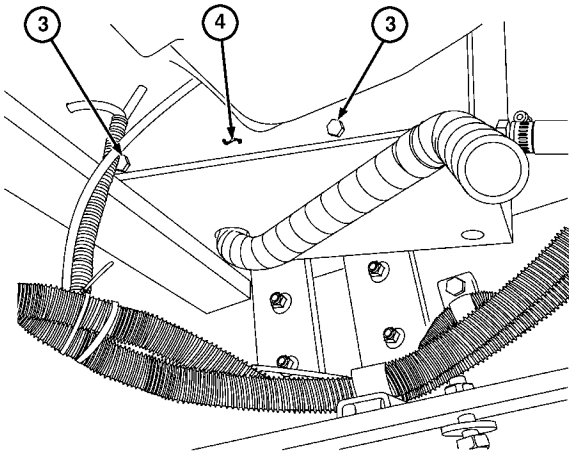
*LOCTITE is a trademark of Loctite Corp.*

CED,OUOE042,5066 –19–15APR99–1/3

3. Remove cap screws (3) and remove cover (4).

4. Disconnect all electrical connections.

5. Disconnect all lines, hoses and pipes.




T121181

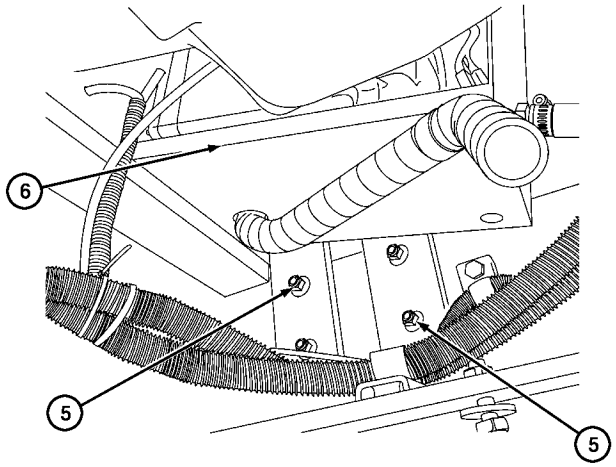
T121181 –UN–20APR99

**3—Cap Screw (2 used)**
**4—Cover**

Continued on next page

CED,OUOE042,5066 –19–15APR99–2/3

6. Remove cap screws (5) and coolant heater (6).



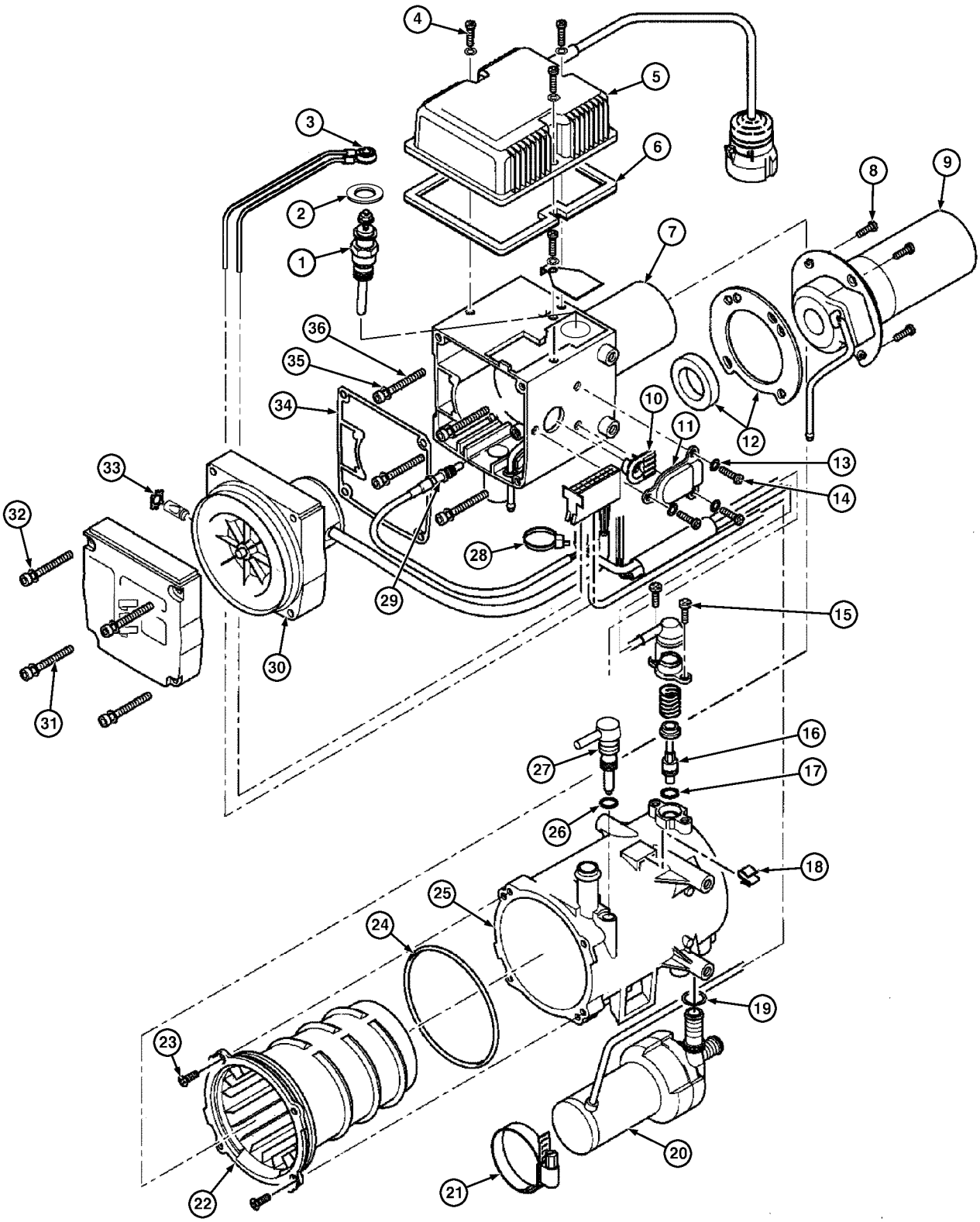

**T121179**

**5—Cap Screws (4 used)**
**6—Coolant Heater**

05
0505B
2

CED,OUOE042,5066 –19–15APR99–3/3

## DISASSEMBLE AND ASSEMBLE ENGINE COOLANT HEATER




T120684

T120684 –UN–25MAR99

Continued on next page

CED,OUOE020,38 –19–18MAR99–1/2

*Cold Weather Starting Aids*

**1—Glow Plug**
**2—Sleeve**
**3—Cable**
**4—Cap Screw (3 used)**
**5—Control Unit**
**6—Seal**
**7—Burner**
**8—Cap Screw (4 used)**
**9—Burner**
**10—Sleeve**
**11—Cover**
**12—Seal**
**13—Spring Washer (3 used)**
**14—Cap Screw (3 used)**
**15—Cap Screw (2 used)**
**16—Sensor**
**17—O-ring**
**18—Clip**
**19—O-ring**
**20—Water Pump**
**21—Hose Clamp**
**22—Heat Exchanger**
**23—Cap Screw (2 used)**
**24—O-ring**
**25—Casing**
**26—O-ring**
**27—Sensor**
**28—Tie Band**
**29—Sensor**
**30—Combustion Air Blower**
**31—Cap Screw (4 used)**
**32—Washer (4 used)**
**33—Indented Ring**
**34—Seal**
**35—Washer**
**36—Cap Screw (4 used)**

CED,OUOE020,38 –19–18MAR99–2/2

05
0505B
5

# Group 0510
# Cooling System

## SERVICE EQUIPMENT AND TOOLS

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

*SERVICEGARD is a trademark of Deere & Company.*

CED,OUOE003,1134 –19–07JUL98–1/2

Breaker Bar

To hold belt tension adjuster.

CED,OUOE003,1134 –19–07JUL98–2/2

## SPECIFICATIONS

05
0510
1

| Item | Measurement | Specification |
|---|---|---|
| Fan-to-Pulley Cap Screw | Torque | 47 N•m (35 lb-ft) |
| Fan Shroud-to-Radiator Cap Screw | Torque | 73 N•m (54 lb-ft) |
| Fan Guard-to-Shroud Cap Screw | Torque | 27 N•m (20 lb-ft) |
| Radiator Expansion Tank Cap Screw | Torque | 73 N•m (54 lb-ft) |

CED,OUOE003,1133 –19–07JUL98–1/1

## REMOVE AND INSTALL FAN, SHROUD, AND GUARDS

TS281 –UN–23AUG88

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

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

1. Drain engine coolant until coolant level is below upper radiator hose (B).
2. Remove radiator expansion tank. (See procedure in this group.)
3. Loosen clamps. Remove upper radiator hose (B).
4. Remove cap screws (C). Remove fan guard (D).
5. Remove cap screws (A). Move fan shroud (E) toward engine.
6. Remove four cap screws. Remove fan, and spacer (G).
7. Remove fan shroud (E).
8. Replace parts as necessary.
9. Install fan shroud (E). Move shroud towards engine.
10. Install fan and spacer. Tighten cap screws.

**Fan-to-Pulley Cap Screw—Specification**

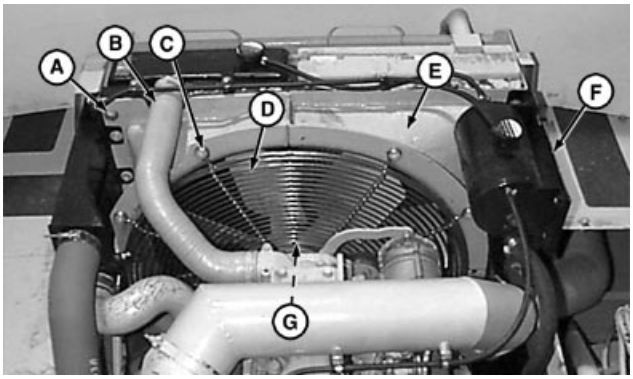
Torque ..... 47 N•m (35 lb-ft)

11. Install fan shroud (E). Tighten cap screws (A).

**Fan Shroud-to-Radiator Cap Screw—Specification**

Torque ..... 73 N•m (54 lb-ft)

12. Install fan guard (D). Tighten cap screws (C).




T115121 –UN–17JUN98

**A—Cap Screw (12 used)**
**B—Upper Radiator Hose**
**C—Cap Screw (4 used)**
**D—Guard**
**E—Shroud**
**F—Expansion Tank**
**G—Cap Screws, Fan, and Spacer**

05
0510
2

**Continued on next page**

CED,OUOE024,215 –19–18MAY98–1/2

**Fan Guard-to-Shroud Cap Screw—Specification**

Torque ..... 27 N•m (20 lb-ft)

13. Install upper radiator hose (B). Tighten clamps.
14. Install radiator expansion tank. (See procedure in this group.)
15. Fill radiator and expansion tank with coolant to proper operation level.

CED,OUOE024,215 –19–18MAY98–2/2

## REMOVE AND INSTALL RADIATOR AND OIL COOLER

05
0510
3

TS281 –UN–23AUG88

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

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

1. Drain coolant from radiator. Approximate capacity is 30 L (8 gal).
2. Drain hydraulic tank. Approximate capacity is 159 L (42 gal).

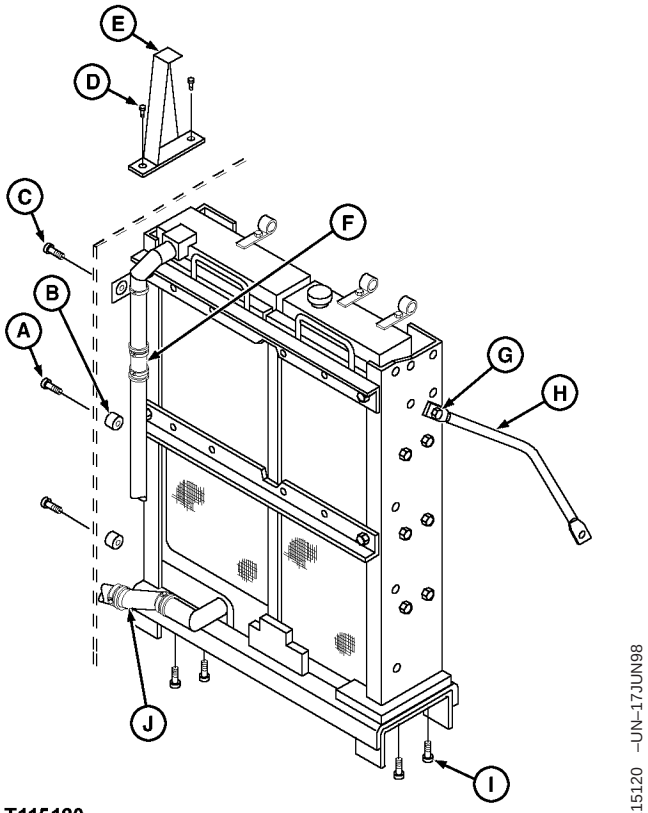
**Continued on next page**

CED,OUOE024,216 –19–18MAY98–1/3

3. Remove plug to drain hydraulic oil from oil cooler.
4. Remove radiator expansion tank. (See procedure in this group.)
5. Remove charge air cooler. (See procedure in Group 0520.)

*NOTE: It is not necessary to evacuate the air conditioning system.*

6. Remove cap screws from air conditioning condenser. (See procedure in Group 1830).
7. Remove fan, shroud, and guards. (See procedure in this group.)
8. Loosen clamp and remove lower radiator hose.
9. Loosen clamps. Remove hoses (F and J).
10. Remove cap screws (D). Remove cover (E).
11. Remove cap screws (A, C, G, and I). Remove spacers (B).




T115120 –UN–17JUN98

T115120

**A—Cap Screw (2 used)**
**B—Spacer (2 used)**
**C—Cap Screw**
**D—Cap Screw (2 used)**
**E—Cover**
**F—Upper Hose**
**G—Cap Screw**
**H—Support**
**I—Cap Screw (4 used)**
**J—Lower Hose**

**CAUTION: Use appropriate lifting device for heavy components.**

*NOTE: The radiator and oil cooler are removed as an assembly.*

12. Remove radiator and oil cooler assembly.
13. Disassemble oil cooler and radiator. (See procedure in this group.)
14. Repair or replace as necessary.
15. Assemble oil cooler and radiator. (See procedure in this group.)
16. Install radiator and oil cooler assembly.
17. Install spacers (B) and tighten cap screws (A, C, G, and I).

05
0510
4

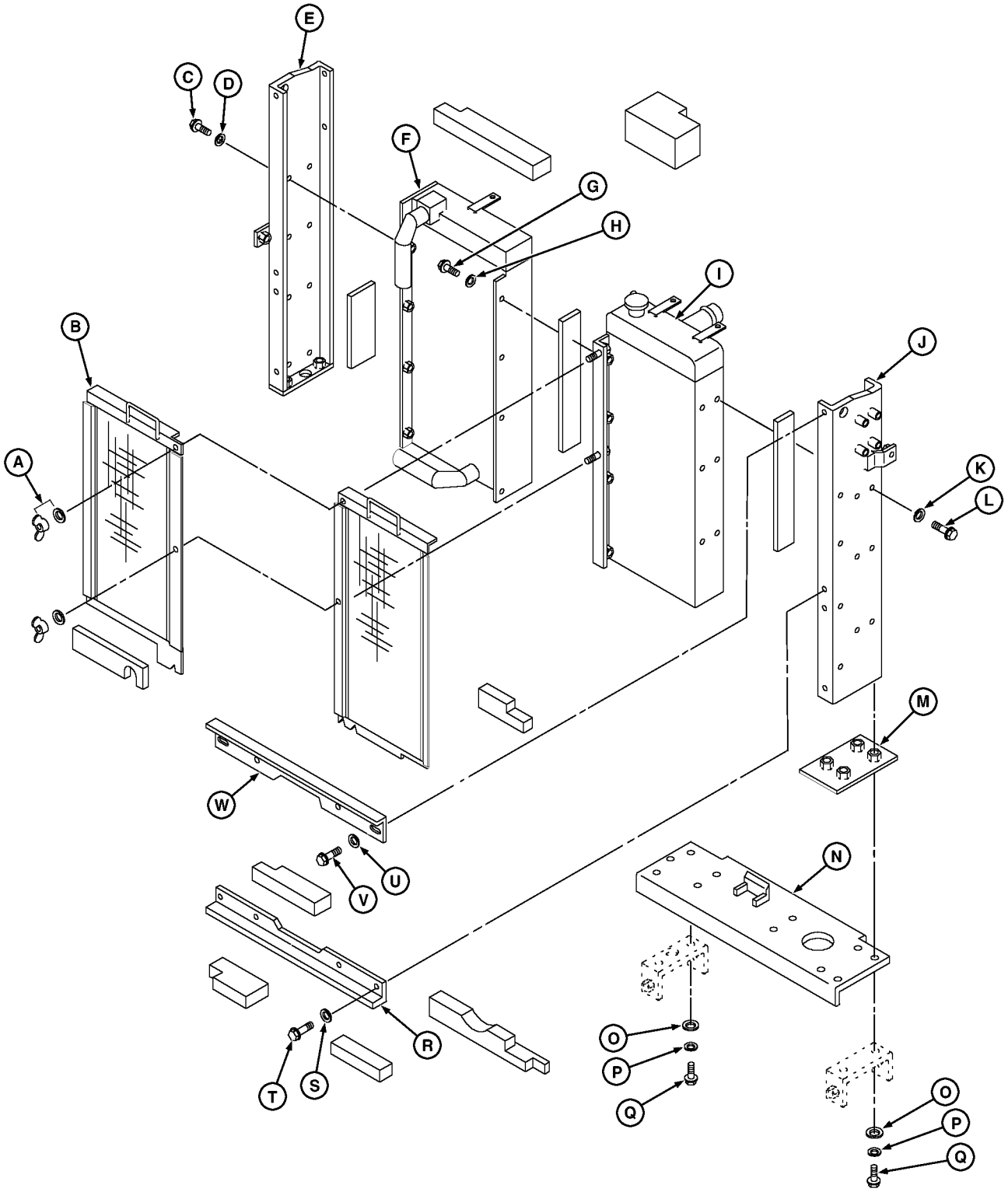
**Continued on next page**

18. Install cover (E). Tighten cap screws (D).
19. Install hoses (F and J). Tighten clamps.
20. Install lower radiator hose. Tighten clamp.
21. Install fan, shroud, and guards. (See procedure in this group).
22. Install air conditioning condenser. (See procedure in Group 1830.)
23. Install charge air cooler. (See procedure in Group 0520.)
24. Install radiator expansion tank. (See procedure in this group.)
25. Fill hydraulic tank. Approximate capacity is 159 L (42 gal).
26. Fill radiator and expansion tank with coolant. Approximate capacity is 30 L (8 gal).



CED,OUOE024,216 –19–18MAY98–3/3

## DISASSEMBLE AND ASSEMBLE RADIATOR AND OIL COOLER ASSEMBLY




T115839

Continued on next page

CED,OUOE024,217 –19–19MAY98–1/2

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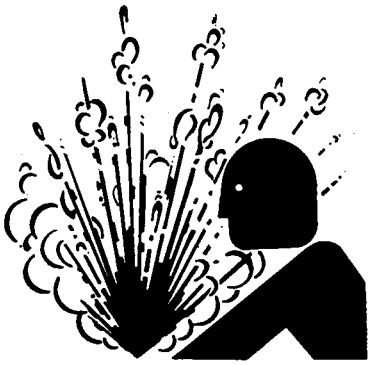
**A—Wing Nut and Washer (2 used)**
**B—Radiator Screen (2 used)**
**C—Cap Screw (3 used)**
**D—Washer (3 used)**
**E—Forward Support**
**F—Oil Cooler**
**G—Cap Screw (4 used)**
**H—Washer (4 used)**
**I—Radiator**
**J—Rear Support**
**K—Washer (3 used)**
**L—Cap Screw (3 used)**
**M—Spacer**
**N—Lower Support**
**O—Lock Washer (4 used)**
**P—Washer (4 used)**
**Q—Cap Screw (4 used)**
**R—Bottom Bracket**
**S—Washer (2 used)**
**T—Cap Screw (2 used)**
**U—Washer (2 used)**
**V—Cap Screw (2 used)**
**W—Upper Bracket**

CED,OUOE024,217 –19–19MAY98–2/2

## REMOVE AND INSTALL COOLANT EXPANSION TANK

**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 completely.**



TS281 –UN–23AUG88

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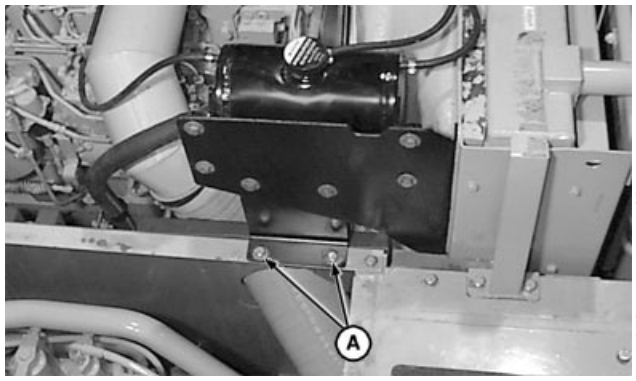
1. Drain engine coolant until coolant level is below upper radiator hose.

CED,OUOE024,218 –19–19MAY98–1/3

2. Remove cap screws (A).




T115053 –UN–17JUN98

**A—Cap Screw (2 used)**

**Continued on next page**

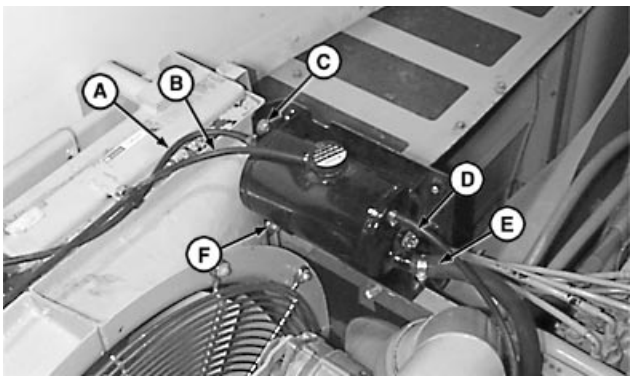
CED,OUOE024,218 –19–19MAY98–2/3

3. Loosen clamps. Remove hoses (A, B, D, and E).
4. Remove cap screws (C and F). Remove tank.
5. Repair or replace as necessary.
6. Install tank.
7. Install and tighten cap screws (C and F).

**Radiator Expansion Tank Cap Screw—Specification**

Torque ..... 73 N•m (54 lb-ft)

8. Install hoses.
9. Fill radiator to proper operating level.




T115052 –UN–17JUN98

**A—Coolant Expansion Tank-to-Radiator Cap Neck Line**
**B—Coolant Expansion Tank-to-Coolant Overflow Tank**
**C—Cap Screw**
**D—Coolant Expansion Tank-to-Top of Engine Block**
**E—Coolant Expansion Tank-to-Lower Radiator Hose**
**F—Cap Screw**

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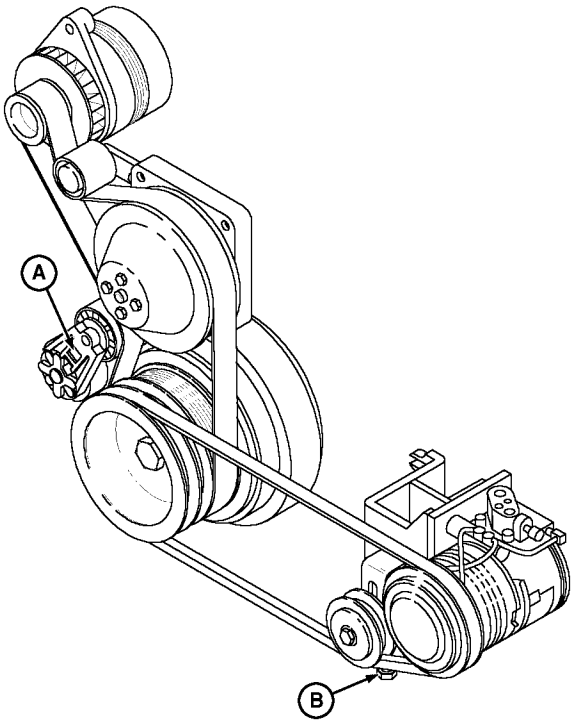
CED,OUOE024,218 –19–19MAY98–3/3

## REMOVE AND INSTALL FAN AND AIR CONDITIONER BELTS

1. Loosen adjusting screw (B). Remove air conditioning belt.
2. Install breaker bar in square drive hole (A).
3. Hold tension adjuster away from belt while removing old belt and installing a new one.
4. Slowly release wrench tension to allow tension adjuster to move clockwise against new belt. Tension is automatically adjusted.
5. Remove breaker bar.
6. Install air conditioning belt. Tighten adjusting screw (B).




T115779 –UN–17JUN98

**T115779**

**A—Square Drive Hole**
**B—Adjusting Screw**

TX,0510,DU283A –19–06JUN92–1/1

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# Group 0515
# Speed Controls

## SERVICE EQUIPMENT AND TOOLS

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

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CED,OUOE003,1126 –19–17SEP98–1/6

Clamp-On Electronic Tachometer . . . . . JT05801

Check engine speed.

CED,OUOE003,1126 –19–17SEP98–2/6

Laptop Computer . . . . . JT07290

To display information read and monitored by the excavator diagnostics program.

CED,OUOE003,1126 –19–17SEP98–3/6

Excavator Diagnostics Program Disk . . . . . JT07274F

To read and monitor information available from the engine and pump controller.

Continued on next page

CED,OUOE003,1126 –19–17SEP98–4/6

*Speed Controls*

Cable . . . . . .JT07273

To connect the laptop computer to diagnostic port of excavator.

CED,OUOE003,1126 –19–17SEP98–5/6

Feeler Gauge

To check shut-off lever stop clearance.

CED,OUOE003,1126 –19–17SEP98–6/6

05
0515
2

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Engine Fast Idle | Speed | 2150 ± 50 rpm at fast idle stop on injection pump |
| Engine Slow Idle | Speed | 1050 + 100 - 0 rpm |
| Engine Control Motor Arm Cap Screw | Torque | 13 N•m (115 lb-in) |
| Engine Auto-Idle | Speed | 1200 ± 100 rpm |
| Engine E (Economy) Mode | Speed | 1900 ± 100 rpm |
| Engine Fast Idle in Standard Mode | Speed | 2050 ± 75 rpm |
| Fuel Shut-Off Solenoid Cap Screw | Torque | 23 N•m (17 lb-ft) |
| Fuel Shut-Off Solenoid Hex Nut | Torque | 7 N•m (5 lb-ft) |
| Fuel Shut-Off Solenoid Ball Joint Hole-to-Fuel Shut-Off Lever Hole | Distance | 3—6 mm (1/8—1/4 in.) short of alignment |
| Fuel Shut-Off Solenoid Plunger-to-Ball Joint Nut | Torque | 8 N•m (70 lb-in.) |
| Fuel Shut-Off Lever-to-Stop Position Stop | Distance | within 3 mm (0.125 in.) of stop position stop |

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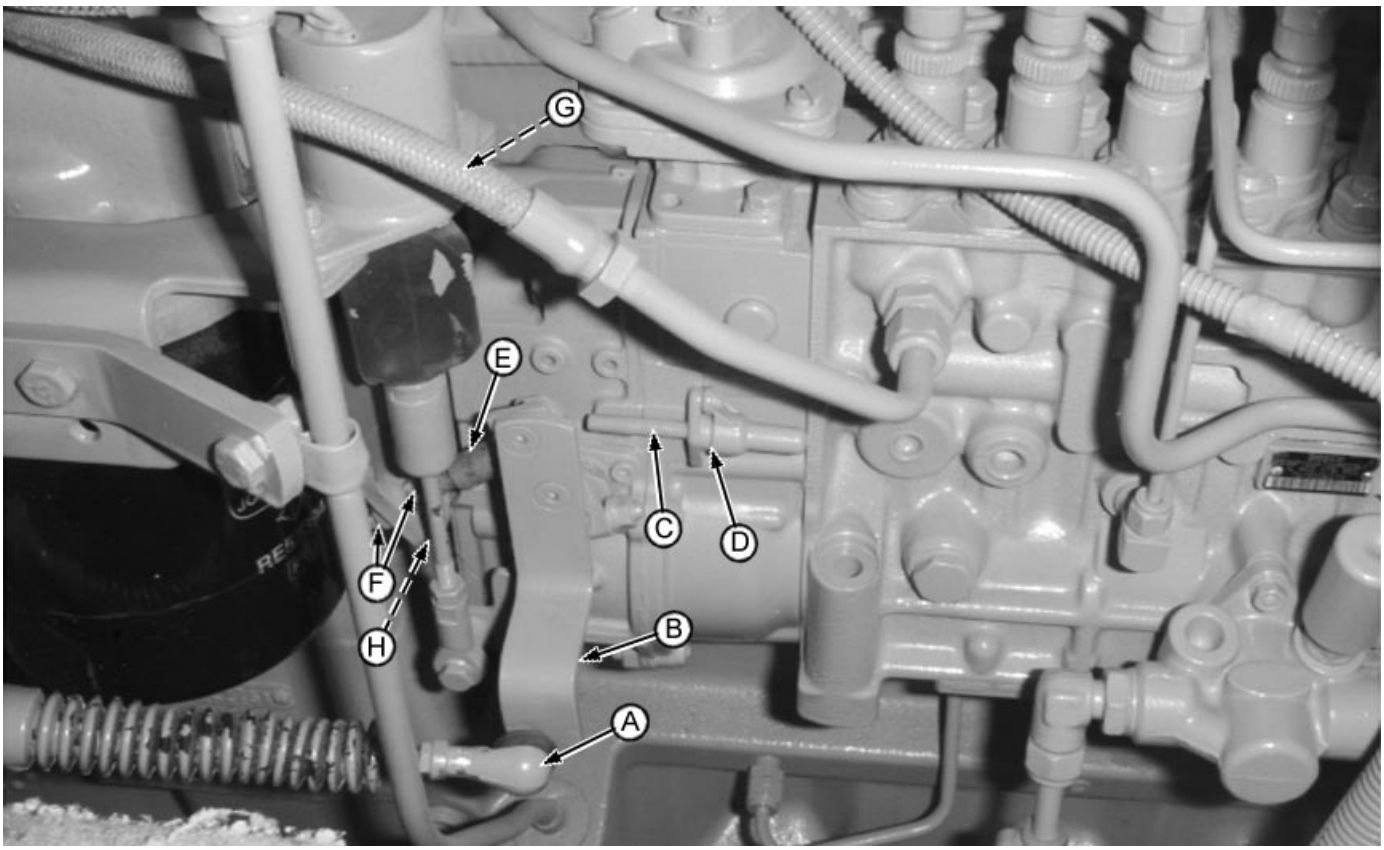
CED,OUOE003,1090 –19–08SEP98–1/1

## INJECTION PUMP FAST AND SLOW IDLE STOPS ADJUSTMENT

1. Connect the tachometer or the laptop computer with excavator diagnostics program. Select “14 Actual engine speed” from Monitor Data Items. (See JT05801 Clamp-On Electronic Tachometer Installation in this group or for laptop computer installation, see procedure in Group 9025-25.)
2. Start the engine.
3. Warm engine to its normal operating temperature.
4. Stop the engine.

**Continued on next page** CED,OUOE003,1084 –19–08SEP98–1/4




T115766B –UN–08JUN98

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**A—Speed Control Cable**
**B—Injection Pump Lever**
**C—Fast Idle Stop**
**D—Nut**
**E—External Slow Idle Stop**
**F—Nut (2 used)**
**G—Internal Slow Idle Stop**
**H—Supplementary Idle Screw**

5. Disconnect the speed control cable (A) from injection pump lever (B).

6. Check that injection pump lever moves freely from external slow idle stop (E) to the fast idle stop (C) and back.

7. Start the engine.

8. Push injection pump lever against fast idle stop (C).

   Record the engine fast idle speed.

*NOTE: The fast idle stop on the injection pump serves as the stop when the HP (high power) mode is actuated.*

9. Push injection pump lever against the external slow idle stop (F).

   Record the engine slow idle speed.

10. Adjust the fast and external slow idle stops as needed.

**Engine Fast Idle—Specification**

Speed..... 2150 ± 50 rpm at fast idle stop on injection pump

**Engine Slow Idle—Specification**

Speed..... 1050 + 100 - 0 rpm

11. Loosen nut (D) on the fast idle stop (C).

12. Hold injection pump lever against the fast idle stop.

**Continued on next page**

CED,OUOE003,1084 –19–08SEP98–2/4

Turn fast idle stop in to decrease engine fast idle speed; turn stop out to increase engine fast idle speed.

Hold fast idle stop and tighten nut.

**IMPORTANT: The slow idle speed must be adjusted to specification so the injection pump lever only contacts the external slow idle stop (E) and not the internal slow idle stop (G). The internal slow idle stop is adjusted at the factory so it is not contacted when slow idle speed is adjusted to specification. Seals on the injection pump lever shaft may be damaged if internal slow idle stop is used as the stop when injection pump lever is connected to the engine control motor. The engine slow idle speed specification given is with the engine installed in the machine and the pumps, alternator, and fan installed.**

13. Loosen nuts (F) on the external slow idle stop (E).

14. Hold injection pump lever against the external slow idle stop.

    Turn external slow idle stop in to increase engine slow idle speed; turn stop out to decrease engine slow idle speed.

    Hold external slow idle stop and tighten nuts.

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**Continued on next page**

CED,OUOE003,1084 –19–08SEP98–3/4

15. Pull injection pump lever rapidly to fast idle and then decelerate to slow idle. Slow idle must be to specification.

**Engine Slow Idle—Specification**

Speed ..... 1050 + 100 - 0 rpm

*NOTE: Injection pump shown removed for clarity of photograph.*

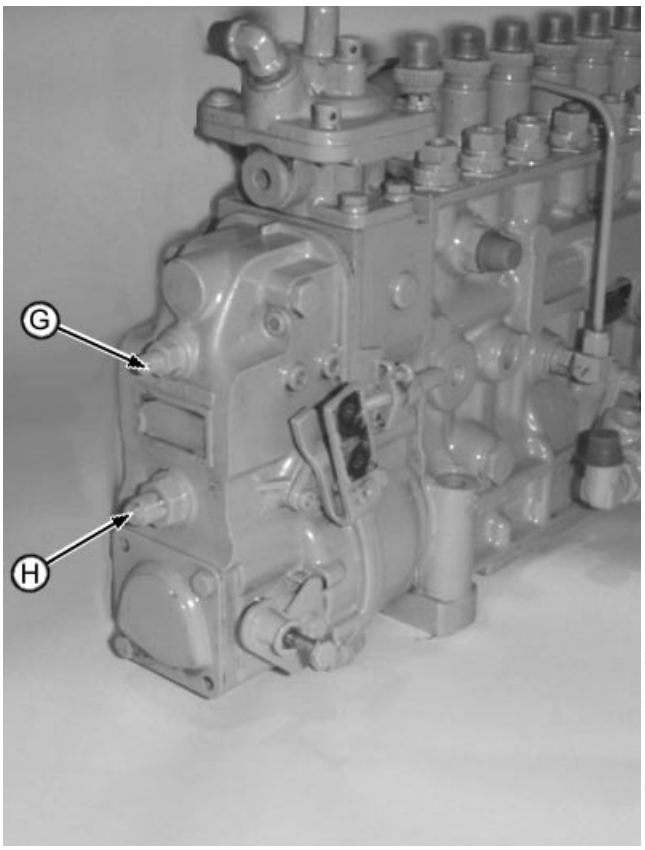
Turning the supplementary idle screw (H) in no more than 1/4 of a turn may help to reduce surging or hunting. If surging or hunting continues, repair injection pump.

16. Stop the engine.

17. Connect the cable to lever.

    Check that the threaded portion of cable is centered in bulkhead bracket. Loosen and tighten the nuts to centered threaded portion of cable in bulkhead bracket. Cable can be adjusted in the bulkhead bracket if more cable travel is need in one direction.

18. Do Engine Control Motor and Sensor Adjustment and then the Engine Speed Learning Procedure. (See procedures in this group.)




T115579B –UN–08JUN98

**G—Internal Slow Idle Stop**
**H—Supplementary Idle Screw**

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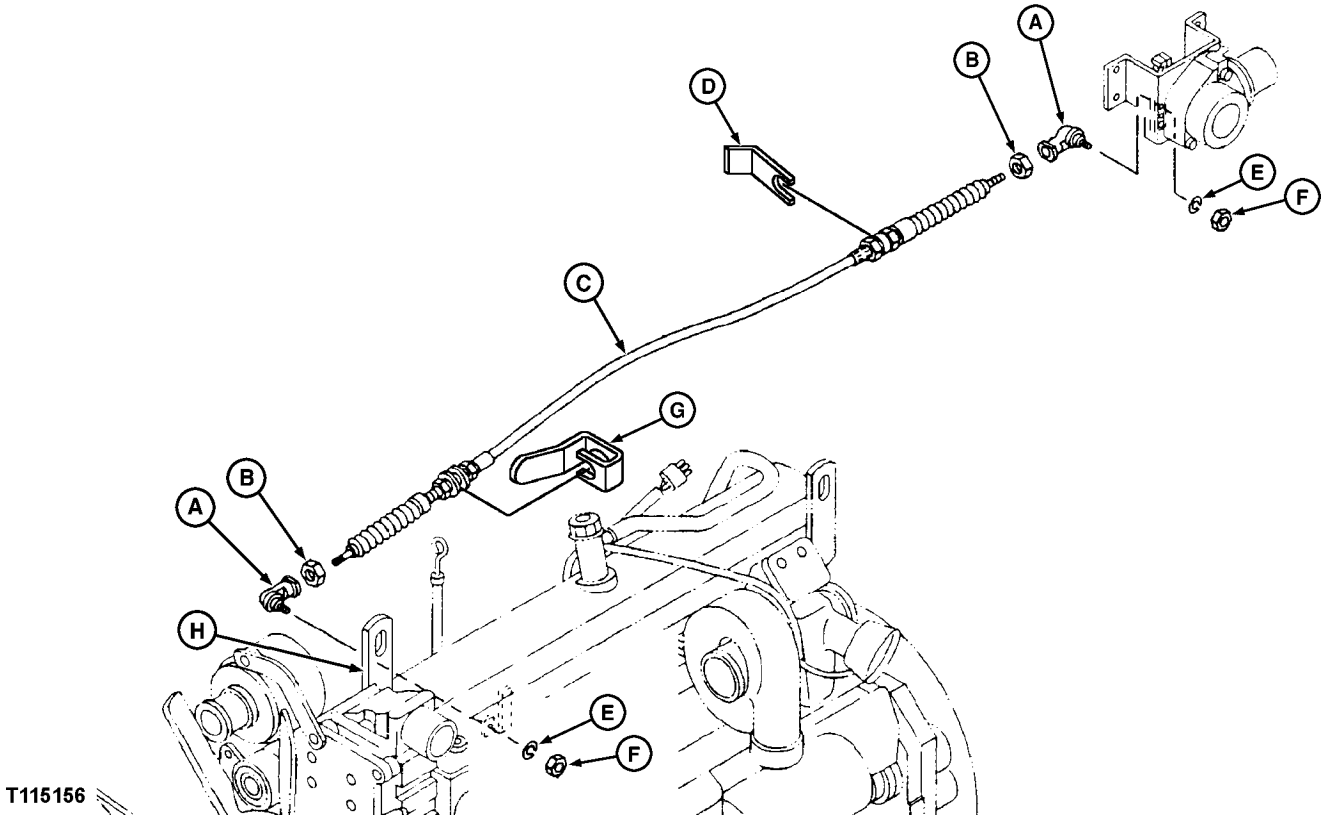
CED,OUOE003,1084 –19–08SEP98–4/4

## REMOVE AND INSTALL ENGINE SPEED CONTROL CABLE




T115156 –UN–17JUN98

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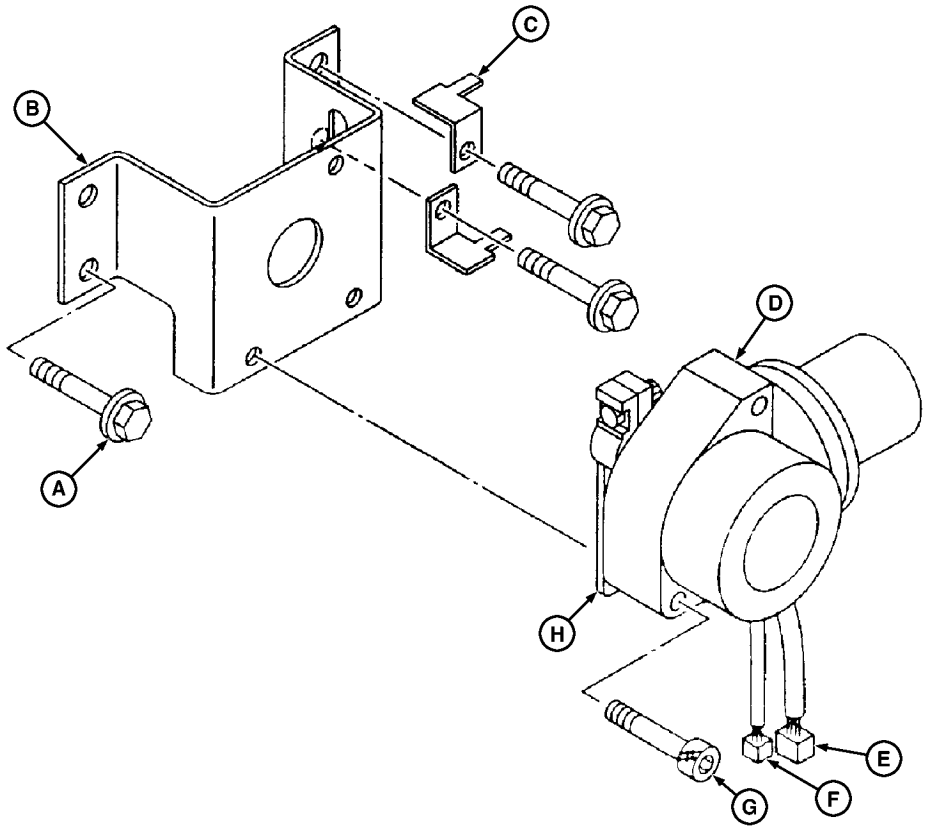
**A—Ball Joint (2 used)**
**B—Nut (2 used)**
**C—Speed Control Cable**
**D—Bracket**
**E—Lock Washer (2 used)**
**F—Nut (2 used)**
**G—Bracket**
**H—Injection Pump Lever**

**IMPORTANT: The ball joints (A) are installed on the cable to full thread engagement. A ball joint can be used to lengthen a cable end, if needed, but must have at least 6 mm (1/4 in.) of thread engagement to avoid stripping the threads on cable end.**

1. Install ball joints (A) to full thread engagement. Tighten nuts.
2. Install speed control cable (C) in brackets (D and G). Initially, tighten nuts so threaded portions of cable are centered in brackets. As needed, adjust cable in brackets to connect ball joint to lever or arm.
3. Connect ball joint to engine control motor arm.
4. Do Engine Control Motor Adjustment and Sensor and then the Engine Speed Learning Procedure. (See procedures in this group.)

CED,OUOE024,219 –19–12SEP98–1/1

## REMOVE AND INSTALL ENGINE CONTROL MOTOR




T115157

T115157 –UN–17JUN98

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**A—Cap Screw**
**B—Bracket**
**C—Bracket**
**D—Motor Assembly**
**E—Connector (4-Wire)**
**F—Connector (3-Wire)**
**G—Cap Screw (3 used)**
**H—Arm**

*NOTE: The engine control angle sensor is located inside the engine control motor housing. The sensor is serviced as an assembly with the engine control motor.*

1. Remove engine speed control cable at engine control motor. (See procedure in this group).
2. Disconnect connectors (E and F).
3. Remove cap screw (A) and brackets (B and C). Remove bracket and motor assembly.
4. Remove arm (H) from motor assembly (D).
5. Remove cap screws (G).
6. Remove motor assembly (D) from bracket (B).
7. Repair or replace as necessary.
8. Install motor assembly (D) on bracket (B). Tighten cap screws (G).
9. Install arm (H) on motor assembly (D).
10. Install brackets (B and C). Tighten cap screws (A).
11. Install engine speed control cable at engine control motor. (See procedure in this group).
12. Adjust arm (H) so speed control cable is horizontal.
13. Do Engine Control Motor and Sensor Adjustment and then the Engine Speed Learning Procedure. (See procedures in this group.)

TX,05,GG2306 –19–08SEP98–1/1

## ENGINE CONTROL MOTOR AND SENSOR ADJUSTMENT

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor and sensor adjustment and engine speed learning procedure must be performed. (See procedures in this group.)

- Engine
- Engine speed control cable
- Engine control motor and sensor
- Engine and pump controller
- Fast and slow idle stops

1. Check that the fast idle and slow idle stop screws on the injection pump are adjusted to specification. (See Injection Pump Fast and Slow Idle Stops Adjustment in this group.)

2. Turn key switch to ON.



3. Turn the engine rpm dial to slow idle.

CED,OUOE003,1085 –19–08SEP98–1/2

4. Loosen cap screw (A) in engine control motor arm (B).

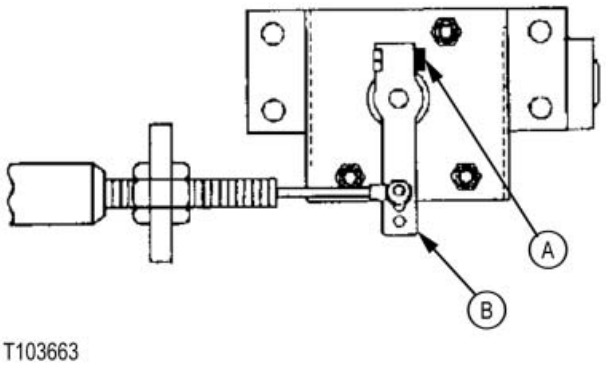
5. Adjust the arm (B) on the shaft so the injection pump lever just contact the slow idle stop screw.

6. Tighten cap screw (A).

**Engine Control Motor Arm Cap Screw—Specification**

Torque ..... 13 N•m (115 lb-in)

7. Do Engine Speed Learning Procedure in this group.




T103663 –UN–11SEP96

T103663

**A—Cap Screw**
**B—Arm**

CED,OUOE003,1085 –19–08SEP98–2/2

## ENGINE SPEED LEARNING PROCEDURE

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor adjustment and engine learning control procedure must be performed.

- Engine
- Engine speed control cable
- Engine control motor and sensor
- Engine and pump controller
- Fast and slow idle stop brackets

1. Stop the engine.

2. Disconnect the laptop computer from the diagnostic test port.

3. Wait for 5 seconds.

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CED,OUOE003,1086 –19–08SEP98–1/2

4. Push engine learning switch (C) up to top position. The switch is a three position switch. Make sure it is in the top position.
5. Turn key switch ON. Wait 5 seconds.
6. Turn key switch OFF. Wait 5 seconds.
7. Push engine learning switch to middle position.
8. Check engine speeds.

**Engine Slow Idle—Specification**

Speed ..... 1050 + 100 - 0 rpm

**Engine Auto-Idle—Specification**

Speed ..... 1200 ± 100 rpm

**Engine E (Economy) Mode—Specification**

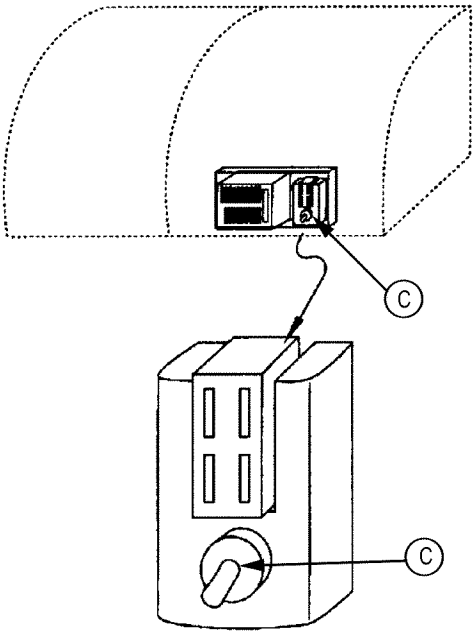
Speed ..... 1900 ± 100 rpm

**Engine Fast Idle in Standard Mode—Specification**

Speed ..... 2050 ± 75 rpm

If slow idle speed is still not to specification, check the engine control sensor. (See Engine Control (EC) Sensor Harness Test in Group 9025-25.)

*NOTE: The laptop computer with excavator diagnostic software can be used to change the default speeds for slow idle, auto-idle, economy mode, and fast idle in standard mode. See Excavator Diagnostic Software Special Function—Engine Speed in Group 9025-25.*




T103674

T103674 –UN–11SEP96

**C—Engine Learning Switch**

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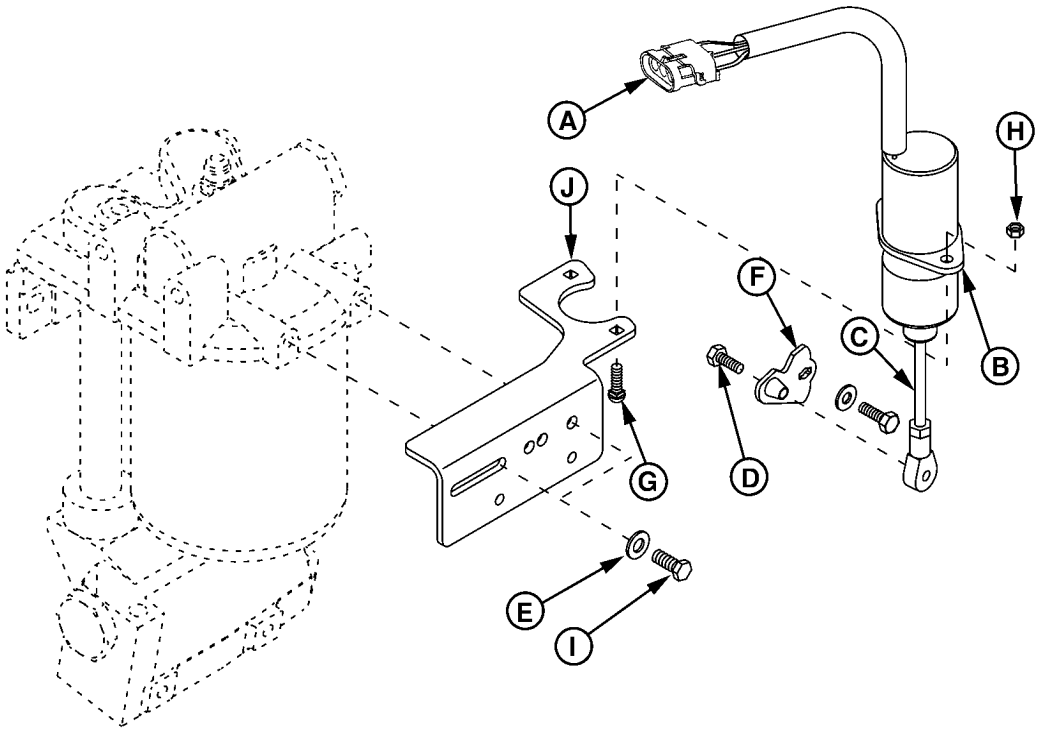
CED,OUOE003,1086 –19–08SEP98–2/2

## REMOVE AND INSTALL FUEL SHUT-OFF SOLENOID

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

1. Disconnect electrical wiring connector (A) in solenoid lead.

2. Remove cap screw (D), and detach solenoid shaft (C) from fuel shut-off lever (F).

3. Remove fuel shut-off solenoid (B) from solenoid mounting bracket (J) by removing hex nuts (H) and machine screws (G).

4. If solenoid mounting bracket is to be removed, remove cap screws (I) and washers (E) that fasten the bracket to oil filter base.

5. Inspect condition of solenoid and replace parts as necessary. (A repair kit is available from parts for this solenoid assembly.)

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

*NOTE: Electric fuel shut-off solenoids are factory adjusted to a specified length and should not require additional adjustment. See CTM134 for diagnosis of fuel shut-off solenoid.*

6. To install fuel shut-off solenoid, reverse removal procedure. Tighten cap screws (I) and hex nuts (H).

**Fuel Shut-Off Solenoid Cap Screw—Specification**

Torque..... 23 N•m (17 lb-ft)

**Fuel Shut-Off Solenoid Hex Nut—Specification**

Torque..... 7 N•m (5 lb-ft)

CED,OUOE024,220 –19–20MAY98–1/1

## FUEL SHUT-OFF SOLENOID LINKAGE CHECK AND ADJUSTMENT

1. Disconnect ball joint (C) from fuel shut-off lever (D).
2. Turn key switch to ON. It is not necessary to start engine for this procedure.
3. Push plunger (F) into solenoid housing until the plunger bottoms. With key switch ON, solenoid hold coil is energized and will hold plunger in the run position.
4. Manually pull fuel shut-off lever (D) up against the run position stop (upper stop) (H).
5. Check that hole in ball joint (C) is 3—6 mm (1/8—1/4 in.) short of aligning with hole in fuel shut-off lever.

**Fuel Shut-Off Solenoid Ball Joint Hole-to-Fuel Shut-Off Lever Hole—Specification**

05
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Distance..... 3—6 mm (1/8—1/4 in.) short of alignment

The 3—6 mm (1/8—1/4 in.) is the amount of overtravel needed to compress the spring in the plunger to hold the shut-off lever against the run position stop when plunger is bottomed in the solenoid housing.

Adjust ball joint as necessary.

6. Manually pull fuel shut-off lever up against the run position stop (upper stop).

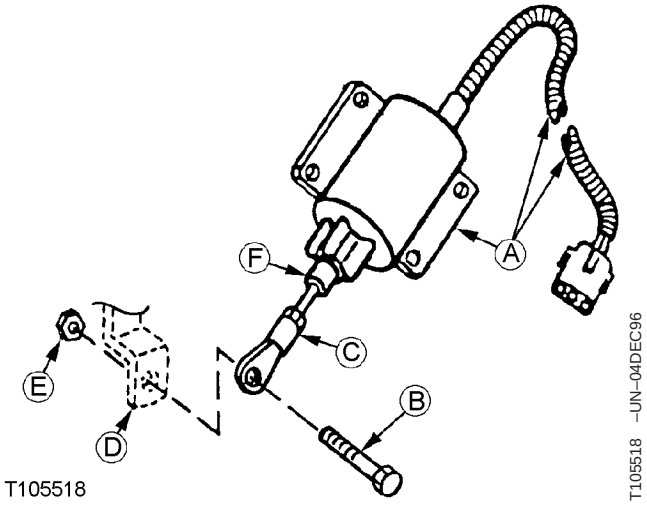
   Adjust ball joint so hole is aligned with hole in shut-off lever and then turn ball joint to shorten linkage by three turns.

   Hold ball joint and tighten nut.

**Fuel Shut-Off Solenoid Plunger-to-Ball Joint Nut—Specification**

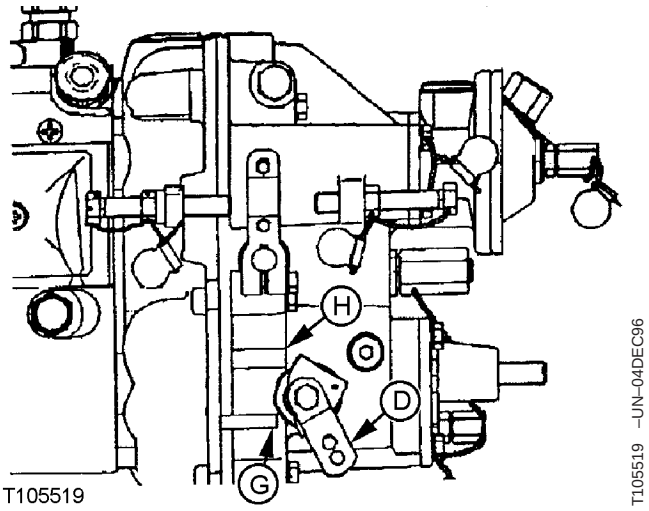
Torque ..... 8 N•m (70 lb-in.)

7. Turn key switch to OFF.




T105518

T105518 –UN–04DEC96




T105519

T105519 –UN–04DEC96

**A—Shut-Off Solenoid**
**B—Cap Screw**
**C—Ball Joint**
**D—Fuel Shut-Off Lever**
**E—Lock Nut**
**F—Plunger**
**G—Stop Position Stop (Lower Stop)**
**H—Run Position Stop (Upper Stop)**

**Continued on next page**

8. Connect ball joint to fuel shut-off lever using cap screw (B) and nut (E).

**IMPORTANT: Failure to have the shut-off lever tight against run position stop (upper stop) can result in low engine horsepower.**

9. Turn the key switch to ON.

   Push plunger into solenoid housing so hold coil holds the plunger in the run position.

   Check that shut-off lever is tight against run position stop using a 0.025 mm (0.001 in.) feeler gauge. If feeler gauge passes between shut-off lever and stop, shorten the linkage two more turns.

10. Turn key switch to OFF.

    The spring inside the solenoid housing boot will extend the plunger to push the shut-off lever down to the stop position stop (lower stop ) (G).

    Check that shut-off lever is within the specified distance of stop position stop.

**Fuel Shut-Off Lever-to-Stop Position Stop—Specification**

| | |
|---|---|
| Distance | within 3 mm (0.125 in.) of stop position stop |



CED,OUOE003,1087 –19–08SEP98–2/2

# Group 0520
# Intake System

## ESSENTIAL TOOLS

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

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CED,OUOE003,1139 –19–07JUL98–1/2

Inlet Air Adapter . . . . . JDG51

Used for intake manifold pressure test.

CED,OUOE003,1139 –19–07JUL98–2/2

## SERVICE EQUIPMENT AND TOOLS

05
0520
1

*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.*

CED,OUOE003,1138 –19–07JUL98–1/2

Air Pressure Regulator 1/4 in. Plastic Hose

To pressurize air intake system to check for leaks.

CED,OUOE003,1138 –19–07JUL98–2/2

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Air Intake System | Pressure | 14—21 kPa (0.14—0.21 bar) (2—3 psi) |
| Charge Air Cooler Duct Cap Screw | Torque | 73 N•m (54 lb-ft) |

CED,OUOE003,1140 –19–07JUL98–1/1

## AIR INTAKE SYSTEM LEAKAGE TEST

1. Remove air cleaner cover and primary filter element.
2. Put large plastic bag inside and over end of element. Install element and cover.

T5906AP –UN–23FEB89

0520,CC4 –19–07JUL98–1/2

3. Remove fitting for start aid nozzle from intake manifold and install JDG51 Inlet Air Adapter (A).
4. Connect air pressure regulator to adapter using hose and fitting.

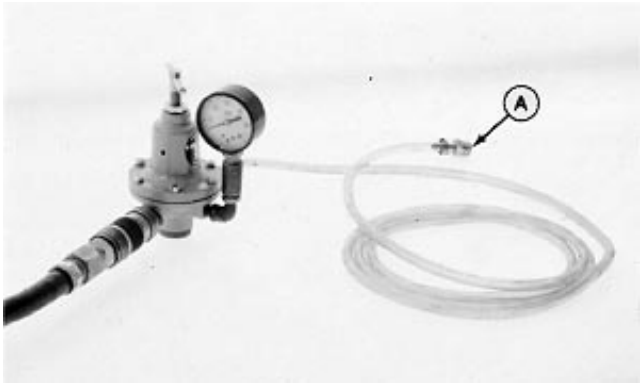
**IMPORTANT: DO NOT start unit when turning crankshaft slightly to close intake valves; plastic bag could be sucked into engine.**

5. Pressurize air intake system to specification. If intake system cannot be pressurized, turn crankshaft slightly to close intake valves.

**Air Intake System—Specification**

Pressure ..... 14—21 kPa (0.14—0.21 bar) (2—3 psi)

6. Spray soap solution over all connections from the air cleaner to turbocharger and air intake manifold to check for leaks. Repair all leaks.




T6089AR –UN–25OCT88

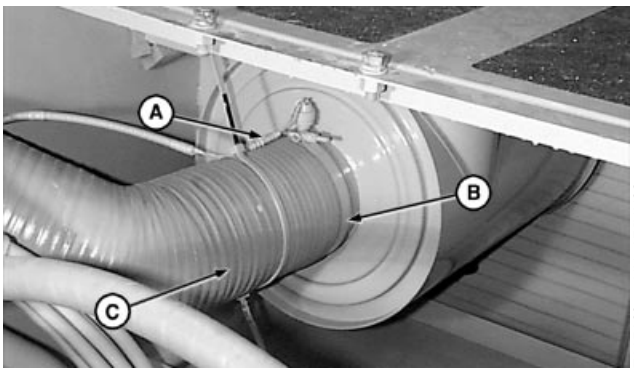
**A—JDG51 Air Inlet Adapter**

05 0520 2

0520,CC4 –19–07JUL98–2/2

## REMOVE AND INSTALL AIR CLEANER

1. Disconnect filter restriction indicator switch connector (A).
2. Loosen clamp (B).
3. Disconnect hose (C).

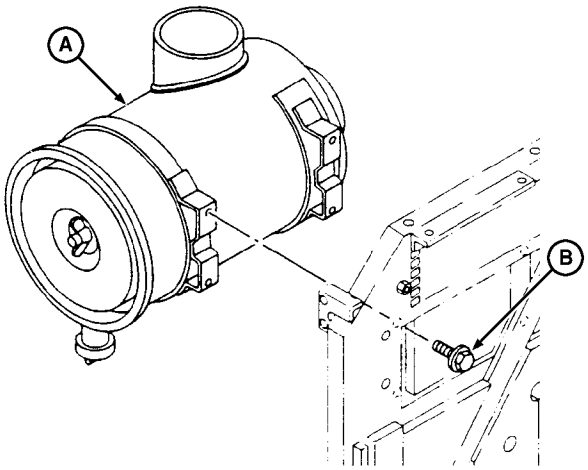



**A—Connector**
**B—Clamp**
**C—Hose**

TX,05,VV2573 –19–07JUL98–1/2



4. Remove cap screws (B).
5. Remove air cleaner (A).
6. Replace parts as necessary.
7. Install air cleaner.
8. Connect hose and tighten hose clamp.
9. Connector filter restriction indicator switch connector.



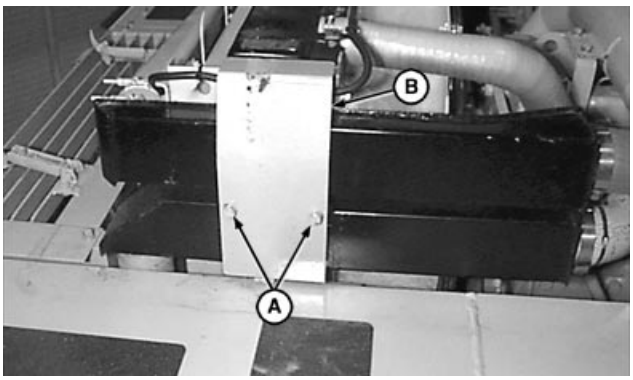

**T115161**

**A—Air Cleaner**
**B—Cap Screw (4 used)**

TX,05,VV2573 –19–07JUL98–2/2

## REMOVE AND INSTALL CHARGE AIR COOLER

1. Remove cap screws (A). Remove cover (B).




**A—Cap Screw (2 used)**
**B—Cover**

CED,OUOE024,222 –19–20MAY98–1/9

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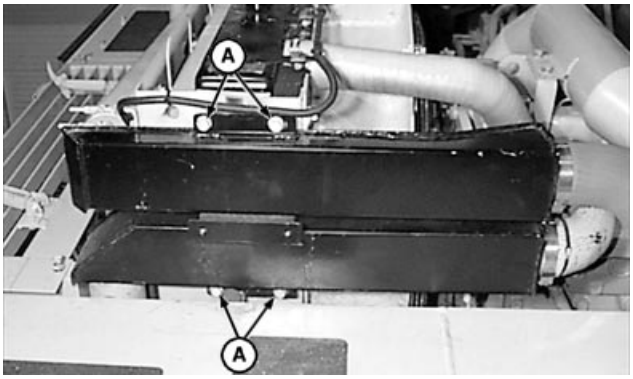
2. Remove cap screw (A).

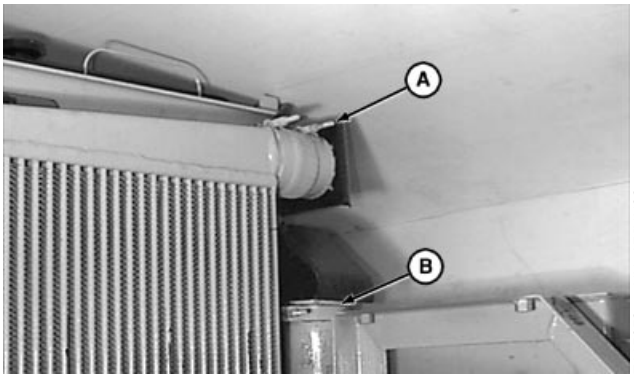



**A—Cap Screw (4 used)**

**Continued on next page**

CED,OUOE024,222 –19–20MAY98–2/9

3. Loosen clamps (A and B).

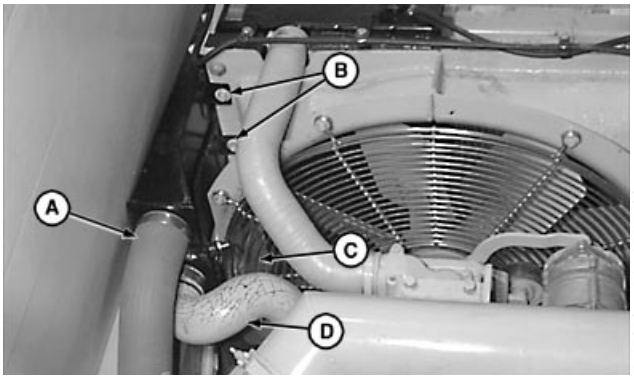



**A—Clamp**
**B—Clamp**

CED,OUOE024,222 –19–20MAY98–3/9



4. Loosen clamps. Remove hoses (A and D).
5. Disconnect connector (C).
6. Remove cap screws (B). Remove charge air cooler ducts. Repair or replace as necessary.

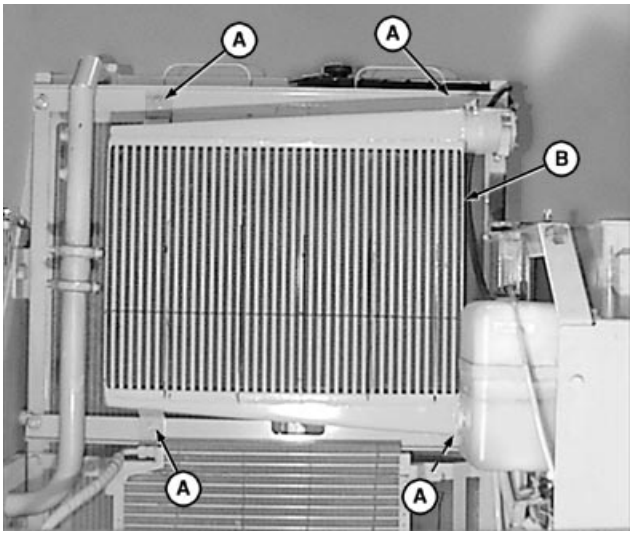



**A—Charge Air Cooler Duct Upper Hose-to-Turbocharger**
**B—Cap Screw (2 used)**
**C—Connector**
**D—Charge Air Cooler Duct Lower Hose-to-Intake Manifold**

**Continued on next page**

CED,OUOE024,222 –19–20MAY98–4/9

7. Remove cap screw (A). Remove charge air cooler (B).
8. Repair or replace as necessary.
9. Install charge air cooler (B). Tighten cap screws (A).




T115060 –UN–17JUN98

**A—Cap Screw (4 used)**
**B—Charge Air Cooler**

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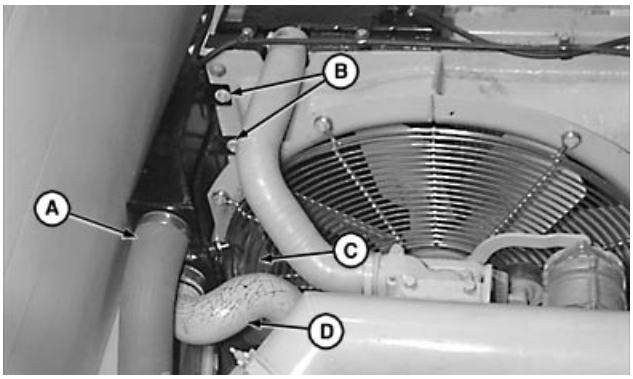
CED,OUOE024,222 –19–20MAY98–5/9

10. Install charge air cooler ducts. Tighten cap screws (B).

**Charge Air Cooler Duct Cap Screw—Specification**

Torque ..... 73 N•m (54 lb-ft)

11. Connect connector (C).
12. Install hoses (A and D). Tighten clamps.



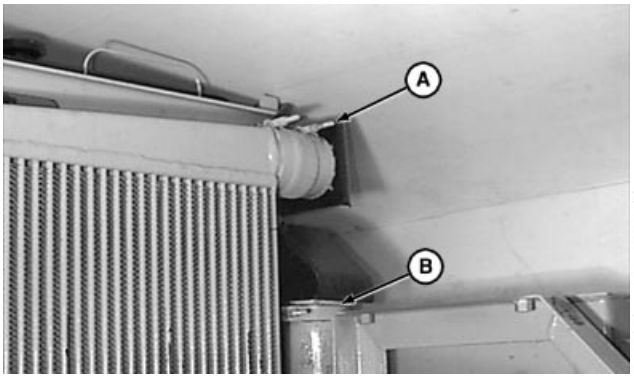

T115059 –UN–17JUN98

**A—Charge Air Cooler Duct Upper Hose-to-Turbocharger**
**B—Cap Screw (2 used)**
**C—Connector**
**D—Charge Air Cooler Duct Lower Hose-to-Intake Manifold**

**Continued on next page**

CED,OUOE024,222 –19–20MAY98–6/9

13. Tighten clamps (A and B).




**A—Clamp**
**B—Clamp**

CED,OUOE024,222 –19–20MAY98–7/9

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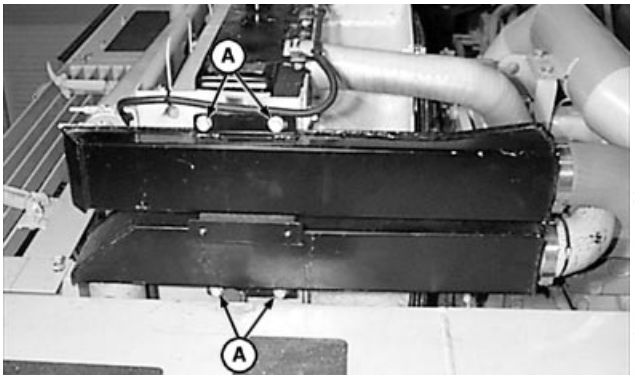
14. Tighten cap screw (A).

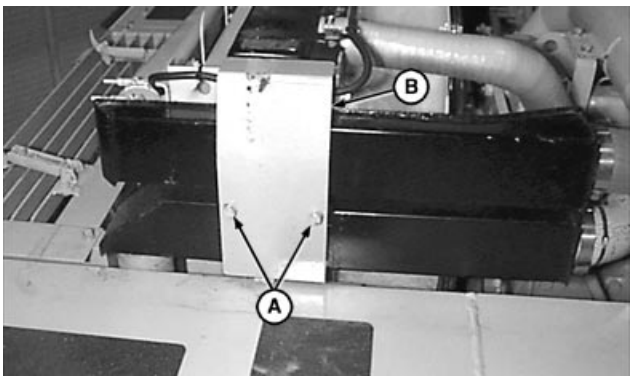



**A—Cap Screw (4 used)**

**Continued on next page**

CED,OUOE024,222 –19–20MAY98–8/9

15. Install cover (B). Tighten cap screws (A).




**A—Cap Screw (2 used)**
**B—Cover**

CED,OUOE024,222 –19–20MAY98–9/9

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0520
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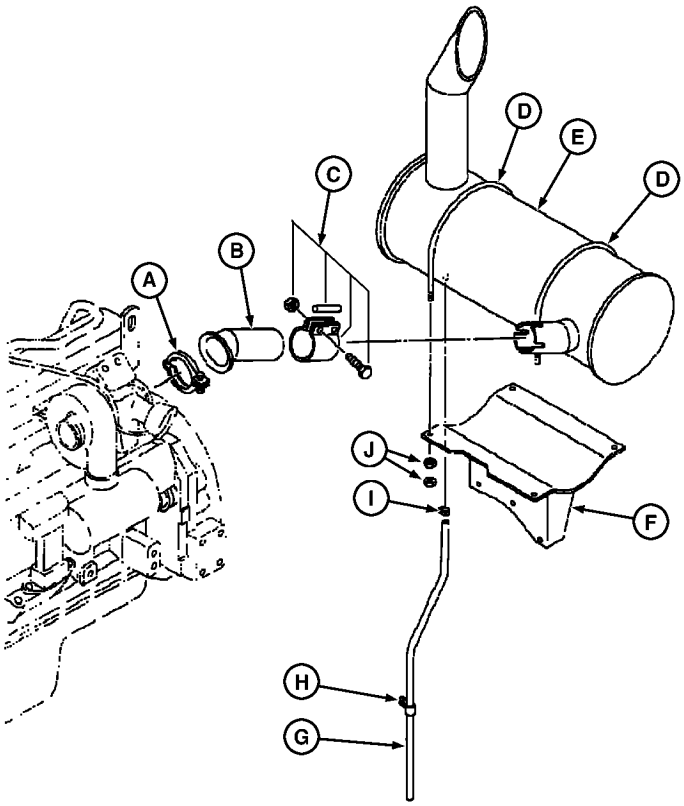
## REMOVE AND INSTALL MUFFLER




T115172

T115172 –UN–17JUN98

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A—Clamp
B—Exhaust Pipe
C—Clamp
D—U-Bolt (2 used)
E—Muffler
F—Bracket
G—Tube
H—Clip
I—Clamp
J—Nut (8 used)

CED,OUOE024,223 –19–20MAY98–1/1

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| T43512 (U.S.)<br>TY9473 (Canadian)<br>242 (LOCTITE®) | Thread Lock and Sealer (Medium Strength) | Apply to float and gasket-to-tank cap screws. |

*LOCTITE is a trademark of Loctite Corp.*

CED,OUOE003,1141 –19–07JUL98–1/1

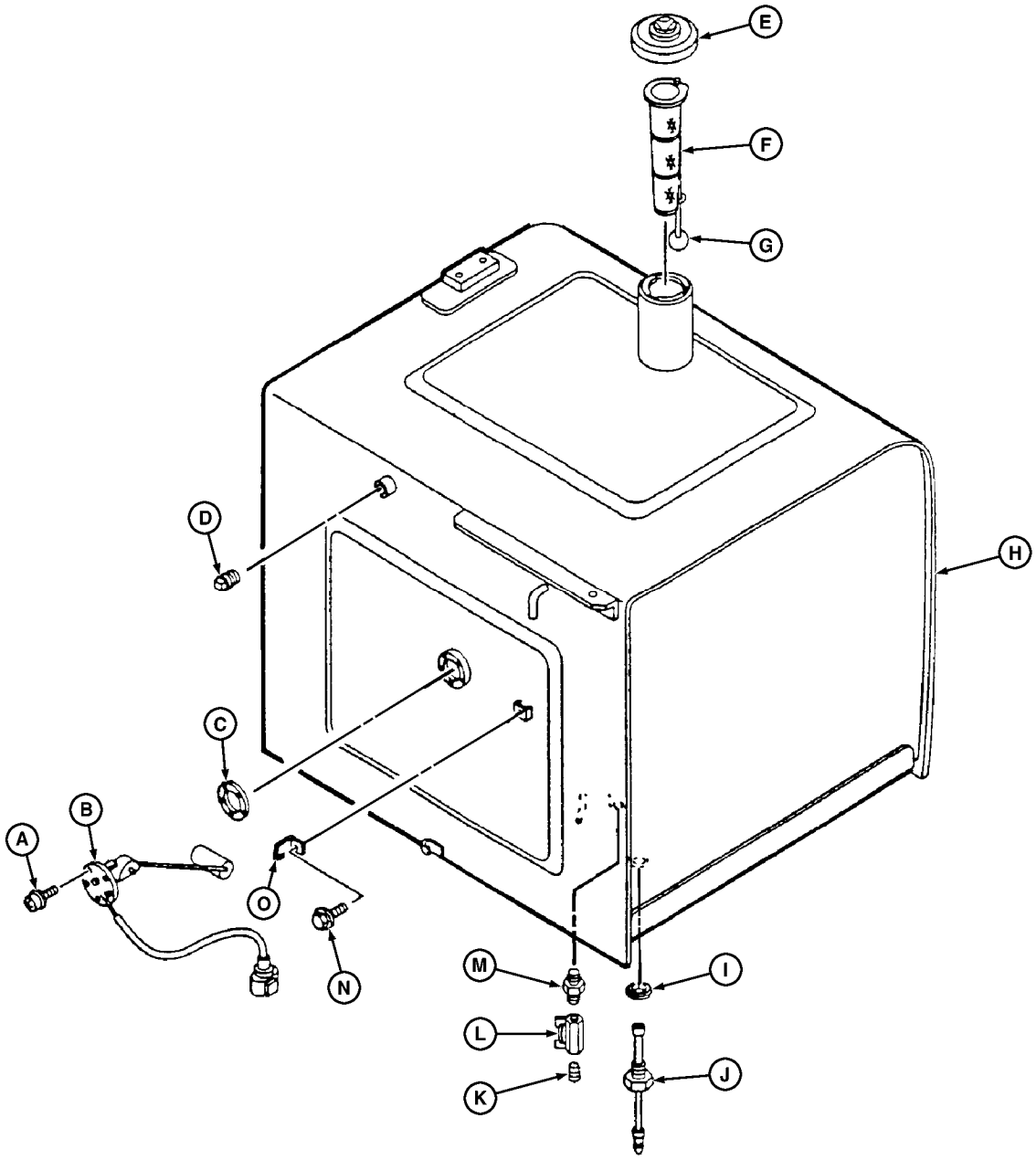
## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Fuel Tank (Empty) | Weight | 126 kg (278 lb) approximate |
| Fuel Level Sender Cap Screw | Torque | 4.5 N•m (40 lb-in.) |
| Fuel Inlet Line | Torque | 17 N•m (150 lb-in.) maximum |



CED,OUOE003,1142 –19–07JUL98–1/1

## REMOVE AND INSTALL FUEL TANK




T115162 –UN–17JUN98

T115162

A—Screw (5 used)
B—Float
C—Packing
D—Plug
E—Cap
F—Strainer
G—Float
H—Fuel Tank
I—Seal
J—Level Switch
K—Plug
L—Ball Valve
M—Adapter
N—Cap Screw
O—Bracket

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 this group.)

Continued on next page

TX,0560,DW246 –19–20MAY98–1/2

1. Drain fuel. Approximate capacity is 560 L (148 gal).
2. Disconnect connectors.

**CAUTION: The approximate weight of the fuel tank (without fuel) is 126 kg (278 lb).**

**Fuel Tank (Empty)—Specification**

Weight..... 126 kg (278 lb) approximate

3. Remove bottom access panel.
4. Disconnect fuel lines.
5. Remove cap screws as required.
6. Apply thread lock and sealer (medium strength) to threads of screws (A).
7. Tighten cap screws.

**Fuel Level Sender Cap Screw—Specification**

Torque..... 4.5 N•m (40 lb-in.)

8. Connect connectors.
9. Install cap screws under fuel tank.
10. Install bottom access cover.
11. Fill fuel tank with proper fuel. (See Fuel Specifications in Fuels and Lubricants, Group 0004.)

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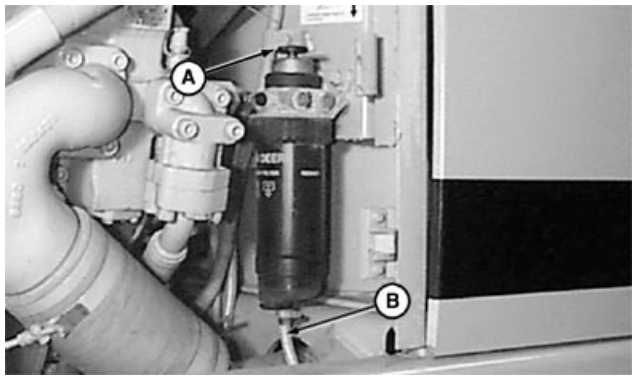
TX,0560,DW246 –19–20MAY98–2/2

## REMOVE AND INSTALL PRIMARY FUEL FILTER (WATER SEPARATOR)

1. Open right access door to access water separator.
2. Open drain valve (B) and press pump (A) to extract water from the fuel system. Collect waste in a container and dispose of it properly.

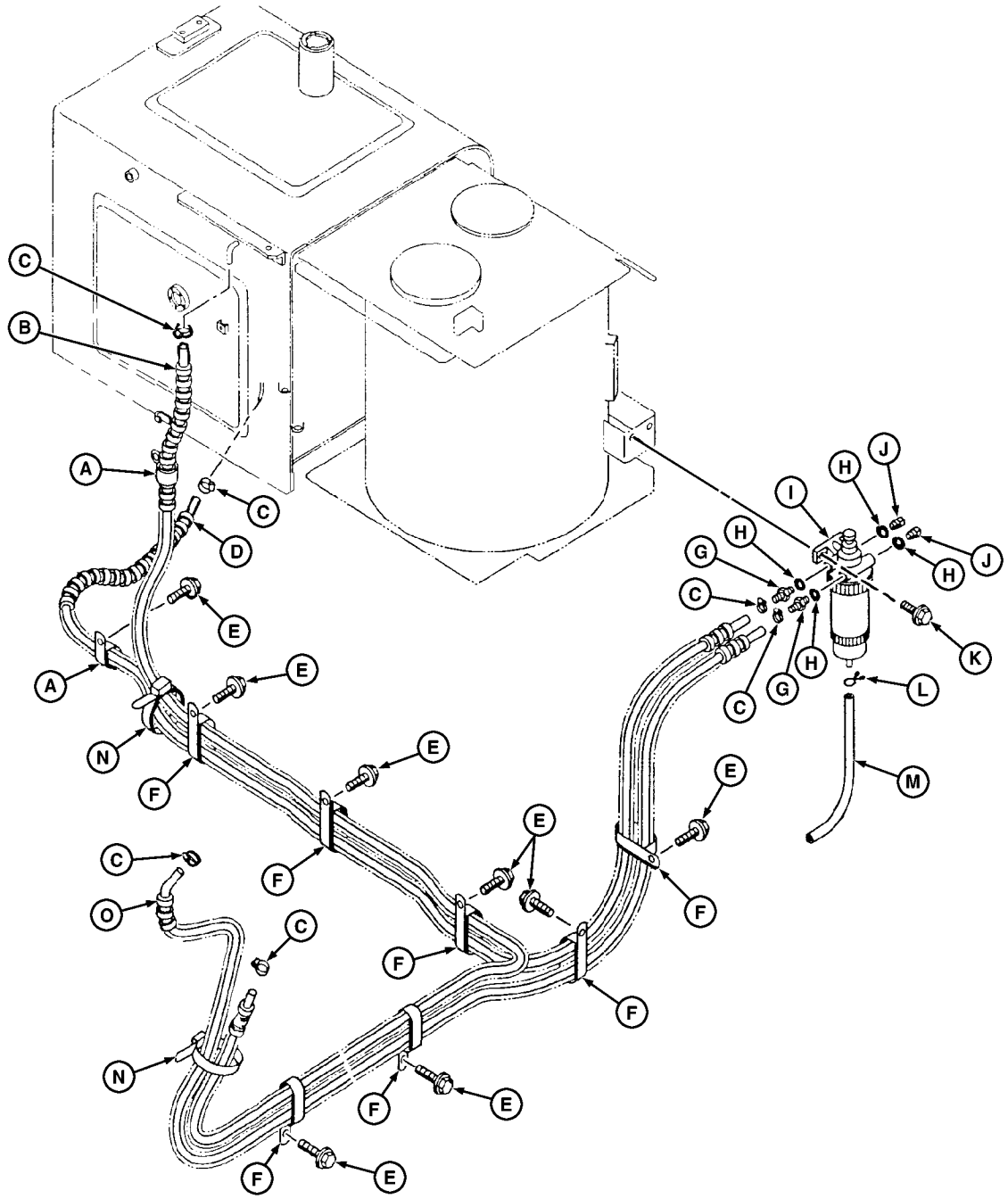



T115183 –UN–17JUN98

**A—Pump**
**B—Drain Valve**

**Continued on next page**

TX,0560,DW247 –19–20MAY98–1/2




T115184 –UN–17JUN98

**A—Clip (2 used)**
**B—Fuel Hose**
**C—Hose Clip**
**D—Fuel Hose**
**E—Cap Screw (8 used)**
**F—Clip (7 used)**
**G—Adapter (2 used)**
**H—O-Ring (4 used)**
**I—Water Separator**
**J—Plug (2 used)**
**K—Cap Screw (2 used)**
**L—Clamp**
**M—Drain Hose**
**N—Band Clip (2 used)**
**O—Fuel Hose**

3. Loosen clamps (C) to disconnect hoses (D and O).

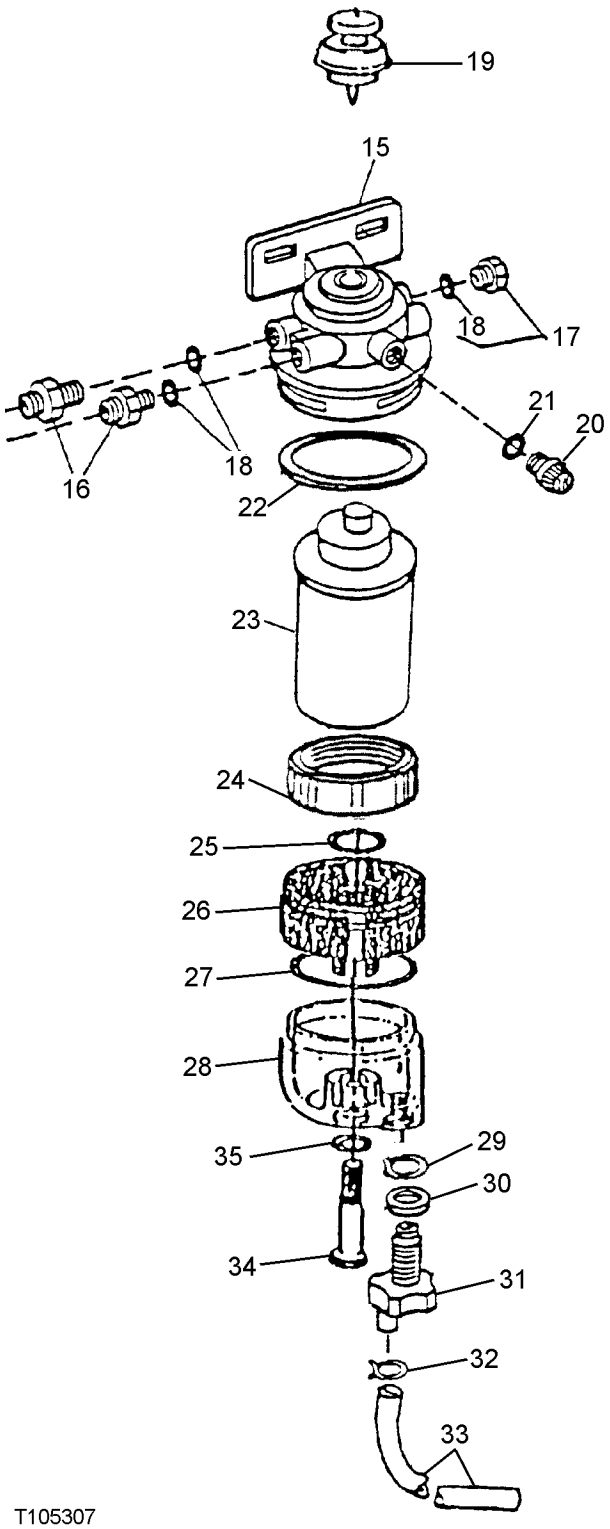
4. Remove cap screws (K) to remove primary fuel filter and housing.

TX,0560,DW247 –19–20MAY98–2/2

## DISASSEMBLE AND ASSEMBLE PRIMARY FUEL FILTER (WATER SEPARATOR)

**IMPORTANT: The filter elements for the final and primary filters are not interchangeable because of the filter material. The final filter element has three keys and the primary filter element has four keys. The keys in the filter element must align with the notches in the filter head.**

1. Loosen drain valve (31) to drain fuel into a container.
2. Loosen element retainer (24) to remove filter element (23).
3. Remove sediment bowl (28). Clean the bowl.
4. Slowly loosen retainer for hand primer. Remove the diaphragm and O-ring from the filter head (15).




T105307

T105307 –UN–26NOV96

**15—Filter Head**
**16—Fitting (2 used)**
**17—Plug (2 used)**
**18—O-Ring (4 used)**
**19—Hand Primer**
**20—Bleed Screw**
**21—O-Ring**
**22—Seal**
**23—Primary Filter Element**
**24—Element Retainer**
**25—O-Ring**
**26—Sediment Bowl Adapter**
**27—O-Ring**
**28—Sediment Bowl**
**29—Seal**
**30—O-Ring**
**31—Drain Valve**
**32—Clamp**
**33—Drain Hose**
**34—Screw**
**35—O-Ring**

**Continued on next page**

TX,0560,DW248 –19–21SEP98–1/2

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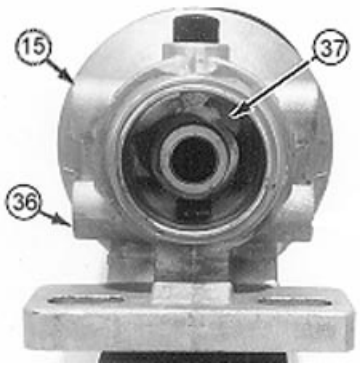
5

5. Remove plug from inlet passage (36).
6. Clean debris from cavity (37) in filter head (15).




T105349 –UN–26NOV96

**15—Filter Head**
**36—Inlet Passage**
**37—Cavity**

TX,0560,DW248 –19–21SEP98–2/2

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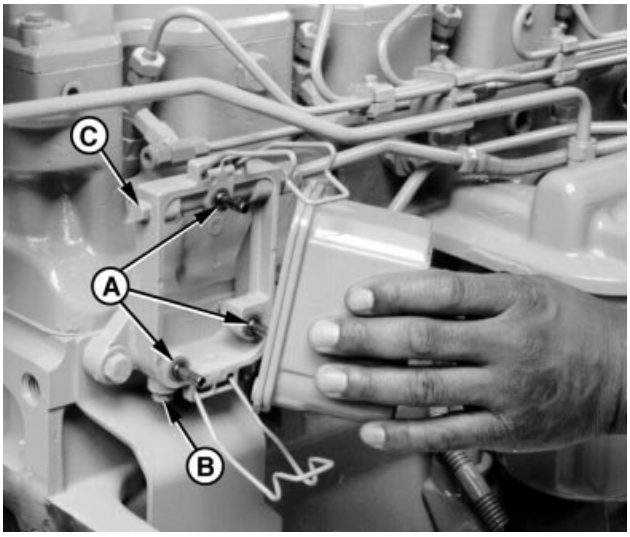
6

## REPLACE FINAL FUEL FILTER ELEMENT

1. Close fuel shut off valve at bottom of fuel tank.
2. Loosen bleed plug (C) and remove drain plug (B). Drain fuel from filter.
3. With fuel filter held firmly against base, lift up on top retaining spring and pull down on bottom retaining spring. Pull fuel filter off guide pins (A) of fuel filter base and discard filter.



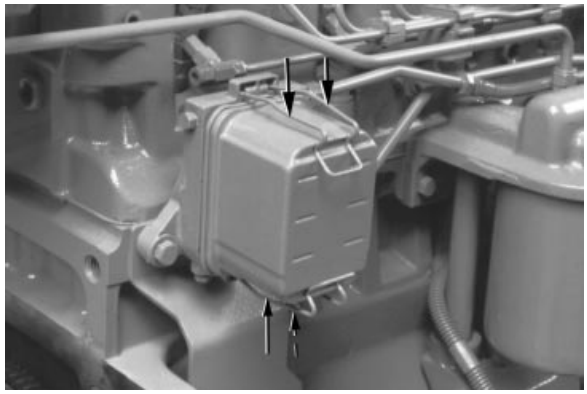

RG7051 –UN–26NOV97

**A—Guide Pin**
**B—Drain Plug**
**C—Bleed Plug**

**Continued on next page**

CED,OUOE024,224 –19–20MAY98–1/2

4. Install fuel filter onto guide pins on fuel filter base. Hold filter firmly against base.
5. Secure bottom retaining spring first, then secure top retaining spring.
6. Install drain plug. Tighten bleed plug and drain plug securely. Do not overtighten.
7. Open fuel shut-off valve and bleed fuel system. (See procedure in this group.)




CED,OUOE024,224 –19–20MAY98–2/2

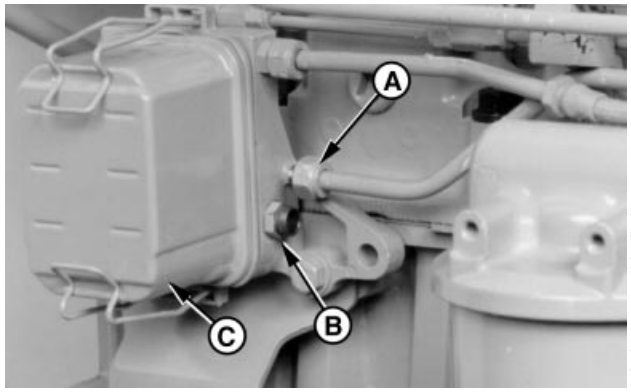
## REPLACE FINAL FUEL FILTER CHECK VALVE

1. Drain and remove fuel filter (C) as described earlier in this group.
2. Remove fuel filter inlet line (A) (shown removed).
3. Inspect and clean fuel filter base.
4. Remove check valve housing (B) from fuel filter base and discard.
5. Install new check valve and tighten securely.
6. Install fuel inlet line and tighten to maximum specification. DO NOT overtighten.

**Fuel Inlet Line—Specification**

Torque ..... 17 N•m (150 lb-in.) maximum

7. Install fuel filter and bleed fuel system. (See procedure in this group.)




**A—Fuel Filter Inlet Line**
**B—Check Valve Housing**
**C—Fuel Filter**

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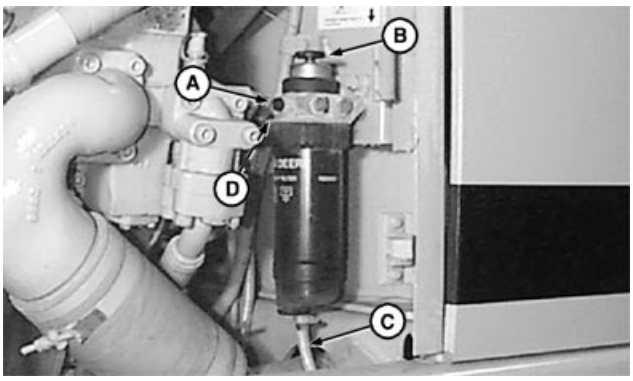
CED,OUOE024,225 –19–20MAY98–1/1

## BLEED THE FUEL SYSTEM

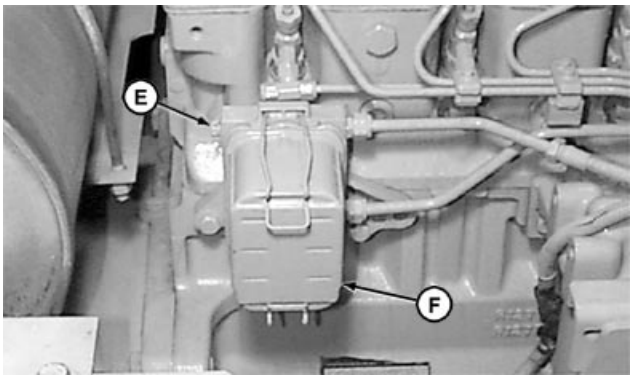
1. Place pan under primary filter (water separator) drain hose (C).
2. Open bleed screw (A) and push pump (B) until fuel free of bubbles flows from around the bleed screw.
3. Close bleed screw (A) and loosen bleed screw (E) from final fuel filter.
4. Push pump until only fuel flows from bleed screw opening.

*NOTE: If you run out of fuel and air is in the supply line to the injection pump continue next step.*

5. Loosen fuel line (D) at injection pump and push pump until fuel free of bubbles flows from connector.
6. Tighten fuel line.




T115054 –UN–17JUN98




T115055 –UN–17JUN98

**A—Bleed Screw**
**B—Pump**
**C—Drain Hose**
**D—Fuel Line**
**E—Bleed Screw**
**F—Final Fuel Filter**

CED,OUOE024,226 –19–20MAY98–1/1

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**BLANK**

# CHAPTER 13

# SECTION 07

# DAMPENER DRIVE (FLEX COUPLING) REPAIR

**BLANK**

# Group 0752
# Elements

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| T43512 (U.S.)<br>TY9473 (Canadian)<br>242 (LOCTITE®) | Thread Lock and Sealer (Medium Strength) | Apply to threads of flex coupling cap screws. |
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | Apply to threads of gearbox fill plug. |

*LOCTITE is a trademark of Loctite Corp.*

CED,OUOE003,1145 –19–07JUL98–1/1

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Set Screw-to-Coupling | Torque | 108 N•m (80 lb-ft) |
| Flywheel Insert and Hub Insert Cap Screw | Torque | 312 N•m (230 lb-ft) |

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0752
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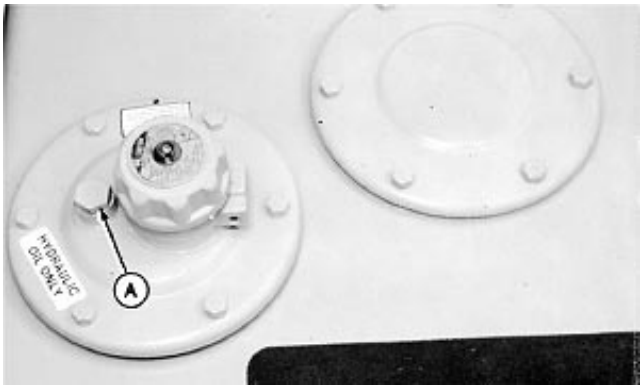
CED,OUOE003,1146 –19–07JUL98–1/1

## REMOVE AND INSTALL DAMPENER DRIVE (FLEX COUPLING)

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure in hydraulic oil tank.
2. Drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).
3. Drain pump drive gearbox. Approximate oil capacity is 1.0 L (1.3 qt).
4. Remove the hood. Remove the hood support and covers.
5. Remove the muffler and muffler bracket. (See procedure in Group 0530)
6. Remove hydraulic pump and splitter drive. (See procedure in Group 0851).




T7869AT –UN–12NOV92

**A—Vent Plug**

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0752
2

**Continued on next page**

TX,07,VV2579 –19–07JUL98–1/2

*NOTE: Flex coupling may come off with pump or stay on the flywheel.*

7. Remove parts (A—G).

8. Replace parts as necessary.

9. Install parts (A—G). Apply thread lock and sealer (medium strength) to set screws (A) and cap screws (B and D).

10. Tighten set screws (A).

**Set Screw-to-Coupling—Specification**

Torque ..... 108 N•m (80 lb-ft)

11. Tighten cap screws (B and D).

**Flywheel Insert and Hub Insert Cap Screw—Specification**

Torque ..... 312 N•m (230 lb-ft)

12. Install splitter drive and hydraulic pump. (See procedure in Group 0851.)

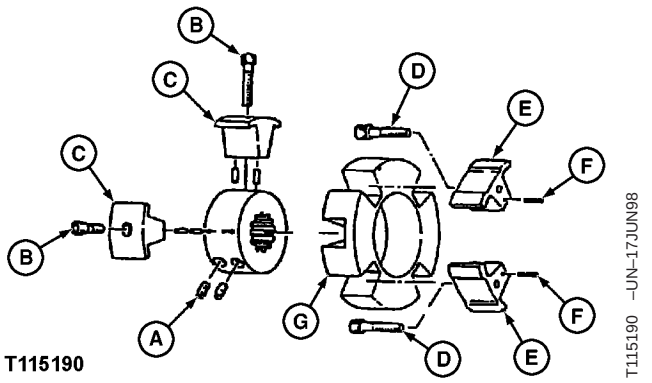
**IMPORTANT: Hydraulic pump and drive gearbox will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new pump or gearbox is installed or oil has been drained from the pump, gearbox or hydraulic oil tank.**

13. Fill pump housing and pump drive gearbox with oil. (See Hydraulic Pump and Drive Gearbox Start-Up Procedure in Group 3360.)

    Apply pipe sealant to drain plug threads.

14. Install muffler and muffler bracket. (See procedure in Group 0530.)

15. Install hood, hood support, and cover.




**A—Set Screw**
**B—Cap Screw**
**C—Insert**
**D—Cap Screw**
**E—Insert**
**F—Spring Pin**
**G—Coupling**

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0752
3

TX,07,VV2579 –19–07JUL98–2/2

**BLANK**

# CHAPTER 14

# SECTION 08

# SPLITTER DRIVE REPAIR

**BLANK**

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| TY16285 (U.S.)<br>TY9485 (Canadian)<br>7649 (LOCTITE®) | Cure Primer | Cleans and cures mating surfaces prior to application of sealants. |
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | Apply to threads of splitter drive elbow fitting and plug. |
| T43514 (U.S.)<br>TY9475 (Canadian)<br>277 (LOCTITE®) | Plastic Gasket | Apply to mating surfaces of hydraulic pumps and splitter housing. |

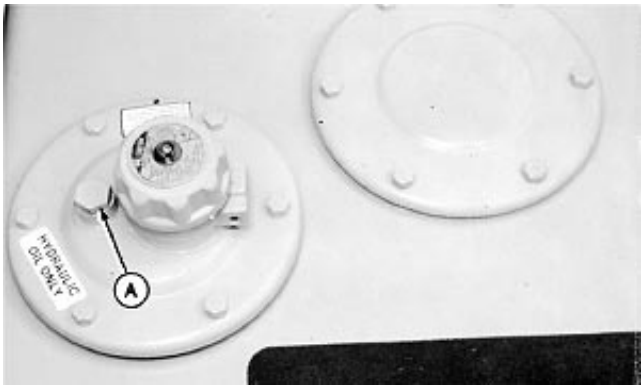
*LOCTITE is a trademark of Loctite Corp.*

CED,OUOE003,1129 –19–17SEP98–1/1

## REMOVE AND INSTALL SPLITTER HOUSING

**CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Do not remove vent plug. Release pressure by loosening vent plug.**

1. Loosen vent plug (A) to release air pressure in hydraulic tank.
2. Drain hydraulic tank. Approximate capacity is 159 L (42 gal).
3. Remove muffler and bracket. (See procedure in Group 0530.)




T7869AT –UN–12NOV92

**A—Vent Plug**

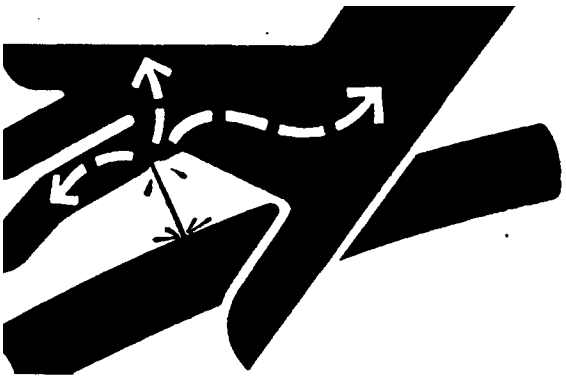
Continued on next page

CED,OUOE024,231 –19–22MAY98–1/3

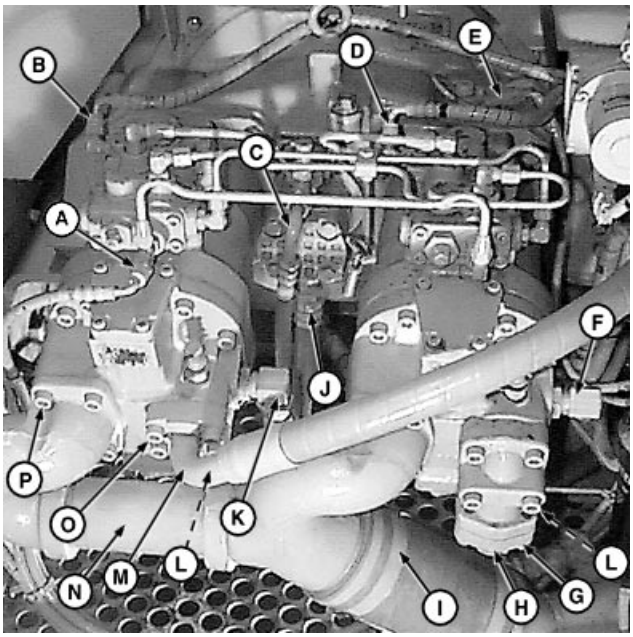
**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.**

4. Disconnect lines (A—D, F, H, J, K, M and N).

5. Disconnect electrical connectors (E and L).



X9811 –UN–23AUG88




T115538 –UN–17JUN98

**A—Rear Pump Regulator Front Piston Port-to-Solenoid Valve Manifold**
**B—Rear Pump Regulator Rear Piston Port-to-PC Sensor Block Line**
**C—Pilot Pump Top Port-to-Pilot Filter Line**
**D—Front Pump Regulator Rear Piston Port-to-PC Sensor Block Line**
**E—Engine Speed Sensor Electrical Connector**
**F—Front Pump Side Port-to-Plugged End on Frame**
**G—Cap Screw (4 used)**
**H—Front Pump Pressure Port-to-Front Control Valve Port D Line**
**I—Clamp (4 used)**
**J—Pilot Pump Bottom Port-to Reservoir Line**
**K—Rear Pump Side Port-to-Plugged End on Frame**
**L—Front and Rear Pump Pressure Sensor Electrical Connectors**
**M—Rear Pump Pressure Port-to-Rear Control Valve Pressure Port Line**
**N—Reservoir-to-Front and Rear Pumps Suction Line**
**O—Cap Screw (4 used)**
**P—Cap Screw (8 used)**

**Continued on next page**

**CAUTION: The approximate weight of splitter housing with pumps is 195 kg (430 lb).**

**Splitter Housing with Pumps—Specification**

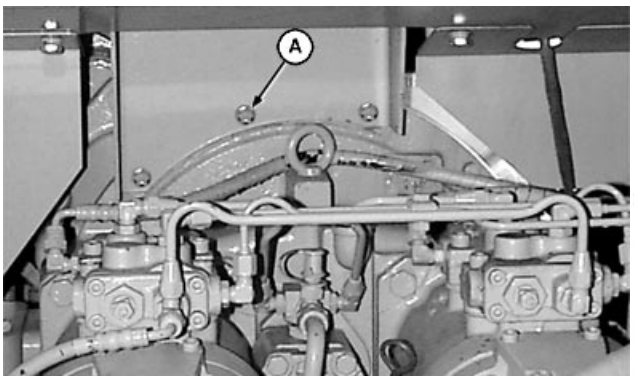
Weight..... 195 kg (430 lb) approximate

6. Remove cap screws (A). Remove splitter housing and pumps.
7. Replace parts as necessary.
8. Install splitter housing and pumps.
9. Connect lines.
10. Tighten cap screws (G, O, and P).

**Splitter Drive Cap Screw—Specification**

Torque ..... 90 N•m (65 lb-ft)

11. Connect electrical connectors (E and L).
12. Install muffler and bracket. (See procedure in Group 0530).
13. Do hydraulic pump start-up procedure. (See procedure in Group 3360.)



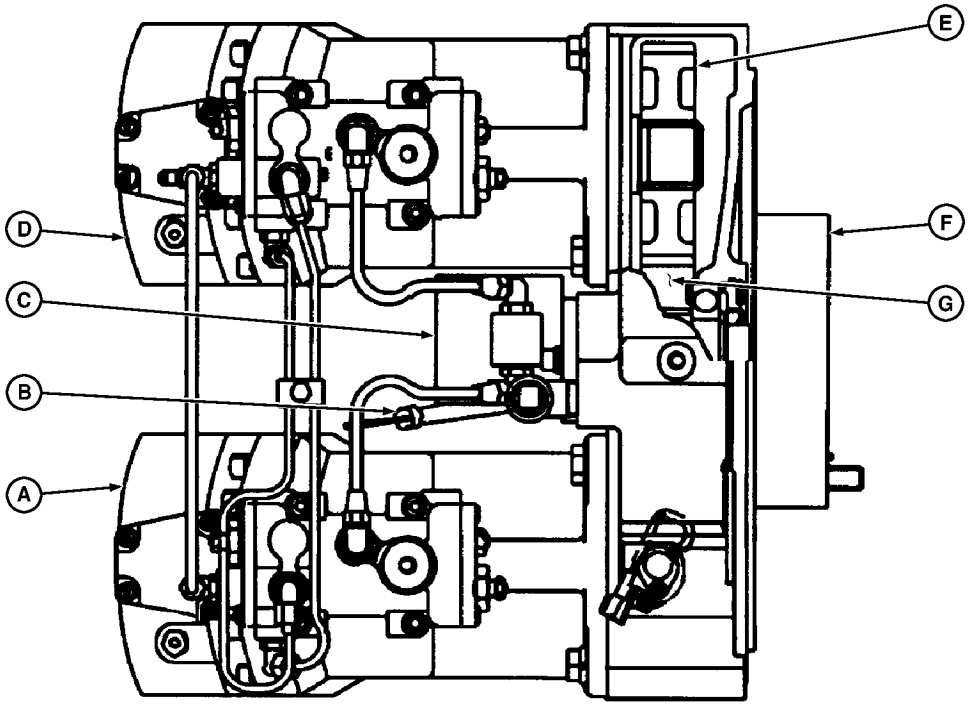

T115554 –UN–17JUN98

**A—Cap Screw (8 used)**



CED,OUOE024,231 –19–22MAY98–3/3

## DISASSEMBLE SPLITTER HOUSING




T115560

T115560 –UN–17JUN98

**A—Front Pump**
**B—Dipstick**
**C—Pilot Pump**
**D—Rear Pump**
**E—Driven Gear (2 used)**
**F—Flex Coupling**
**G—Drive Gear**

08 0800 4

**CAUTION: The approximate weight of splitter housing with pumps is 195 kg (430 lb).**

**Splitter Housing with Pumps—Specification**

Weight..... 195 kg (430 lb) approximate

1. Remove plug (C) to drain oil. Approximate capacity is 1.0 L (1.3 qt).
2. Remove dipstick (B).
3. Remove pumps (A, C, and D). (See procedure in Group 3360.)

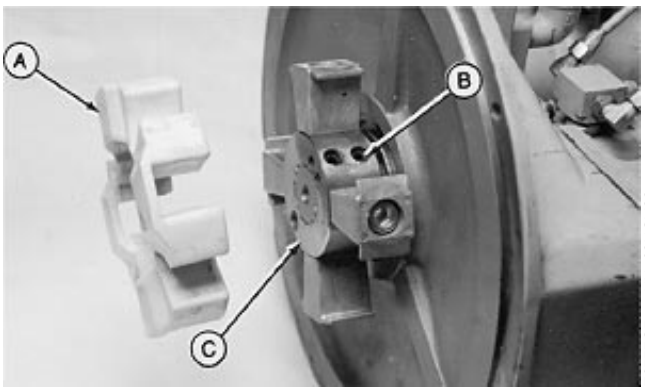
**Continued on next page**

CED,OUOE024,232 –19–22MAY98–1/5

4. Remove flex coupling (A).

5. Loosen set screws (B).

   Remove coupling (C) using a puller. Small section of coupling is slightly deformed by tightening the set screws to make an interference fit.




**A—Flex Coupling**
**B—Set Screw**
**C—Coupling**

**Continued on next page**

CED,OUOE024,232 –19–22MAY98–2/5

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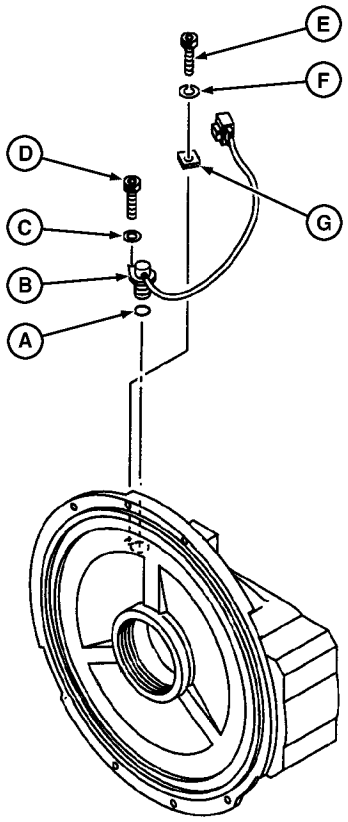
6. Remove parts (A—G) as necessary from splitter housing. Remove speed sensor (B) to prevent damage to sensor when gears are removed.




T115561

T115561 –UN–17JUN98

**A—O-Ring**
**B—Engine Speed Sensor**
**C—Washer**
**D—Cap Screw**
**E—Cap Screw**
**F—Lock Washer**
**G—Connector Bracket**

**Continued on next page**

CED,OUOE024,232 –19–22MAY98–3/5

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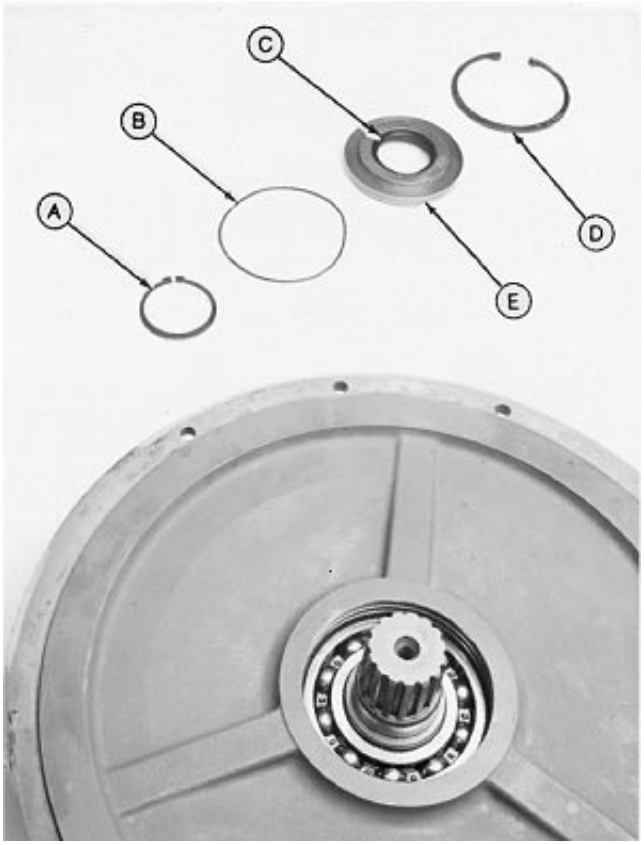
7. Remove parts (A—E).




T6557GW –UN–08NOV88

**A—Snap Ring**
**B—O-Ring**
**C—Oil Seal**
**D—Snap Ring**
**E—Cover**

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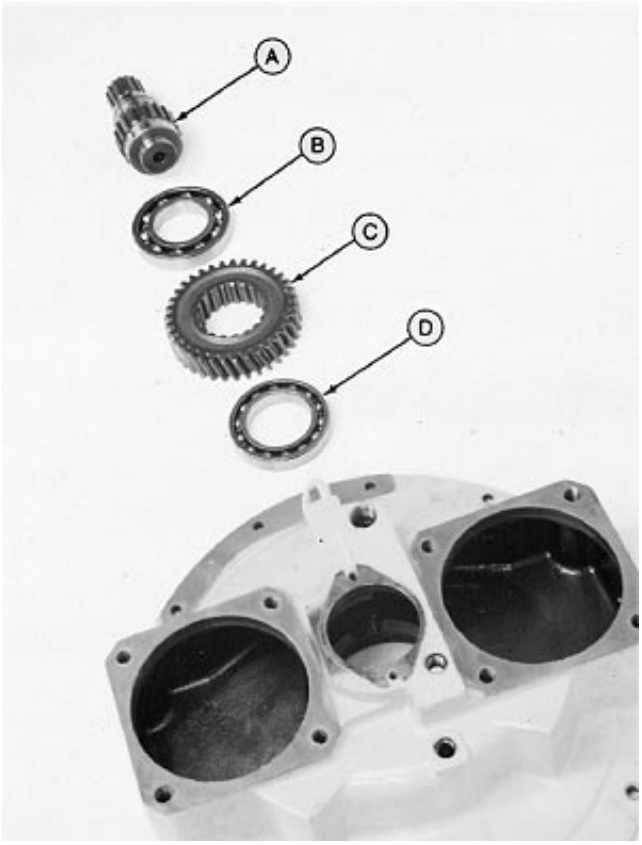
**Continued on next page**

CED,OUOE024,232 –19–22MAY98–4/5

8. Press out shaft (A) with ball bearing (B).

9. Lift out gear (C) through gear case opening.

10. Tap out ball bearing (D).




**A—Shaft**
**B—Ball Bearing**
**C—Gear**
**D—Ball Bearing**

CED,OUOE024,232 –19–22MAY98–5/5

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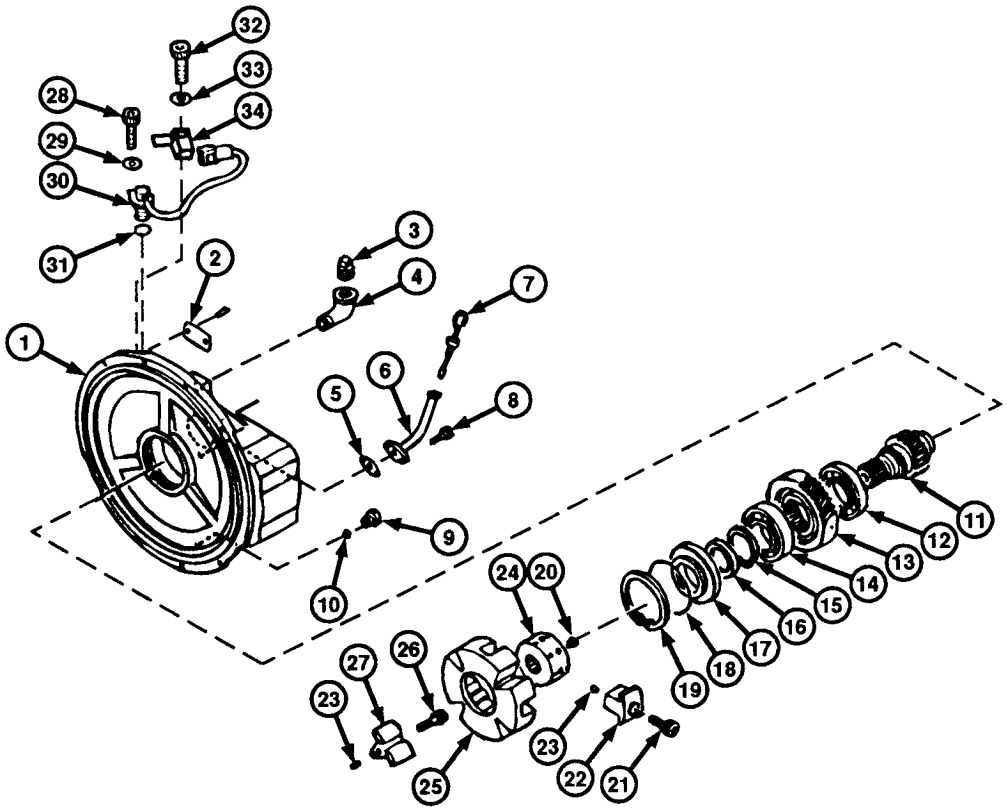
## ASSEMBLE SPLITTER HOUSING




**1—Housing**
**2—Screw (2 used)**
**3—Plug**
**4—Elbow Fitting**
**5—Gasket**
**6—Oil Tube**
**7—Dipstick**
**8—Cap Screw (2 used)**
**9—Plug**
**10—Packing**
**11—Shaft**
**12—Ball Bearing**
**13—Drive Gear**
**14—Ball Bearing**
**15—Snap Ring**
**16—Oil Seal**
**17—Cover**
**18—O-Ring**
**19—Snap Ring**
**20—Set Screw (2 used)**
**21—Cap Screw (4 used)**
**22—Insert (4 used)**
**23—Spring Pin (12 used)**
**24—Coupling**
**25—Flex Coupling**
**26—Cap Screw (4 used)**
**27—Insert (4 used)**
**28—Cap Screw**
**29—Washer**
**30—Engine Speed Sensor (N Sensor)**
**31—O-Ring**
**32—Cap Screw**
**33—Lock Washer**
**34—Connector Bracket**

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1. Starting with ball bearing (12), install parts (11—19) in housing (1).

   Ball bearings (12 and 14) are a press fit in housing and on drive shaft (11).

   Install oil seal (16) in cover (17) so lip (spring side) is toward ball bearing (14).

2. Clean threads of elbow fitting (4) and plug (3) using clean and cure primer. Apply pipe sealant to threads. Install fitting and plugs.

3. Install gasket (5), oil tube (6), dipstick (7), and cap screws (8).

4. Install parts (28—34). Tighten cap screw (28).

**Speed Sensor Cap Screw—Specification**

Torque..... 9.8 N•m (87 lb-in.)

**Continued on next page**

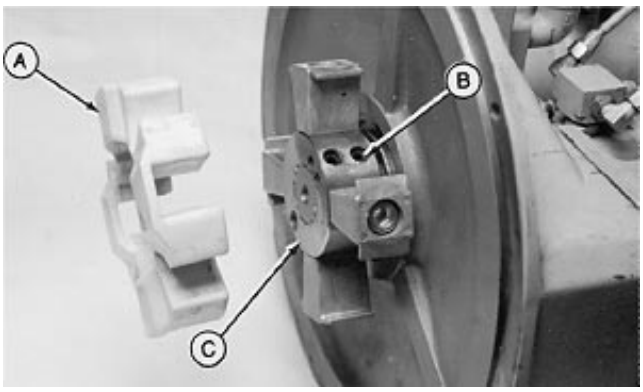
CED,OUOE024,233 –19–22MAY98–1/3

5. Install coupling (C). Tighten set screws (B).

**Dampener Drive Set Screw—Specification**

Torque ..... 110 N•m (80 lb-ft)

6. Install flex coupling (A).




T6557GR –UN–08NOV88

**A—Flex Coupling**
**B—Set Screw**
**C—Coupling**

**Continued on next page**

CED,OUOE024,233 –19–22MAY98–2/3

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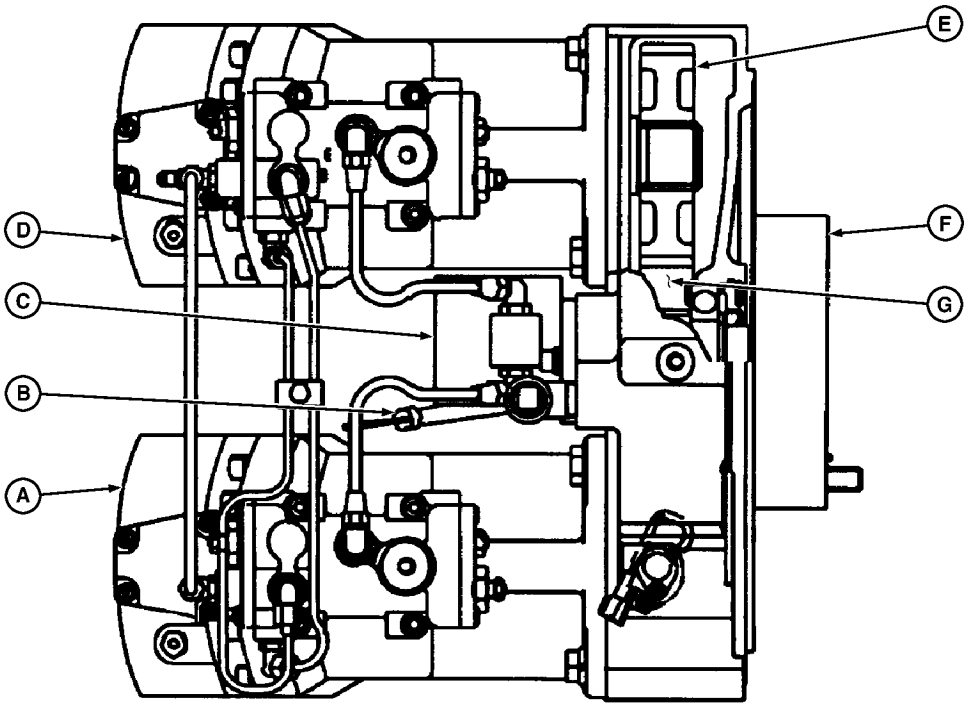


T115560 –UN–17JUN98

T115560

**A—Front Pump**
**B—Dipstick**
**C—Pilot Pump**
**D—Rear Pump**
**E—Driven Gear (2 used)**
**F—Flex Coupling**
**G—Drive Gear**

7. Clean front and rear pump (A and D) mounting surfaces using clean and cure primer. Apply plastic gasket.

   Install pumps. Install sealing washers, lock washers, and cap screws. Tighten cap screws. (See procedure in Group 3360.)

**Pump Mounting Cap Screw—Specification**

Torque..... 147 N•m (110 lb-ft)

8. Install pilot pump (C). Install washers, lock washers, and cap screws. Tighten cap screws.

**Pilot Pump Cap Screw—Specification**

Torque..... 49 N•m (35 lb-ft)

9. Add gear oil. (See Swing Gearbox, Propel Gearbox, and Pump Gearbox Oils, Group 0004.)

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CED,OUOE024,233 –19–22MAY98–3/3

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# CHAPTER 15

# SECTION 16

# ELECTRICAL SYSTEM REPAIR

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# Group 1671
# Batteries, Support, and Cables

## 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.*

CED,OUOE003,1149 –19–08JUL98–1/4

Battery Post and Clamp Cleaner . . . . . JT05838

To clean corrosion off battery posts and clamps.

CED,OUOE003,1149 –19–08JUL98–2/4

Coolant and Battery Tester . . . . . JT05460

To check battery electrolyte specific gravity.

CED,OUOE003,1149 –19–08JUL98–3/4

Battery Load Tester . . . . . JT05832

To check battery capacity.

CED,OUOE003,1149 –19–08JUL98–4/4

16
1671
1

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Engine Slow Idle | Speed | 1050 + 100 - 0 rpm |
| Engine Auto-Idle | Speed | 1200 ± 100 rpm |
| Engine E (Economy) Mode | Speed | 1900 ± 100 rpm |
| Engine Fast Idle in Standard Mode | Speed | 2050 ± 75 rpm |
| Battery | Voltage | 12 Volts |
| | Cold Cranking Amps | 1400 amps at -18°C (0°F) |
| | Reserve Capacity | 440 minutes at 25 amps and 26.7°C (80°F) |
| | BCI Group Size | 4D |
| | Electrolyte Specific Gravity | 1.265—1.280 fully charged |
| Electrical System | Voltage | 24 Volts |

CED,OUOE020,54 –19–20APR99–1/1

16
1671
2

## HANDLE BATTERIES SAFELY

TS204 –UN–23AUG88

**CAUTION: An explosive gas is produced while batteries are in use or being charged. Keep flames or sparks away from the battery area. Make sure the batteries are charged in a well ventilated area.**

**Never lay a metal object on top of a battery as a short circuit can result.**

Battery acid is harmful on contact with skin or fabrics. If acid spills, follow these first aid tips:

1. Immediately remove any clothing on which acid spills.
2. If acid contacts the skin, rinse the affected area with running water for 10 to 15 minutes.
3. If acid comes into contact with the eyes, flood the eyes with running water for 15 to 30 minutes. See a doctor at once. Never use any medication or eye drops unless prescribed by the doctor.
4. To neutralize acid spilled on the floor, use one of the following mixtures: 0.5 kg (1 lb) of baking soda in 4 L (1 gal) of water, or 0.4 L (1 pt) of household ammonia in 4 L (1 gal) of water.
5. Acid from the batteries can also damage the paint and metal surfaces of the machine. Avoid over filling the battery cells.

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1671
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TX,16,VV2564 –19–04MAR97–1/1

## PROCEDURE FOR TESTING BATTERIES

1. VISUAL CHECK

   a. Check for damage such as cracked or broken case and electrolyte leakage.

      If damage is seen, replace battery.

   b. Check electrolyte level. (See procedure in this group)

      If low, add distilled water to specified level and charge battery.

   c. Check terminals for corrosion.

      If corroded, clean using a wire brush or battery post cleaner such as JT05838 Battery Post and Clamp Cleaner.

   d. Check posts for looseness.

      If posts are loose, replace battery.

2. HYDROMETER TEST

   Check specific gravity with a hydrometer or battery tester such as JT05460 Coolant/Battery Tester.

   Record specific gravity reading for each cell.

   If high and low readings vary LESS than 0.050 and average specific gravity is between 1.225 and 1.280, battery is fully charged, go to LOAD TEST.

   If high and low readings vary LESS than 0.050 and average specific gravity is LESS than 1.225, charge battery and repeat test. If average specific gravity is still LESS than 1.225, replace both batteries.

   If high and low readings vary MORE than 0.050, charge battery and repeat test. If high and low readings still vary MORE than 0.050, replace both batteries.

3. LOAD TEST

   Check battery capacity with a load tester such as JT05832 Battery Load Tester. Follow tester manufacturer's instructions for proper load test procedures.

   If one battery fails load test, replace both batteries.

TX,16,UU3291 –19–01SEP95–1/1

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## CHECKING ELECTROLYTE SPECIFIC GRAVITY

TS204 –UN–23AUG88

**CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.**

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

**Always remove grounded (-) battery clamp first and replace it last.**

**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:**

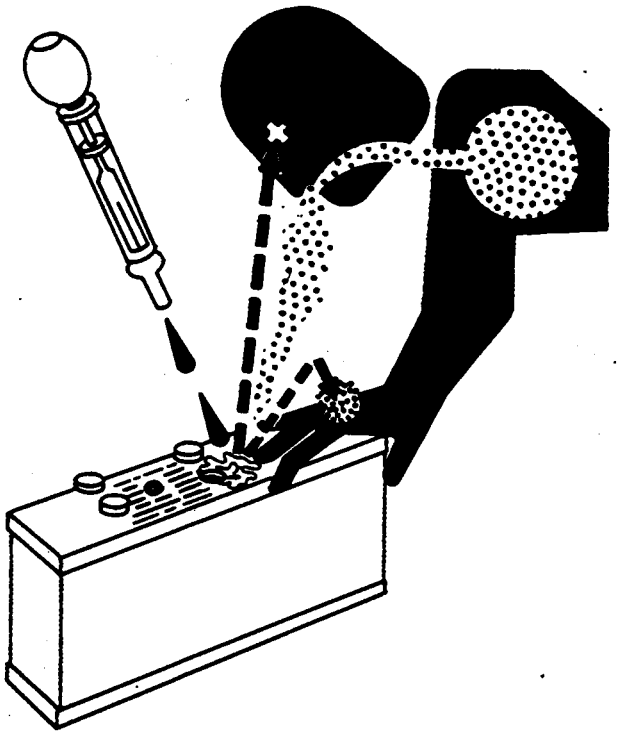
1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoiding spilling or dripping electrolyte.**
5. **Use proper jump start procedure.**

**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 1.9 L (2 quarts).**
3. **Get medical attention immediately.**



TS203 –UN–23AUG88

Check the specific gravity of electrolyte in each battery cell using a battery and coolant tester such as JT05460 Coolant and Battery Tester.

T85402 –UN–10NOV88

Continued on next page

TX,16,UU3292 –19–21SEP94–1/2

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*Batteries, Support, and Cables*

Follow directions included with the tester.

A fully charged battery will have a corrected specific gravity reading of 1.260. If the reading is below 1.200, charge the battery.

*NOTE: In tropical areas, use 1.225 for the full charge reading. In cold areas, use 1.280 for the full-charge reading.*

TX,16,UU3292 –19–21SEP94–2/2

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1671
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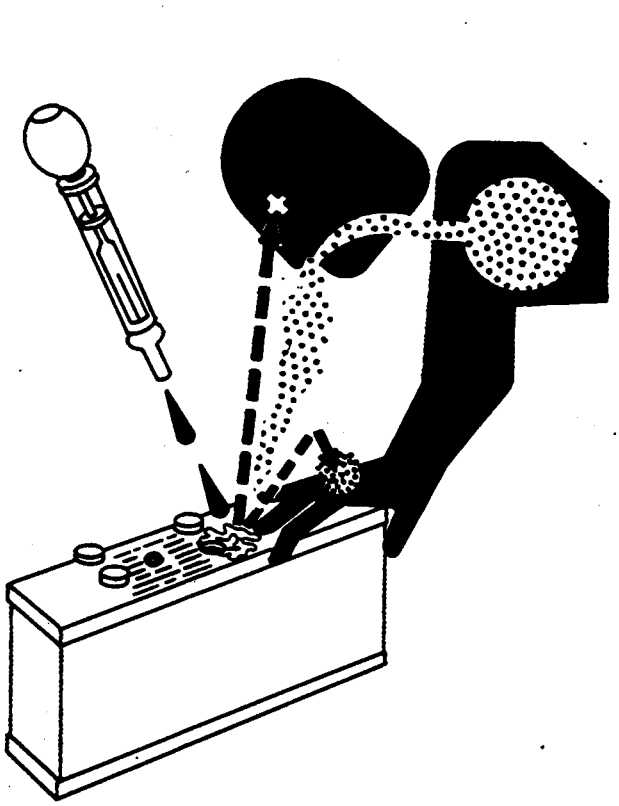
## CHECK BATTERY ELECTROLYTE LEVEL AND TERMINALS



TS203 –UN–23AUG88

**CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.**

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

**Always remove grounded (-) battery clamp first and replace it last.**

**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 10—15 minutes. Get medical attention immediately.**

**If acid is swallowed:**

1. **Drink large amounts of water or milk.**
2. **Then drink milk of magnesia, beaten eggs, or vegetable oil.**
3. **Get medical attention immediately.**

1. Remove hold-down clamps.

2. Remove battery covers.

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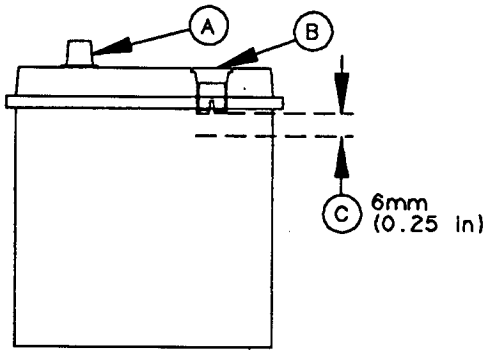
**Continued on next page**

TX,16,UU3217 –19–01SEP95–1/2

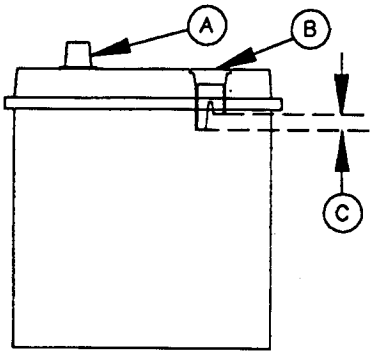
**IMPORTANT: During freezing weather, batteries must be charged after water is added to prevent battery freezing. Charge battery using a battery charger or by running the engine.**

3. Fill each cell to within specified range with distilled water. DO NOT overfill.




T6996DB –UN–10FEB89

*Single Level Fill Tube Application*




T6996DA –UN–10FEB89

*Dual Level Fill Tube Application*

**A—Battery Post**
**B—Fill Tube**
**C—Electrolyte Level Range**

TX,16,UU3217 –19–01SEP95–2/2

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8

## USING BOOSTER BATTERIES—24-VOLT SYSTEM

1. Turn key switch to OFF.

**CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.**

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

**Always remove grounded (-) battery clamp first and replace it last.**

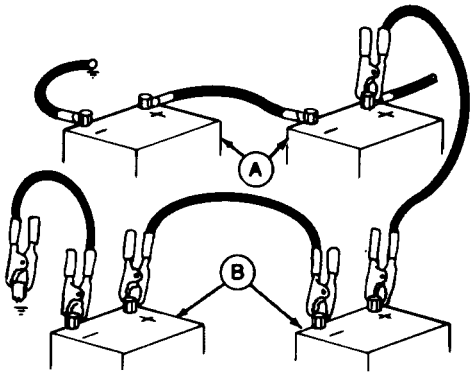
**IMPORTANT: Machine electrical system is 24-volt negative (-) ground. Use only 24-volt booster batteries Disconnect PVC and monitor controller from harness in case batteries are connected incorrectly.**

2. Disconnect engine and pump controller and monitor controller connectors and connect booster batteries (B) to machine batteries (A) making the last connection at machine frame, away from batteries.

   Rock the clamps to make sure they make good contact.

   When possible, use equipment with a switch in the cable that connects booster batteries to machine batteries.

TS204 –UN–23AUG88




T7233JN –UN–21MAY90

*Two Battery Application*

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1671
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**Continued on next page**

TX,16,UU3294 –19–25SEP91–1/2

**CAUTION: Avoid possible injury or death from machinery runaway.**

**Do not start engine by shorting across starter terminals. Machine will start in gear if normal circuitry is bypassed.**

**NEVER start engine while standing on ground. Start engine only from operator's seat, with transmission in neutral or park.**

TS177 –UN–11JAN89

3. Start engine while seated on operator's seat.

   After engine starts, disconnect clamp at machine frame first and then disconnect remaining clamps.

TX,16,UU3294 –19–25SEP91–2/2

## CHARGE BATTERY

**CAUTION: Battery gas can explode. Keep sparks and flames away from batteries. Use a flashlight to check battery electrolyte level.**

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

**Always remove grounded (-) battery clamp first and replace it last.**

TS204 –UN–23AUG88

**IMPORTANT: When charging a battery in the machine, battery cables and PVC and EC controller connectors must be disconnected to avoid damage to electrical components and controllers if battery charger cables are inadvertently connected to battery wrong.**

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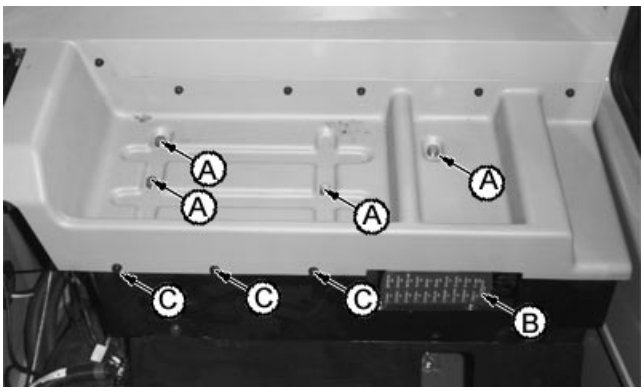
*NOTE: Follow manufacturer's instructions to use battery charger as a booster to start engine.*

1. Disconnect all battery cables starting at the negative (-) ground cable.

**Continued on next page**

TX,16,UU3295 –19–05JUN92–1/3

2. Remove cap screws (A and C) and the fuse box cover (B) to remove the rear console cover.

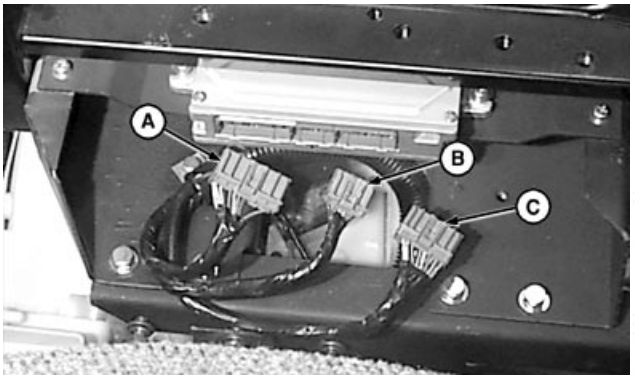



T107932B –UN–07MAR97

**A—Cap Screw (4 used)**
**B—Fuse Box Cover**
**C—Cap Screw (3 used)**

TX,16,UU3295 –19–05JUN92–2/3

3. Loosen EPC connectors and remove connectors (A—C).
4. Turn charger off before connecting or disconnecting it.
5. Charge battery following manufacturer's instructions for your battery charger.
6. After battery is charged, connect the positive (+) cable, then connect the negative (-) ground cable.
7. Push connectors into EPC controller.
8. Install rear console cover and fuse box cover
9. After connecting batteries, engine speeds must be recalibrated:




T115226 –UN–17JUN98

**A—EPC Connector**
**B—EPC Connector**
**C—EPC Connector**

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11

TX,16,UU3295 –19–05JUN92–3/3

## ENGINE SPEED LEARNING PROCEDURE

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor adjustment and engine learning control procedure must be performed.

- Engine
- Engine speed control cable
- Engine control motor and sensor
- Engine and pump controller
- Fast and slow idle stop brackets

1. Stop the engine.

2. Disconnect the laptop computer from the diagnostic test port.

3. Wait for 5 seconds.

**Continued on next page**

CED,OUOE003,1086 –19–08SEP98–1/2

16
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12

4. Push engine learning switch (C) up to top position. The switch is a three position switch. Make sure it is in the top position.
5. Turn key switch ON. Wait 5 seconds.
6. Turn key switch OFF. Wait 5 seconds.
7. Push engine learning switch to middle position.
8. Check engine speeds.

**Engine Slow Idle—Specification**

Speed ..... 1050 + 100 - 0 rpm

**Engine Auto-Idle—Specification**

Speed ..... 1200 ± 100 rpm

**Engine E (Economy) Mode—Specification**

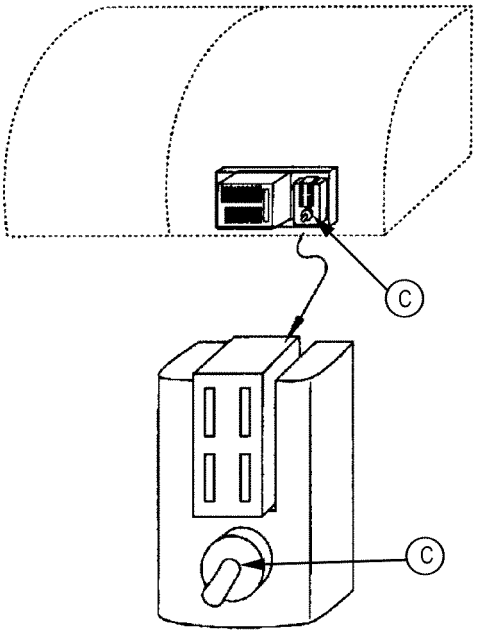
Speed ..... 1900 ± 100 rpm

**Engine Fast Idle in Standard Mode—Specification**

Speed ..... 2050 ± 75 rpm

If slow idle speed is still not to specification, check the engine control sensor. (See Engine Control (EC) Sensor Harness Test in Group 9025-25.)

*NOTE: The laptop computer with excavator diagnostic software can be used to change the default speeds for slow idle, auto-idle, economy mode, and fast idle in standard mode. See Excavator Diagnostic Software Special Function—Engine Speed in Group 9025-25.*




T103674

T103674 –UN–11SEP96

**C—Engine Learning Switch**

16
1671
13

CED,OUOE003,1086 –19–08SEP98–2/2

## REMOVE AND INSTALL BATTERIES

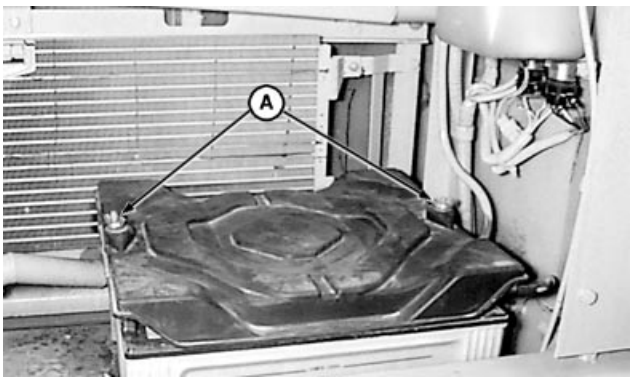
**CAUTION: Prevent personal injury from exploding battery. Keep sparks and flames away from battery.**

TS204 –UN–23AUG88

1. Remove wing nuts (A).
2. Disconnect negative (-) battery cables first, then positive (+) cables.

**IMPORTANT: If one battery in a 24-volt system has failed, replace both batteries.**

3. Remove batteries.




T115227 –UN–17JUN98

**A—Wing Nuts**

**Battery—Specification**

| | |
|---|---|
| Voltage | 12 Volts |
| Cold Cranking Amps | 1400 amps at -18°C (0°F) |
| Reserve Capacity | 440 minutes at 25 amps and 26.7°C (80°F) |
| BCI Group Size | 4D |
| Electrolyte Specific Gravity | 1.265—1.280 fully charged |

**Electrical System—Specification**

| | |
|---|---|
| Voltage | 24 Volts |

TX,16,UU3296 –19–30SEP94–1/1

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14

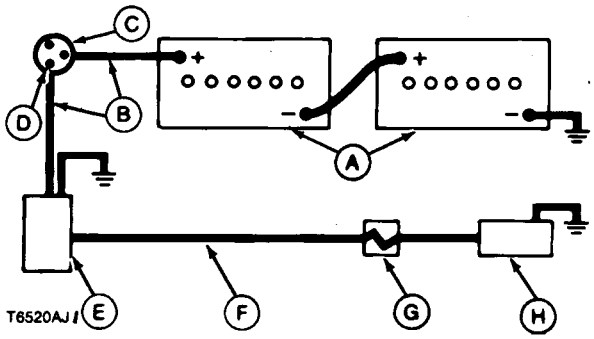
## ADDING 12-VOLT ACCESSORIES

**IMPORTANT: This machine has a 24-volt electrical system. Installing 12-volt accessories without addition of 24-volt-to-12-volt converter may cause battery failure. See your John Deere dealer.**

When possible, use 24-volt accessories. If 12-volt accessories are added, use a 24-volt-to-12-volt converter. Converters are available from your John Deere dealer (see the Industrial Equipment Attachment Guide) or electronic retail stores. This converter may be wired into the ACC terminal of the ignition switch (see drawing).

Converter capacity requirements depend on the load of the accessories installed. Follow electronic dealer and manufacturer's recommendations to determine the capacity of the converter required and its installation requirements.

DO NOT connect an accessory to one battery. Connecting a 12-volt accessory to one battery will cause one battery to overcharge, and the other battery to undercharge, causing battery failure.




T6520AJ1 –UN–18OCT88

**A—Battery**
**B—24 Volts**
**C—Ignition Switch**
**D—ACC Terminal**
**E—Converter**
**F—12 Volts**
**G—In-Line Fuse**
**H—12-Volt Accessory**

TX,16,UU3297 –19–30SEP94–1/1

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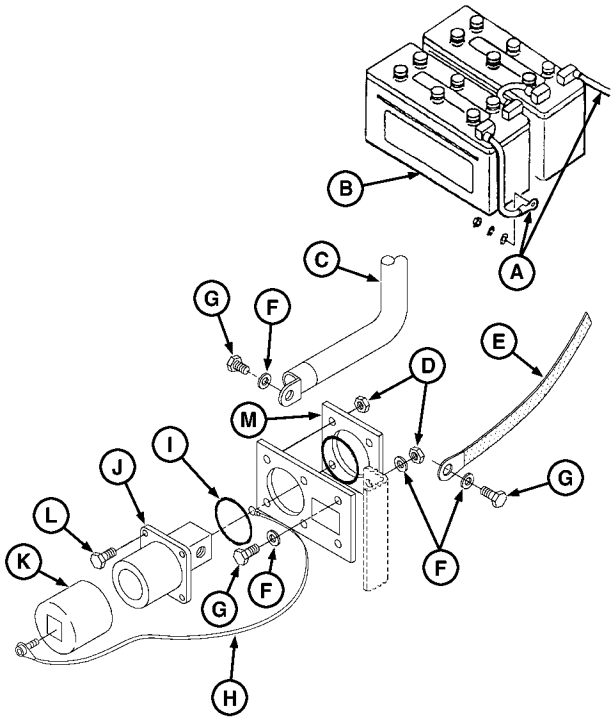
1671
15

## REMOVE AND INSTALL 24-VOLT SLAVE RECEPTACLE

1. Disconnect negative (-) battery cable (A) from battery (B).
2. Remove cap screws (G) and washers (F).
3. Disconnect cables (C and E).
4. Remove cover (K).
5. Remove cap screws (L), washers (M) and flange nuts (D).
6. Remove 24-volt slave receptacle (J), insulators (I) and cover keeper (H). Replace parts as necessary.




T121222 –UN–07JUN99

T121222

**A—Negative (-) Battery Cable**
**B—Battery**
**C—Positive (+) Cable**
**D—Flange Nut (4 used)**
**E—Negative (-) Cable**
**F—Washer (2 used)**
**G—Cap Screw (2 used)**
**H—Cover Keeper**
**I—Insulator (2 used)**
**J—24-Volt Slave Receptacle**
**K—Cover**
**L—Cap Screw (4 used)**
**M—Washer (8 used)**

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16

CED,OUOE020,55 –19–20APR99–1/1

# Group 1672
# Alternator, Regulator, and Charging System Wiring

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Alternator Mounting Top Strap Cap Screw | Torque | 27 N•m (20 lb-ft) |
| Alternator Mounting Cap Screw and Nut | Torque | 47 N•m (35 lb-ft) |
| Ground Terminal Nut | Torque | 2.3 N•m (20 lb-in.) |
| Output B+ Terminal Nut | Torque | 3.6 N•m (32 lb-in.) |
| D+ Terminal Nut | Torque | 2.3 N•m (20 lb-in.) |

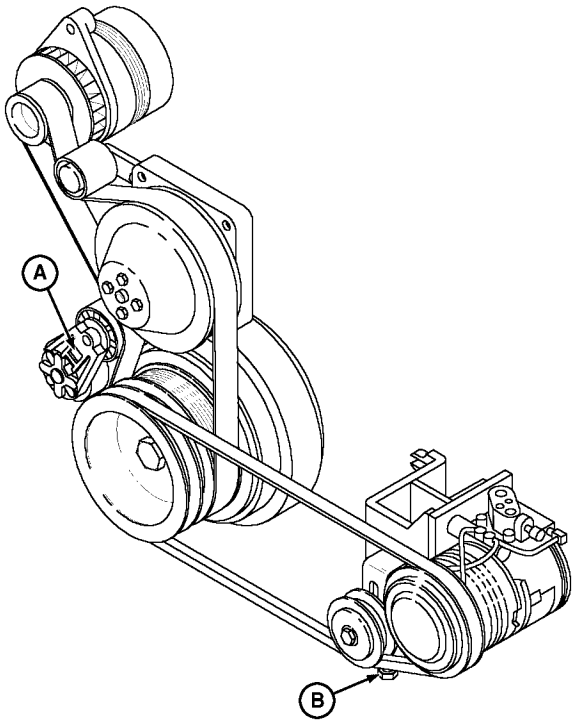
CED,OUOE003,1153 –19–07JUL98–1/1

16
1672
1

## REMOVE AND INSTALL ALTERNATOR

**IMPORTANT: Always disconnect battery negative (-) cables before removing alternator or a short circuit could result.**

1. Loosen adjusting screw (B). Remove air conditioning belt.
2. Install breaker bar in square drive hole (A).
3. Hold tension adjuster away from belt while removing old belt.




T115779 –UN–17JUN98

**T115779**

**A—Square Drive Hole**
**B—Adjusting Screw**

**Continued on next page**

CED,OUOE003,1152 –19–07JUL98–1/2

16
1672
2

4. Disconnect wiring leads (C—E).
5. Remove cap screw and washer (B) and cap screw and nut (A) to remove alternator.
6. Replace parts as necessary.
7. Install alternator. Install lower cap screw and nut (A) so head of cap screw is toward belt.
8. Install cap screw and washer (B).
9. Tighten cap screw (B) and cap screw and nut (A).

**Alternator Mounting Top Strap Cap Screw—Specification**

Torque ..... 27 N•m (20 lb-ft)

**Alternator Mounting Cap Screw and Nut—Specification**

Torque ..... 47 N•m (35 lb-ft)

10. Connect wiring leads. Tighten ground terminal nut, output B+ terminal nut, and D+ terminal nuts.

**Ground Terminal Nut—Specification**

Torque ..... 2.3 N•m (20 lb-in.)

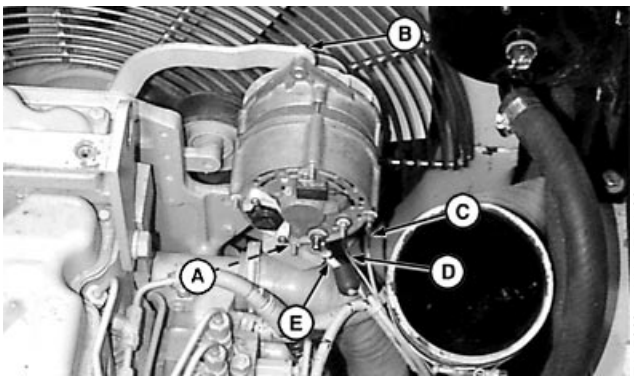
**Output B+ Terminal Nut—Specification**

Torque ..... 3.6 N•m (32 lb-in.)

**D+ Terminal Nut—Specification**

Torque ..... 2.3 N•m (20 lb-in.)

11. Slowly turn breaker bar clockwise to place tension adjuster assembly against belt. Tension is automatically adjusted.
12. Remove breaker bar from assembly.
13. Install air conditioning belt. Tighten adjusting screw.




T115262 –UN–17JUN98

**A—Cap Screw, Nut**
**B—Cap Screw, Washer**
**C—Ground Terminal Wiring Lead**
**D—D+ Terminal (YEL)**
**E—B+ Terminal (WHT)**

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CED,OUOE003,1152 –19–07JUL98–2/2

# Robert Bosch Alternator Repair



## SPECIAL OR ESSENTIAL TOOLS

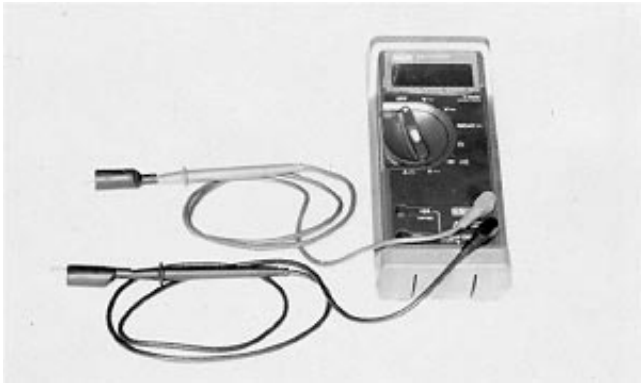
*NOTE: Order tools according to information given in the U.S. SERVICEGARD™ Catalog or in the European Microfiche Tool Catalog (MTC).*

*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,2144 –19–15MAR97–1/2

Digital Multimeter . . . . . .JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.



RW11274 –UN–12DEC88

RG,RG34710,2144 –19–15MAR97–2/2

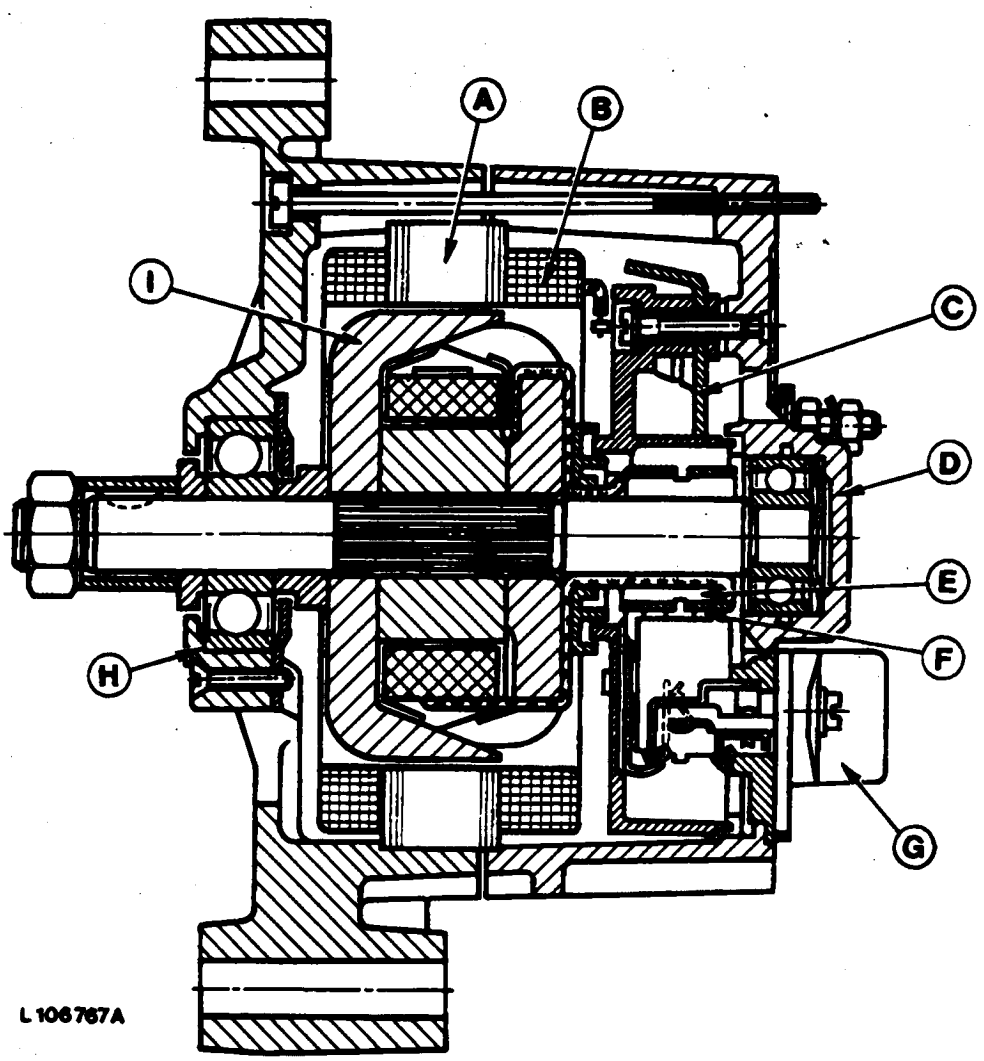
# ROBERT BOSCH CHARGING CIRCUIT SPECIFICATIONS

| | | | Rating | |
|---|---|---|---|---|
| **John Deere Part No.** | **Robert Bosch Part No.** | **Alternator Model/Series** | **Volts** | **Amps** |
| AE53101 | 9 120 060 042 | K1 | 12 (14) | 120 |
| AH137883 | 0 120 484 011 | K1 | 12 (14) | 95 |
| AL78690 | 0 120 484 016 | K1 | 12 (14) | 85 |
| AL78692 | 0 120 484 017 | K1 | 12 (14) | 120 |
| AL78689 | 0 120 488 267 | K1 | 12 (14) | 55 |
| AL81436 | 0 120 488 290 | K1 | 12 (14) | 55 |
| AL81437 | 0 120 484 020 | K1 | 12 (14) | 85 |
| AL81438 | 0 120 488 019 | K1 | 12 (14) | 120 |
| AT161324 | 0 120 488 206 | K1 | 24 (28) | 45 |
| AT168711 | 0 120 468 136 | N1 | 24 (28) | 80 |
| AT173624 | 0 120 488 205 | K1 | 12 (14) | 65 |
| AT175194 | 9 120 060 041 | K1 | 12 (14) | 95 |
| AT175195 | 9 120 060 039 | K1 | 24 (28) | 45 |
| AT175839 | 0 120 468 055 | N1R | 12 (14) | 135 |
| AT85458 | 0 122 469 004 | N1 | 24 (28) | 50 |
| AZ38462 | 0 120 484 012 | K1 | 12 (14) | 95 |
| RE36267 | 0 120 484 011 | K1 | 12 (14) | 90 |
| RE36268 | 0 120 468 055 | N1 | 12 (14) | 135 |

| **Item** | **Specification** |
|---|---|
| Minimum length of carbon brushes | 5 mm (0.2 in.) |
| When soldering new brushes, make sure they do not protrude beyond brush bracket by more than | 10 mm (0.4 in.) |
| Minimum slip ring diameter | 26.8 mm (1.055 in.) |
| Maximum radial run-out of slip rings | 0.03 mm (0.0012 in.) |
| Maximum radial run-out of rotor shaft | 0.05 mm (0.002 in.) |
| Stator winding resistance | 0.40—0.44 ohms |
| Rotor winding resistance | 4.0—4.40 ohms |
| Armature end play | 0.1—0.3 mm (0.004—0.012 in.) |
| **Torques** | |
| Drive and frame-to-end frame | 4.0—5.5 N•m (33—48 lb-in.) |
| Fan pulley shaft nut | 35—45 N•m (25—32 lb-ft) |

RG,RG34710,2145 –19–15MAR97–1/1

## ALTERNATOR, SECTION VIEW




L106767A –UN–06APR89

**A—Stator Assembly**
**B—Stator Winding**
**C—Heat Sink**
**D—Bearing and End Frame**
**E—Slip Ring**
**F—Carbon Brush**
**G—Regulator**
**H—Bearing and Drive End Frame**
**I—Rotor**

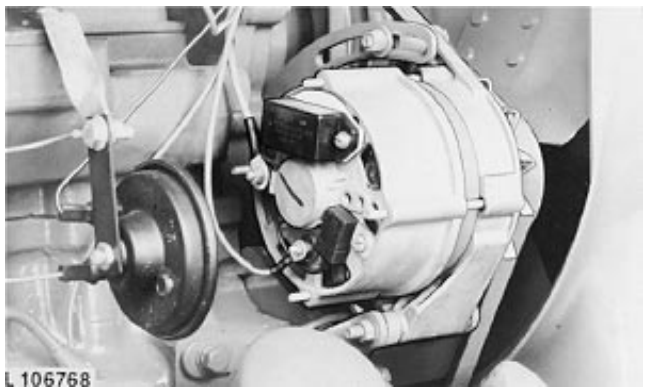
RG,RG34710,2146 –19–15MAR97–1/1

## ALTERNATOR—REMOVAL

Disconnect ground straps of battery.

Disconnect cables from alternator.

Remove alternator per instructions in machine technical manual.




L106768 –UN–11JUL89

RG,RG34710,2147 –19–15MAR97–1/1

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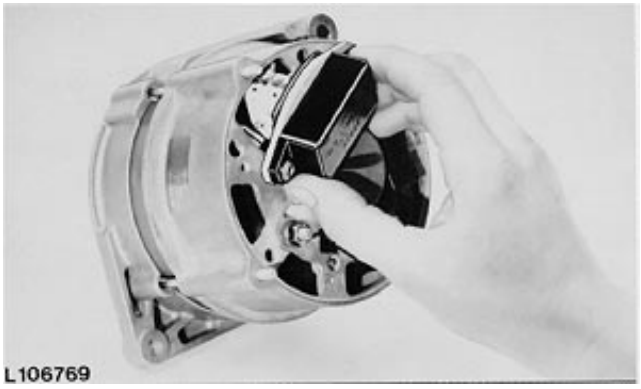
4

## REMOVING BRUSH HOLDER WITH REGULATOR

*NOTE: Before dismantling alternator, first remove brush holder with regulator so carbon brushes will not break during disassembly.*



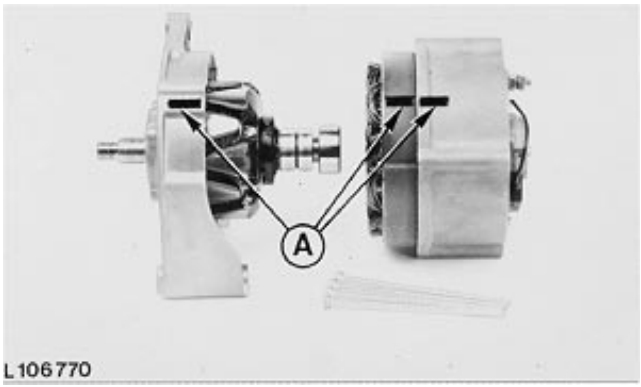

L106769 –UN–11JUL89

RG,RG34710,2148 –19–15MAR97–1/1

## ALTERNATOR—DISASSEMBLY

Mark position of both bearing end frames and stator for later assembly (A).

Press rotor out of drive end frame.




L106770 –UN–11JUL89

RG,RG34710,2149 –19–15MAR97–1/1

## STATOR—REMOVAL

Unsolder stator windings from diode leads of diode plate.

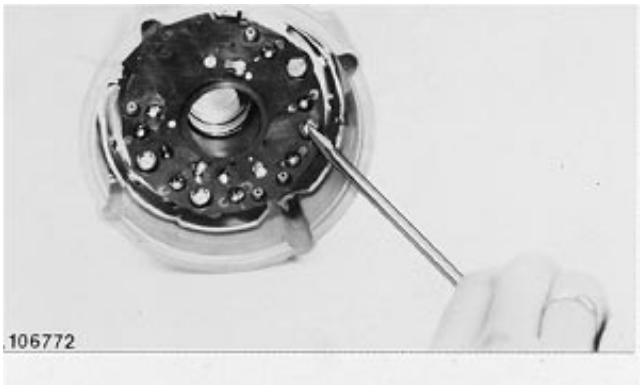

L106771 –UN–11JUL89

RG,RG34710,2150 –19–15MAR97–1/1

## DIODE PLATE—REMOVAL

Remove screws from connections “D+” and “B+”.

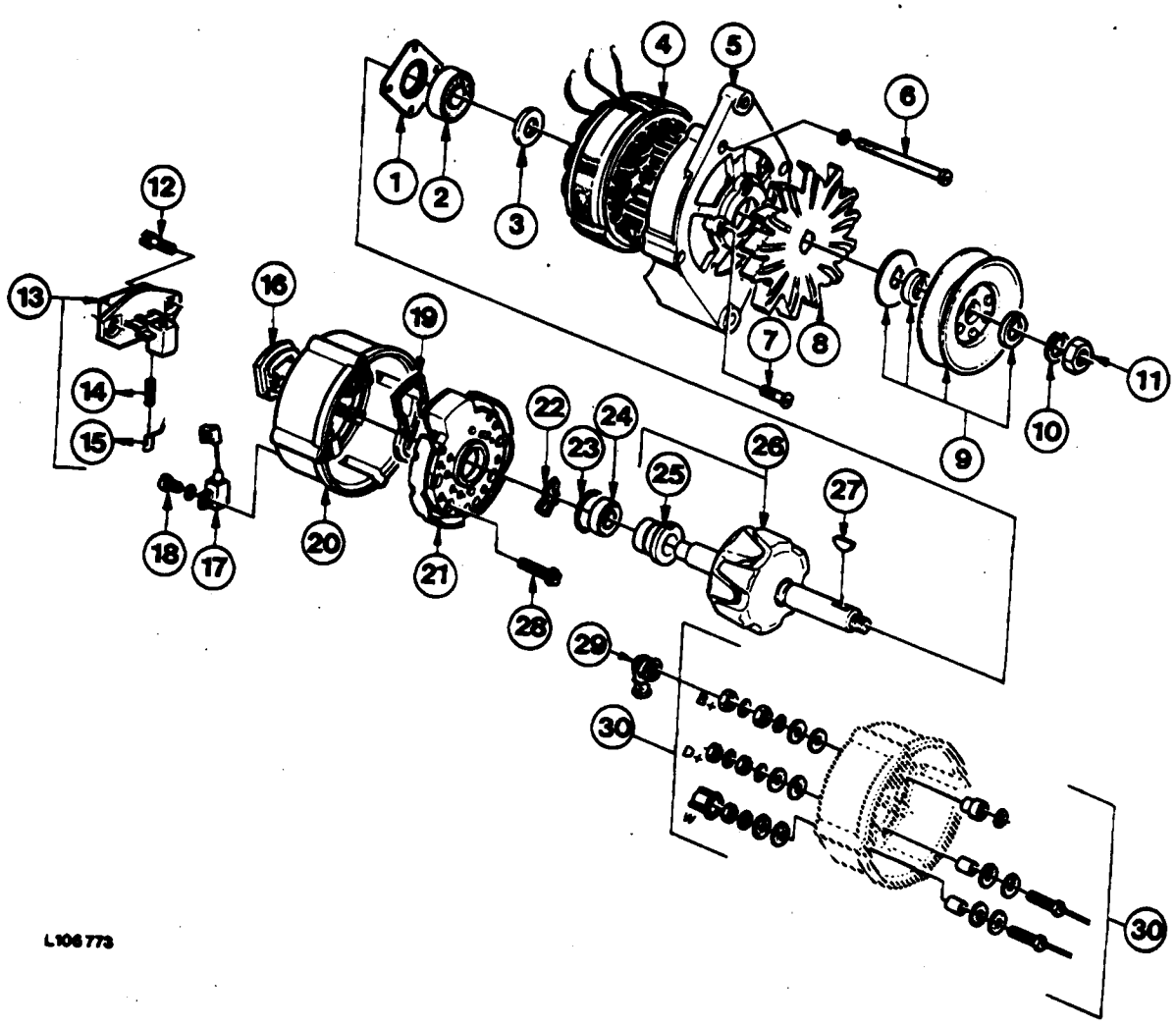
Lift out diode plate.




L106772 –UN–11JUL89

RG,RG34710,2151 –19–15MAR97–1/1

## ALTERNATOR, EXPLODED VIEW




1—Retaining Plate
2—Ball Bearing
3—Washer
4—Stator Coil
5—Drive End Frame
6—Cylinder Screw (4 Used)
7—Countersunk Screw (4 Used)[1]
8—Fan
9—Belt Pulley Repair Set
10—Snap Ring[1]
11—Hex. Nut[1]
12—Screw With Spring Washer (2 Used)
13—Regulator With brush Holder
14—Compression Spring (2 Used)
15—Carbon Brush (2 Used)
16—Gasket
17—Suppression Capacitor
18—Cylinder Screw
19—Gasket
20—End Frame
21—Diode Plate
22—Spring Washer[1]
23—O-Ring
24—Ball Bearing
25—Slip Ring
26—Rotor
27—Woodruff Key[1]
28—Screw With Spring Washer (3 Used)
29—Protective Cap
30—Repair Kit for Terminals W, D+ and B+

*[1]Rotor Repair Kit.*

RG,RG34710,2152 –19–15MAR97–1/1

## TESTING ROTOR FOR SHORT CIRCUIT

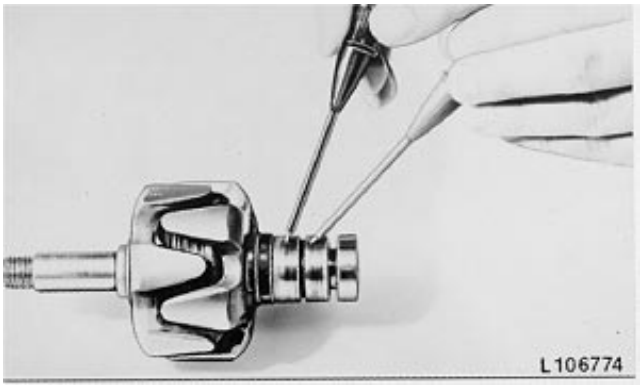
With a test lamp:

Test lamp must light brightly.

With an ohmmeter:

Ohmmeter indication must be between 4.0 and 4.4 ohms.

If test fails, replace rotor.




L106774 –UN–11JUL89

RG,RG34710,2153 –19–15MAR97–1/1

## TESTING ROTOR FOR GROUND

Use an ohmmeter to test for continuity.

Attach ohmmeter to rotor and each slip ring.

Replace rotor if test shows continuity.

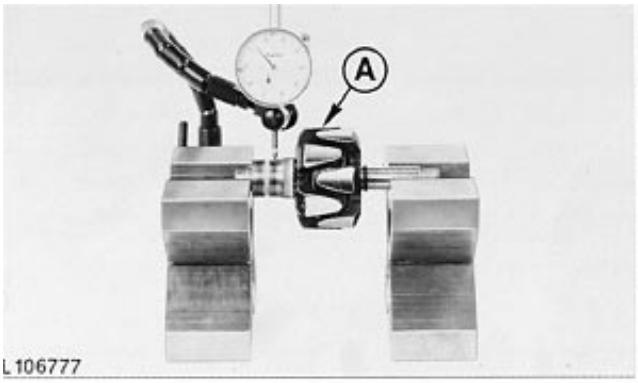

L106775 –UN–11JUL89

RG,RG34710,2154 –19–15MAR97–1/1

## TESTING SLIP RINGS AND ROTOR SHAFT FOR RADIAL RUNOUT

Maximum radial runout of slip rings: 0.03 mm (0.0012 in.)

Maximum radial runout of rotor shaft: 0.05 mm (0.002 in.)




L106777 –UN–11JUL89

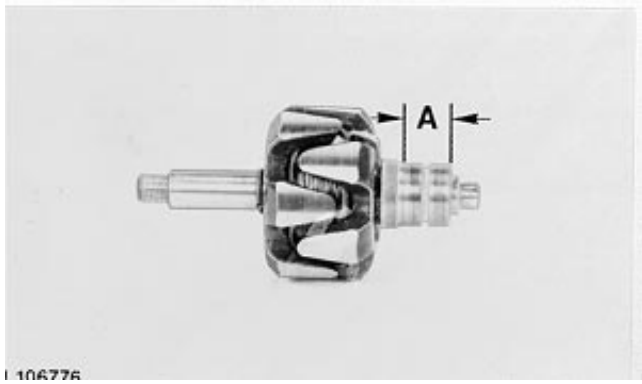
**A—Rotor Shaft Test Point**

RG,RG34710,2155 –19–15MAR97–1/1

## TURNING DOWN SLIP RINGS

Turn down slip rings to a length of 20 mm (0.79 in.) only; refer to (A).

Minimum diameter of slip rings 26.8 mm (1.055 in.).




L106776 –UN–11JUL89

RG,RG34710,2156 –19–15MAR97–1/1

## TESTING STATOR COIL FOR SHORT CIRCUIT

Test phase outlets with respect to each other as follows: A and B; B and C; A and C.

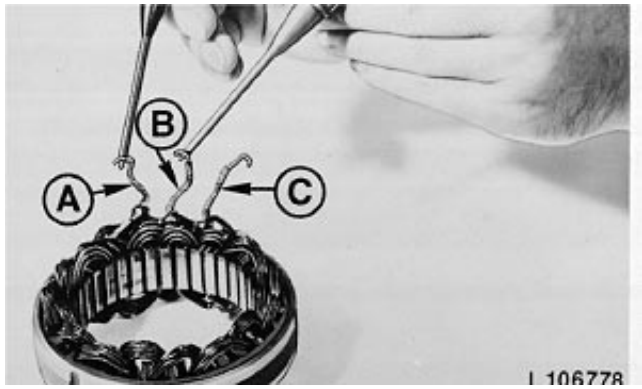
With test lamp:

Test lamp must light up brightly

With ohmmeter:

Indications between 0.40 and 0.44 ohms.

If test fails, replace stator coil.




L106778 –UN–11JUL89

RG,RG34710,2157 –19–15MAR97–1/1

## TESTING STATOR COIL FOR GROUNDS

Connect ohmmeter (or test lamp) to stator lead and stator frame.

Repeat test for each stator lead.

If test shows continuity, replace stator.


L106779 –UN–11JUL89

RG,RG34710,2158 –19–15MAR97–1/1

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8

## REPLACING CARBON BRUSHES

Replace carbon brushes if dimension (A) is less than 5 mm (0.2 in.).

Solder new carbon brushes in such a way that dimension (A) does not exceed 10 mm (0.4 in.).

**IMPORTANT: The service life of carbon brushes and ball bearings are matched to each other. Therefore, always replace ball bearings when renewing carbon brushes. Before installing new carbon brushes, slip rings must be checked and turned down if necessary.**

*NOTE: When soldering copper lead, make sure solder (rosin/tin solder only) does not seep into the copper leads.*


L106780 –UN–11JUL89

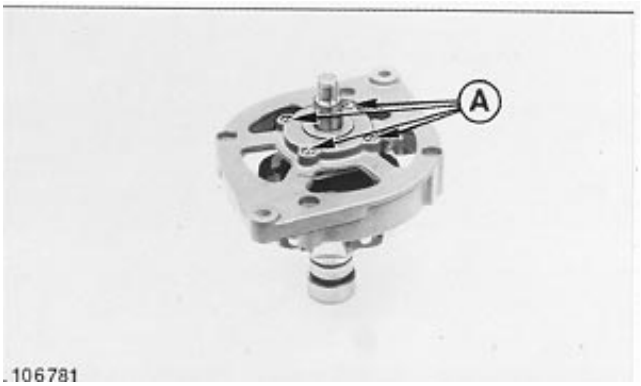
RG,RG34710,2159 –19–15MAR97–1/1

## REPLACING BALL BEARINGS

Remove attaching screws (A) of drive end frame retaining plate and force rotor out of drive end frame.

Pull off rotor ball bearing.

Removed ball bearings must be replaced.



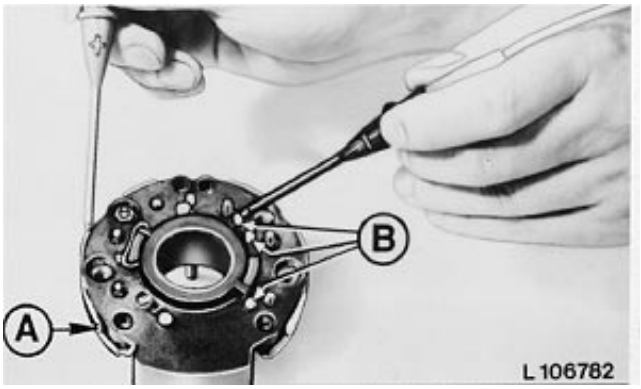

L106781 –UN–11JUL89

RG,RG34710,2160 –19–15MAR97–1/1

## CHECKING POSITIVE DIODES

Consecutively place positive test probe of ohmmeter to positive heat sink (A) and negative test probe to leads (B) of diodes.

Meter must not show continuity.




L106782 –UN–11JUL89

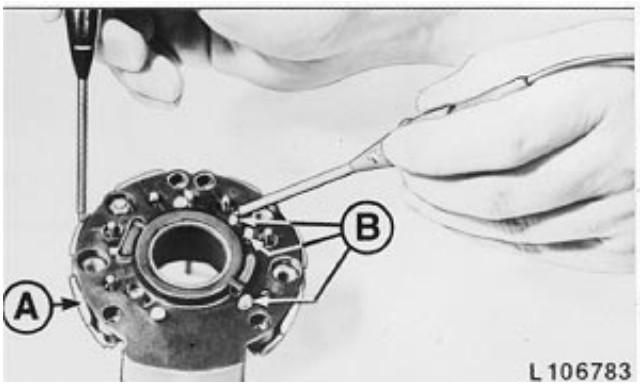
**Continued on next page**

RG,RG34710,2161 –19–15MAR97–1/2

If no fault is found in the above described test, carry out this test with reversed polarity (see illustration).

Meter must show continuity.

*NOTE: Test voltage 6—12 volts DC.*



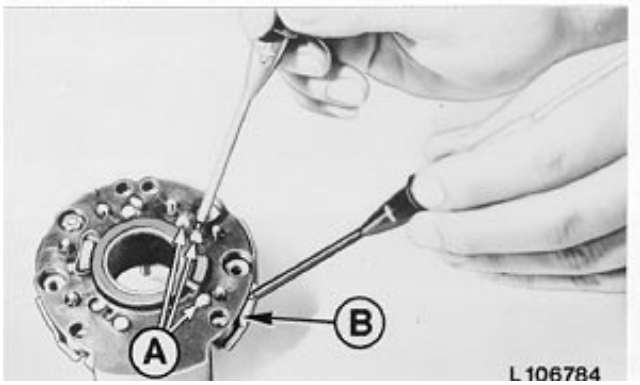

L106783 –UN–11JUL89

RG,RG34710,2161 –19–15MAR97–2/2

## CHECKING NEGATIVE DIODES

Consecutively place positive test probe of ohmmeter to positive heat sink (B) and negative test probe to leads (A) of diodes.

Meter must not show continuity.



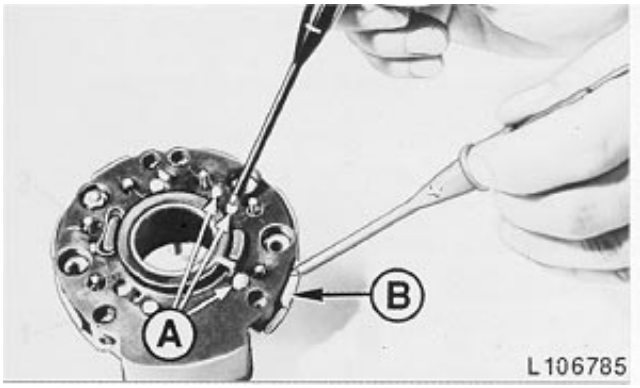

L106784 –UN–11JUL89

RG,RG34710,2162 –19–15MAR97–1/2

If no fault is found in the above described test, carry out this test with reversed polarity (see illustration).

Meter must show continuity.

*NOTE: Test voltage 6—12 volts DC.*



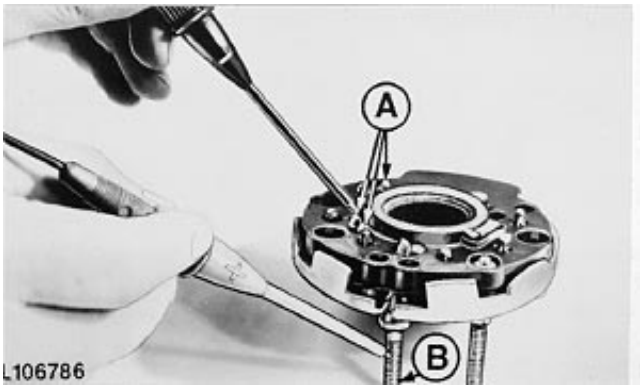

L106785 –UN–11JUL89

RG,RG34710,2162 –19–15MAR97–2/2

## TESTING EXCITING DIODES

Place positive test probe of an ohmmeter on connection “D+” (B) and negative probe onto diode lead (A).

Meter must not show continuity.




L106786 –UN–11JUL89

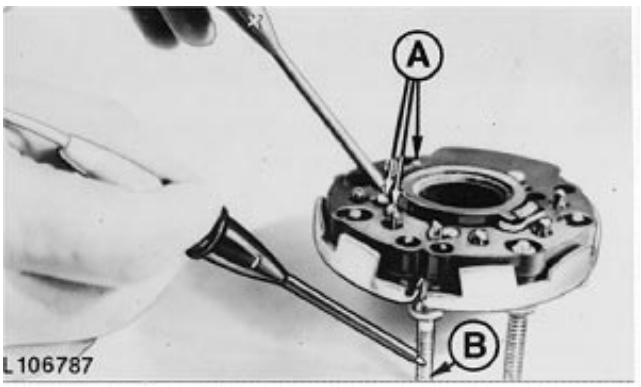
**Continued on next page**

RG,RG34710,2163 –19–15MAR97–1/2

If no fault is found in the above described test, carry out this test with reversed polarity (see illustration).

Meter must show continuity.

*NOTE: Test voltage 6—12 volts DC.*



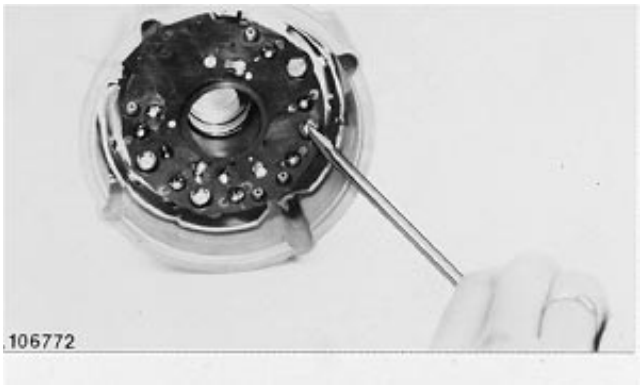

L106787 –UN–11JUL89

RG,RG34710,2163 –19–15MAR97–2/2

## DIODE PLATE INSTALLATION

Pay attention to perfect insulation connections “B+”, “D+” and the positive diode heat sink in respect to end frame.

Install diode plate as shown and tighten screws.




L106772 –UN–11JUL89

RG,RG34710,2164 –19–15MAR97–1/1

## SOLDERING STATOR COILS

**IMPORTANT: Use only rosin core solder.**

Make sure that no solder seeps inside diode plate.

Avoid overheating diodes.


L106771 –UN–11JUL89

RG,RG34710,2165 –19–15MAR97–1/1

## PRESSING BALL BEARING ONTO ROTOR SHAFT

For pressing on, use a sleeve which presses against the ball bearing inner race.

**IMPORTANT: Never press onto drive end frame; damage may result.**


L106788 –UN–11JUL89

RG,RG34710,2166 –19–15MAR97–1/1

*Robert Bosch Alternator Repair*



## PRESSING ROTOR INTO DRIVE END FRAME

Use a new retaining plate (A) when installing new ball bearing.

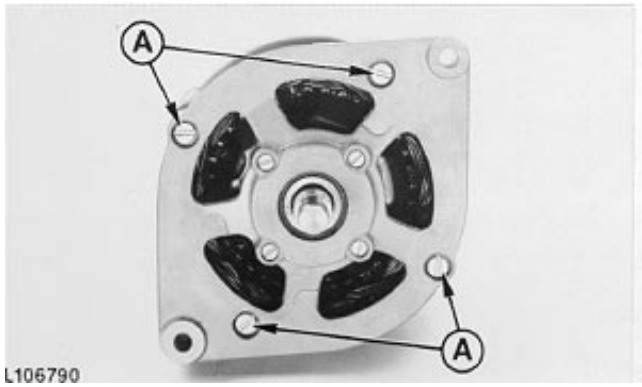

L106789 –UN–11JUL89

RG,RG34710,2167 –19–15MAR97–1/1

## ALTERNATOR—ASSEMBLY

Apply high temperature bearing grease such as Bosch Ft70v1 or Delco Remy No. 194891 to end frame bearing seat. Place spring washer end in frame and carefully join both alternator halves, paying attention to markings.

Tighten screws (A) to 4—5.5 N•m (33—48 lb-in.)

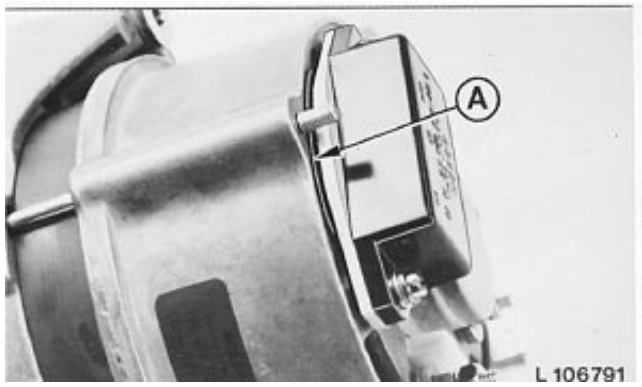



L106790 –UN–11JUL89

RG,RG34710,2168 –19–15MAR97–1/1

## INSTALLING BRUSH HOLDER WITH REGULATOR

Carefully insert brush holder with regulator. Make sure that gasket (A) fits correctly. Tighten screws securely.



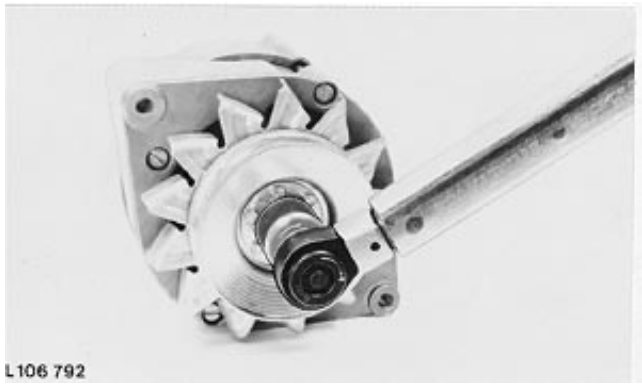

L106791 –UN–11JUL89

RG,RG34710,2169 –19–15MAR97–1/1

## FAN AND BELT PULLEY—INSTALLATION

Tighten securing nut to 35—45 N•m (25—32 ft-lb).

*NOTE: To install alternator and adjust belt tension, refer to machine technical manual.*




L106792 –UN–11JUL89

RG,RG34710,2170 –19–15MAR97–1/1

# Group 1674
# Wiring Harness and Switches

## 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.*

CED,OUOE003,1156 –19–07JUL98–1/5

TS447 –UN–22JUN89

DEUTSCH™ Electrical Repair Tool Kit . . . . . JDG359

To repair DEUTSCH™ electrical connector bodies.

*DEUTSCH is a trademark of the Deutsch Co.*

CED,OUOE003,1156 –19–07JUL98–2/5

JDG359 DEUTSCH™ Electrical Repair Tool Kit Includes:

| | |
|---|---|
| Crimper | JDG360 |
| 12—14 Gauge Extractor (Set of Two) | JDG361 |
| 16—18 Gauge Extractor (Set of Two) | JDG362 |
| 20—24 Gauge Extractor (Set of Two) | JDG363 |

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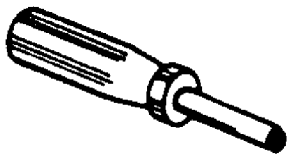
*DEUTSCH is a trademark of the Deutsch Co.*

CED,OUOE003,1156 –19–07JUL98–3/5

RG6783 –UN–05DEC97

WEATHER PACK™ Extraction Tool . . . . . .JDG364[1]



RG6783

*JDG364*

Used to replace terminal contact in WEATHER PACK™ connector body.

*WEATHER PACK is a trademark of Packard Electric.*

*[1]Included in JT07195A Electrical Repair Kit.*

**Continued on next page**

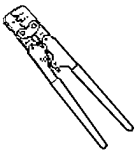
CED,OUOE003,1156 –19–07JUL98–4/5

*Wiring Harness and Switches*

RW25542 –UN–20AUG96

WEATHER PACK™ Crimping Tool . . . . . JDG783

Use to crimp WEATHER PACK terminals.



*JDG783*

*WEATHER PACK is a trademark of Packard Electric.*

CED,OUOE003,1156 –19–07JUL98–5/5

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Engine Slow Idle | Speed | 1050 + 100 - 0 rpm |
| Engine Auto-Idle | Speed | 1200 ± 100 rpm |
| Engine E (Economy) Mode | Speed | 1900 ± 100 rpm |
| Engine Fast Idle in Standard Mode | Speed | 2050 ± 75 rpm |

CED,OUOE003,1157 –19–07JUL98–1/1

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## FUNCTIONAL SCHEMATIC AND COMPONENT LOCATION LEGEND

*NOTE: A2—Engine and Pump Controller (SE8, W2)*

*A2 indicates component identification number.*

*Engine and Pump Controller indicates component name.*

*SE8 indicates section numbers of SYSTEM FUNCTIONAL SCHEMATIC where component is located.*

*W2 is the identification number of the COMPONENT LOCATION and HARNESS CONNECTOR (WITH WIRE AND PIN LOCATION) drawings for the component. This would indicate that the Engine and Pump Controller is connected to W2 Cab Harness.*

- A1—Radio (SE14, W2)
- A2—Engine and Pump Controller (SE8, W2)
- A3—Air Conditioner Controller (SE17, W9)
- A4—Engine Mode and RPM Control Unit (SE4, W2)
- A5—Monitor Controller and Display (SE5, W3)
- A6—Quick Hitch Control Box (SE19, W2)

- B1—Air Filter Restriction Switch (SE6, W1)
- B2—Fuel Level Switch (SE6, W1)
- B3—Engine Coolant Temperature Switch (SE6, W1)
- B4—Engine Oil Pressure Switch (SE6, W1)
- B5—Hydraulic Oil Level Switch (SE6, W1)
- B6—Engine Coolant Level Switch (SE6, W1)
- B7—Engine Oil Level Switch (SE6, W1)
- B8—Fuel Level Sensor (SE6, W1)
- B9—Engine Coolant Temperature Sensor (SE4, W1)
- B10—Not Used
- B11—Not Used
- B12—Charge Air Temperature Switch (SE6, W1)
- B13—Boom Up Pressure Switch (SE7, W1)
- B14—Dig Pressure Switch (SE7, W1)
- B15—Propel Pressure Switch (SE7, W1)
- B16—Engine Speed (N) Sensor (SE8, W1)
- B17—Engine Control (EC) Sensor (Located Inside Engine Control Motor Housing) (SE7, W1)
- B18—Rear Pump Pressure Sensor (SE7, W1)
- B19—Front Pump Pressure Sensor (SE7, W1)
- B20—Arm In Pressure Sensor (SE7, W1)
- B21—Rear Pump Control Pressure Sensor (SE7, W1)
- B22—Front Pump Control Pressure Sensor (SE7, W1)
- B23—Right Speaker (SE14, W2)
- B24—Left Speaker (SE14, W2)
- B25—High Note Horn (SE15, W1)
- B26—Low Note Horn (SE15, W1)
- B27—Air Conditioner High and Low Pressure Switch (SE17, W9)
- B28—Not Used
- B29—Air Conditioner and Heater Thermistor (SE17, W9)
- B30—Hydraulic Oil Filter Restriction Switch (SE6, W1)
- B31—Not Used
- B32—Overload Alarm Proximity Switch (SE19, W1)
- B33—Overload Alarm Pressure Switch (SE19, W1)
- B34—Auxiliary Hydraulic Control Switch (SE18, W2)

- E1—Left Work Light (SE13, W1)
- E2—Not Used
- E3—Cab Dome Light (SE15, W2)
- E4—Monitor Controller and Display Backlight (SE5, W3)
- E5—Engine RPM Dial Backlight (SE4, W2)
- E6—Right Work Light (SE13, W1)
- E7—Left Cab Drive Light (SE13, W1)
- E8—Right Cab Drive Light (SE13, W1)
- E9—Left Rear Light (SE13, W1)
- E10—Right Rear Light (SE13, W1)

- F1—Radio and Monitor Controller Backup 5 Amp Fuse (marked Back Up) (SE6, W2)
- F2—Engine and Pump Controller 10 Amp Fuse (marked Controller) (SE9, W2)
- F3—Engine Control (EC) Motor 10 Amp Fuse (marked EC Motor) (SE9, W2)
- F4—Solenoid 5 Amp Fuse (marked Solenoid) (SE9, W2)

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Continued on next page

CED,OUOE012,182 –19–19APR99–1/4

- F5— Power On 10 Amp Fuse (marked Pow. On) (SE3, W2)
- F6—Monitor Controller and Display 5 Amp Fuse (marked Sw. Box) (SE4, W2)
- F7—Switched Power 5 Amp Fuse (marked Option 1) (SE18, W2)
- F8—Switched Power 10 Amp Fuse (marked Option 2) (SE18, W2)
- F9—Battery Power 5 Amp Fuse (marked Option 3) (SE18, W2)
- F10—Travel Alarm 5 Amp Fuse (marked Option 1) (SE18, W2)
- F11—Work and Drive Lights 20 Amp Fuse (marked Lamp) (SE13, W2)
- F12—Windshield Wiper 10 Amp Fuse (marked Wiper) (SE12, W2)
- F13—Blower Motor 20 Amp Fuse (marked Heater) (SE16, W2)
- F14—Air Conditioner Controller and Relays 5 Amp Fuse (marked Heater) (SE17, W2)
- F15—Horn 10 Amp Fuse (marked Horn) (SE15, W2)
- F16—Radio 5 Amp Fuse (marked Radio) (SE14, W2)
- F17—Lighter 10 Amp Fuse (marked Lighter) (SE15, W2)
- F18—Dome Light 5 Amp Fuse (marked Room Lamp) (SE15, W2)
- F19—Auxiliary 10 Amp Fuse (marked Auxiliary) (SE18, W2)
- F20—Start Aid 20 Amp Fuse (marked Start Aid) (SE2, W2)
- F21—Battery Power 40 Amp Fusible Link (SE1, W1)
- F22—Alternator Power 60 Amp Fusible Link (SE1, W1)
- F23—Fuel Shutoff 40 Amp Fusible Link (SE1, W1)
- F24—Quick Hitch 5 Amp Fuse (SE19, W2)

- G1—Battery (SE1, W1)
- G2—Battery (SE1, W1)
- G3—Alternator (SE3, W1)
- G4—24 Volt Power Plug (SE15, W3)
- G5—24 Volt Slave Receptacle (SE1, W1)

- H1—Dig Mode Indicator Light (SE5, W3)
- H2—Grading Mode Indicator Light (SE5, W3)
- H3—Precision Mode Indicator Light (SE5, W3)
- H4—Attachment Mode Indicator Light (SE5, W3)
- H5—High Power Mode Indicator Light (SE4, W3)
- H6—Economy Mode Indicator Light (SE4, W3)
- H7—Auto Idle Mode Indicator Light (SE4, W3)
- H8—Monitor Controller and Display Alarm (SE5, W3)
- H9—Overload Alarm (SE19, W2)
- H10—Travel Alarm (SE10, W1)
- H11—Spare Indicator Light (SE4, W3)
- H12—Hydraulic Oil Level Indicator Light (SE4, W3)
- H13—Fuel Level Indicator Light (SE4, W3)
- H14—Air Filter Restriction Indicator Light (SE4, W3)
- H15—Charge Air Temperature Indicator Light (SE4, W3)
- H16—Engine Coolant Temperature Indicator Light (SE4, W3)
- H17—Engine Oil Pressure Indicator Light (SE4, W3)
- H18—Alternator Voltage Indicator Light (SE4, W3)
- H19—Engine Oil Level Indicator Light (SE4, W3)
- H20—Engine Coolant Level Indicator Light (SE4, W3)
- H21—Hydraulic Oil Filter Restriction Light (SE5, W3)
- H22—Quick Hitch Alarm (SE19, W2)
- H23—Quick Hitch Indicator Light (SE19, W2)

- K1—Alternator Shut Down Relay (Marked R1) (SE3, W3)
- K2—Windshield Washer Relay (Marked R2) (SE11, W3)
- K3—Work Light Relay (Marked R3) (SE13, W3)
- K4—Drive Light Relay (Marked R4) (SE13, W3)
- K5—Horn Relay (Marked R5) (SE15, W3)
- K6—Windshield Wiper Relay (Motor Ground and Intermittent) (Marked R6) (SE11, W3)
- K7—Windshield Wiper Relay (Wiper Run) (Marked R7) (SE12, W3)
- K8—Windshield Wiper Relay (Hold for Park) (Marked R8) (SE12, W3)
- K9—Windshield Wiper Relay (Motor Ground for Park) (Marked R9) (SE2, W3)
- K10—Propel Auto Idle Relay (Marked R10) (SE7, W3)
- K11—Starter Protection Relay (Marked R11) (SE2, W3)

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**Continued on next page**

- K12—Start Aid Relay (Marked R12)
- K13—Starter Relay (SE2, W1)
- K14—Battery Relay (SE1, W1)
- K15—Fuel Shutoff Relay (SE3, W1)
- K16—Overload Alarm Relay (SE19, W1)
- K17—Not Used
- K18—Not Used
- K19—Not Used
- K20—Not Used
- K21—Not Used
- K22—Not Used
- K23—Not Used
- K24—Air Conditioner Blower Motor and Main Power (Low Speed) Relay (SE17, W9)
- K25—Air Conditioner Compressor Clutch Relay (SE17, W9)
- K26—Air Conditioner Blower Motor (Low Medium Speed) Relay (SE17, W9)
- K27—Air Conditioner Blower Motor (Medium Speed) Relay (SE17, W9)
- K28—Air Conditioner Blower Motor (High Speed) Relay (SE17, W9)

- M1—Starter (SE2, W1)
- M2—Engine Control (EC) Motor (SE8, W1)
- M3—Windshield Wiper Motor (SE11, W3)
- M4—Windshield Washer Motor (SE11, W1)
- M5—Heater Blower Motor (Without Air Conditioner) (SE16, W2)
- M6—Air Conditioner and Heater Blower Motor (SE17, W9)
- M7—Not Used
- M8—Not Used
- M9—Air Conditioner Internal and External Cab Air Servomotor (SE17, W9)
- M10—Air Conditioner Blower Port Change Servomotor (SE17, W9)
- M11—Air Conditioner Air Mixer Servomotor (SE17, W9)

- P1—Hour Meter (SE5, W3)
- P2—Engine Coolant Temperature Gauge (SE4, W3)
- P3—Fuel Gauge (SE4, W3)

- R1—Not Used
- R2—Heater Blower Motor Dropping Resistor Block (Without Air Conditioner) (SE16, W2)
- R3—Not Used
- R4—Engine Coolant Temperature Gauge Resistor (150 ohms) (SE5, W3)
- R5—Fuel Gauge Resistor (220 ohms) (SE5, W3)
- R6—Alternator Excitation Resistor (SE3, W2)
- R7—Not Used
- R8—Not Used
- R9—Not Used
- R10—Engine RPM Dial (SE4, W2)
- R11—Air Conditioner and Heater Blower Motor Dropping Resistor Block (SE17, W9)

- S1—Key Switch (SE1, W2)
- S2—Horn Switch (SE15, W2)
- S3—Dome Light Switch (SE15, W2)
- S4—Heater Blower Motor Switch (Without Air Conditioner) (SE16, W2)
- S5—Fluid Level Check Switch (SE5, W3)
- S6—Buzzer Stop Switch (SE5, W3)
- S7—Work Mode Selection Switch (SE5, W3)
- S8—Propel Speed Change Switch (SE5, W3)
- S9—Wiper Speed Switch (SE5, W3)
- S10—Drive and Work Light Switch (SE5, W3)
- S11—Economy (E) Mode Switch (SE4, W2)
- S12—High Power (HP) Mode Switch (SE4, W2)
- S13—Auto Idle Switch (SE5, W3)
- S14—Windshield Wiper Enable Switch (SE4, W2)
- S15—Windshield Washer Switch (SE5, W3)
- S16—Learning Switch (SE9, W2)
- S17—Travel Alarm Cancel Switch (SE10, W2)
- S18—Start Aid Switch (SE2, W2)
- S19—Power Boost Switch (SE9, W2)
- S20—Rear Lights Switch (SE13, W2)
- S21—Quick Hitch Switch (SE12, W2)

- V1—Start Aid Diode (SE2, W1)
- V2—Alternator Shut Down Relay Isolation Diode (SE3, W2) (Red/Wht and Red/Blk)
- V3—Switched Power Fuse (F8) Suppression Diode (SE18, W2) (Blk and Red)
- V4—Propel Auto Idle Relay (marked R10) Isolation Diode (SE7, W2) (Wht/Blk and Yel)

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**Continued on next page**

CED,OUOE012,182 –19–19APR99–3/4

- V5—Windshield Wiper Relay (marked R8) Isolation Diode (SE12, W3) (Blu/Blk and Blu/Red)
- V6—Windshield Wiper Motor Suppression Diode (SE11, W3) (Blk and LGrn/Wht)
- V7—Windshield Wiper Motor Suppression Diode (SE11, W3) (Blk and Blu/Wht)
- V8—Fuel Shutoff Solenoid Hold-In Coil Suppression Diode (SE3, W2) (Brn/Blk and Blk)
- V9—Start Relay Coil Suppression Diode (SE2, W2) (Yel/Grn and Blk/Wht)
- V10—Fuel Shutoff Solenoid Pull-In Coil Suppression Diode (SE3, W2) (Red/Blk and Blk)
- V11—Battery Relay Coil Suppression Diode (SE1, W1) (Blk and Red/Wht)

- W1—Engine and Frame Harness
- W2—Cab Harness
- W3—Monitor and Relay Harness
- W4—Radio Antenna (SE14, W2)
- W5—Battery to Frame Ground (W1)
- W6—Engine to Frame Ground (W1)
- W7—Cab to Frame Ground (W2)
- W8—Starter to Frame Ground (SE2, W1)
- W9—Air Conditioner Harness

- X1—Diagnostic Connector (SE9, W2)
- X2—Learning Switch Connector (SE9, W2)
- X3—Attachment Pressure Switch Connector (SE9, W2)
- X4—Accel Connector (SE8, W2)
- X5—Optional Connector (SE18, W2)
- X6—Auxiliary Connector (SE18, W2)
- X7—Optional Right Speaker Connector (SE14, W2)
- X8—Engine and Frame Harness to Cab Harness Connector (W1, W2)
- X9—Engine and Frame Harness to Cab Harness Connector (W1, W2)
- X10—Monitor Controller and Display Connector (20-Pin) (W3)
- X11—Monitor Controller and Display Connector (16-Pin) (W3)
- X12—Monitor Controller and Display Connector (12-Pin) (W3)
- X13—Engine and Pump Controller Connector (26-Pin) (W2)
- X14—Engine and Pump Controller Connector (16-Pin) (W2)
- X15—Engine and Pump Controller Connector (22-Pin) (W2)
- X16—Air Conditioner Harness to Cab Harness Connector (SE17, W2, W9)
- X17—Air Conditioner Controller Connector (16-Pin) (SE17, W9)
- X18—Air Conditioner Controller Connector (12-Pin) (SE17, W9)
- X19—Monitor and Relay Harness to Cab Harness Connector (2-Pin) (W2, W3)
- X20—Monitor and Relay Harness to Cab Harness Connector (6-Pin) (W2, W3)
- X21—Monitor and Relay Harness to Cab Harness Connector (12-Pin) (W2, W3)
- X22—Monitor and Relay Harness to Cab Harness Connector (16-Pin) (W2, W3)
- X23—Monitor and Relay Harness to Cab Harness Connector (8-Pin) (W2, W3)
- X24—Optional Connector (W3)
- X25—Optional Connector (W3)
- X26—Engine and Frame Harness to Cab Harness Connector (W1, W2)
- X27—Auxiliary Power Terminal Strip (SE8, W1, W2)
- X28—Rear Light Switch Harness to Rear Light Harness Connector (SE13, W1)

- Y1—Air Conditioner Compressor Clutch (SE17, W1 and W9)
- Y2—Quick Hitch Solenoid (SE19, W1)
- Y3—Not Used
- Y4—Start Aid Solenoid (SE2, W1)
- Y5—Power Boost Proportional Solenoid (SE7, W1)
- Y6—Propel Speed Change Proportional Solenoid (SE8, W1)
- Y7—Fuel Shutoff Solenoid (SE3, W1)
- Y8—Speed Sense Proportional Solenoid (SE7, W1)
- Y9—Arm Regenerative Proportional Solenoid (SE7, W1)

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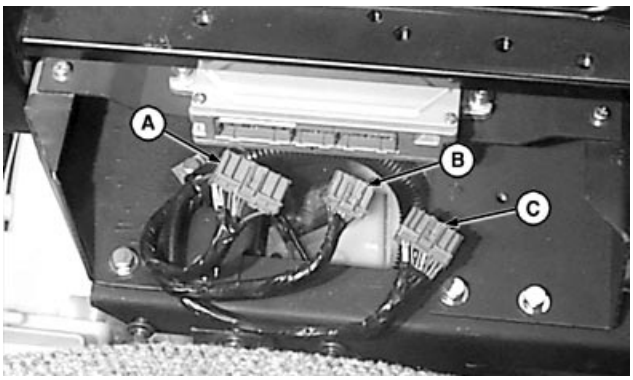
CED,OUOE012,182 –19–19APR99–4/4

**FOLDOUT PAGE 15-37 IS AT REAR OF MANUAL**

## CONNECTING ENGINE AND PUMP CONTROLLER (EPC) HARNESS CONNECTOR

**IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.**

1. Push connectors into engine and pump controller.
2. Complete engine speed learning procedure.



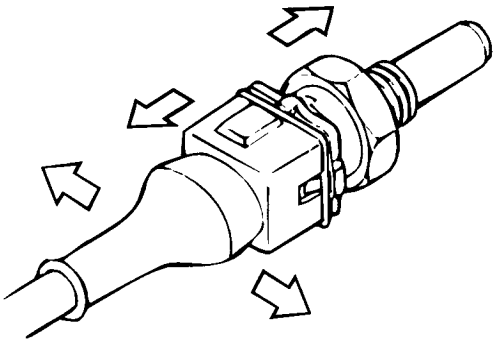

T115226 –UN–17JUN98

**A—EPC Harness Connector**
**B—EPC Harness Connector**
**C—EPC Harness Connector**

TX,16,UU3306 –19–07JUL98–1/1

## DISCONNECTING SPRING WIRE RETAINER CONNECTORS

1. Grasp connector halves; move half of connector from side-to-side as it's being pulled apart. Wire retainer will slide over retaining tabs. Do not pull on wiring leads.
2. To reconnect, push together until wire retainer "clicks" over tabs.



T8197AO CV

T8197AO –UN–14MAR94

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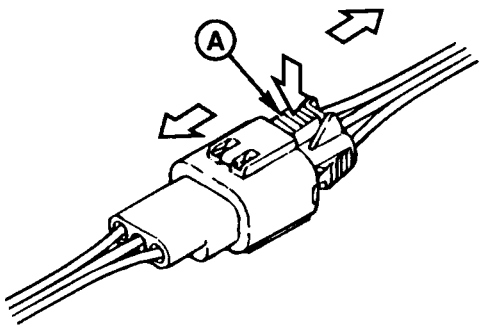
TX,16,UU3307 –19–18JUL94–1/1

## DISCONNECTING TAB RETAINER CONNECTORS

**IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller or other components may result. Disconnect connectors only when instructed during a test or check.**

1. Push retainer tab (A).
2. Hold tab and pull connector halves apart; do not pull on wiring leads.




T7535AE

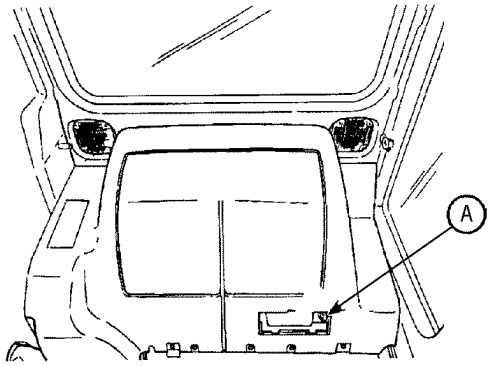
T7535AE –UN–22MAY91

**A—Retainer Tab**

TX,16,UU3308 –19–19NOV92–1/1

## REPLACING FUSES

The fuse box is located behind the seat.




T105381 –UN–26NOV96

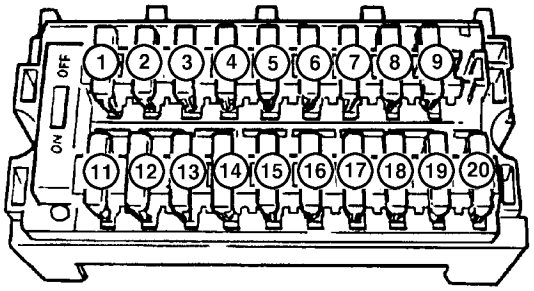
**A—Fuse Box Cover**

16
1674
9

**Continued on next page**

CED,OUOE024,227 –19–08SEP98–1/2

**IMPORTANT: Install fuse with correct amperage rating to prevent electrical system damage from overload.**




T113934

T113934 –UN–07APR98

**1—5 Amp Backup**
**2—10 Amp Controller**
**3—10 Amp EC Motor**
**4—5 Amp Solenoid**
**5—10 Amp Power On**
**6—5 Amp Switch Box**
**7—5 Amp Option 1**
**8—10 Amp Option 2**
**9—5 Amp Option 3**
**10—5 Amp Travel (Alarm)**
**11—20 Amp Lamp**
**12—10 Amp Wiper (Windshield and Washer)**
**13—20 Amp Heater**
**14—5 Amp AirCon (Air Conditioning)**
**15—10 Amp Horn**
**16—5 Amp Radio**
**17—10 Amp Lighter**
**18—5 Amp Room Lamp (Dome Light)**
**19—10 Amp Auxiliary**
**20—20 Amp Start Aid**

16
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10

CED,OUOE024,227 –19–08SEP98–2/2

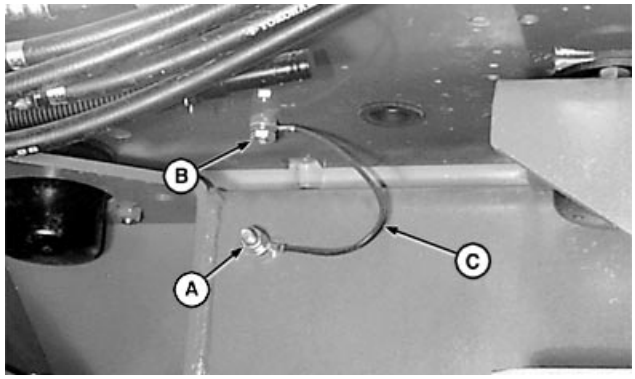
## FUSE (BLADE-TYPE) COLOR CODES

| Amperage Rating | Color |
|---|---|
| 1 | Black |
| 3 | Violet |
| 4 | Pink |
| 5 | Tan |
| 7-1/2 | Brown |
| 10 | Red |
| 15 | Light Blue |
| 20 | Yellow |
| 25 | Natural (White) |
| 30 | Light Green |

04T,90,J22 –19–28SEP92–1/1

## REMOVE AND INSTALL CAB GROUND STRAPS

Remove cover under cab for access to ground straps (C) and nuts (A and B).




**A—Nut**
**B—Nut**
**C—Ground Strap (4 used)**

16
1674
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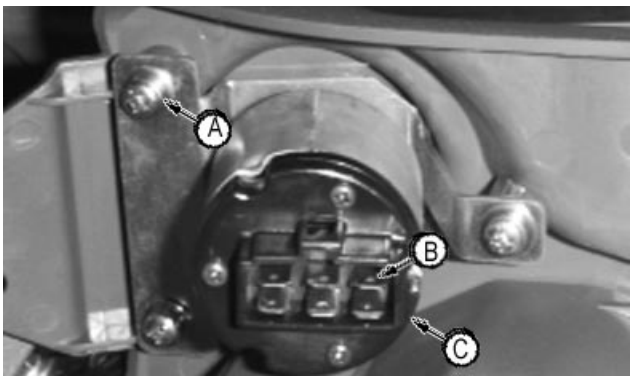
TX,16,UU3311 –19–07JUL98–1/1

## REMOVE AND INSTALL STARTER SWITCH

1. Disconnect battery ground (-) cable.
2. Remove four cap screws from under control lever boot.
3. Turn cover. Remove cap screws.
4. Disconnect wiring harness connector (B).
5. Replace parts as necessary.



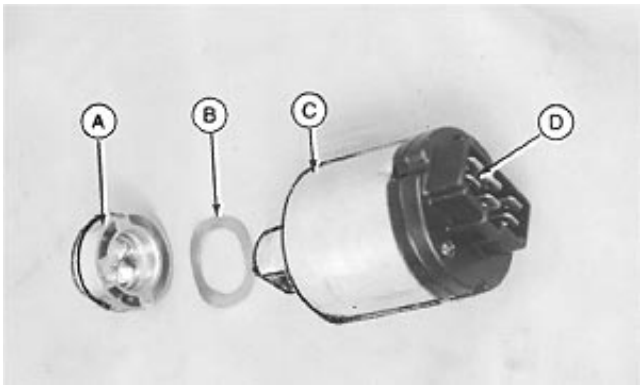

T105435B –UN–06MAR97

**A—Screw (3 used)**
**B—Connector**
**C—Key Switch**

TX,16,UU3312 –19–08JUN92–1/2

6. Connect wiring harness to connector (D).
7. Install switch (C) and spring washer (B) through bracket and install nut (A).
8. Install covers and boot.
9. Connect battery ground (-) cable.
10. After connecting batteries, the engine controller must be recalibrated or reset for engine speed.

Machine can now be started and operated as usual.




T7681CX –UN–22JAN92

**A—Nut**
**B—Spring Washer**
**C—Start Switch**
**D—Wiring Harness Connector**

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12

TX,16,UU3312 –19–08JUN92–2/2

## ENGINE SPEED LEARNING PROCEDURE

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor adjustment and engine learning control procedure must be performed.

- Engine
- Engine speed control cable
- Engine control motor and sensor
- Engine and pump controller
- Fast and slow idle stop brackets

1. Stop the engine.

2. Disconnect the laptop computer from the diagnostic test port.

3. Wait for 5 seconds.

**Continued on next page**

CED,OUOE003,1086 –19–08SEP98–1/2

16
1674
13

4. Push engine learning switch (C) up to top position. The switch is a three position switch. Make sure it is in the top position.
5. Turn key switch ON. Wait 5 seconds.
6. Turn key switch OFF. Wait 5 seconds.
7. Push engine learning switch to middle position.
8. Check engine speeds.

**Engine Slow Idle—Specification**

Speed ..... 1050 + 100 - 0 rpm

**Engine Auto-Idle—Specification**

Speed ..... 1200 ± 100 rpm

**Engine E (Economy) Mode—Specification**

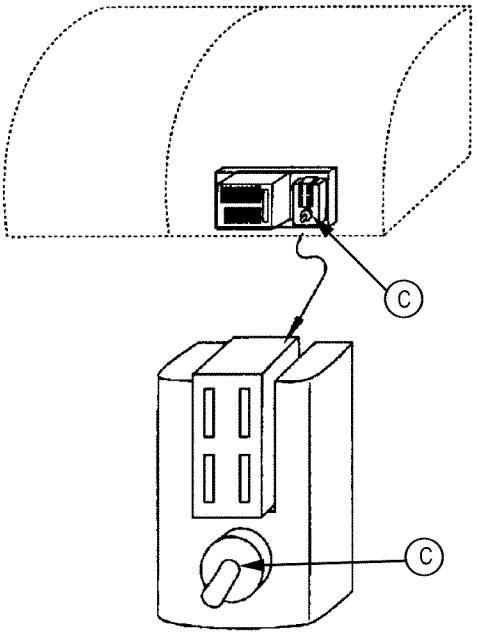
Speed ..... 1900 ± 100 rpm

**Engine Fast Idle in Standard Mode—Specification**

Speed ..... 2050 ± 75 rpm

If slow idle speed is still not to specification, check the engine control sensor. (See Engine Control (EC) Sensor Harness Test in Group 9025-25.)

*NOTE: The laptop computer with excavator diagnostic software can be used to change the default speeds for slow idle, auto-idle, economy mode, and fast idle in standard mode. See Excavator Diagnostic Software Special Function—Engine Speed in Group 9025-25.*




T103674

T103674 –UN–11SEP96

**C—Engine Learning Switch**

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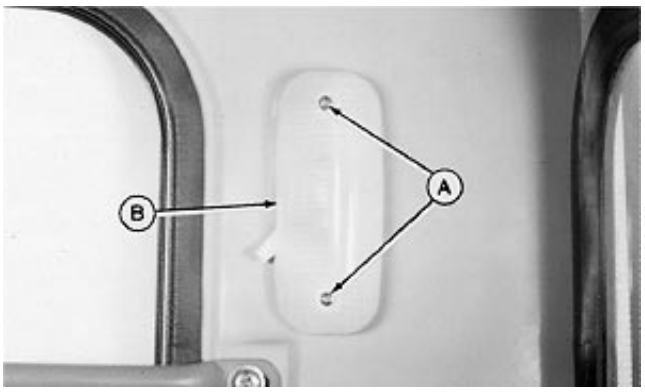
1674
14

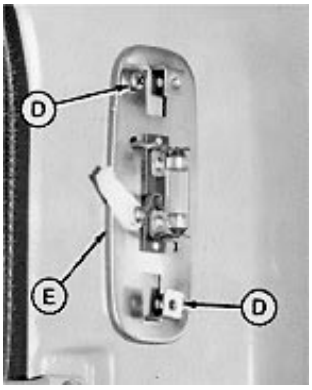
CED,OUOE003,1086 –19–08SEP98–2/2

## REMOVE AND INSTALL DOME LIGHT SWITCH

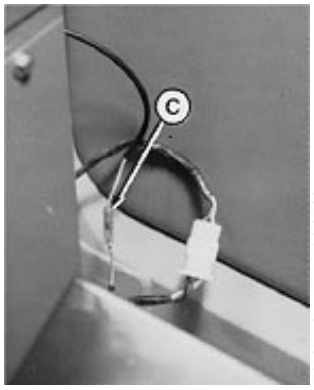
1. Remove cap screws (A) and cover (B).
2. Disconnect connector (C).
3. Remove caps screws (D) and switch (E). Repair or replace as needed.
4. Install parts (A—E).




T6557JI –UN–19OCT88




T6557LM –UN–19OCT88




T6585NG –UN–19OCT88

**A—Cap Screw (2 used)**
**B—Cover**
**C—Connector**
**D—Cap Screw (2 used)**
**E—Switch**

TX,16,UU3313 –19–08JUN87–1/1

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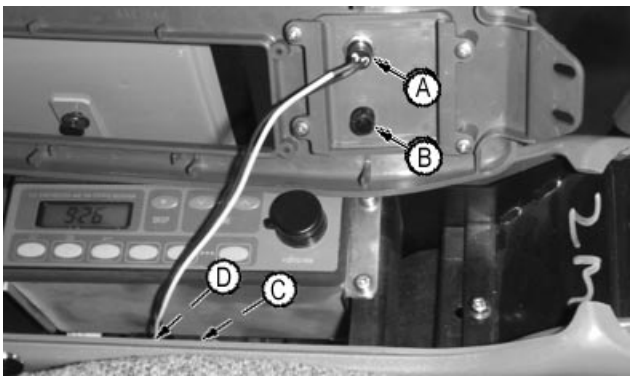
1674
15

## REMOVE AND INSTALL TRAVEL ALARM CANCEL SWITCH AND START AID SWITCH

1. Disconnect battery ground (-) cable.
2. Remove cap screws. Remove upper cover.
3. Disconnect wires (C and D). Remove switches (A and B).
4. Replace parts as necessary.
5. Install switches.
6. Connect wiring connectors.
7. Install covers.
8. Connect battery ground (-) cable.




T105433B –UN–06MAR97

**A—Travel Alarm Cancel Switch**
**B—Ether Aid Switch (Not Shown)**
**C—Ether Aid Wire (Not Shown)**
**D—Travel Alarm Wire**

TX,16,UU3314 –19–17SEP98–1/1

## REPLACE DEUTSCH™ CONNECTORS

1. Select correct size extractor tool for size of wire to be removed:
   - JDG361 Extractor Tool[1] for 12 to 14 gauge wire.
   - JDG362 Extractor Tool[1] for 16 to 18 gauge wire.
   - JDG363 Extractor Tool[1] for 20 gauge wire.

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*DEUTSCH is a trademark of the Deutsch Co.*

*[1]Included in JDG359 DEUTSCH Electrical Repair Kit.*

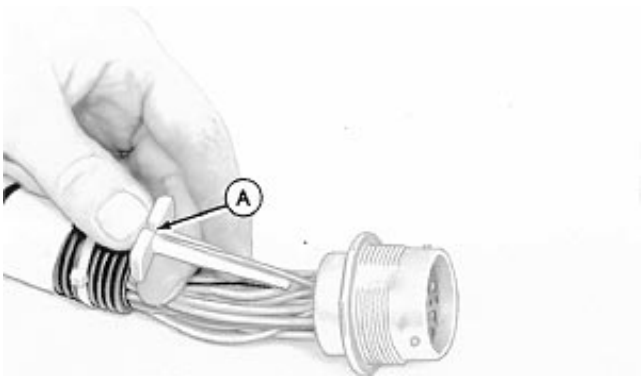
**Continued on next page**

ECONN,J –19–03NOV94–1/3

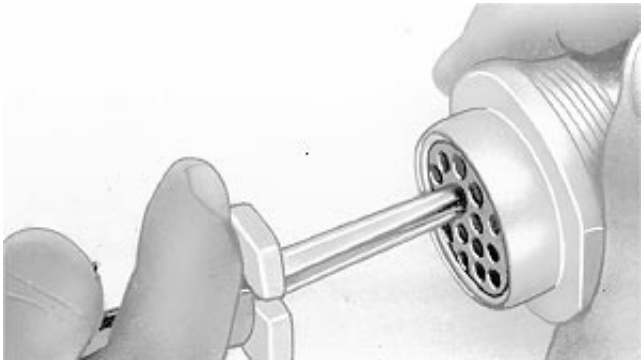
2. Start correct size extractor tool over wire at handle (A).
3. Slide extractor tool rearward along wire until tool tip snaps onto wire.

**IMPORTANT: Do NOT twist tool when inserting in connector.**

4. Slide extractor tool along wire into connector body until it is positioned over terminal contact.
5. Pull wire out of connector body, using extractor tool.




TS0124 –UN–23AUG88



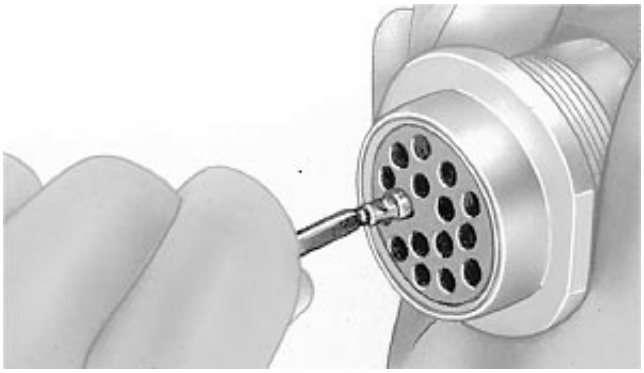
TS120 –UN–23AUG88

**A—Extractor Tool Handle**

ECONN,J –19–03NOV94–2/3

**IMPORTANT: Install contact in proper location using correct size grommet.**

6. Push contact straight into connector body until positive stop is felt.
7. Pull on wire slightly to be certain contact is locked in place.
8. Transfer remaining wires to correct terminal in new connector.



TS122 –UN–23AUG88

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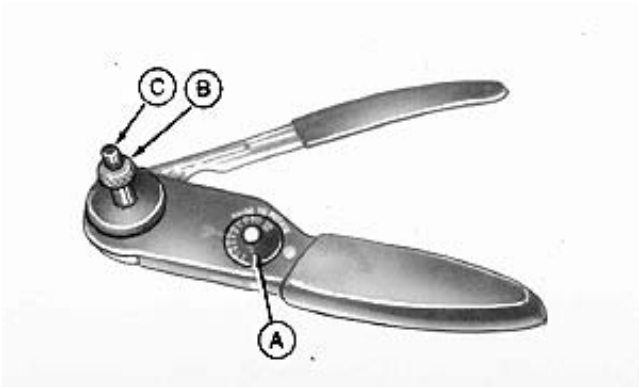
ECONN,J –19–03NOV94–3/3

## INSTALL DEUTSCH™ CONTACT

1. Strip 6 mm (1/4 in.) insulation from wire.
2. Adjust selector (A) on JDG360 Crimper[1] for correct wire size.
3. Loosen lock nut (B) and turn adjusting screw (C) in until it stops.




TS117 –UN–23AUG88

**A—Crimper Selector**
**B—Lock Nut**
**C—Adjusting Screw**

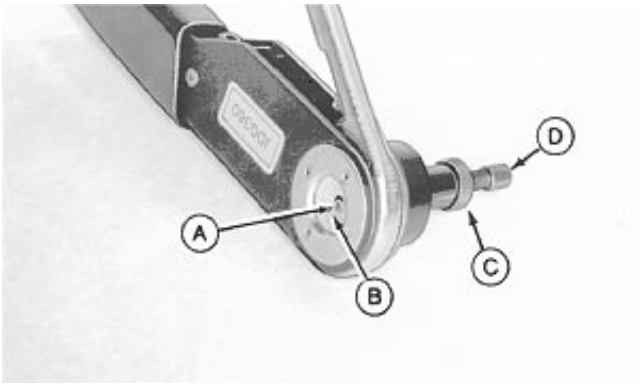
*DEUTSCH is a trademark of the Deutsch Co.*

*[1]Included in JDG359 Deutsch Electrical Repair Kit.*

ECONN,W –19–04JUN90–1/4

**IMPORTANT: Select proper size contact “sleeve” or “pin” to fit connector body.**

4. Insert contact (A) and turn adjusting screw (D) until contact is flush with cover (B).
5. Tighten lock nut (C).




TS0134 –UN–23AUG88

**A—Contact**
**B—Cover**
**C—Lock Nut**
**D—Adjusting Screw**

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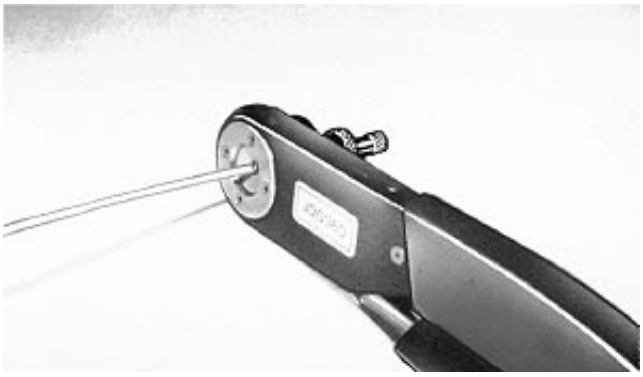
ECONN,W –19–04JUN90–2/4

**IMPORTANT: Contact must remain centered between indentors while crimping.**

6. Insert wire in contact and crimp until handle touches stop.
7. Release handle and remove contact.



TS118 –UN–23AUG88

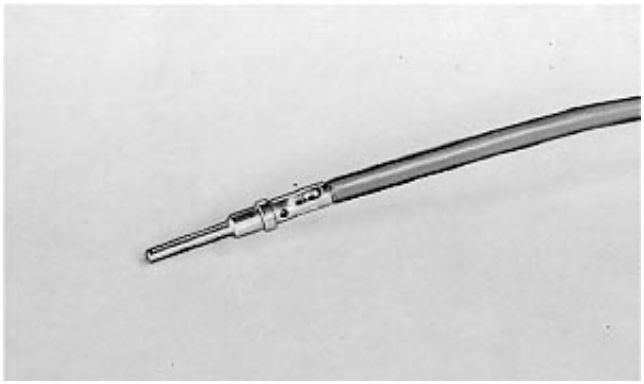
**Continued on next page**

ECONN,W –19–04JUN90–3/4

**IMPORTANT: If all wire strands are not crimped into contact, cut off wire at contact and repeat contact installation procedures.**

*NOTE: Readjust crimping tool for each crimping procedure.*

8. Inspect contact to be certain all wires are in crimped barrel.



TS0135 –UN–23AUG88

ECONN,W –19–04JUN90–4/4

## REPLACE WEATHER PACK™ CONNECTOR

**IMPORTANT: Identify wire color locations with connector terminal letters.**

1. Open connector body.
2. Insert JDG364 Extraction Tool[1] over terminal contact in connector body.
3. Hold extractor tool fully seated and pull wire from connector body.

*NOTE: If terminal cannot be removed, insert wire or nail through extractor tool handle and push terminal contact from connector.*

TS0128 –UN–23AUG88

*WEATHER PACK is a trademark of Packard Electric.*

*[1]Included in JT07195A Electrical Repair Kit.*

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19

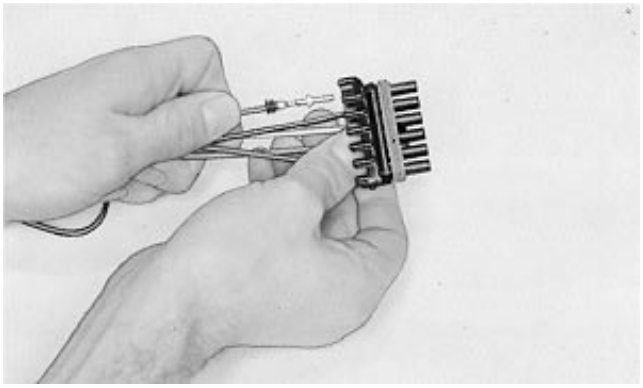
**Continued on next page**

ECONN,O –19–03NOV94–1/2

**IMPORTANT: Carefully spread contact lances to assure good seating on connector body.**

*NOTE: Connector bodies are “keyed” for proper contact mating. Be sure contacts are in proper alignment.*

4. Push contact into new connector body until fully seated.
5. Pull on wire slightly to be certain contact is locked in place.
6. Transfer remaining wires to correct terminal in new connector.
7. Close connector body.



TS0130 –UN–23AUG88

ECONN,O –19–03NOV94–2/2

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1674
20

## INSTALL WEATHER PACK™ CONTACT

*NOTE: Cable seals are color coded for three sizes of wire:*

- *Green - 18 to 20 gauge wire*
- *Gray - 14 to 16 gauge wire*
- *Blue - 10 to 12 gauge wire*

1. Slip correct size cable seal on wire.

2. Strip insulation from wire to expose 6 mm (1/4 in.) and align cable seal with edge of insulation.

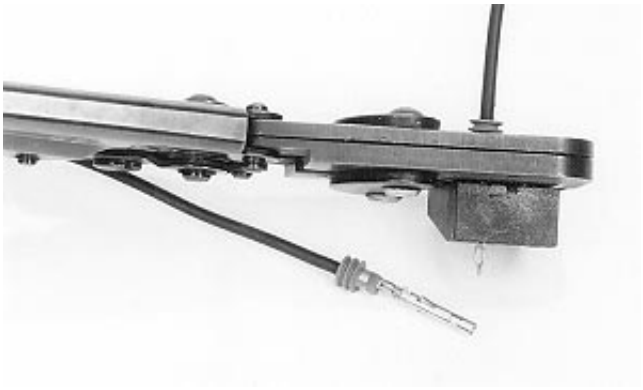
*NOTE: Contacts have numbered identification for two sizes of wire:*

- *#15 for 14 to 16 gauge wire*
- *#19 for 18 to 20 gauge wire*

3. Put proper size contact on wire and crimp in place with a “W” type crimp, using JDG783 Crimping Tool.

TS0136 –UN–23AUG88

*Correct Size Cable*



TS1623 –UN–02NOV94

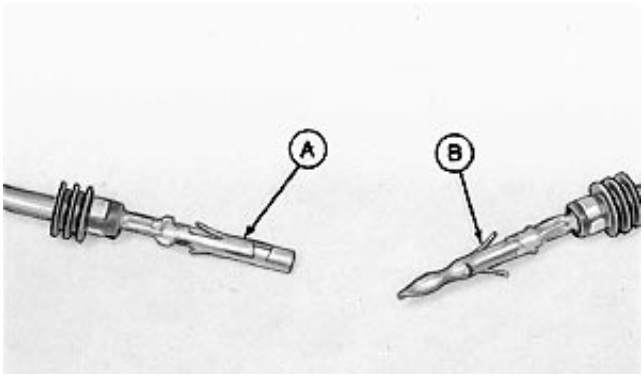
*Strip Insulation*

*WEATHER PACK is a trademark of Packard Electric.*

ECONN,AA –19–04JUN90–1/2

**IMPORTANT: Proper contact installation for “sleeve” (A) and “pin” (B) is shown.**

4. Secure cable seal to contact as shown, using JDG783 Crimping Tool.




TS0139 –UN–02DEC88

*Contact Installation*

**A—Sleeve**
**B—Pin**

ECONN,AA –19–04JUN90–2/2

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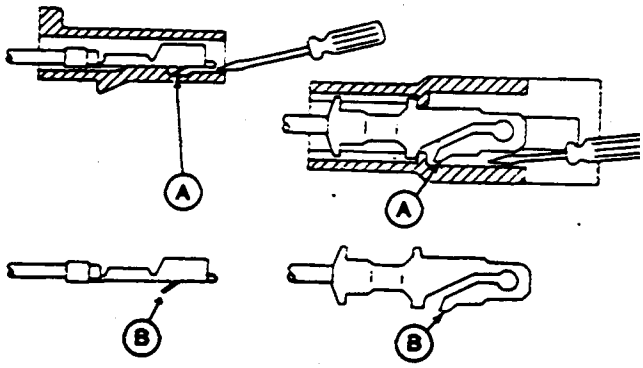
## REMOVE CONNECTOR BODY FROM BLADE TERMINALS

1. Depress locking tang (A) on terminal, using a small screw driver. Slide connector body off.
2. Be sure to bend locking tang back to its original position (B) before installing connector body.




RW4218 –UN–23AUG88

**A—Locking Tang (Depressed Position)**
**B—Locking Tang (Original Position)**

DX,ECONN,V1 –19–02NOV94–1/1

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1674
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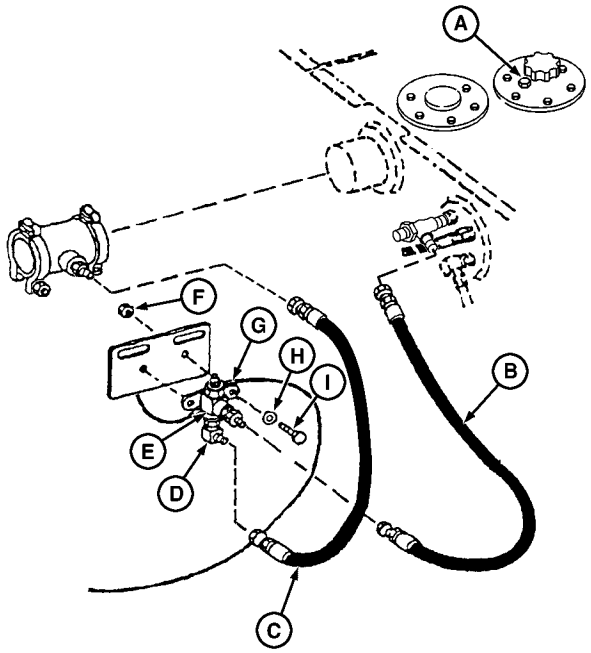
## REMOVE AND INSTALL HYDRAULIC OIL FILTER RESTRICTION SWITCH

1. Loosen vent plug (A) to relieve hydraulic oil tank pressure.
2. Remove connector (G).
3. Disconnect hoses (B and C).
4. Remove elbow (D).
5. Remove cap screws (I), washers (H) and nuts (F).
6. Remove switch (E). Replace parts as necessary.




T121226 –UN–07JUN99

T121226

**A—Vent Plug**
**B—Hose**
**C—Hose**
**D—Elbow**
**E—Switch**
**F—Nut (2 used)**
**G—Connector**
**H—Washer (2 used)**
**I—Cap Screw (2 used)**

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1674
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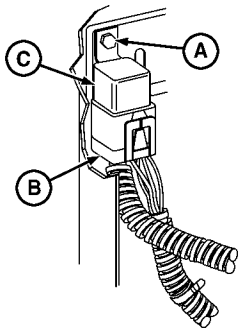
CED,OUOE020,57 –19–20APR99–1/1

## REMOVE AND INSTALL OVERLOAD ALARM RELAY

1. Disconnect connector (B).
2. Remove cap screw (A) and relay (C). Replace parts as necessary.




T121225 –UN–07JUN99

T121225

**A—Cap Screw**
**B—Connector**
**C—Relay**

CED,OUOE020,58 –19–20APR99–1/1

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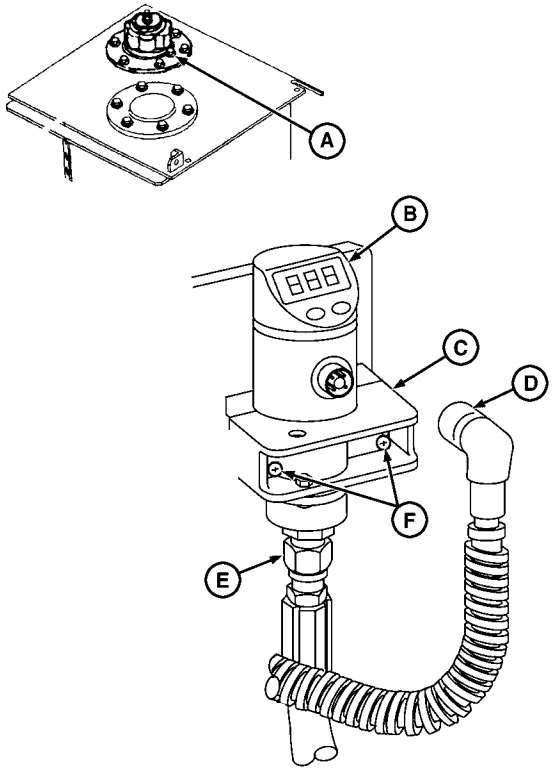
1674
24

## REMOVE AND INSTALL OVERLOAD ALARM PRESSURE SWITCH

1. Loosen vent plug (A) on hydraulic oil tank to relieve hydraulic oil tank pressure.
2. Disconnect connector (D).
3. Disconnect hose (E).
4. Remove cap screws (F), mount (C) and pressure switch (B). Replace parts as necessary.




T121223

**A—Vent Plug**
**B—Pressure Switch**
**C—Mount**
**D—Connector**
**E—Hose**
**F—Cap Screw (2 used)**

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1674
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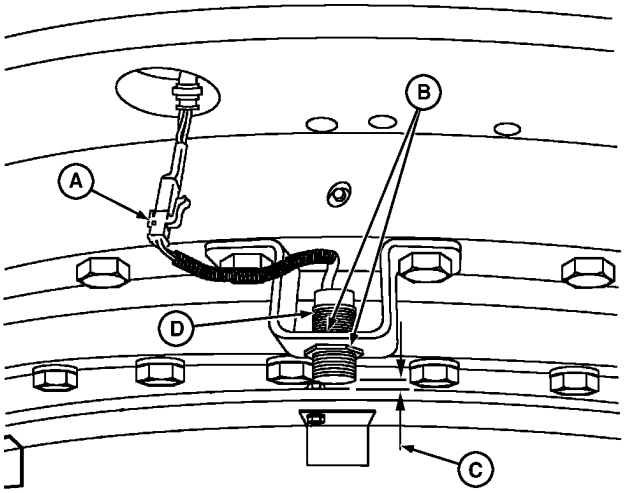
CED,OUOE020,59 –19–20APR99–1/1

## REMOVE AND INSTALL OVERLOAD ALARM PROXIMITY SWITCH

1. Disconnect connector (A).
2. Remove nuts (B) and proximity switch (D). Replace parts as necessary.
3. Adjust gap (C) to 6.5—9.5 mm (1/4—3/8 in.).




T121224 –UN–07JUN99

T121224

**A—Connector**
**B—Nut (2 used)**
**C—Gap 6.5—9.5 mm (1/4—3/8 in.)**
**D—Proximity Switch**

CED,OUOE020,60 –19–20APR99–1/1

## REMOVE AND INSTALL AUXILIARY HYDRAULIC CONTROL SWITCH

16
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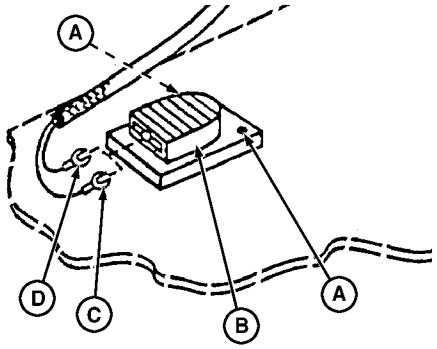
26

1. Remove connectors (C and D).
2. Remove cap screws (A).
3. Remove switch (B). Replace parts as necessary.




T121227 –UN–07JUN99

T121227

**A—Cap Screw (2 used)**
**B—Switch**
**C—Connector**
**D—Connector**

CED,OUOE020,61 –19–03MAY99–1/1

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Engine Slow Idle | Speed | 1050 + 100 - 0 rpm |
| Engine Auto-Idle | Speed | 1200 ± 100 rpm |
| Engine E (Economy) Mode | Speed | 1900 ± 100 rpm |
| Engine Fast Idle in Standard Mode | Speed | 2050 ± 75 rpm |

CED,OUOE003,1159 –19–07JUL98–1/1

## WELDING ON MACHINE

**IMPORTANT: Electrical current traveling from the welder through the machine electrical system may damage the machine electrical system, including battery, EPC controller. Disconnect battery ground cable and EPC electrical connectors before welding on the machine.**

Before welding on the machine, follow the steps listed below to protect the machine electrical system.

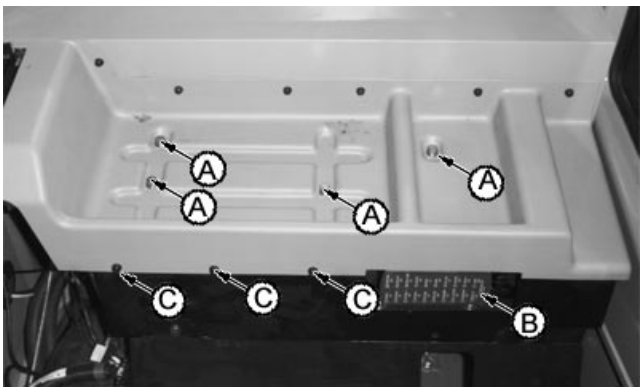
16
1675
1

Continued on next page

TX,16,UU3320 –19–07JUL98–1/3

1. Inside the cab, remove four cap screws (A and C) and the fuse box cover (B) to remove the rear console cover.

2. Disconnect the battery ground and positive cables.



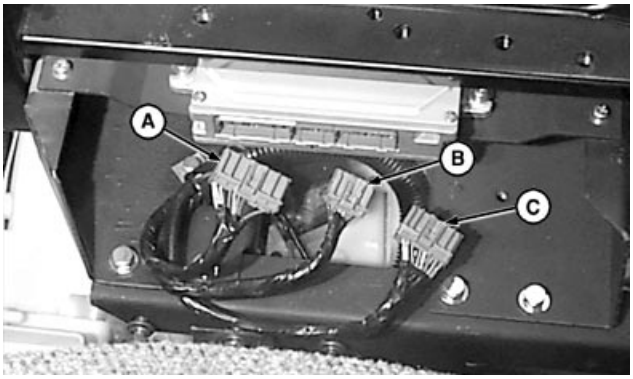

T107932B –UN–07MAR97

**A—Cap Screw (4 used)**
**B—Fuse Box Cover**
**C—Cap Screw (3 used)**

TX,16,UU3320 –19–07JUL98–2/3

3. Disconnect the engine and pump controller electrical connectors.

   After reconnecting batteries, engine speeds must be recalibrated. (See Engine Speed Learning Procedure in this group.)




T115226 –UN–17JUN98

**A—EPC Connector**
**B—EPC Connector**
**C—EPC Connector**

16
1675
2

TX,16,UU3320 –19–07JUL98–3/3

## ENGINE SPEED LEARNING PROCEDURE

When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine control motor adjustment and engine learning control procedure must be performed.

- Engine
- Engine speed control cable
- Engine control motor and sensor
- Engine and pump controller
- Fast and slow idle stop brackets

1. Stop the engine.

2. Disconnect the laptop computer from the diagnostic test port.

3. Wait for 5 seconds.

**Continued on next page**

CED,OUOE003,1086 –19–08SEP98–1/2

16
1675
3

4. Push engine learning switch (C) up to top position. The switch is a three position switch. Make sure it is in the top position.
5. Turn key switch ON. Wait 5 seconds.
6. Turn key switch OFF. Wait 5 seconds.
7. Push engine learning switch to middle position.
8. Check engine speeds.

**Engine Slow Idle—Specification**

Speed ..... 1050 + 100 - 0 rpm

**Engine Auto-Idle—Specification**

Speed ..... 1200 ± 100 rpm

**Engine E (Economy) Mode—Specification**

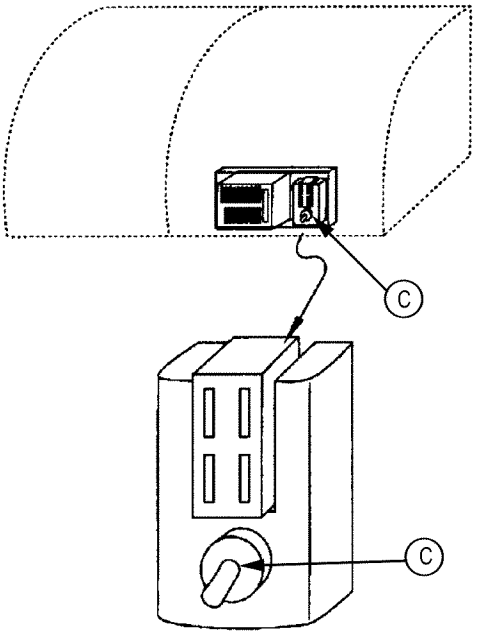
Speed ..... 1900 ± 100 rpm

**Engine Fast Idle in Standard Mode—Specification**

Speed ..... 2050 ± 75 rpm

If slow idle speed is still not to specification, check the engine control sensor. (See Engine Control (EC) Sensor Harness Test in Group 9025-25.)

*NOTE: The laptop computer with excavator diagnostic software can be used to change the default speeds for slow idle, auto-idle, economy mode, and fast idle in standard mode. See Excavator Diagnostic Software Special Function—Engine Speed in Group 9025-25.*




T103674

**C—Engine Learning Switch**

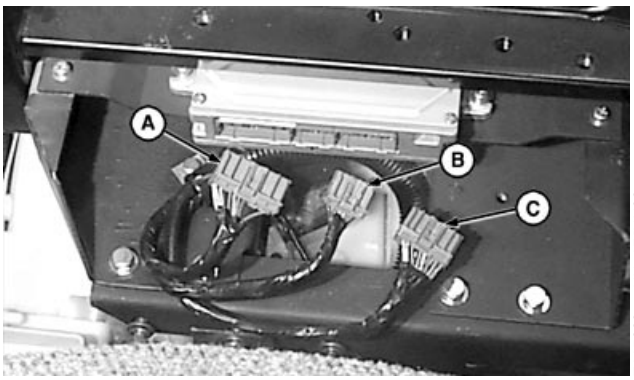
16
1675
4

CED,OUOE003,1086 –19–08SEP98–2/2

## CONNECTING ENGINE AND PUMP CONTROLLER (EPC) HARNESS CONNECTOR

**IMPORTANT: Do not disconnect electrical connectors while the engine is running. Damage to Engine and Pump Controller, or other components may result. Disconnect connectors only when instructed during a test or check.**

1. Push connectors into engine and pump controller.
2. Complete engine speed learning procedure.




**A—EPC Connector**
**B—EPC Connector**
**C—EPC Connector**

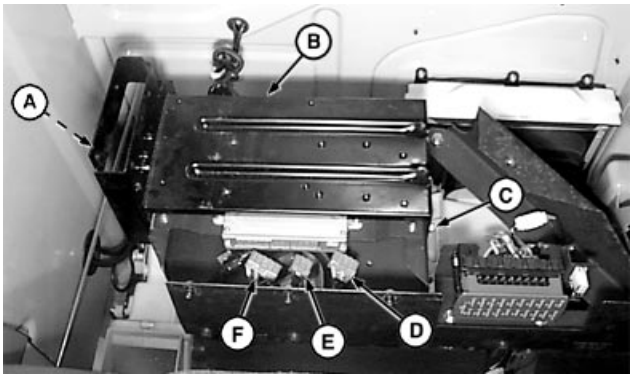
TX,16,UU3321 –19–07JUL98–1/1

16
1675
5

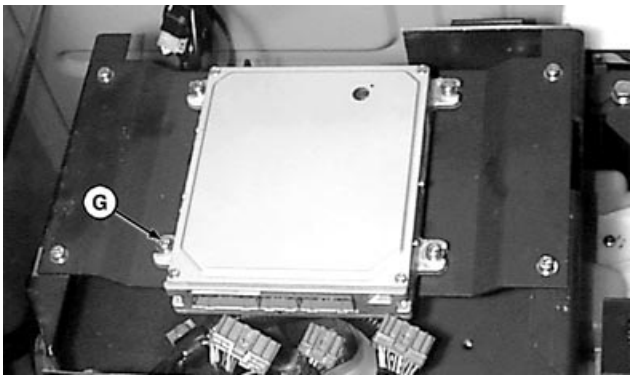
## REMOVE AND INSTALL ENGINE AND PUMP CONTROLLER (EPC)

**IMPORTANT: If a controller problem is indicated, the real problem may be poor connector pin contact. Before replacing controller, remove and install controller connectors. Check machine operation.**

1. Disconnect battery ground cable.
2. Move seat forward and remove access cover.
3. Disconnect cable connectors (D—F).
4. Disconnect electrical connectors (A).
5. Remove cap screws (C) and remove cover (B).
6. Remove screws (G).
7. Install engine and pump controller.
8. Do engine speed learning procedure. (See procedure in this group.)




T115267 –UN–17JUN98




T115268 –UN–17JUN98

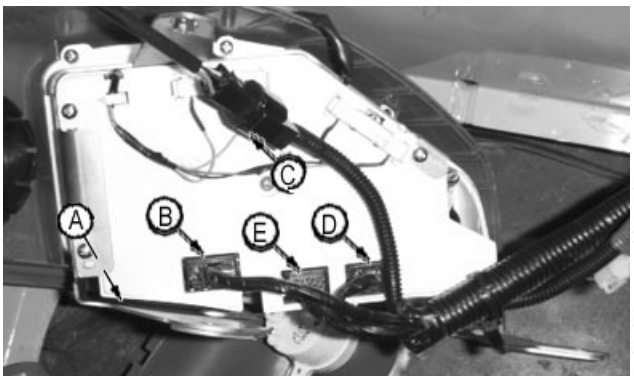
**A—Electrical Connector (2 used)**
**B—Cover**
**C—Cap Screw (4 used)**
**D—EPC Connector**
**E—EPC Connector**
**F—EPC Connector**
**G—Screw (4 used)**

16
1675
6

CED,OUOE003,1158 –19–07JUL98–1/1

## REMOVE AND INSTALL MONITOR CONTROLLER

1. Disconnect battery ground cable.
2. Move seat forward and remove access cover.
3. Disconnect wiring harness connectors (C).
4. Remove screws (B) and monitor controller (A).
5. Install monitor controller and connect wiring harnesses.
6. Install cover and connect battery cable. Do engine speed recalibration. (See Engine and Pump Controller (EPC) in this group.)



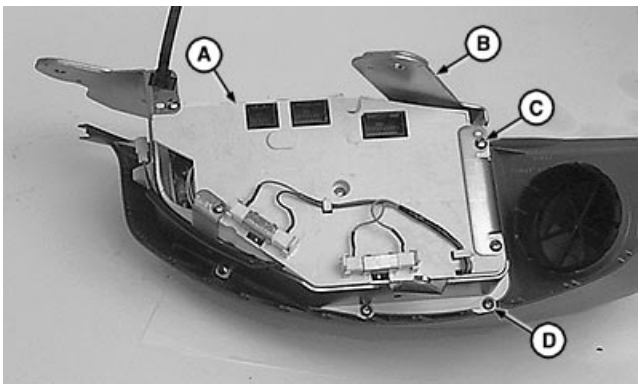

T105427B –UN–06MAR97

TX,16,UU3323 –19–23JUN94–1/1

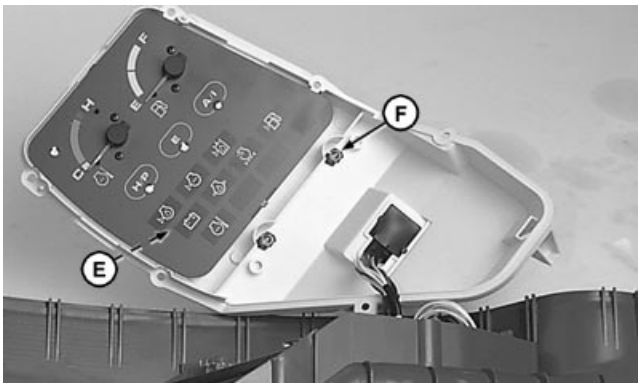
16
1675
7

## REPLACE MONITOR PANEL AND SWITCH PANEL BULB

1. Remove monitor controller. (See procedure in Group 1675.)
2. Remove cap screws (C) and bracket (B).
3. Remove cap screws (D) and monitor controller (A).
4. Replace bulbs (E and F) as necessary.




T113808 –UN–18MAR98




T113809 –UN–18MAR98

**A—Monitor Controller**
**B—Bracket**
**C—Cap Screw (4 used)**
**D—Cap Screw (6 used)**
**E—Monitor Panel Bulb (12 used)**
**F—Switch Panel Bulb (2 used)**

CED,OUOE024,229 –19–20MAY98–1/1

## REMOVE AND INSTALL MONITOR PANEL

1. Remove monitor controller. (See Remove and Install Monitor Controller in Group 1675.)

Continued on next page

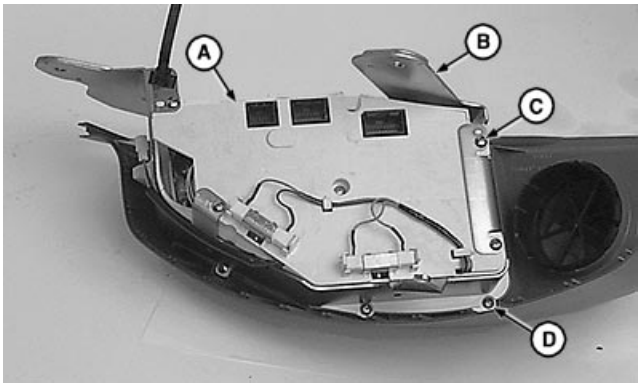
CED,OUOE042,183 –19–23JAN98–1/3

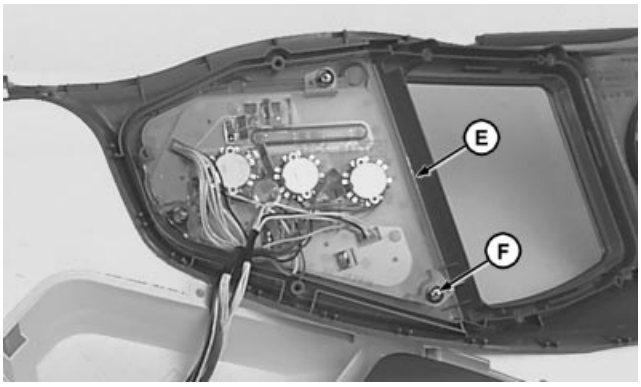
2. Remove panel control knobs (A).


**A—Control Knob (3 used)**

CED,OUOE042,183 –19–23JAN98–2/3

3. Remove cap screws (C) and bracket (B).
4. Remove cap screws (D) and monitor controller (A).
5. Remove cap screws (F) and switch panel (E).
6. Replace parts as necessary.



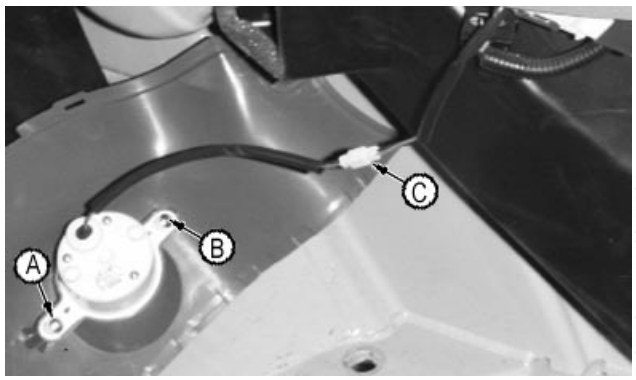

**A—Monitor Controller**
**B—Bracket**
**C—Cap Screw (4 used)**
**D—Cap Screw (6 used)**
**E—Switch Panel**
**F—Cap Screw (3 used)**

CED,OUOE042,183 –19–23JAN98–3/3

16
1676
2

## REMOVE AND INSTALL HOUR METER

1. Remove bottom panel.
2. Remove connector (C).
3. Remove screws (A and B). Remove hour meter.
4. Repair or replace parts as required.
5. Install hour meter.
6. Install bottom panel.




T105416B –UN–06MAR97

**A—Screw**
**B—Screw**
**C—Connector**

TX,16,UU3327 –19–11JUL92–1/1

## CHANGING PROPEL ALARM VOLUME

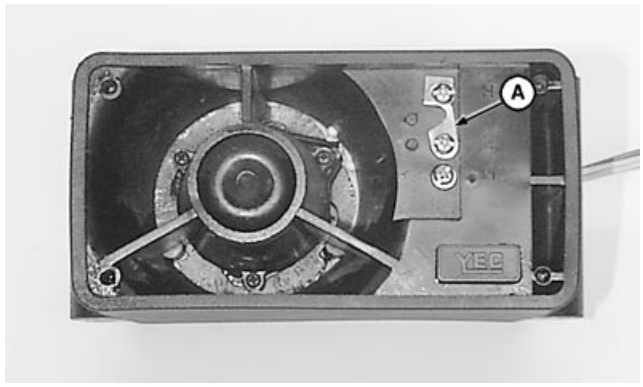
**IMPORTANT: It may be necessary to adjust propel alarm volume to meet local regulations.**

*NOTE: Alarm removed from machine for clarity.*

1. Remove four sheet metal screws to remove propel alarm front cover.

*NOTE: This machine is shipped with the propel alarm set in the "High" position.*

2. Adjust volume level of propel alarm by connecting metallic bar to appropriate terminals. The alarm can be set at "LOW", "MED" (medium), or "HIGH" volume levels.
3. Install front cover.




T113342 –UN–12MAR98

**A—Volume Level**

CED,OUOE042,232 –19–12MAR98–1/1

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1676
3

# Group 1677
# Starting Motors

## GENERAL INFORMATION

**IMPORTANT: Never operate starting motor longer than 30 seconds. Allow at least 2 minutes for cooling and battery recovery before operating again. Overheating caused by excessive operation will seriously damage starting motor.**

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1677
1

RG,RG34710,2335 –19–15MAR97–1/1

## TYPICAL STARTING CIRCUIT OPERATION

When wire from relay (A) is energized, current flows through both pull-in winding (C) and hold-in winding (D) to ground.

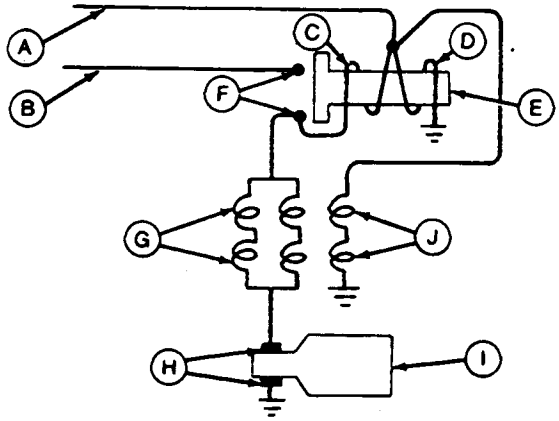
Current through windings engages solenoid plunger (E), which closes main contacts (F). When main contacts close, current through pull-in windings stops. Current continues through hold-in winding, keeping solenoid engaged and main contacts closed.

With main contacts closed, current flows from battery cable (B) to starting motor at a very high rate. Four heavy field windings (G) carry current to commutator brushes (H).

Light shunt windings (J) are wrapped together with two of the heavy field windings. Shunt windings are connected to solenoid switch terminal and directly to ground. They provide additional low speed torque to assist engine rotation and prevent overspeeding of motor.

From field windings, current flows through armature windings (I) to ground, making contact through commutator brushes (H).

Strong magnetic fields are set up by current flow through field windings and armature windings. Windings are arranged so that magnetic fields constantly repel each other, rotating armature.




RG1313 –UN–20APR89

**A—Wire From Relay**
**B—Cable from Battery**
**C—Pull-In Winding**
**D—Hold-In Winding**
**E—Solenoid Plunger**
**F—Main Contacts**
**G—Field Windings**
**H—Commutator Brushes**
**I—Armature**
**J—Shunt Windings**

RG,RG34710,2336 –19–15MAR97–1/1

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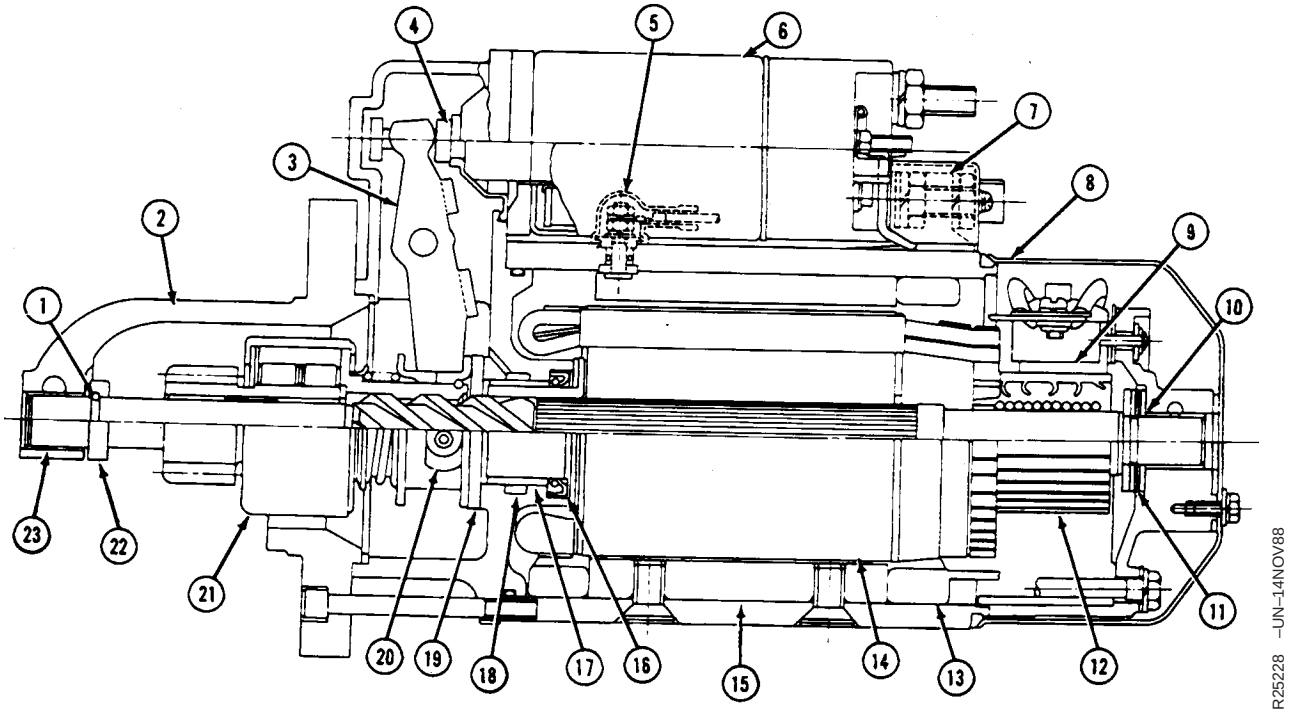
1677
2

## TYPICAL STARTING MOTOR OPERATION




**1—Snap Ring**
**2—Drive End Housing**
**3—Shift Lever**
**4—Plunger**
**5—Shunt Field Terminal**
**6—Solenoid Assembly**
**7—Field Connector**
**8—End Frame Cover**
**9—Brush**
**10—Bushing**
**11—Thrust Washer**
**12—Commutator**
**13—Field Windings**
**14—Armature**
**15—Pole Shoe**
**16—Oil Seal**
**17—Bushing**
**18—Felt**
**19—Brake Washer**
**20—Wear Pads**
**21—Overrunning Clutch**
**22—Pinion Stop**
**23—Bushing**

When solenoid (6) engages, it pulls shift lever (3). Shift lever pushes overrunning clutch drive (21) to engage pinion in stater gear on flywheel. As armature (14) turns, it cranks engine.

When engine starters, overrunning clutch spins freely on shaft. This prevents overspeeding of armature by flywheel.

When key switch is released, current to solenoid hold-in winding is shut off. Current can feed through both pull-in and hold-in windings from main contacts, but direction of current is reversed in pull-in winding. The two windings cancel each other, and solenoid is released.

A spring pushes solenoid back to disengaged position. This opens main contacts and shuts off current to field windings and armature.

Shift lever retracts overrunning clutch drive, disengaging pinion from flywheel. Brake washer (19) slows armature to a stop.

RG,RG34710,2337 –19–15MAR97–1/1

# Robert Bosch Starting Motor Repair

## SPECIAL OR ESSENTIAL TOOLS

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

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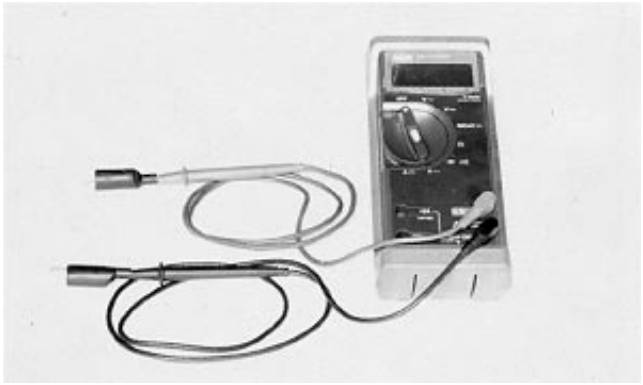
*SERVICEGARD is a trademark of Deere & Company.*

RG,RG34710,2338 –19–15MAR97–1/2

Digital Multimeter . . . . . .JT05791

Test electrical components for voltage, resistance, or current flow. It is especially good for measuring low voltage or high resistance circuits.



RW11274 –UN–12DEC88

RG,RG34710,2338 –19–15MAR97–2/2

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10
2

# ROBERT BOSCH STARTING MOTOR SPECIFICATIONS

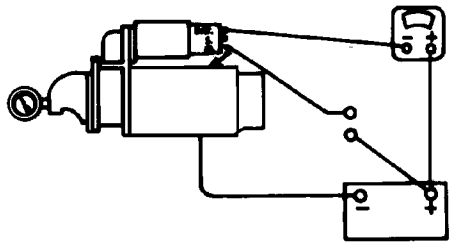
| NO LOAD TEST | | | | | | |
|---|---|---|---|---|---|---|
| **John Deere Part No.** | **Bosch Model No.** | **System Voltage** | **Rating kW** | **Volts** | **Amps (Max.)** | **rpm kW** |
| AL110503 | 0 001 367 078 | 12 | 3.0 | 11.5 | 130 | 700080007000 |
| AL110504 | 0 001 369 022 | 12 | 3.1 | 11.511.5 | 170 | |
| AL41247 | 0 001 362 312 | 12 | 2.7 | | 125 | |
| AL62690 | 0 001 362 316 | 12 | 2.7 | 11.511.511.5 | 125 | 700080007000 |
| AL62772 | 0 001 369 005 | 12 | 3.1 | | 170 | |
| AL78760 | 0 001 367 075 | 12 | 3.0 | | 130 | |
| AL81154 | 0 001 367 077 | 12 | 3.0 | 11.511.511.5 | 130 | 7000 |
| RE30493 | 0 001 362 324 | 12 | 2.7 | | 125 | 7000 |
| RE65169 | 0 001 369 021 | 12 | 3.1 | | 170 | 8000 |

| **Item** | **Specification** |
|---|---|
| Minimum voltage of solenoid | 8 volts |
| Testing armature for grounded circuit, voltage | 40 volts a.c. |
| Testing field coils for grounded circuit, voltage | 40 volts a.c. |
| Testing field coils for open windings, voltage | 6—12 volts d.c. |
| Testing brush holder insulation for grounded circuit, voltage | 40 volts a.c. |
| **2.7 kW Starting Motor** | |
| Minimum diameter of commutator (When turning down, armature shaft locating points are slightly off center.) | 39.5 mm (1.555 in.) |
| Commutator out-of-roundness, max | 0.03 mm (0.0012 in.) |
| Out-of-roundness of stack of armature plates, max | 0.05 mm (0.002 in.) |
| Undercutting insulation after initial turn-down of commutator by approximately: (then finish-turn) | 0.5—0.8 mm (0.02—0.03 in.) |
| Brush pressure (check with a spring scale) | 26—28 N (5.7—6 lb) |
| Minimum brush length | 7.5 mm (0.30 in.) |
| Armature end play | 0.1—0.3 mm (0.004—0.012 in.) |
| Armature braking torque | 0.45—0.75 N•m (4.0—6.6 in-lb) |
| Overrunning torque | 0.40—0.55 N•m (3.5—4.8 in-lb) |
| **3.0 and 3.1 kW Starting Motor** | |
| Minimum diameter of commutator (important for turning down: Note: Armature shaft locating points are slightly off center) | 42.5 mm (1.67 in.) |
| Commutator out-of roundness, max | 0.03 mm (0.0012 in.) |
| Out-of roundness of stack of armature plates, max | 0.05 mm (0.002 in.) |
| Undercutting insulation after initial turn-down of commutator by approximately: (then finish-turn) | 0.5—0.8 mm (0.02—0.03 in.) |
| Minimum brush length | 7.5 mm (0.30 in.) |
| Armature end play | 0.1—0.3 mm (0.003—0.012 in.) |
| Armature braking torque | 0.5—1.2 N•m (0.43—1.40 in-lb) |
| Overrunning torque | 0.35—0.65 N•m (0.30—0.56 in-lb) |

RG,RG34710,2339 –19–15MAR97–1/1

## MAKE NO-LOAD TEST

1. Make connections as shown, and use an ammeter (A) capable of measuring several hundred amps.
2. Measure current draw in amps and compare with specifications given earlier in this group.
3. If speed and current draw are slightly low, connect a voltmeter between motor terminal and frame. Observe voltage during test. Voltage may be reduced because of high current draw on battery.
4. If speed or current draw is significantly different than specified, diagnose problem per chart which follows.



RG3897 –UN–05DEC97

**A—Ammeter**
**B—Battery**
**C—Starter Frame**
**D—Tachometer**
**E—Battery Terminal**
**F—Switch**
**G—Field Coil Connector**

RG,RG34710,2340 –19–15MAR97–1/1

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3

## DIAGNOSING STARTING MOTOR MALFUNCTIONS

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10
4

**FAILS TO OPERATE, NO CURRENT DRAW**

Open field circuit (all field windings)

Open armature windings

Defective brush contact with commutator

Open solenoid windings

Defective solenoid contacts

**FAILS TO OPERATE, HIGH CURRENT DRAW**

Grounded field windings or armature windings

Seized bearings

**LOW SPEED, LOW CURRENT DRAW**

High internal resistance

Defective brush contact with commutator

**LOW SPEED, HIGH CURRENT DRAW**

Low Speed, High Current Draw

**HIGH SPEED, HIGH CURRENT DRAW**

Shorted field windings

*NOTE: This test will not detect individual open-circuited field coils—the stator would have a slow cranking speed but would pass this test.*

RG,RG34710,2341 –19–15MAR97–1/1

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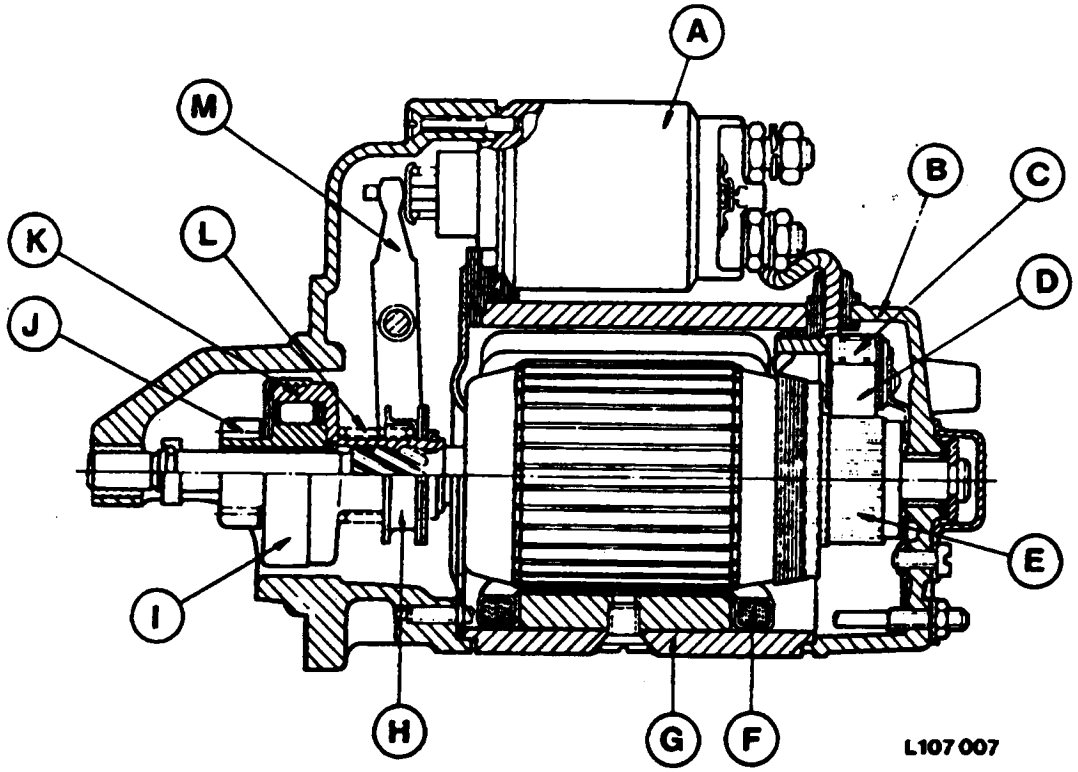
5

## ROBERT BOSCH STARTING MOTOR



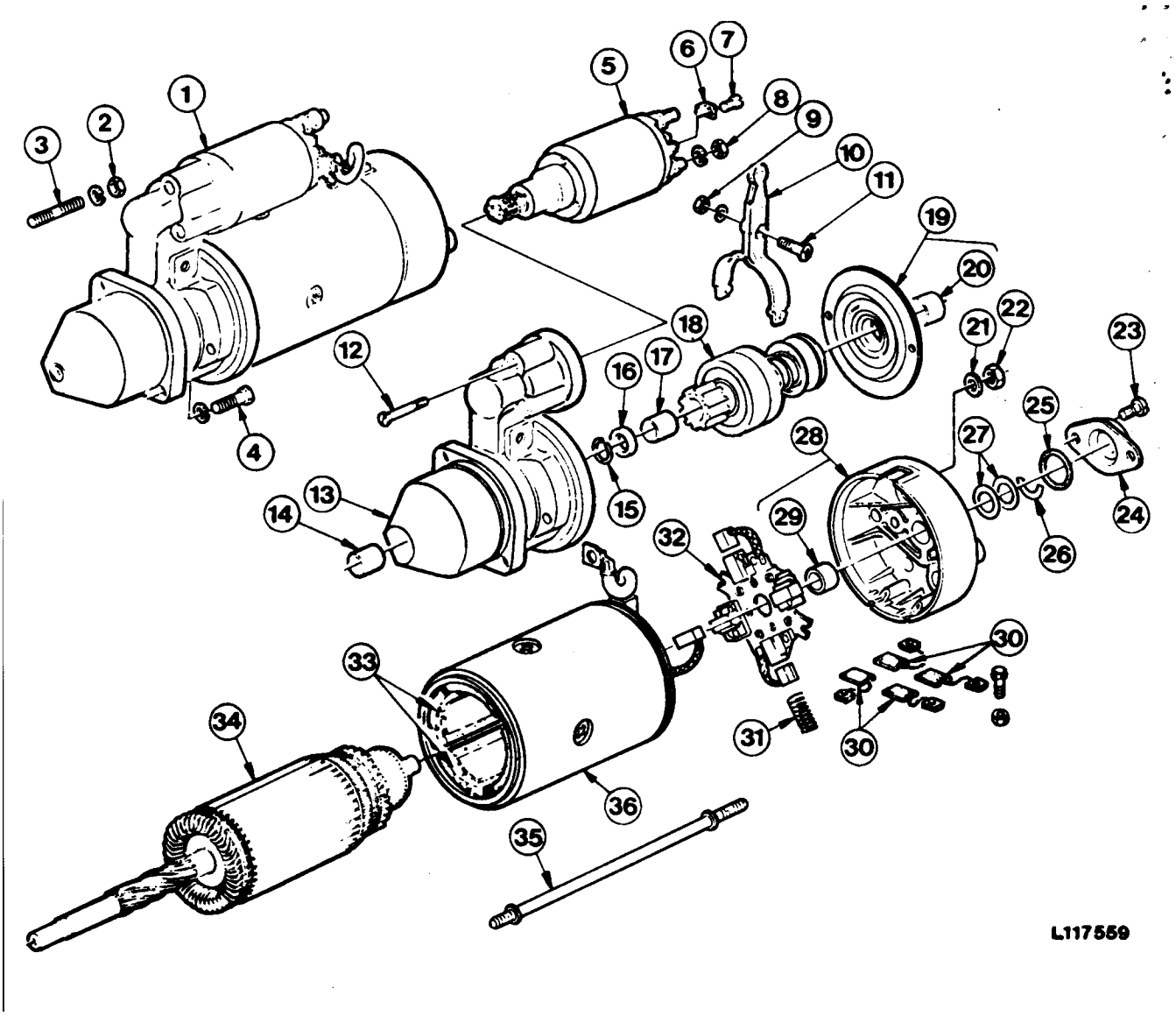

L107007 –UN–06APR89

**A—Solenoid Switch**
**B—Commutator End Frame**
**C—Compression Spring**
**D—Carbon Brush**
**E—Commutator**
**F—Field Winding**
**G—Field Frame**
**H—Guide Ring**
**I—Overrunning Clutch (Roller-Type)**
**J—Pinion**
**K—Drive Hub**
**L—Engaging Spring**
**M—Engaging Lever**

RG,RG34710,2342 –19–15MAR97–1/1

60
10
6

## STARTING MOTOR, EXPLODED VIEW




L117559 –UN–02FEB89

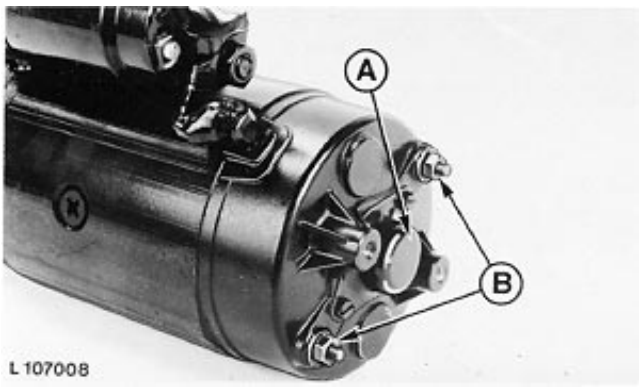
1—Starting Motor Assembly
2—Hex Nut
3—Stud
4—Cap Screw
5—Solenoid Switch
6—Securing Clip
7—Cylinder Head Screw
8—Hex Nuts (4 Used)
9—Hex Nut
10—Engaging Lever
11—Pivot Screw
12—Countersunk Screw (3 Used)
13—Drive End Frame Assembly
14—Bushing
15—Snap Ring
16—Stop Ring
17—Bushing
18—Drive With Pinion
19—Center Bearing
20—Bushing
21—Washer (2 Used)
22—Hex Nut (2 Used)
23—Cylinder Head Screw (2 Used)
24—Cover Cap
25—Rubber Ring
26—Fixing Washer
27—Shims
28—Commutator End Frame
29—Bushing
30—Carbon Brushes (Kit)
31—Compression Spring (4 Used)
32—Carbon Brush Plate
33—Winding
34—Armature
35—Stud (2 Used)
36—Field Frame

RG,RG34710,2343 –19–15MAR97–1/1

## DISASSEMBLY

Unscrew cover cap (A) and remove fixing washer and shims. Be careful with rubber ring.

Remove hex nuts (B).



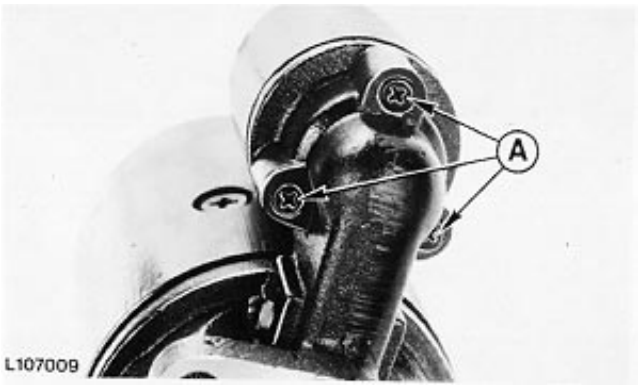

L107008 –UN–17JUL89

RG,RG34710,2344 –19–15MAR97–1/1

## SOLENOID SWITCH—REMOVAL

Disconnect wiring connection from solenoid switch.

Remove attaching screws (A) and pull out solenoid switch with pinion head.




L107009 –UN–17JUL89

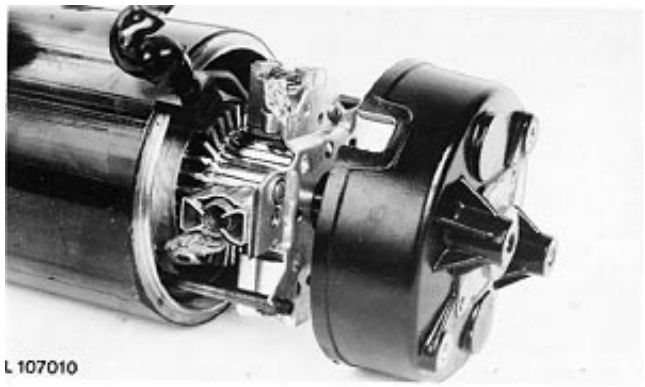
RG,RG34710,2345 –19–15MAR97–1/1

## CARBON BRUSH PLATE—REMOVAL

Carefully remove commutator end frame as shown.

*NOTE: When removing commutator end frame the brush compression springs may spring out of the brush holders.*

Pull carbon brushes out of carbon brush plate and remove carbon brush plate from armature shaft.




L107010 –UN–17JUL89

RG,RG34710,2346 –19–15MAR97–1/1

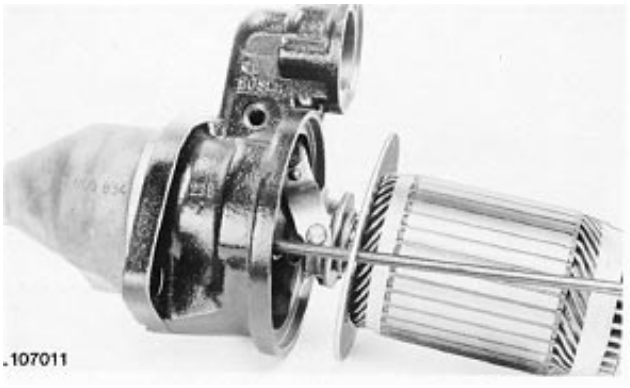
*Robert Bosch Starting Motor Repair*



## ARMATURE—REMOVAL

Carefully pull armature with drive end frame assembly from field frame (do not damage windings).

Remove engaging lever and armature jointly out of drive end frame assembly.



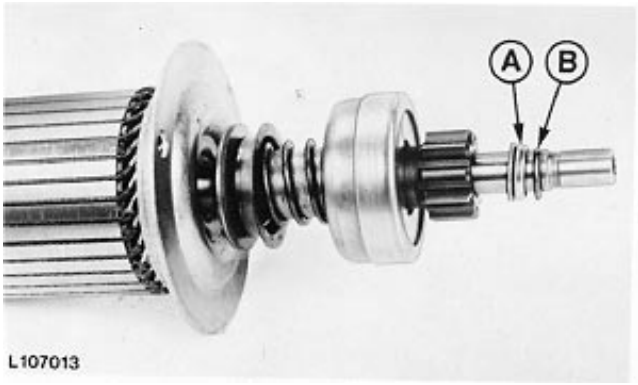

L107011 –UN–17JUL89

RG,RG34710,2347 –19–15MAR97–1/1

## SNAP RING—REMOVAL

Drive back stop ring (A) and bend open snap ring (B).

Remove drive with pinion and center bearing from armature shaft.




L107013 –UN–17JUL89

RG,RG34710,2348 –19–15MAR97–1/1

## CLEANING PARTS

Wash parts in solvent and dry with compressed air.

*NOTE: Armature, windings and drive with pinion must not be placed in cleaning fluid.*

Inspect all parts for wear and mechanical damage.

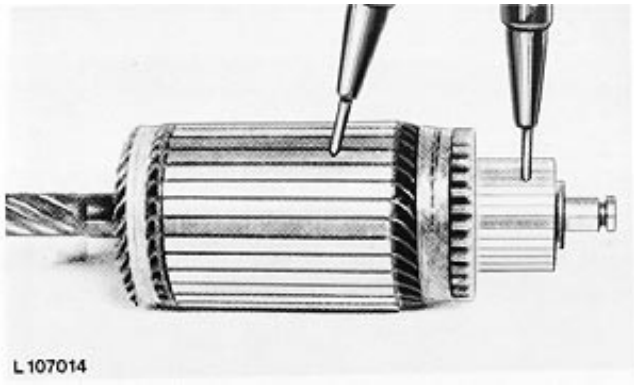
RG,RG34710,2349 –19–15MAR97–1/1

## TESTING ARMATURE FOR GROUNDS

Set ohmmeter to read on highest scale.

Place one test lead on the armature core or shaft. Place other lead on commutator.

If the test meter indicator swings toward zero, the armature is grounded. Replace armature.




L107014 –UN–17JUL89

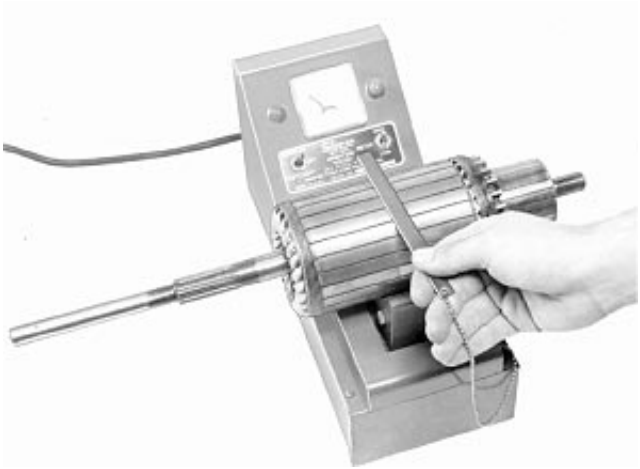
RG,RG34710,2350 –19–15MAR97–1/1

## TESTING ARMATURE FOR SHORT CIRCUIT

Place armature in a growler and hold hacksaw blade above each slot while slowly rotating the armature.

If coil is shorted, the blade will be attracted to and repelled from the slot.

Short circuit most often occurs because of copper dust or filings between two commutator segments. Clean commutator segments to correct this short.



RG78074C1 –UN–09JAN90

60
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9

RG,RG34710,2351 –19–15MAR97–1/1

## TESTING ARMATURE FOR OPEN CIRCUIT

Set ohmmeter to read on lowest scale.

Place one test lead on commutator segment. Place other test lead on an adjacent segment. Repeat this operation for all segments by moving one lead at a time.

If the test meter indicator does not swing to zero and remains stationary, the armature coil between these two segments is open. Replace armature.

RG,RG34710,2352 –19–15MAR97–1/1

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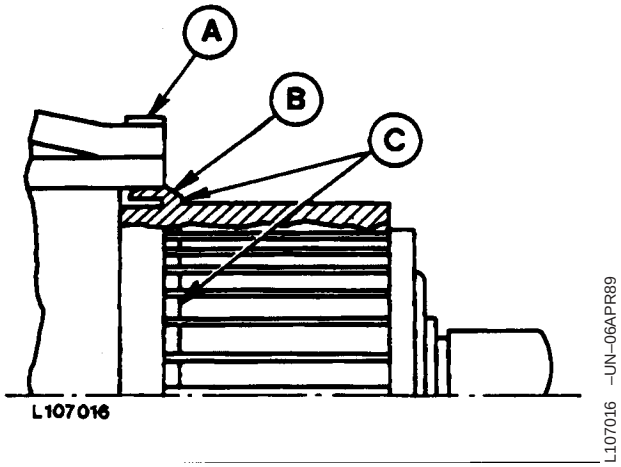
10
10

## TURNING COMMUTATOR DOWN

Minimum diameter: 42.5 mm (1.67 in.)

After turning the commutator down, undercut its insulation by approximately. 0.5—0.8 mm (0.02—0.03 in.) with a commutator saw and then finish-turn.




**A—Solenoid Lug**
**B—Claw**
**C—Turn Down Only to Here**

RG,RG34710,2353 –19–15MAR97–1/1

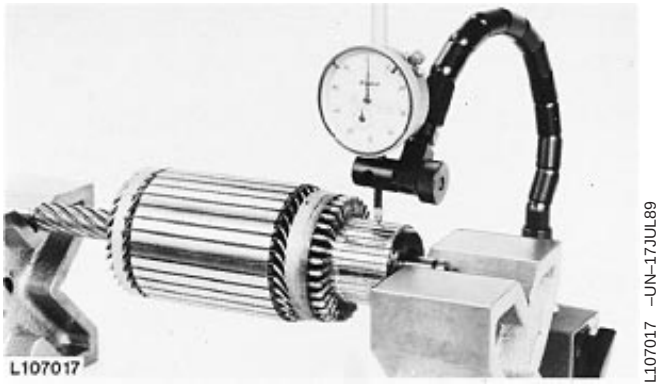
## TESTING COMMUTATOR FOR OUT-OF-ROUNDNESS

Out of roundness:

Commutator, max: 0.03 mm (0.0012 in.)

Stack of armature plates, max: 0.05 mm (0.002 in.)

Check armature once again for grounds and short circuits.



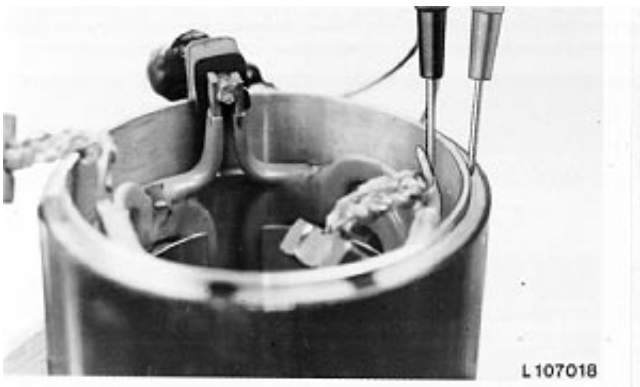

RG,RG34710,2354 –19–15MAR97–1/1

## TESTING FIELD WINDING FOR GROUND CIRCUITS

Set ohmmeter to read on highest scale.

Place one test lead on a clean spot on field frame. Place other lead on brush lead.

If the ohmmeter indicator swings toward zero, a grounded circuit is indicated. Replace the field windings.




L107018 –UN–17JUL89

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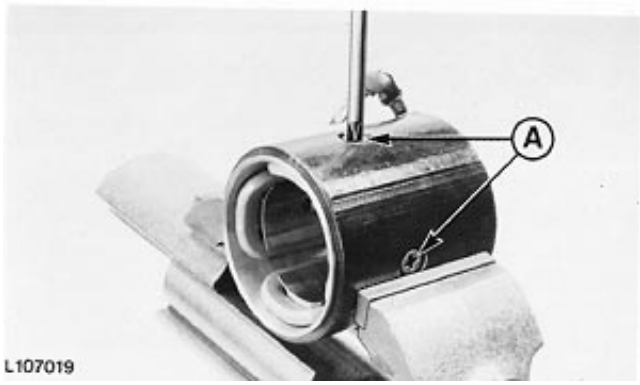
11

RG,RG34710,2355 –19–15MAR97–1/1

## FIELD WINDING—REMOVAL

Mark position of pole shoes and winding ends and unscrew pole shoe screws (A).




L107019 –UN–17JUL89

RG,RG34710,2356 –19–15MAR97–1/1

## MAKE OPEN CIRCUIT TEST FOR FIELD WINDINGS

60
10
12

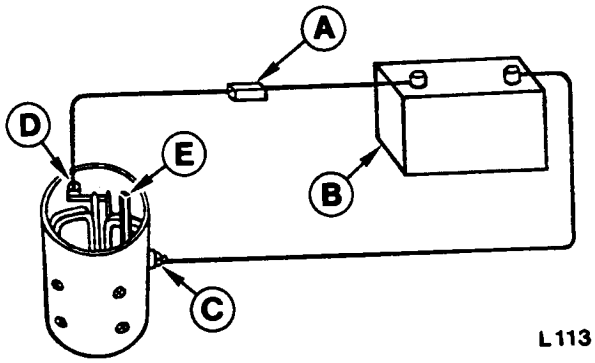
All four field windings are connected in parallel. Test each winding for an open circuit.

Connect a test battery (B) to field terminal (C) and either insulated brush lead (D), using a resistor (A) to limit current draw.

Use a hacksaw blade (E) to test winding for magnetism. If any winding is not magnetic, the winding is open circuited. Repair or replace windings.

*NOTE: Because 1/4-ohm resistors capable of carrying several hundred watts are not widely available, a suggested alternative is to connect four 1-ohm resistors in parallel. Each resistor should be rated for at least 150 watts. A carbon pile can also be used. Limit current to 40—70 amps.*

There is no suitable way to check field windings for short circuits. Winding resistance is too low to permit detection of a short circuit.




L113431 –UN–02FEB89

**A—1/4-ohm Resistor**
**B—12-Volt Battery**
**C—Field Terminal**
**D—Insulated Brush Lead**
**E—Hacksaw Blade**

RG,RG34710,2357 –19–15MAR97–1/1

## LUBRICATION OF STARTING MOTOR (BEFORE AND DURING ASSEMBLY)

| Lubrication Point | Lubrication Instructions |
|---|---|
| Bushings | Soak new bushings for at least 1/2 hour before installation. |
| Armature shaft | Coat drive and commutator end journals of shaft, splines and bearing surfaces of clutch drive with a light film of grease. |
| Shift Lever | Lubricate bearing surfaces and pivot bolts liberally with grease. |
| Solenoid switch | Coat inside of yoke and bolt threads with a light film of grease. |

*NOTE: Keep contacts free from grease.*

RG,RG34710,2358 –19–15MAR97–1/1

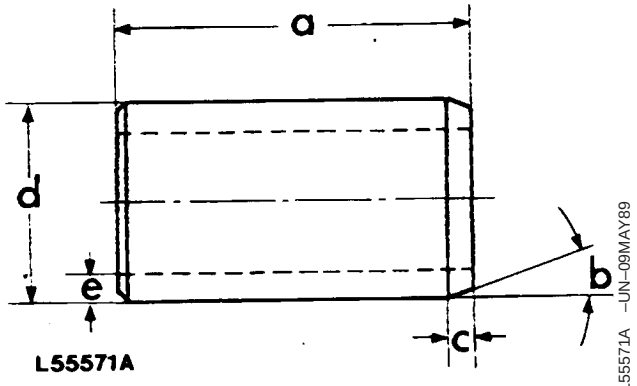
## FIELD WINDING—INSTALLATION

Slightly warm windings and insert together with pole shoes into field frame. Insert pole shoe screws.

Press suitable mandrel (see illustration) between pole shoes.

Firmly tighten pole shoe screws and press out mandrel.

Check installed windings for shorted or open circuits.




**A—85 mm (3.35 in.)**
**B—5° Chamfer**
**C—12—14 mm (0.47—0.55 in.)**
**D—75.80—75.85 mm (2.984—2.986 in.)**
**E—Wall Thickness 12—15 mm (0.47—0.59 in.)**

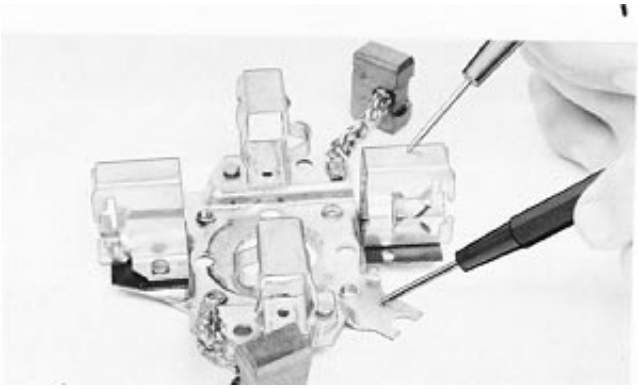
RG,RG34710,2359 –19–15MAR97–1/1

## CHECKING CARBON BRUSH PLATE FOR GROUNDS

Set ohmmeter on its highest scale.

Place one test lead on commutator end frame. Place other lead on brush holder.

If needle swings toward zero, the positive brush holder is grounded and should be replaced.




RG,RG34710,2360 –19–15MAR97–1/1

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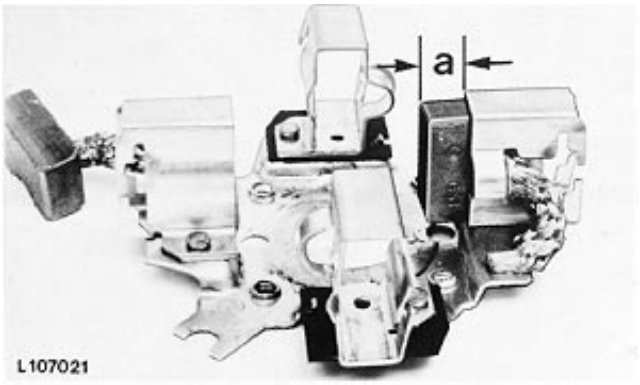
10
14

## TESTING CARBON BRUSHES

The carbon brushes must move freely in their guides.




L107021 –UN–17JUL89

**a—Minimum Length 7.5 mm (0.30 in.)**

RG,RG34710,2361 –19–15MAR97–1/1

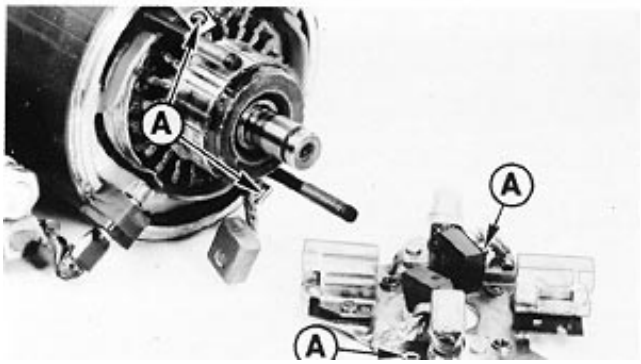
## REPLACE CARBON BRUSHES

Cut off old brushes at end of brush strands.

Secure new brushes in bores (A).

Check for easy movement of carbon brushes in brush holders.

*NOTE: Screws and hex nuts are included in the repair kit.*



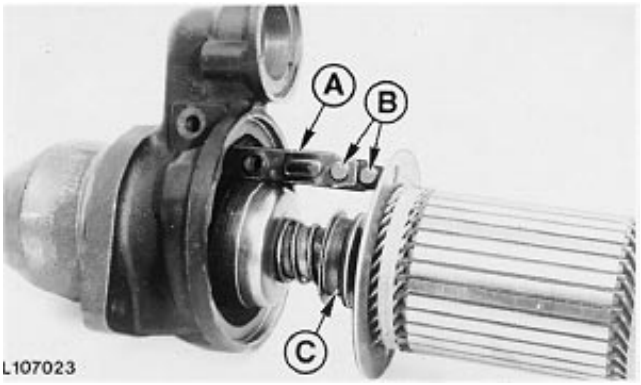

L117234 –UN–17JUL89

RG,RG34710,2362 –19–15MAR97–1/1

## ENGAGING LEVER—INSTALLATION

Driving hub pins (B) of engaging lever (A) must engage in guide (C) of drive pinion.

Screw in studs and slide field frame over armature.

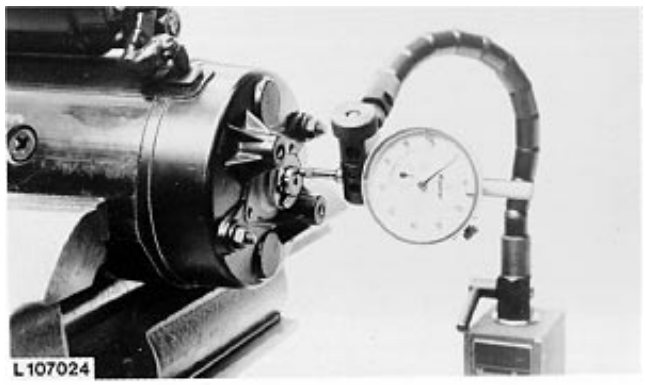



L107023 –UN–17JUL89

RG,RG34710,2363 –19–15MAR97–1/1

## TESTING ARMATURE END PLAY

Check end play of armature using a dial indicator. End play should be 0.1—0.3 mm (0.004—0.012 in.)




L107024 –UN–17JUL89

RG,RG34710,2364 –19–15MAR97–1/1

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10
15

## INSTALLING STARTING MOTOR

Refer to machine technical manual for installing starting motor and adjusting belt tension.

RG,RG34710,2365 –19–15MAR97–1/1

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# CHAPTER 16

# SECTION 17

# FRAME OR SUPPORTING STRUCTURE REPAIR

**BLANK**

# Group 1740
# Frame Installation

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Weld Metal | Tensile Strength<br>Yield Strength<br>Elongation | 482.6 mPa (70,000 psi)<br>413.7 mPa (60,000 psi)<br>22% |
| Structural Assembly | Preheat Temperature | 38°C (100°F) |
| Ground Engaging Tool | Preheat Temperature | 177°C (350°F) |

CED,OUOE003,1022 –19–22JUL98–1/1

## WELDING ON MACHINE

**IMPORTANT: Electrical current traveling from the welder through the machine electrical system may damage the machine electrical system, including battery, EPC controller. Disconnect battery ground cable and EPC electrical connectors before welding on the machine.**

Before welding on the machine, follow the steps listed below to protect the machine electrical system.

**Continued on next page**

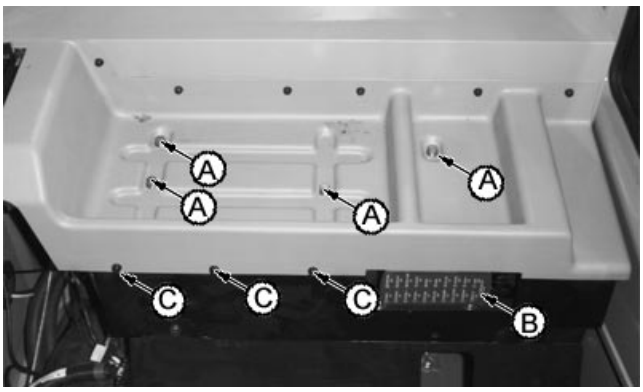
TX,16,UU3320 –19–07JUL98–1/3

17
1740
1

*Frame Installation*

1. Inside the cab, remove four cap screws (A and C) and the fuse box cover (B) to remove the rear console cover.

2. Disconnect the battery ground and positive cables.



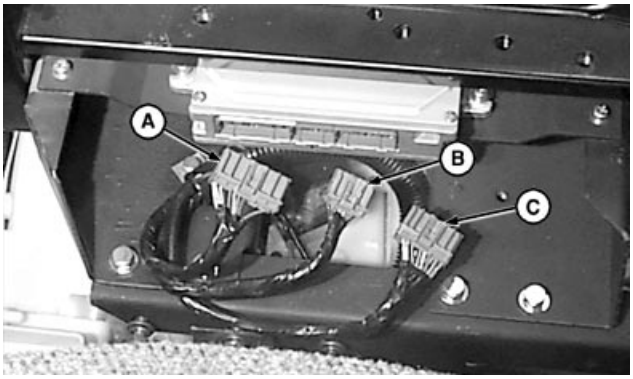

T107932B –UN–07MAR97

**A—Cap Screw (4 used)**
**B—Fuse Box Cover**
**C—Cap Screw (3 used)**

TX,16,UU3320 –19–07JUL98–2/3

3. Disconnect the engine and pump controller electrical connectors.

   After reconnecting batteries, engine speeds must be recalibrated.




T115226 –UN–17JUN98

**A—EPC Connector**
**B—EPC Connector**
**C—EPC Connector**

TX,16,UU3320 –19–07JUL98–3/3

17
1740
2

## WELDING REPAIR OF MAJOR STRUCTURE

**CAUTION: 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.**

**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.**

1. Remove paint before welding or heating.

**IMPORTANT: Disconnect battery ground strap or turn battery disconnect switch to "OFF". Also disconnect the wiring harness connectors to the engine and pump controller.**

**Have only a qualified welder do this job. Connect welder ground clamp close to each weld area so electrical current does not pass through any bearings. Remove or protect all parts that can be damaged by heat or weld splatter.**

2. Use one of the following weld processes:

   - AWS-E-7018 covered electrode with shielded metal arc welding (SMAW) process.
   - AWS-ER-70S-3 wire electrode with gas metal arc welding (GMAW) process.
   - AWS-E70T-1 or E71T-1 wire electrode with flux core arc welding (FCAW) process.

**Weld Metal—Specification**

| | |
|---|---|
| Tensile Strength | 482.6 mPa (70,000 psi) |
| Yield Strength | 413.7 mPa (60,000 psi) |
| Elongation | 22% |

**IMPORTANT: Area to be repaired must be preheated to allow better weld penetration.**

3. To repair weld metal failure, remove failed weld metal using arc or grinding equipment. Thoroughly clean area to be welded. Preheat structural assemblies to a minimum of 38°C (100°F). Preheat ground engaging tools (cutting edges, skid shoes, and teeth shanks) to 177°C (350°F).

   To repair base metal failure remove enough material to allow weld to penetrate to the bottom of crack. Preheat structural assemblies to a minimum of 38°C (100°F). Preheat ground engaging tools (cutting edges, skid shoes, and teeth shanks) to 177°C (350°F).

**Structural Assembly—Specification**

| | |
|---|---|
| Preheat Temperature | 38°C (100°F) |

**Ground Engaging Tool—Specification**

| | |
|---|---|
| Preheat Temperature | 177°C (350°F) |

17
1740
3

TX,17,SB603 –19–07MAR97–1/1

# Group 1749
# Chassis Weights

## 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.*

CED,OUOE003,1023 –19–22JUL98–1/3

M42-4.5 Metric Lifting Eyebolt (2 used) . . . . . .JT05558

To remove and install counterweight.

CED,OUOE003,1023 –19–22JUL98–2/3

Spreader Bar

To remove and install counterweight.

CED,OUOE003,1023 –19–22JUL98–3/3

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Counterweight: | | |
| Counterweight | Weight | 6800 kg (14,991 lb) approximate |
| Frame-to-Counterweight Cap Screw | Torque | 2403 N•m (1772 lb-ft) |

17
1749
1

CED,OUOE042,5065 –19–15APR99–1/1

## REMOVE AND INSTALL COUNTERWEIGHT

1. Park machine on level ground.
2. Remove two plastic caps from top of counterweight (D).

**CAUTION: The approximate weight of 330LCR counterweight is 6800 kg (14,991 lb).**

**Counterweight—Specification**

Weight..... 6800 kg (14,991 lb) approximate

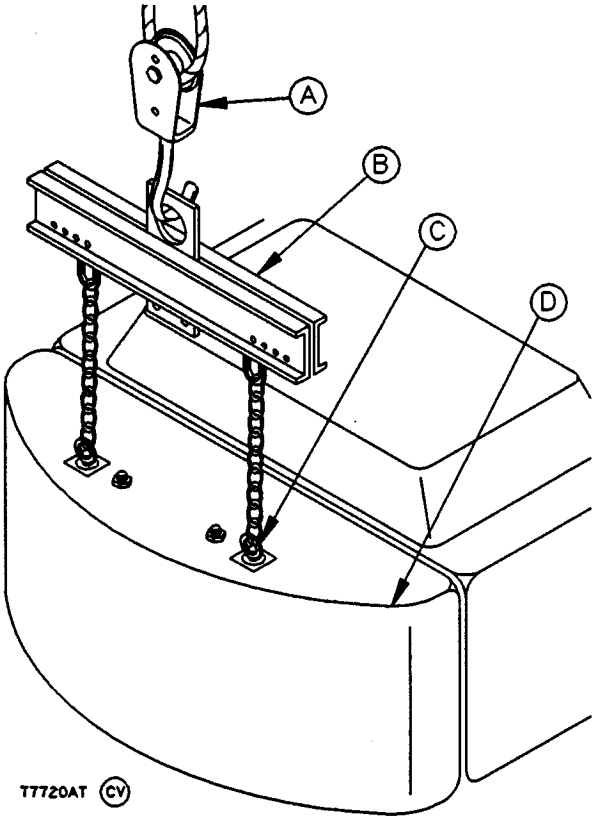
The lifting capacity of a lifting eyebolt decreases as the lift angle increases from vertical. A spreader bar should be used to obtain, as close as possible, a vertical lift from eyebolts.

3. Connect counterweight to a hoist (A) using a spreader bar (B) and M42-4.5 metric lifting eyebolts (C) such as JT05558 Metric Lifting Eyebolt.
4. Remove cap screws and washers (E).
5. Remove counterweight.
6. Install cap screws and washers. Tighten cap screws as indicated.

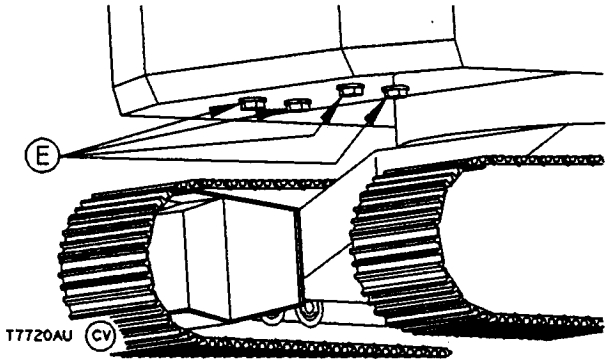
**Frame-to-Counterweight Cap Screw—Specification**

Torque ..... 2403 N•m (1772 lb-ft)

7. Remove hoist, spreader bar, and eyebolts.
8. Install plastic caps.




T7720AT –UN–01MAY92




T7720AU –UN–01MAY92

**A—Hoist**
**B—Spreader Bar**
**C—M42-4.5 Metric Lifting Eyebolt (2 used)**
**D—Counterweight**
**E—Cap Screw and Washer (4 used)**

CED,OUOE042,5064 –19–15APR99–1/1

17
1749
2

**BLANK**

# CHAPTER 17

# SECTION 18

# OPERATOR'S STATION REPAIR

**BLANK**

# Group 1800
# Removal and Installation

## SPECIFICATIONS

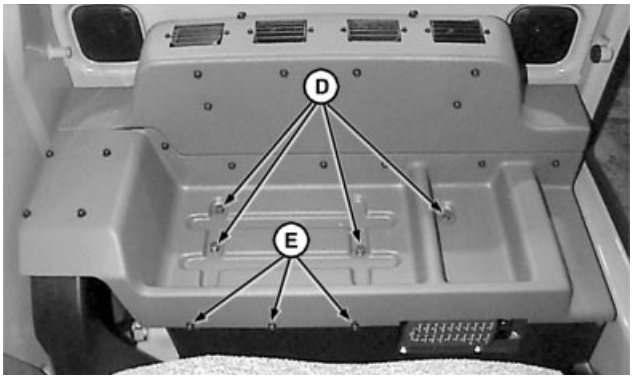
| Item | Measurement | Specification |
|---|---|---|
| Cab | Weight | 250 kg (550 lb) approximate |
| Rubber Mount-to-Frame Cap Screw | Torque | 108 N•m (80 lb-ft) |
| Cab-to-Platform Cap Screw | Torque | 64 N•m (47 lb-ft) |
| Cab and Platform-to-Rubber Mount Lock Nut | Torque | 205 N•m (152 lb-ft) |

CED,OUOE003,1161 –19–07JUL98–1/1

## REMOVE AND INSTALL CAB

*NOTE: It is not necessary to remove the seat to remove the cab.*

1. Remove four cap screws (D) and loosen three screws (E) to remove rear console cover behind seat.
2. Disconnect battery ground cable.
3. Remove cab floor mat.




**D—Cap Screw (4 used)**
**E—Cap Screw (3 used)**

**Continued on next page**

CED,OUOE027,244 –19–18MAY98–1/6

18
1800
1

4. Remove screws (A) to remove cover (B).

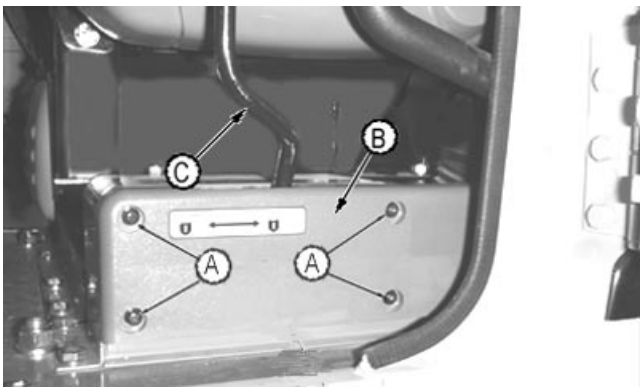
5. Remove spring pin (D) to remove pilot shut-off lever (C).

**IMPORTANT: To avoid possible damage to switch panel during assembly, be sure to mark all corresponding bullet connector wiring leads before disassembly. Connecting bullet connectors to the wrong wiring leads will damage components in the switch panel.**

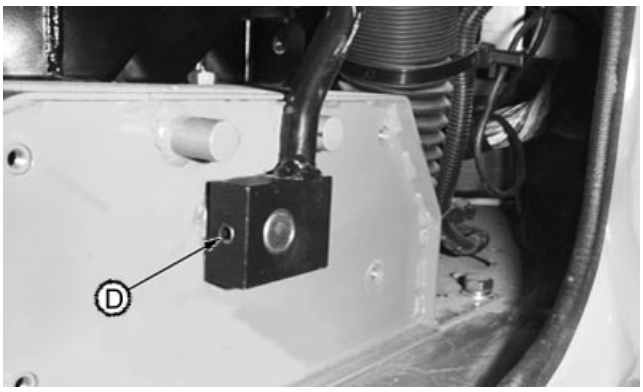
6. Disconnect all main wire harness connectors, radio speaker wires and radio antenna (if equipped), windshield wiper motor, dome light and bullet connectors as required.

7. Loosen and remove fresh air intake cowl cap screws and remove cowl from inside rear wall of cab.

8. Disconnect windshield washer fluid tube from windshield washer pump located in compartment behind cab.




T105963B –UN–13JAN97



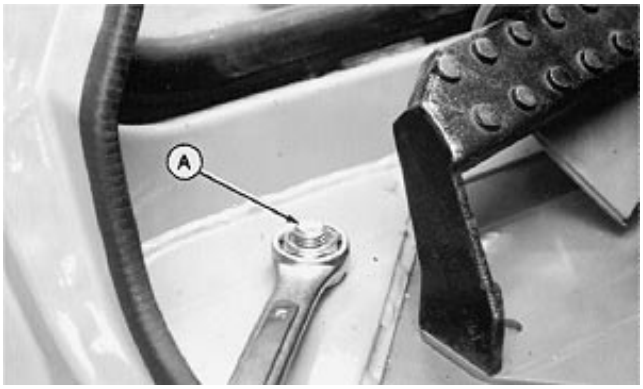

T105992B –UN–13JAN97

**A—Screw (4 used)**
**B—Cover**
**C—Pilot Shut-Off Lever**
**D—Spring Pin**

CED,OUOE027,244 –19–18MAY98–2/6

9. Remove lock nuts (A) and washers located at four inside corners of cab.

10. Remove two cab-to-platform cap screws and washers from each of four sides of cab.




T6585OE –UN–17OCT88

**A—Lock Nut**

Continued on next page

CED,OUOE027,244 –19–18MAY98–3/6

*Removal and Installation*

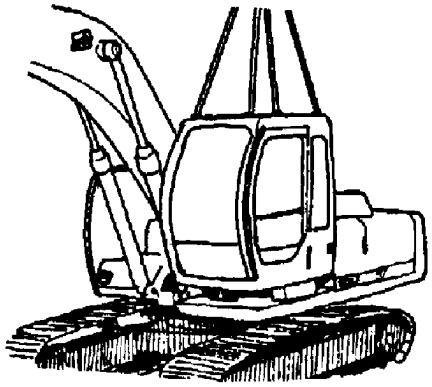
**CAUTION: The approximate weight of cab is 250 kg (550 lb).**

**Cab—Specification**

Weight..... 250 kg (550 lb) approximate

11. Connect cab to hoist, using lifting straps.
12. Slowly lift cab from platform.

    Move cab slightly forward as cab is being raised so front of cab can clear front of propel pedals.



T106453

T106453 –UN–15JAN97

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CED,OUOE027,244 –19–18MAY98–4/6

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1800
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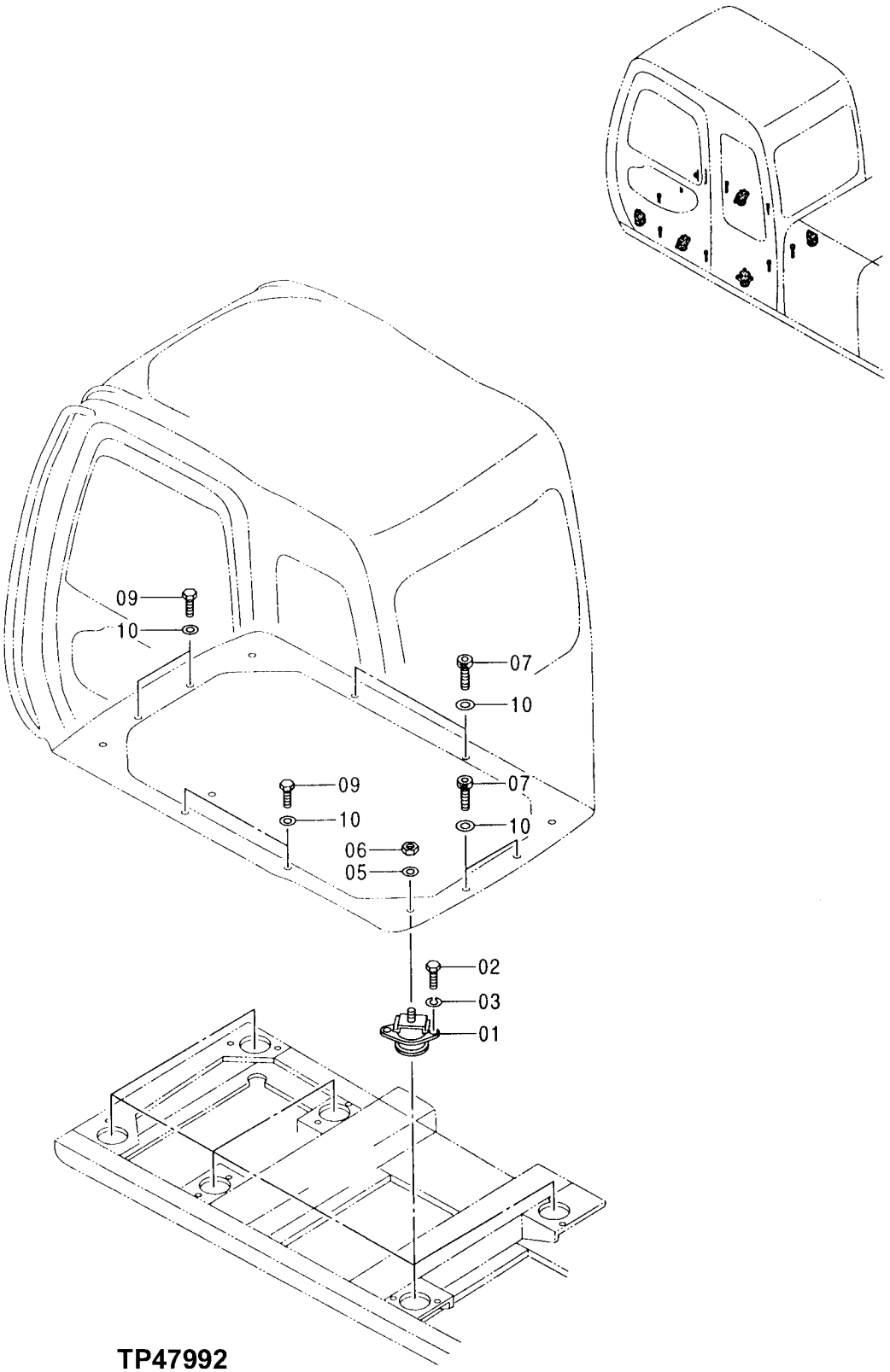


**1—Rubber Mount (6 used)**
**2—Cap Screw (12 used)**
**3—Lock Washer (12 used)**
**5—Washer (6 used)**
**6—Lock Nut**
**7—Cap Screw (4 used)**
**9—Cap Screw (4 used)**
**10—Washer (8 used)**

**Continued on next page**

CED,OUOE027,244 –19–18MAY98–5/6

18
1800
4

13. Repair or replace parts as necessary.

    Lift each corner of platform to remove and install rubber mounts (1).

    Tighten cap screw (2).

    **Rubber Mount-to-Frame Cap Screw—Specification**

    Torque..... 108 N•m (80 lb-ft)

14. Before installing cab, check that all lines and wiring harnesses are out of the way so they are not pinched when cab is installed.

15. Install cap screw (9) with hex head at front and left side. Install cap screw (7) with socket head at rear and right side.

    Tighten cap screws.

    **Cab-to-Platform Cap Screw—Specification**

    Torque..... 64 N•m (47 lb-ft)

    Tighten lock nuts (6).

    **Cab and Platform-to-Rubber Mount Lock Nut—Specification**

    Torque..... 205 N•m (152 lb-ft)

CED,OUOE027,244 –19–18MAY98–6/6

18
1800
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## OTHER MATERIAL

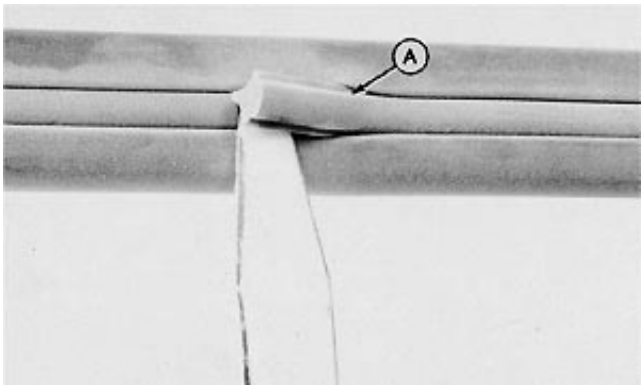
| Number | Name | Use |
|---|---|---|
| TY21517 (U.S.)<br>454 (LOCTITE®) | Instant Gel Adhesive | Apply to frame channel of molding and cab flange. |

*LOCTITE is a trademark of Loctite Corp.*

CED,OUOE003,1162 –19–07JUL98–1/1

## REMOVE AND INSTALL WINDOWPANE AND TWO PIECE MOLDING

1. Remove locking strip (A) from molding using insert tool.




T5903AI –UN–19OCT88

**A—Locking Strip**

TX,1800,VV2501 –19–10JAN97–1/4

**IMPORTANT: Use extreme care to avoid damaging the windowpane.**

2. Carefully push out windowpane from molding.

3. Inspect molding for damage. Replace if necessary.

T5903AJ –UN–19OCT88

**Continued on next page**

TX,1800,VV2501 –19–10JAN97–2/4

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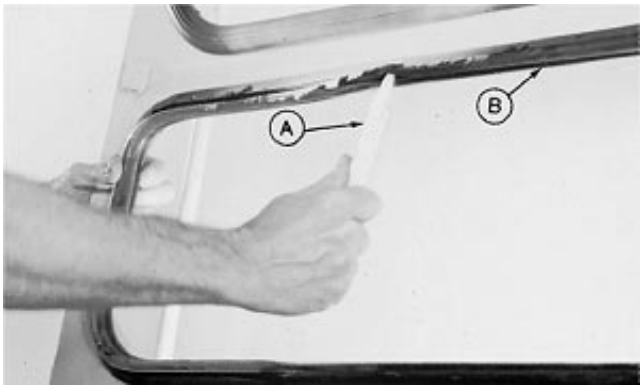
*Operator Enclosure*

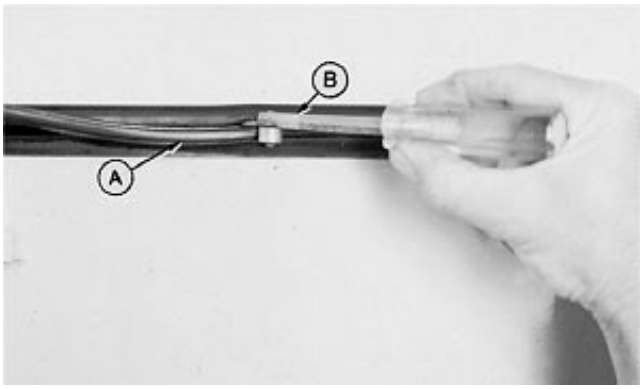
4. Put instant gel adhesive in frame channel of molding (B). Install molding.
5. Install windowpane using insert tool (A) and a soap lubricant.




**A—Windowpane Insert Tool**
**B—Molding**

TX,1800,VV2501 –19–10JAN97–3/4

6. Install locking strip (A) using weather-strip installing tool (B).




**A—Locking Strip**
**B—Weather-Strip Installing Tool**

TX,1800,VV2501 –19–10JAN97–4/4

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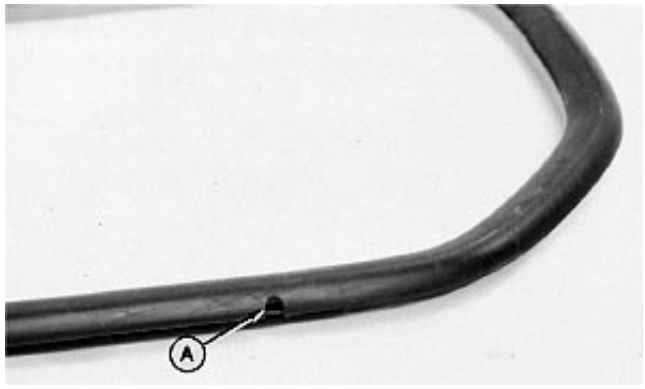
## REMOVE AND INSTALL WINDOWPANE AND ONE PIECE MOLDING

1. Lift inside of molding over cab frame and carefully push windowpane and molding out.
2. Remove molding from windowpane. Replace if necessary.

T6439XE –UN–19OCT88

TX,18,VV2502 –19–10JAN97–1/2

3. Install molding on windowpane. Put drain notches (A) at bottom and toward outside of windowpane.
4. Install windowpane and molding. Lift inside of molding over cab frame.




T6439XD –UN–19OCT88

**A—Drain Notch**

TX,18,VV2502 –19–10JAN97–2/2

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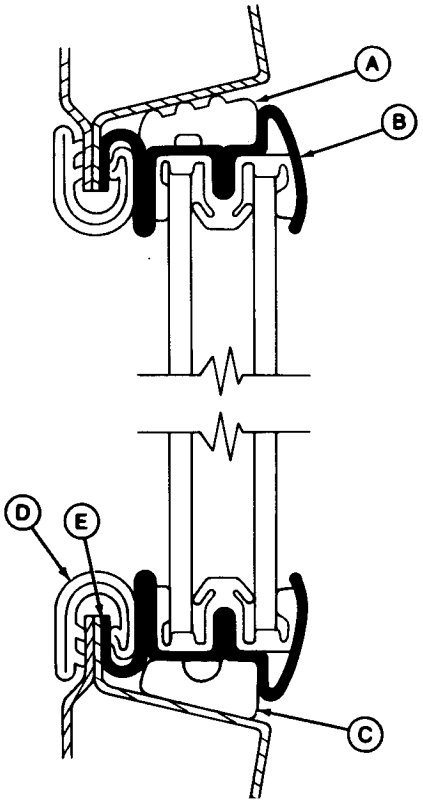
## REMOVE AND INSTALL SLIDING WINDOWS

1. Pull molding (D) from inside of window.
2. Cut adhesive (E) between cab flange and window frame (B) using a putty knife.

**IMPORTANT: Use extreme care to avoid damaging frame and windowpane. Remove window using two people; one to push window out, the other to keep window from falling.**

3. Carefully push window frame from cab.
4. Lift frame slightly at top-center to remove and install windowpanes.
5. Apply instant gel adhesive to cab flange.
6. Install windows and frame with spacers (C) at the bottom and two on each end of frame.
7. Install three spacers (A) at top of frame.
8. Using water as a lubricant, push window frame tight against cab flange.
9. Install molding (D) around window and cab flange.

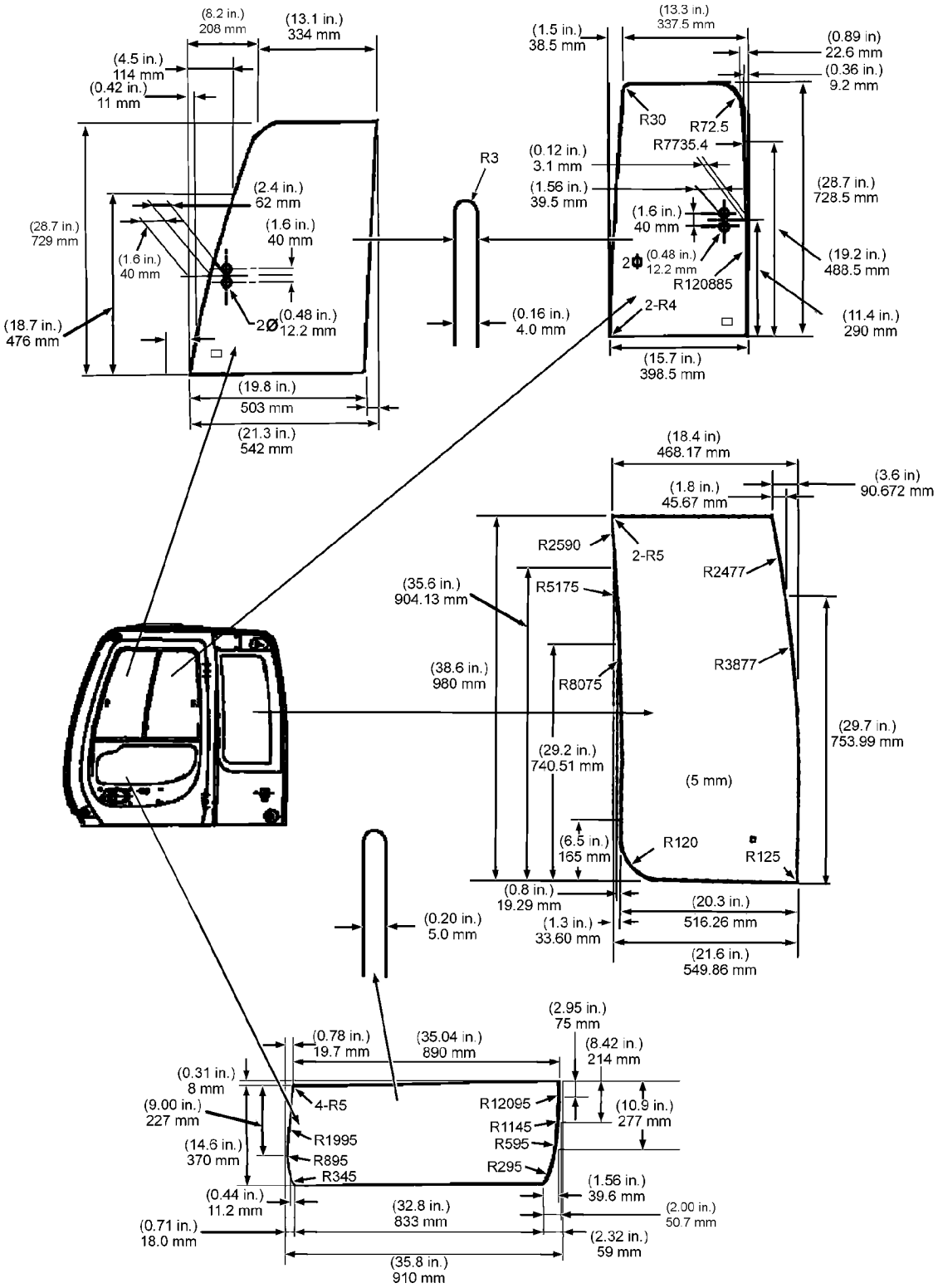



T6439TD –UN–05DEC89

**A—Top Spacer (3 used)**
**B—Window Frame**
**C—Bottom and Side Spacer**
**D—Molding**
**E—Adhesive**

TX,18,VV2503 –19–10JAN97–1/1

## WINDOWPANE DIMENSIONS




T115276

T115276 –UN–01JUL98

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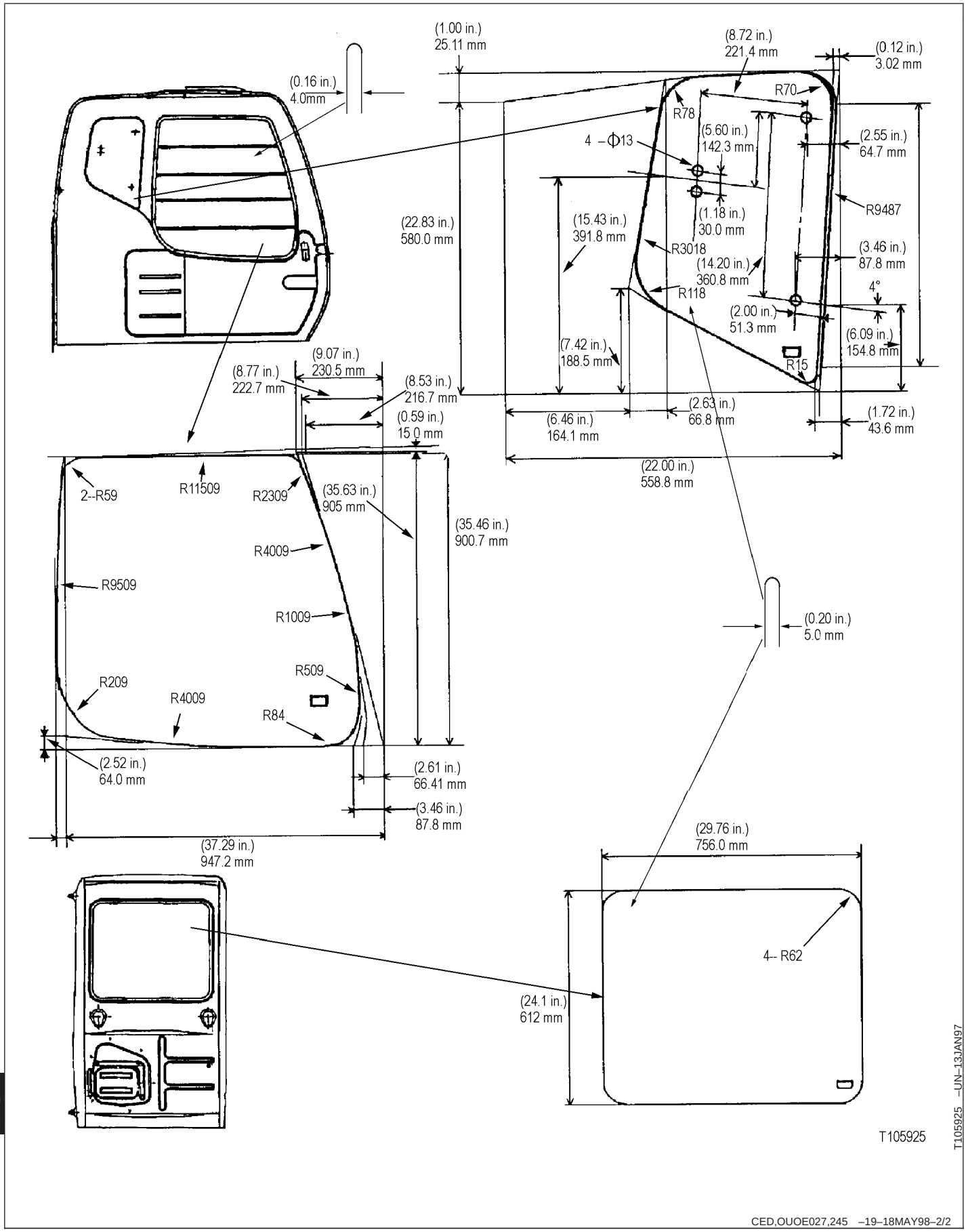
CED,OUOE027,245 –19–18MAY98–1/2

*Operator Enclosure*




CED,OUOE027,245 –19–18MAY98–2/2

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# Group 1821
# Seat and Seat Belt

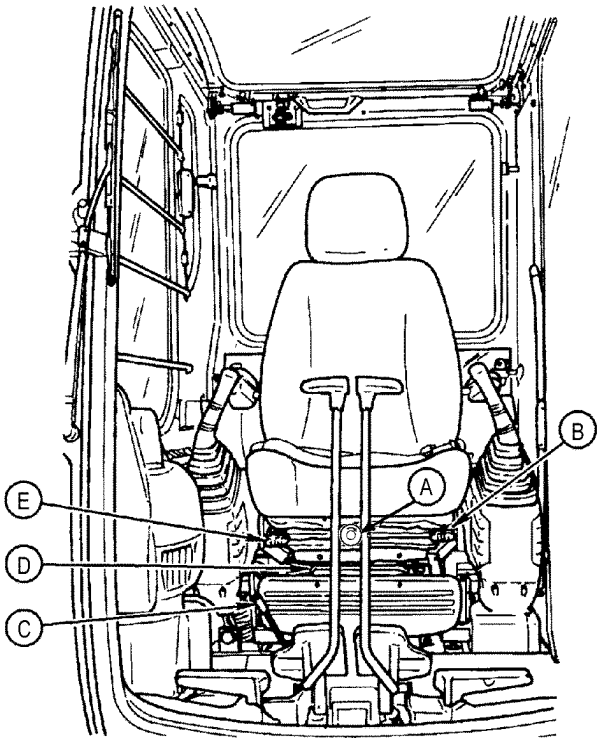
## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Seat and Carrier | Weight | 35 kg (75 lb) approximate |

CED,OUOE003,316 –19–11APR98–1/1

## CHECK SEAT ADJUSTMENTS

1. Turn weight adjustment knob (A) to adjust seat to weight of operator. Weight is displayed on knob.
2. Push seat height and angle adjustment lever (B) down while sitting on seat or while standing and pulling up on seat to obtain desired height. Release lever. Push down lever while sitting on seat to adjust seat to desired angle. Release lever.
3. Push console and seat fore-aft adjustment lever (C) down to adjust seat and both right and left consoles to desired distance from propel pedals and levers. Release lever to lock seat and consoles into position.
4. Pull seat fore-aft adjustment lever (D) up to unlock seat from both consoles. Slide seat to desired distance from control levers. Release lever.
5. Pull backrest adjustment lever (E) up to release backrest lock. Move backrest to desired position. Release lever.




T102204 –UN–26JUL96

**A—Weight Adjustment Knob**
**B—Seat Height and Angle Adjustment Lever**
**C—Console and Seat Fore-Aft Adjustment Lever**
**D—Seat Fore-Aft Adjustment Lever**
**E—Backrest Adjustment Lever**

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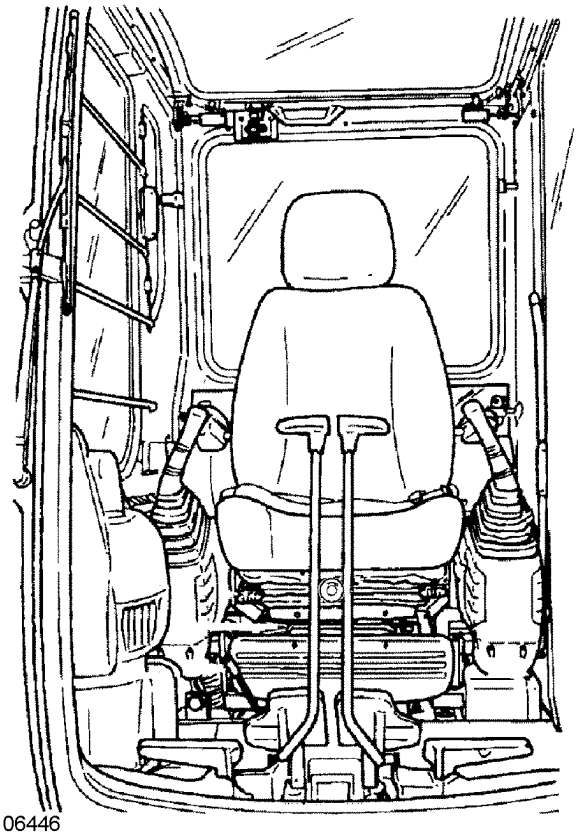
TX,18,GG2448 –19–14JAN97–1/1

## REMOVE AND INSTALL SEAT

1. Pull seat and consoles as far forward as possible.



T106446

T106446 –UN–15JAN97

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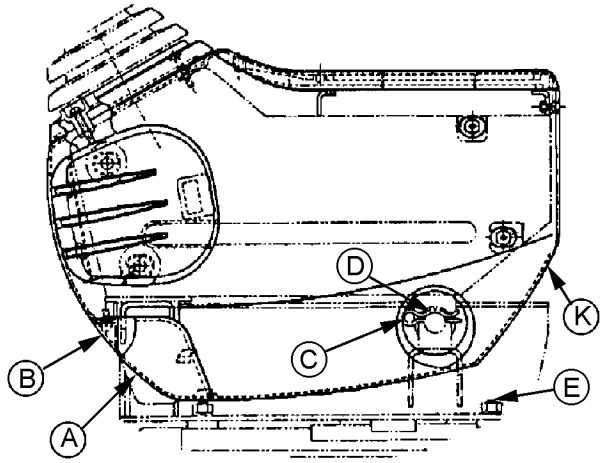
TX,18,GG2446 –19–14JAN97–1/6

2. Remove screws (B) to remove cover (A).
3. Remove cap screws (L).
4. Tip console up.
5. Remove a quick lock pin (C) to remove pin (D).

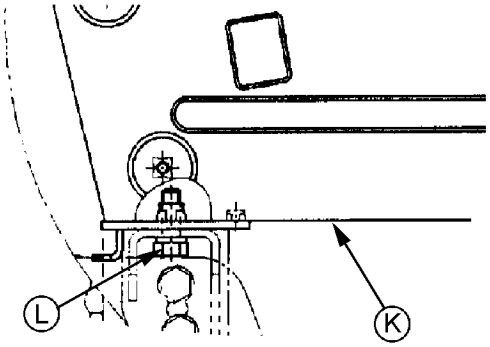
   Lay console on cover behind seat.
6. Remove nuts and washers (E).




T106445 –UN–15JAN97

T106445

*Left Console Shown*




T105912 –UN–02JAN97

T105912

**A—Cover**
**B—Screw (2 used)**
**C—Quick Lock Pin**
**D—Pin**
**E—Nut and Washer (4 used)**
**K—Console**
**L—Cap Screw and Washer**

**Continued on next page**

TX,18,GG2446 –19–14JAN97–2/6

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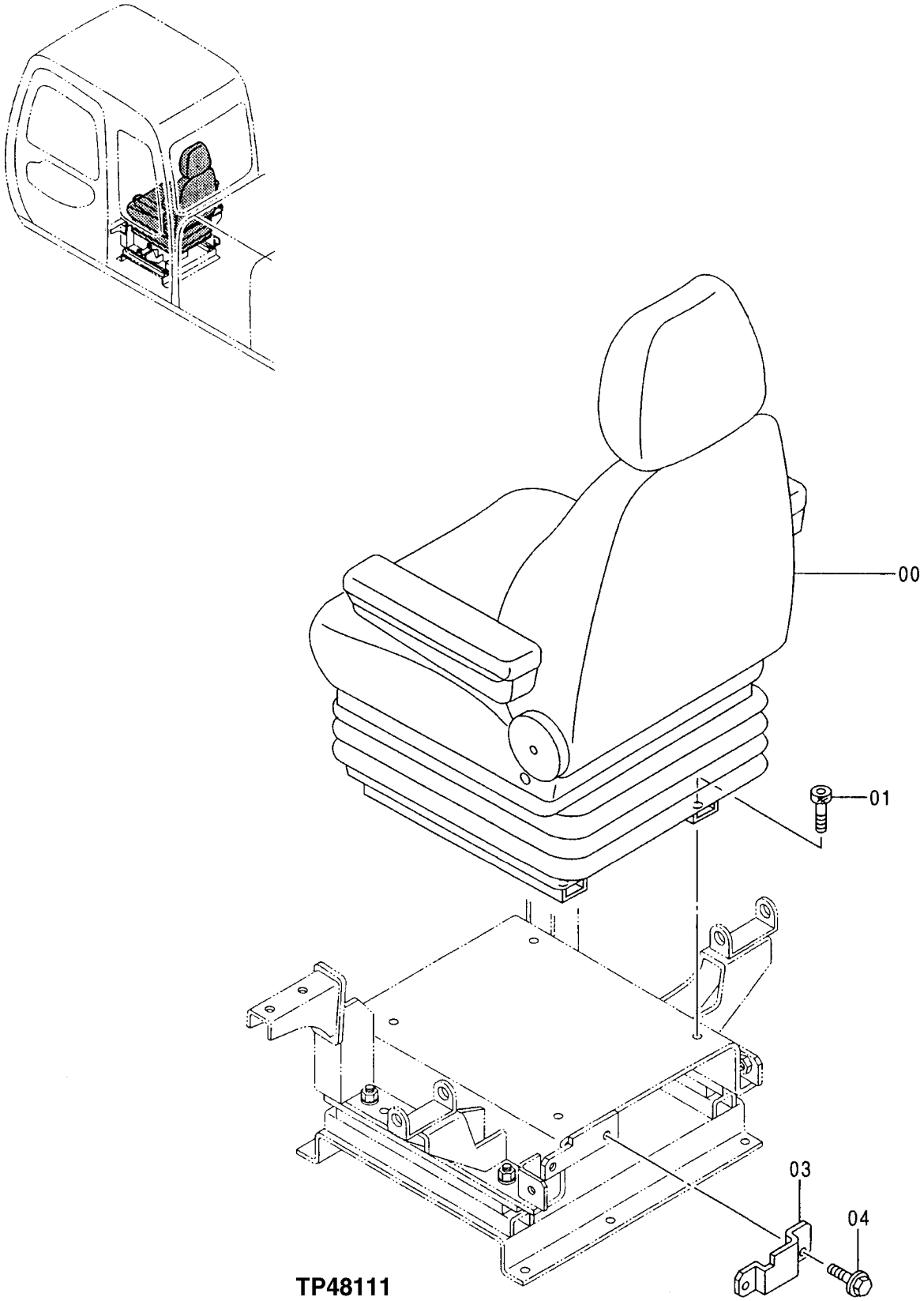
*Seat and Seat Belt*




TP48111 –UN–05AUG96

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TX,18,GG2446 –19–14JAN97–3/6

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4

*Seat and Seat Belt*

**0—Seat**
**1—Cap Screw (4 used)**
**3—Bracket**
**4—Cap Screw, Lock Washer and Washer (2 used)**

**CAUTION: The approximate weight of seat and carrier is 35 kg (75 lb).**

**Seat and Carrier—Specification**

Weight..... 35 kg (75 lb) approximate

7. Remove seat (0) and carrier.

**Continued on next page**

TX,18,GG2446 –19–14JAN97–4/6

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1821
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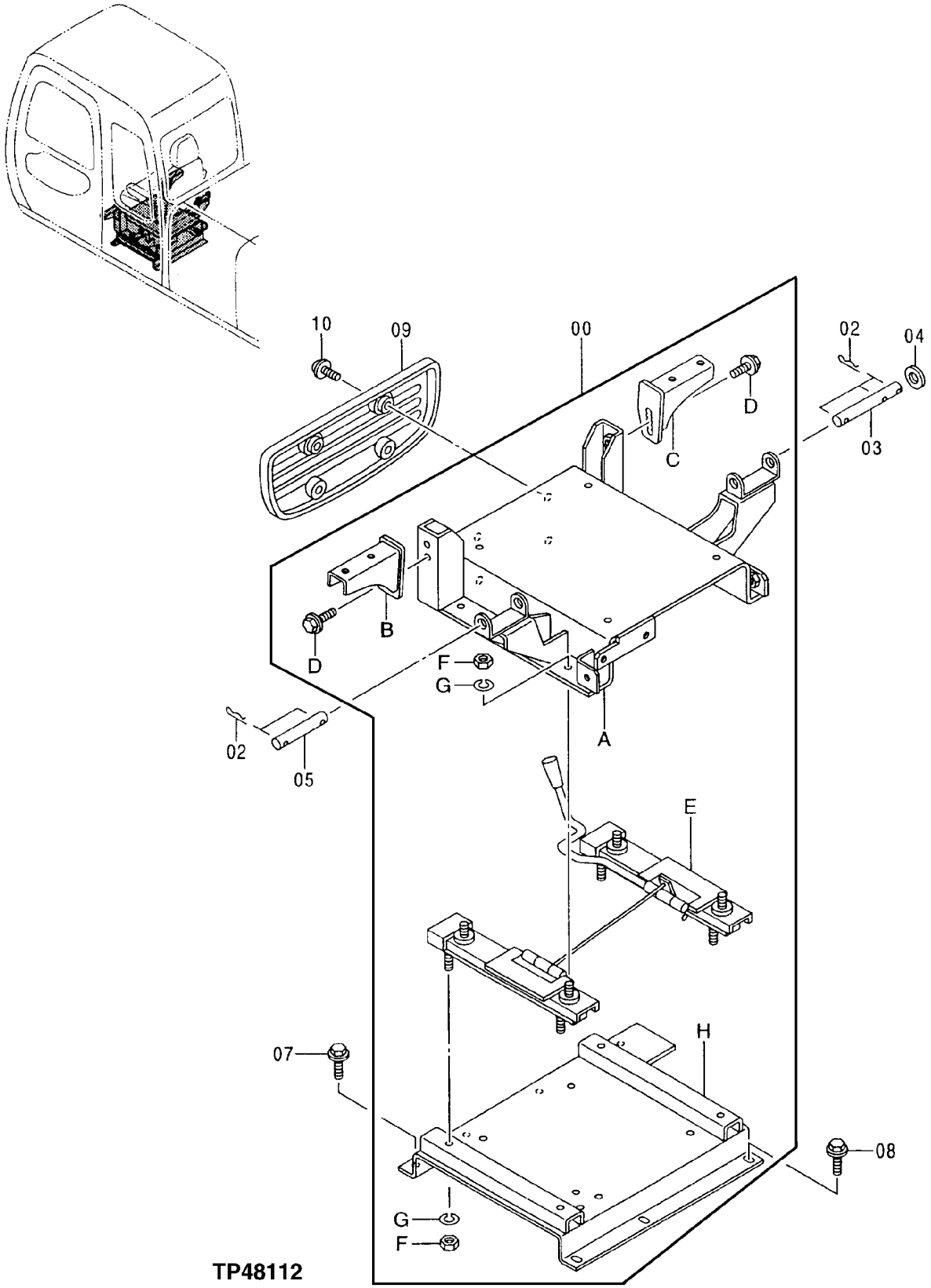
*Seat and Seat Belt*

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TX,18,GG2446 –19–14JAN97–5/6

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6

*Seat and Seat Belt*

**0—Seat Stand**
**0A—Carrier**
**0B—Bracket**
**0C—Bracket**
**0D—Cap Screw, Lock Washer and Washer (4 used)**
**0E—Seat Slide**
**0F—Nut (8 used)**
**0G—Lock Washer (8 used)**
**0H—Seat Base**
**2—Quick Lock Pin (4 used)**
**3—Pin**
**4—Washer**
**5—Pin**
**7—Cap Screw, Lock Washer and Washer (4 used)**
**8—Cap Screw, Lock Washer and Washer (3 used)**
**9—Cover**
**10—Screw, Lock Washer and Washer (4 used)**

8. Remove seat base (0H) if replacement of seat slides (0E) is necessary.
9. Repair or replace parts as needed.

TX,18,GG2446 –19–14JAN97–6/6

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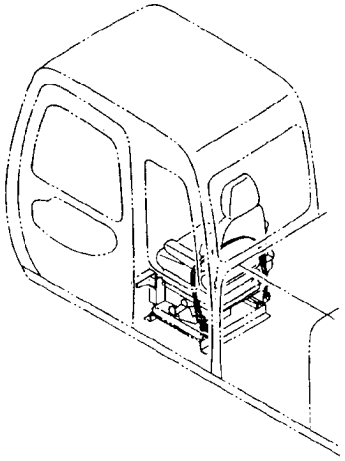
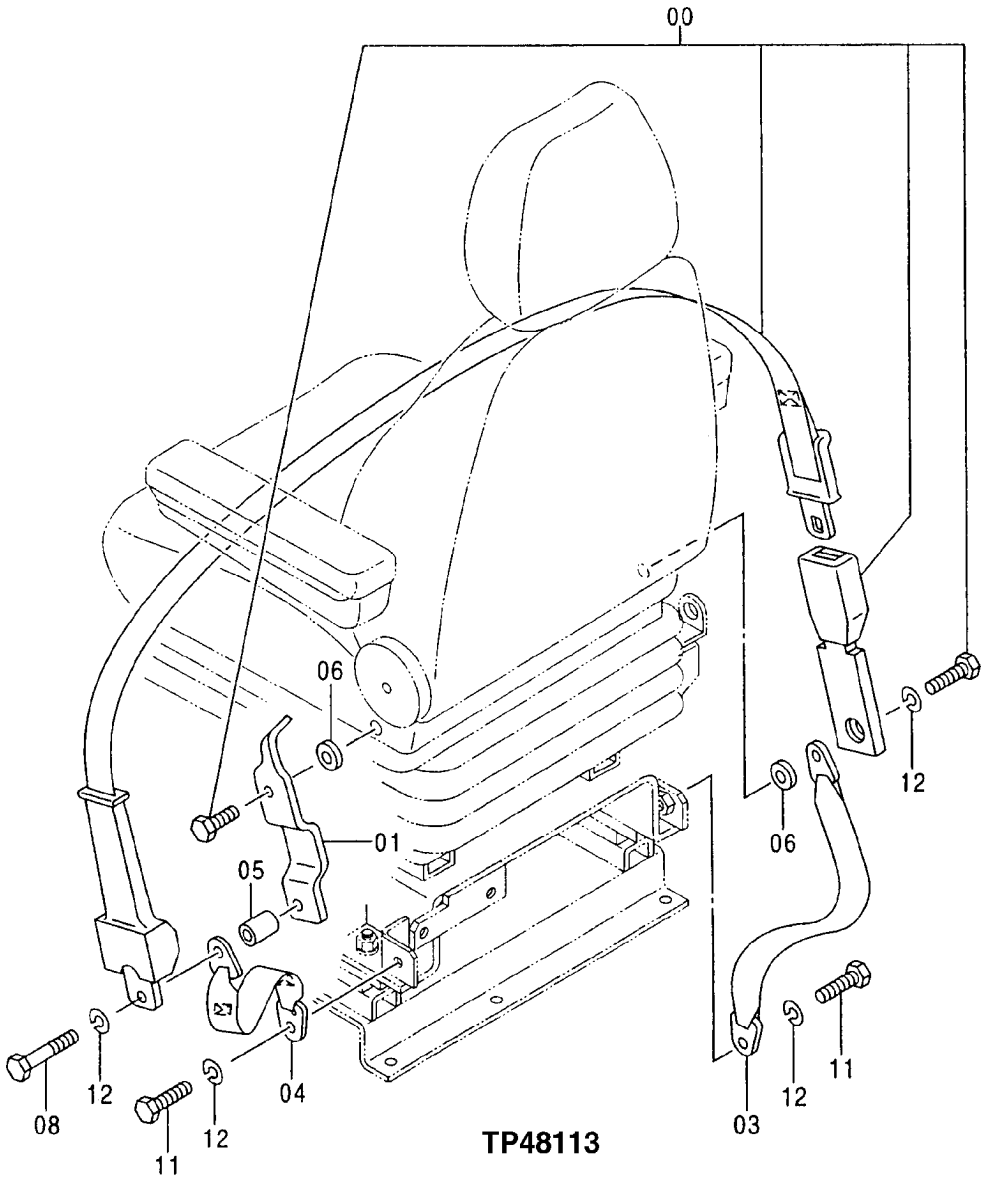
## REMOVE AND INSTALL SEAT BELT






TP48113

TP48113 –UN–05AUG96

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TX,18,GG2447 –19–14JAN97–1/2

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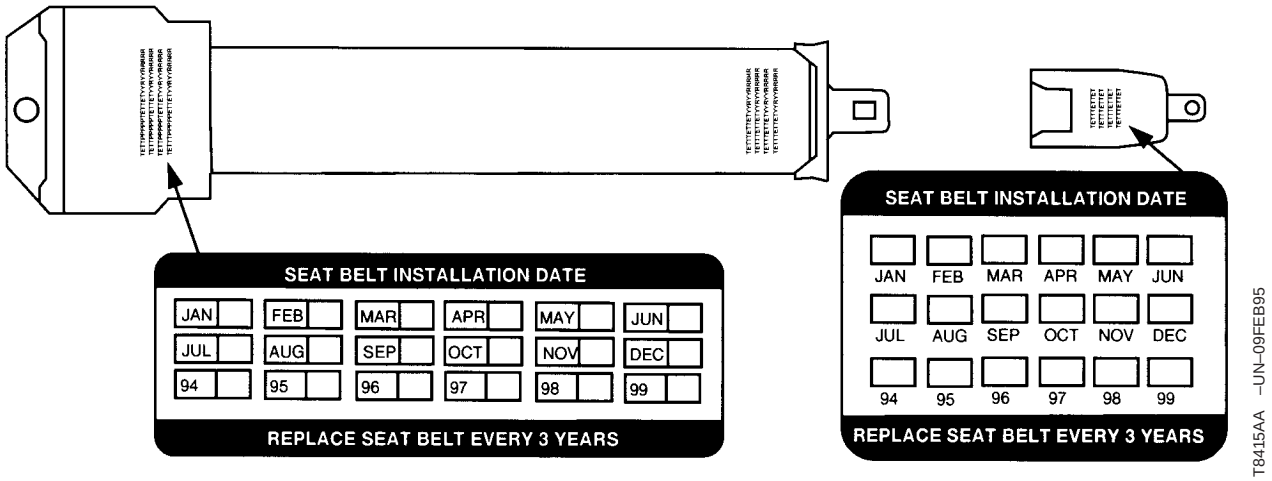
8

*Seat and Seat Belt*

**0—Seat Belt**
**1—Bracket**
**3—Belt**
**4—Belt**
**5—Spacer (Sleeve)**
**6—Spacer (Sleeve) (2 used)**
**8—Cap Screw**
**11—Cap Screw (2 used)**
**12—Spring Washer (4 used)**

TX,18,GG2447 –19–14JAN97–2/2

## INSPECT SEAT BELT




Seat belt and mounting hardware must be inspected for wear or damage before operating the machine. Replace the belt or mounting hardware if worn or damaged.

Replace complete seat belt assembly every three years regardless of appearance. A date label, to determine the age of the belt, is attached to each belt.

TX,18,GG2449 –19–14JAN97–1/1

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1821
9

# Group 1830
# Heating and Air Conditioning

## 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.*

CED,OUOE003,1165 –19–07JUL98–1/4

R134a Refrigerant Recovery/Recycling and Charging Station . . . . . JT02045[1]

Servicing air conditioning system using R134a refrigerant.

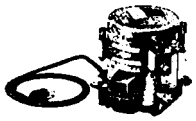
*[1]JT02046 and JT02050 Recovery and Charging Stations can be substituted for the JT02045 Station.*

CED,OUOE003,1165 –19–07JUL98–2/4

T7530AZ –UN–29MAY91

Vacuum Pump . . . . . D05267ST

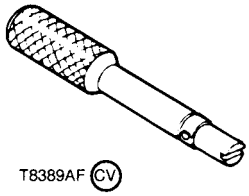
To evacuate air conditioning system.



CED,OUOE003,1165 –19–07JUL98–3/4

Schrader Valve Tool . . . . . .JT02130

To replace Schrader valve in compressor manifold on R134a A/C systems. To replace Schrader valve ports where high and low pressure switches are located in R134a A/C Systems.




T8389AF –UN–03JAN95

CED,OUOE003,1165 –19–07JUL98–4/4

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## SERVICE EQUIPMENT AND TOOLS

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

*SERVICEGARD is a trademark of Deere & Company.*

CED,OUOE003,1166 –19–07JUL98–1/17

Bench Mounted Holding Fixture . . . . . D01006AA

Hold compressor during repair.

CED,OUOE003,1166 –19–07JUL98–2/17

Clutch Hub Holding Tool

To hold clutch hub while removing retaining nut.

CED,OUOE003,1166 –19–07JUL98–3/17

Clutch Hub Remover

Used with forcing screw for removing clutch hub.

CED,OUOE003,1166 –19–07JUL98–4/17

Forcing Screw

Used with clutch hub remover for removing clutch hub.

CED,OUOE003,1166 –19–07JUL98–5/17

Puller Adapter

Used with three jaw puller to remove clutch pulley.

CED,OUOE003,1166 –19–07JUL98–6/17

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Three Jaw Puller

Used with puller adapter to remove clutch pulley.

**Continued on next page**

CED,OUOE003,1166 –19–07JUL98–7/17

*Heating and Air Conditioning*

Special Hex Drive

To remove compressor through-bolts.

CED,OUOE003,1166 –19–07JUL98–8/17

Valve Plate Remover

To remove valve plate from compressor head.

CED,OUOE003,1166 –19–07JUL98–9/17

Pulley Support

To support pulley when removing bearing.

CED,OUOE003,1166 –19–07JUL98–10/17

Bearing Adapter

To remove and install bearing in pulley.

CED,OUOE003,1166 –19–07JUL98–11/17

Puller Adapter

Used with bearing adapter to remove and install bearing.

CED,OUOE003,1166 –19–07JUL98–12/17

Shaft Seal Seat Remover

To remove shaft seal seat from compressor head.

CED,OUOE003,1166 –19–07JUL98–13/17

Shaft Seal Seat Installer

To install shaft seal seat in compressor head.

CED,OUOE003,1166 –19–07JUL98–14/17

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3

Shaft Key Installer

To install shaft key in key way.

**Continued on next page**

CED,OUOE003,1166 –19–07JUL98–15/17

*Heating and Air Conditioning*

Feeler Gauge

To check pulley-to-hub clearance.

CED,OUOE003,1166 –19–07JUL98–16/17

Hex Drive

To remove front and rear head cap screws.

CED,OUOE003,1166 –19–07JUL98–17/17

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| TY16134 (U.S.) | R134a Flushing Solvent | Flush R134a air conditioning system. |
| TY22025 (U.S.) | R134a Compressor Oil | Lubricate R134a air conditioning system. |
| TY15949 (12 oz) (U.S.) | R134a Refrigerant | Charge R134a air conditioning system. |
| TY15950 (15 lb) (U.S.) | R134a Refrigerant | Charge R134a air conditioning system. |
| TY15951 (30 lb) (U.S.) | R134a Refrigerant | Charge R134a air conditioning system. |

CED,OUOE003,1167 –19–07JUL98–1/1

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## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Compressor Head-to-Housing Cap Screw | Torque | 26 N•m (19 lb-ft) |
| Pulley-to-Hub | Clearance | 0.53—0.91 mm (0.021—0.036 in.) |
| Clutch Hub Nut | Torque | 16 N•m (12 lb-ft) |

CED,OUOE003,1168 –19–07JUL98–1/1

## PROPER R134A REFRIGERANT HANDLING

The U.S. Environmental Protection Agency prohibits discharge of any refrigerant into the atmosphere, and requires that refrigerant be recovered using the approved recovery equipment.

**IMPORTANT: To meet government standards relating to the use of refrigerants, R134a is used in the air conditioning system. Because it does not contain chlorine, R134a is not detrimental to the ozone in the atmosphere. However, it is illegal to discharge any refrigerant into the atmosphere. It must be recovered using the appropriate recovery stations.**

**IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerants, hoses, fittings, components or refrigerant oils.**

Recovery, recycling and charging stations for R12 and R134a refrigerants MUST NOT be interchanged. Systems containing R12 refrigerant use a different oil than systems using R134a. Certain seals are not compatible with both types of refrigerants.

TX,18,UU3709 –19–23JUN97–1/1

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## R134A REFRIGERANT CAUTIONS

**CAUTION: DO NOT allow liquid refrigerant to contact eyes or skin. Liquid refrigerant will freeze eyes or skin on contact. Wear goggles, gloves and protective clothing.**

**If liquid refrigerant contacts eyes or skin, DO NOT rub the area. Splash large amounts of COOL water on affected area. Go to a physician or hospital immediately for treatment.**

**DO NOT allow refrigerant to contact open flames or very hot surfaces such as electric welding arc, electric heating element and lighted smoking materials.**

**DO NOT heat refrigerant over 52°C (125°F) in a closed container. Heated refrigerant will develop high pressure which can burst the container.**

**Keep refrigerant containers away from heat sources. Store refrigerant in a cool place.**

**DO NOT handle damp refrigerant container with your bare hands. Skin may freeze to container. Wear gloves.**

**If skin freezes to container, pour COOL water over container to free the skin. Go to a physician or hospital immediately for treatment.**

**(R12 ONLY) Refrigerant exposed to high temperature forms phosgene gas. Inhaling toxic phosgene gas may result in serious illness or death. Phosgene gas has an odor like new mown hay or green corn. If you inhale phosgene gas, go to a physician or hospital immediately for treatment.**

TX,18,UU3710 –19–13AUG96–1/1

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## R134A COMPRESSOR OIL CHARGE CHECK

Remove compressor if R134a leakage was detected and repaired. See Remove and Install Compressor in Repair Manual.

Drain oil from the compressor and record the amount. See Compressor Oil Removal procedure in this group.

*NOTE: Drain oil and save if this is a new compressor.*

If the oil drained from a compressor removed from operation is very black or the amount of oil is less than 6 mL (0.2 fl oz.), perform the following:

1. Remove and discard the receiver-dryer.
2. Remove, clean, but do not disassemble the expansion valve.
3. Flush the complete system with TY16134 air conditioning flushing solvent.
4. If the compressor is serviceable, pour flushing solvent in the manifold ports and internally wash out the old oil.
5. Install a new receiver-dryer.
6. Install required amount of TY22025 refrigerant oil in the compressor. (See R134a Component Oil Charge in this group.)
7. Connect all components, evacuate and charge the system.

CED,OUOE027,281 –19–29MAY98–1/1

## R134A COMPRESSOR OIL REMOVAL

1. Remove compressor from machine. See Remove and Install Compressor in Repair Manual.
2. Remove inlet/outlet manifold from compressor, and clutch dust cover.
3. Drain oil into graduated container while rotating compressor shaft.
4. Record measured oil and discard oil properly.
5. Install new oil. See R134a Component Oil Charge in this group.
6. Install compressor. See Remove and Install Compressor in Repair Manual.

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TX,18,UU3712 –19–13AUG96–1/1

## R134A COMPONENT OIL CHARGE

**CAUTION: All new compressors are charged with a mixture of nitrogen, R134a refrigerant and TY22025 (R134a) refrigerant oil. Wear safety goggles and discharge the compressor slowly to avoid possible injury.**

Compressors can be divided into three categories when determining the correct oil charge for the system.

- New compressor from parts depot.
- Used compressor removed from operation.
- Compressor internally washed with flushing solvent.

Determining the amount of system oil charge prior to installation of compressor on a machine.

1. When the complete system, lines, and components were flushed add the correct amount of oil as described.
   - New compressor from parts depot contains the amount of new oil of 230 ± 20 mL (7.7 ± 0.7 fl oz.). System requires an additional amount of new oil of 100 mL (3.4 fl oz.) of new oil.
   - Used compressor removed from operation, oil drained, and flushed requires 330 ± 20 mL (11.1 ± 0.7 fl oz.) of new oil.
2. When the complete system was not flushed add the correct amount of oil for the compressor plus amount of oil for each component that was serviced.
   - New compressor from parts depot, drain and return 45 mL (1.5 fl oz.) of oil to the compressor. (See Compressor Oil Removal procedure in this group.)
   - Used compressor removed from operation and oil drained, (See Compressor Oil Removal procedure in this group.) Add 45 mL (1.5 fl oz.) of new oil.
   - Used compressor removed from operation, oil drained, and flushed add 60 mL (2.0 fl oz.) of new oil.

*NOTE: Components listed below which have been removed, drained, or flushed, require the removal of the compressor to determine the correct oil charge. Use the following chart as a guide for adding oil to components:*

| | |
|---|---|
| Evaporator | 130 mL (4.4 fl oz) |
| Condenser | 65 mL (2.2 fl oz) |
| Receiver-Dryer | 30 mL (1.0 fl oz) |
| Hoses | 60 mL (2.0 fl oz) |

*NOTE: Hoses = 3 mL per 30 cm (0.1 fl oz. per ft). Approximate total length equals 600 cm (20 ft).*

If any section of hose is removed and flushed or replaced, measure the length of hose and use the formula to determine the correct amount of oil to be added.

**CAUTION: DO NOT leave the system or R134a compressor oil containers open. This oil easily absorbs moisture. DO NOT spill R134a compressor oil on acrylic or ABS plastic. This oil will deteriorate these materials rapidly. Identify R134a oil containers and measures to eliminate accidental mixing of different oils.**

TX,18,UU3713 –19–13AUG96–1/1

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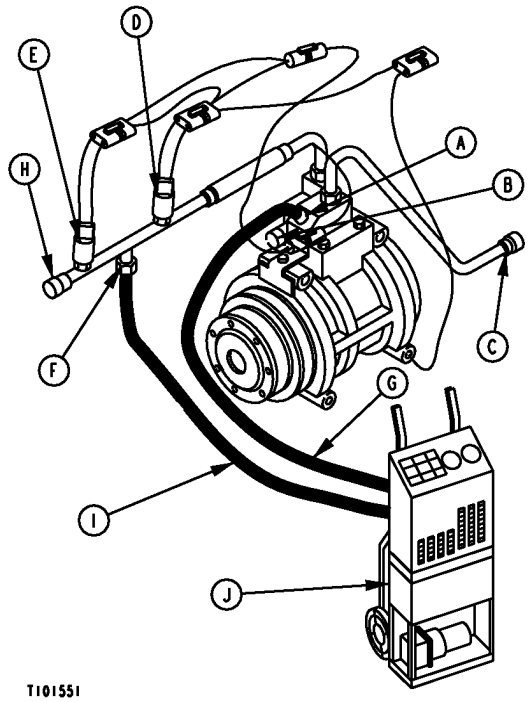
## R134A REFRIGERANT RECOVERY, RECYCLING AND CHARGING STATION INSTALLATION PROCEDURE

**CAUTION: Do not remove high pressure relief valve (B). Air conditioning system will discharge rapidly causing possible injury.**

**IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.**

1. Close both high and low pressure valves on refrigerant recovery, recycling and charging station (J).
2. Remove cap from low pressure test port (A).
3. Connect low pressure blue hose (G) from refrigerant recovery, recycling and charging station (J) to low pressure test port (A) on compressor.
4. Connect high pressure red hose (I) to high pressure quick disconnect (F).
5. Follow the manufacturer's instructions when using the refrigerant recovery, recycling and charging station.




T101551 –UN–10SEP96

**A—Low Pressure Test Port**
**B—High Pressure Relief Valve**
**C—Low Pressure Hose**
**D—Low Pressure Switch**
**E—High Pressure Switch**
**F—High Pressure Quick-Disconnect**
**G—Blue Hose**
**H—High Pressure Hose**
**I—Red Hose**
**J—Refrigerant Recovery/Recycling and Charging Station**

CED,OUOE027,284 –19–29MAY98–1/1

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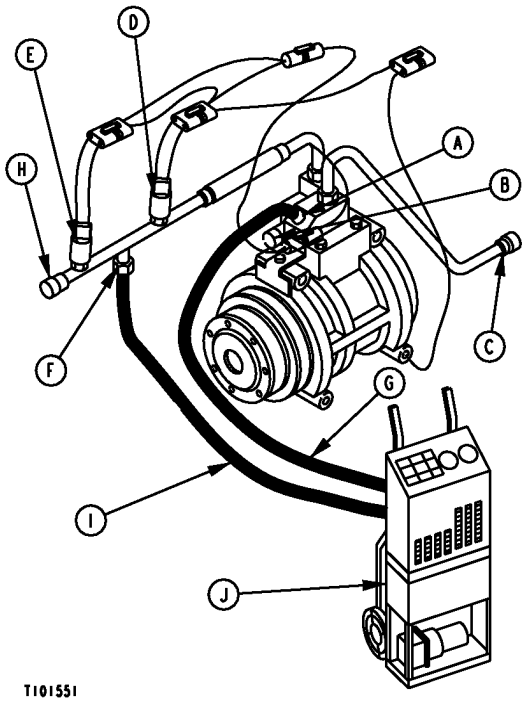
## RECOVER R134A SYSTEM

**CAUTION: Do not remove high pressure relief valve (B). Air conditioning system will discharge rapidly causing possible injury.**

**IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.**

*NOTE: Run the air conditioning system for three minutes to help in the recovery process. Turn air conditioning system off before proceeding with recovery steps.*

1. Connect refrigerant recovery, recycling and charging station. (See installation procedure in this group.)
2. Follow the manufacturer's instructions when using the refrigerant recovery, recycling and charging station.




T101551 –UN–10SEP96

**A—Low Pressure Test Port**
**B—High Pressure Relief Valve**
**C—Low Pressure Hose**
**D—Low Pressure Switch**
**E—High Pressure Switch**
**F—High Pressure Quick-Disconnect**
**G—Blue Hose**
**H—High Pressure Hose**
**I—Red Hose**
**J—Refrigerant Recovery/Recycling and Charging Station**

CED,OUOE027,285 –19–29MAY98–1/1

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## EVACUATE R134A SYSTEM

**CAUTION: Do not remove high pressure relief valve (B). Air conditioning system will discharge rapidly causing possible injury.**

**IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.**

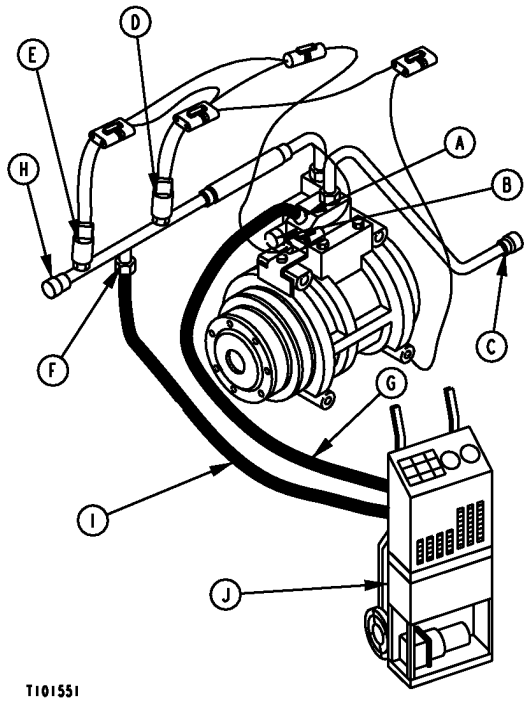
**Do not run compressor while evacuating.**

1. Connect refrigerant recovery, recycling and charging station. (See installation procedure in this group.)
2. Open low and high pressure valves on refrigerant recovery, recycling and charging station.
3. Follow the manufacturer's instructions and evacuate the system.
4. Evacuate system until low pressure gauge registers 98 kPa (980 mbar) (29 in. Hg) vacuum.

   If 98 kPa (980 mbar) (29 in. Hg) vacuum cannot be obtained in 15 minutes, test the system for leaks. (See Leak Testing,Group 9031-25). Correct any leaks.

*NOTE: The vacuum specifications listed are for sea level conditions. Subtract 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level.*

5. When vacuum is 98 kPa (980 mbar) (29 in. Hg), close low-side and high-side valves. Turn vacuum pump off.
6. If the vacuum decreases more than 3.4 kPa (34 mbar) (1 in. Hg) in 5 minutes, there is a leak in the system.
7. Repair leak.
8. Start to evacuate.
9. Open low-side and high-side valves.




T101551 –UN–10SEP96

**A—Low Pressure Test Port**
**B—High Pressure Relief Valve**
**C—Low Pressure Hose**
**D—Low Pressure Switch**
**E—High Pressure Switch**
**F—High Pressure Quick-Disconnect**
**G—Blue Hose**
**H—High Pressure Hose**
**I—Red Hose**
**J—Refrigerant Recovery/Recycling and Charging Station**

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CED,OUOE003,1024 –19–22JUL98–1/2

10. Evacuate system for 30 minutes after 98 kPa (980 mbar) (29 in. Hg) vacuum is reached.

11. Close low-side and high-side valves. Stop evacuation.

12. Charge the system. (See procedure in this group.)

CED,OUOE003,1024 –19–22JUL98–2/2

## CHARGE R134A SYSTEM

**CAUTION: Do not remove high pressure relief valve (B). Air conditioning system will discharge rapidly causing possible injury.**

**IMPORTANT: Use correct refrigerant recovery, recycling and charging stations. DO NOT mix refrigerant, hoses, fittings, components or refrigerant oils.**

1. Connect JT02047 R134a refrigerant recovery, recycling and charging station. (See installation procedure in this group.)

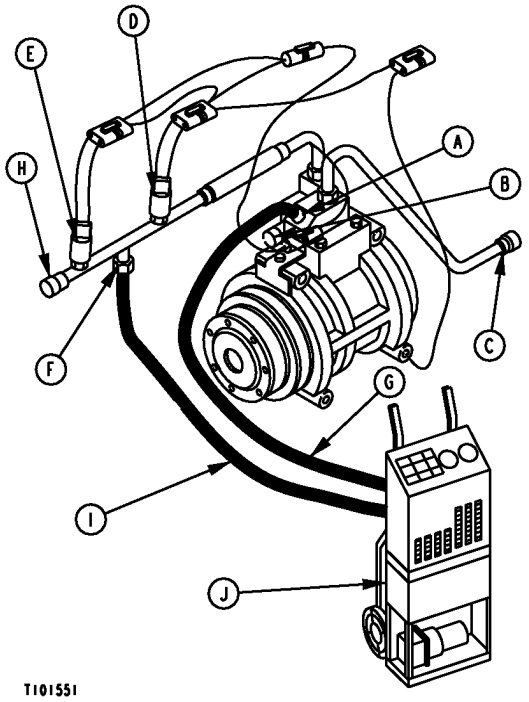
2. Evacuate the system. (See Evacuate Air Conditioning System, this group.)

*NOTE: Before beginning to charge air conditioning system, the following conditions must exist: Engine STOPPED, the pump must be capable of pulling at least 28.6 in. Hg vacuum (sea level). Subtract 3.4 kPa (34 mbar) (1 in. Hg) from 98 kPa (980 mbar) (29 in. Hg) for each 300 m (1000 ft) elevation above sea level.*

3. Follow the manufacturer's instructions and charge the system.

4. Add refrigerant until system is charged with 2.43 kg (5.25 lb).

5. Do air conditioner checks and tests in Groups 9031-10 and 9031-25.




T101551 –UN–10SEP96

**A—Low Pressure Test Port**
**B—High Pressure Relief Valve**
**C—Low Pressure Hose**
**D—Low Pressure Switch**
**E—High Pressure Switch**
**F—High Pressure Quick-Disconnect**
**G—Blue Hose**
**H—High Pressure Hose**
**I—Red Hose**
**J—Refrigerant Recovery/Recycling and Charging Station**

CED,OUOE003,1025 –19–22JUL98–1/1

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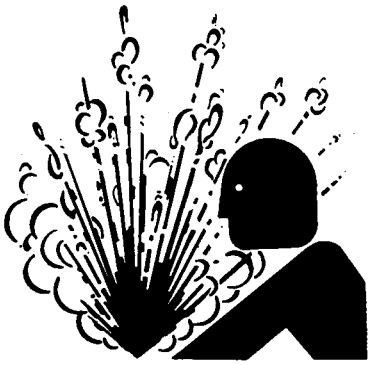
## REMOVE AND INSTALL HEATER CORE AND BLOWER MOTOR



TS281 –UN–23AUG88

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

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

1. Close shut-off valves on engine or drain coolant from radiator. The approximate coolant system capacity is 30 L (8 gal).

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CED,OUOE027,247 –19–18MAY98–1/3

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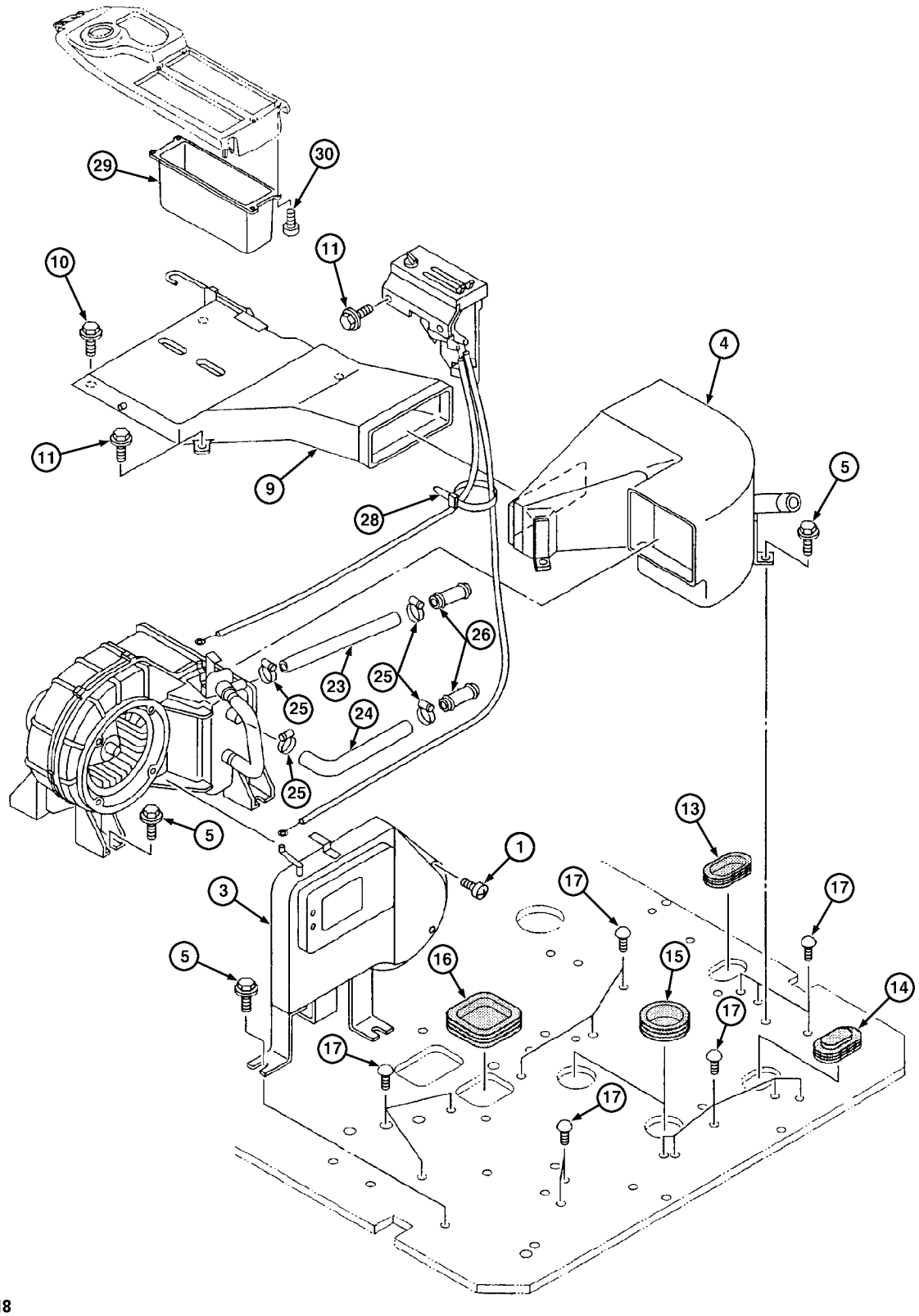


T115018

T115018 –UN–01JUL98

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CED,OUOE027,247 –19–18MAY98–2/3

**01—Screw (3 used)**
**03—Support**
**04—Air Duct**
**05—Cap Screw, Lock Washer, Washer (10 used)**
**09—Air Duct**
**10—Screw with Washer (2 used)**
**11—Cap Screw, Lock Washer, Washer (4 used)**
**13—Rubber Bushing**
**14—Rubber Bushing**
**15—Rubber Bushing (2 used)**
**16—Rubber Bushing**
**17—Plug (16 used)**
**23—Hose**
**24—Hose**
**25—Hose Clamp (4 used)**
**26—Pipe (2 used)**
**28—Tie Band (3 used)**
**29—Tray**
**30—Screw (4 used)**

2. Remove and install blower motor and heater core.

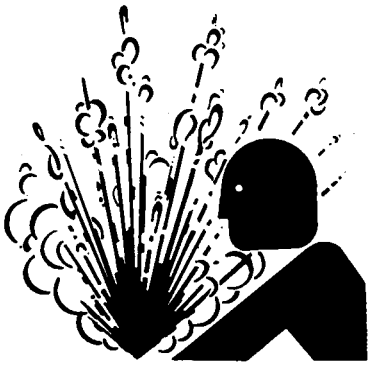
3. Tighten hose clamps (25) until hose just starts to deform around clamp.

CED,OUOE027,247 –19–18MAY98–3/3

## REMOVE AND INSTALL HEATER HOSES

**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 completely.**



TS281 –UN–23AUG88

1. Close shut-off valves on engine or drain coolant from radiator. The approximate coolant system capacity is 30 L (8 gal).

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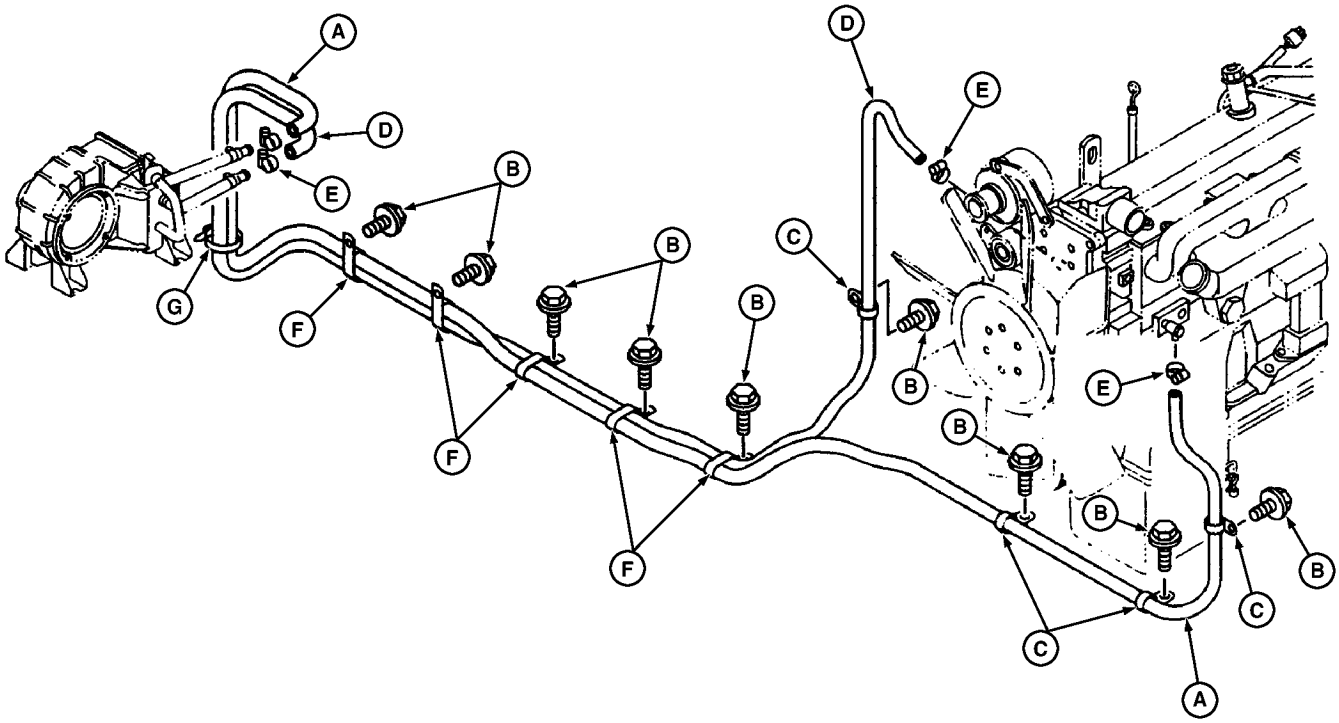
CED,OUOE027,248 –19–18MAY98–1/3




T115019 –UN–01JUL98

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**T115019**

**A—Hose**
**B—Cap Screw (9 used)**
**C—Clip (4 used)**
**D—Hose**
**E—Hose Clamp (4 used)**
**F—Clip (5 used)**
**G—Tie Band**

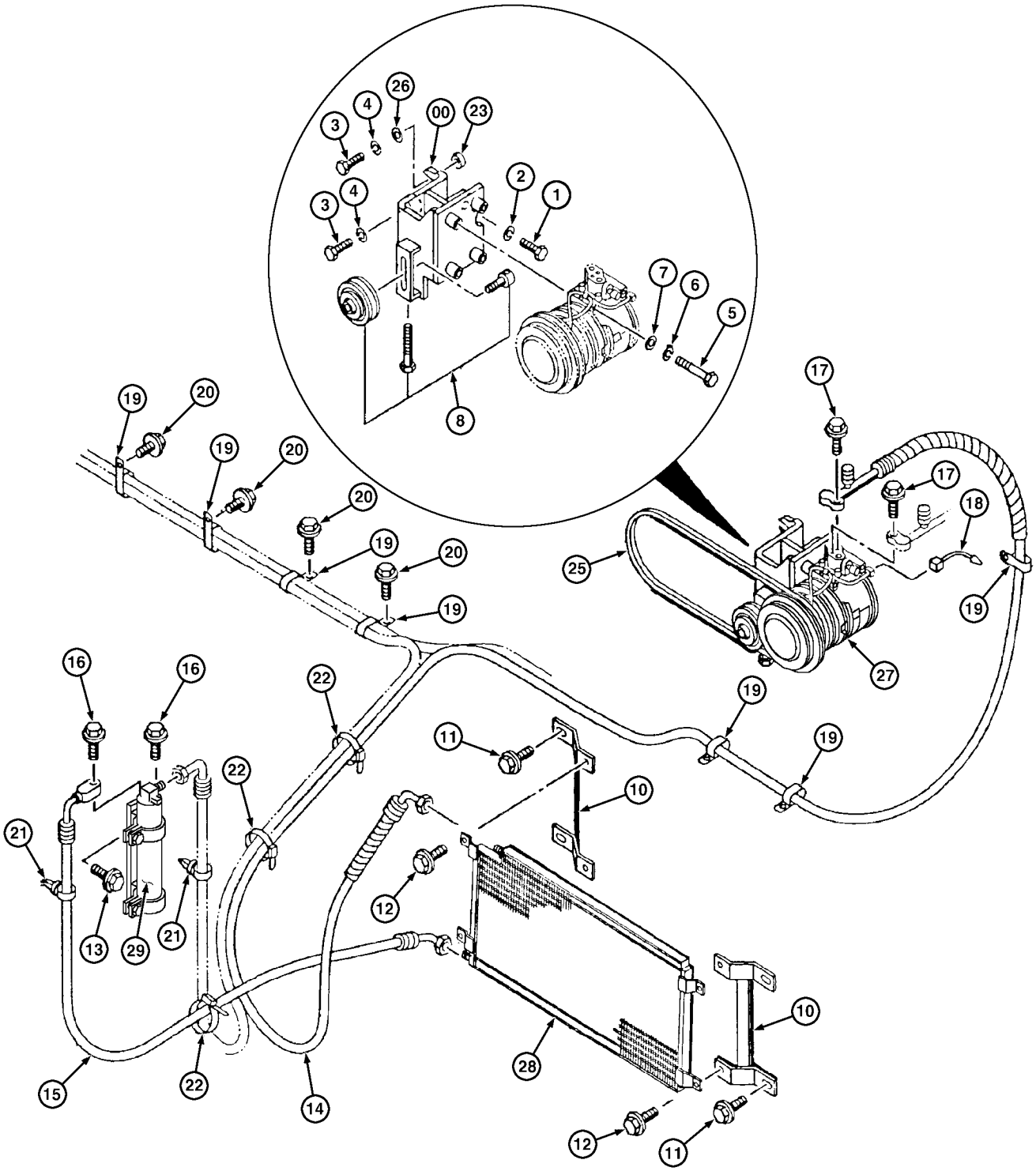
**Continued on next page**

CED,OUOE027,248 –19–18MAY98–2/3

2. Tighten hose clamps (E) until hose just starts to deform around clamp.

CED,OUOE027,248 –19–18MAY98–3/3

## REMOVE AND INSTALL AIR CONDITIONING COMPRESSOR

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CED,OUOE027,272 –19–29MAY98–1/2

**00—Bracket**
**01—Cap Screw**
**02—Spring Washer**
**03—Cap Screw (2 used)**
**04—Spring Washer (2 used)**
**05—Cap Screw (4 used)**
**06—Spring Washer (4 used)**
**07—Washer (4 used)**
**08—Pulley**
**10—Bracket (2 used)**
**11—Cap Screw (4 used)**
**12—Cap Screw (4 used)**
**13—Cap Screw (2 used)**
**14—Hose**
**15—Hose**
**16—Cap Screw (2 used)**
**17—Cap Screw (2 used)**
**18—Wire Harness**
**19—Clip (7 used)**
**20—Cap Screw (4 used)**
**21—Clip (2 used)**
**22—Clip (3 used)**
**23—Spacer**
**25—Compressor V-Belt**
**26—Washer**
**27—Compressor**
**28—Condenser**
**29—Receiver Dryer**

1. Recover the refrigerant from the system. (See procedure in this group.)
2. Remove air conditioning compressor V-belt (25). (See procedure in group 0510.)
3. Remove and install compressor (27). Install caps and plugs to close all open lines.
4. Repair or replace compressor as necessary.
5. Evacuate and charge the system. (Seeprocedures in this group.)
6. Install air conditioning compressor V-belt (25). (See procedure in Group 0510.)
7. Adjust air conditioning compressor V-belt tension. (See procedure in Group 0510.)

CED,OUOE027,272 –19–29MAY98–2/2

## DISASSEMBLE AND INSPECT AIR CONDITIONING COMPRESSOR

1. Mount holding fixture in a bench vise and support compressor on holding fixture.

*NOTE: Mounting fixture can be made with two pieces of flat stock and two lengths of threaded rod.*

*Weld one piece of stack perpendicular to other, drill two holes and install threaded rod as shown.*

*Compressor can also be mounted in pivoting D01006AA Bench Mounted Holding Fixture or similar holding device.*

2. Put compressor in a bench holding fixture.

RW3654 –UN–23JAN89

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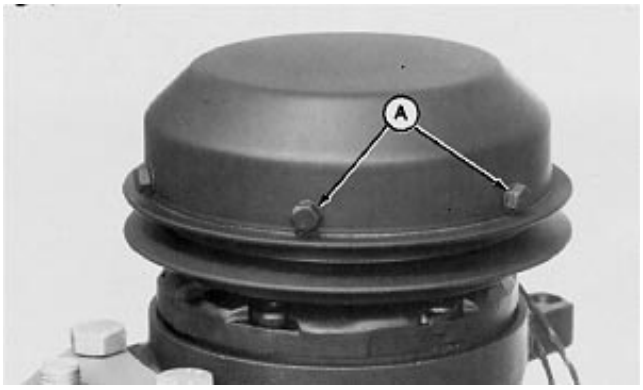
T52,1830,K184 –19–23AUG97–1/26

3. Remove six dust cover cap screws (A) and remove cover.

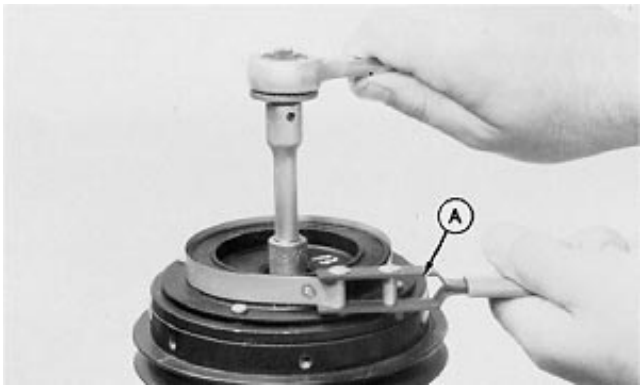



**A—Cap Screw**

T52,1830,K184 –19–23AUG97–2/26

1. Hold clutch hub with clutch hub holding tool (A), and remove clutch hub retaining nut from shaft.

*NOTE: If clutch drive plate slips on hub, drill a 1/4 in. hole through flanges of drive plate and hub. Insert a punch to hold clutch hub for removal of hub retaining nut.*




**A—Clutch Hub Holding Tool**

**Continued on next page**

T52,1830,K184 –19–23AUG97–3/26

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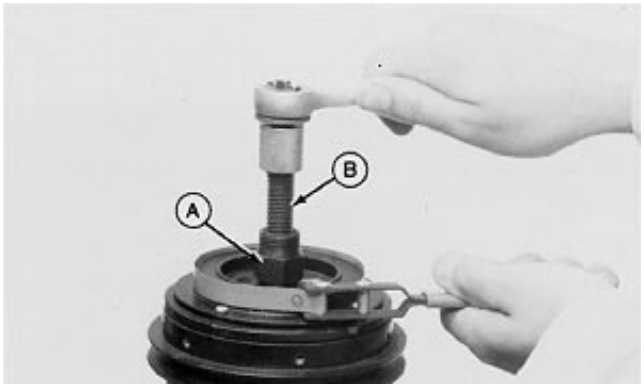
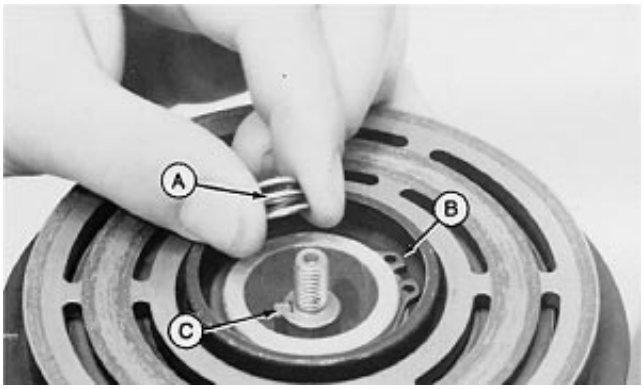
2. Screw lower portion (A) clutch hub remover into hub.
3. Install forcing screw (B). Hold hub and tighten forcing screw until hub can be removed.




**A—Lower Portion of Hub Remover**
**B—Forcing Screw**

T52,1830,K184 –19–23AUG97–4/26

4. Remove shims (A) from shaft and note quantity. Save shims for reinstallation.
5. Remove and discard snap ring (B) and shaft key (C).




**A—Shaft Shim**
**B—Snap Ring**
**C—Shaft Key**

**Continued on next page**

T52,1830,K184 –19–23AUG97–5/26

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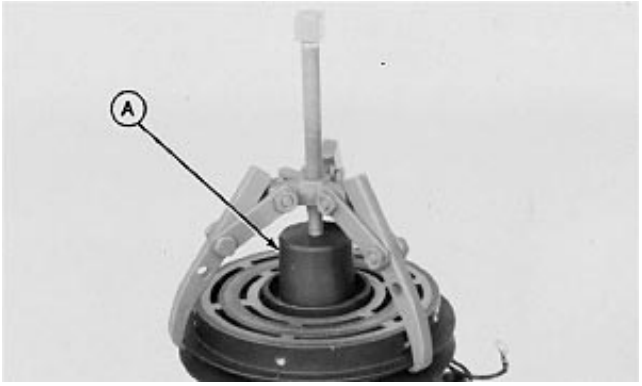
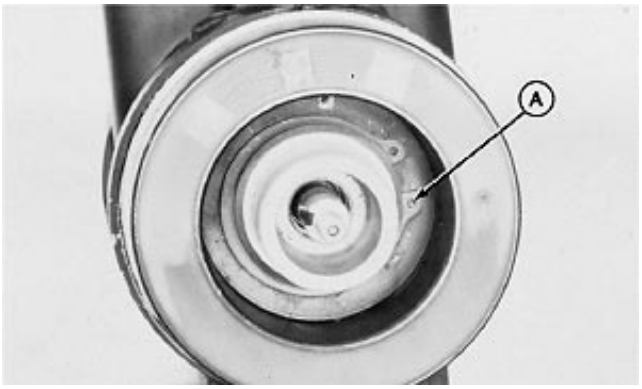
6. Install puller adapter (A) and use a suitable three jaw puller as shown to remove clutch pulley.




**A—Puller Adapter**

T52,1830,K184 –19–23AUG97–6/26

7. Remove snap ring (A) and disconnect clutch field coil wire from compressor body. Remove clutch field coil.




**A—Snap Ring**

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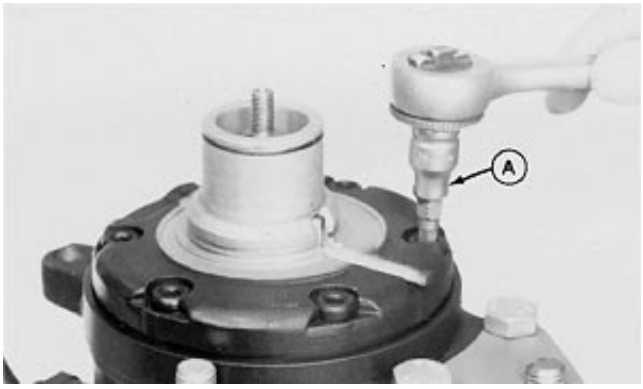
T52,1830,K184 –19–23AUG97–7/26

8. Remove six through-bolts using special hex drive (A).

**IMPORTANT: Do not remove through-bolts unless suction and discharge manifolds are in place and tight.**

9. Carefully pry head from body using a screw driver. Pry only slightly around the circumference of the head. Repeat this procedure until head is removed.

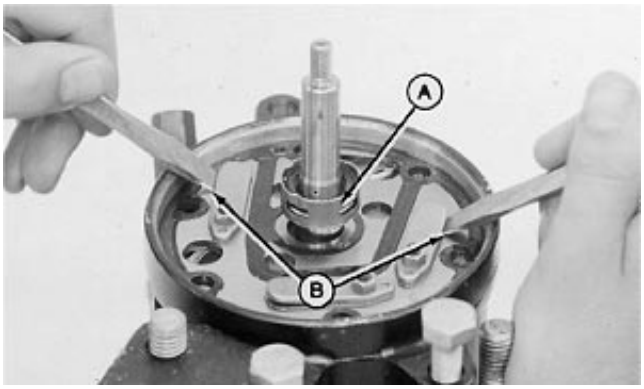



**A—Special Hex Drive**

T52,1830,K184 –19–23AUG97–8/26

10. Remove and discard shaft seal (A).

11. Use two screw drivers to remove discharge valve plate (B).




**A—Shaft Seal**
**B—Discharge Valve Plate**

**Continued on next page**

T52,1830,K184 –19–23AUG97–9/26

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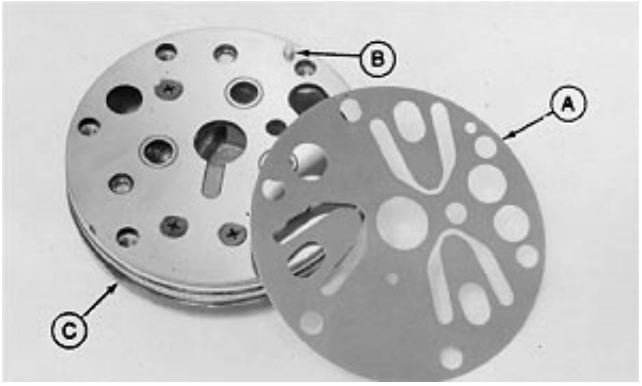
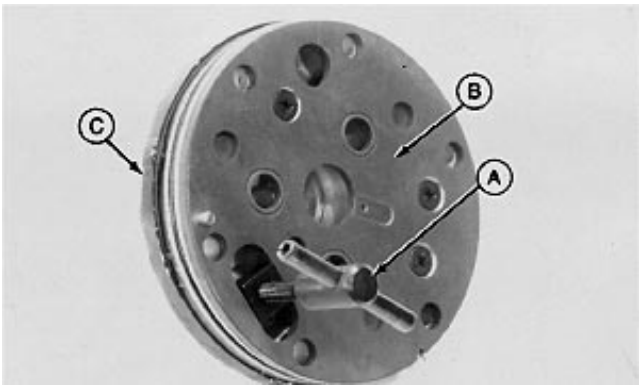
12. If shaft seal and valve plate remain with compressor head, carefully separate inlet reed valve (A) from valve plate (C). Do not lose locating dowel pin (B).




**A—Inlet Reed Valve**
**B—Valve Plate**
**C—Dowel Pin**

T52,1830,K184 –19–23AUG97–10/26

13. Install valve plate remover (A) and carefully pull valve plate (B) from head (C).



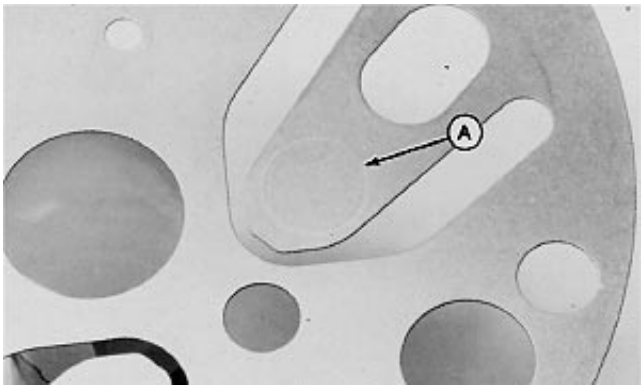

**A—Valve Plate Remover**
**B—Valve Plate**
**C—Head**

**Continued on next page**

T52,1830,K184 –19–23AUG97–11/26

14. Inspect valve plate side of inlet reed valves for a complete circular wear pattern (A).

15. If wear pattern has any voids in it, replace reed valve.

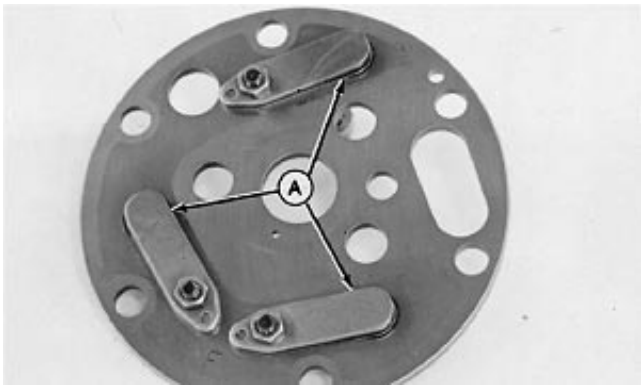



**A—Circular Wear Pattern**

T52,1830,K184 –19–23AUG97–12/26

16. Inspect discharge valve for general condition. Valves (A) should have slight pressure against valve plate.

17. Hold valve plate up to light and verify that valve is against its seat. If condition is doubtful, replace valve plate.




**A—Discharge Valve**

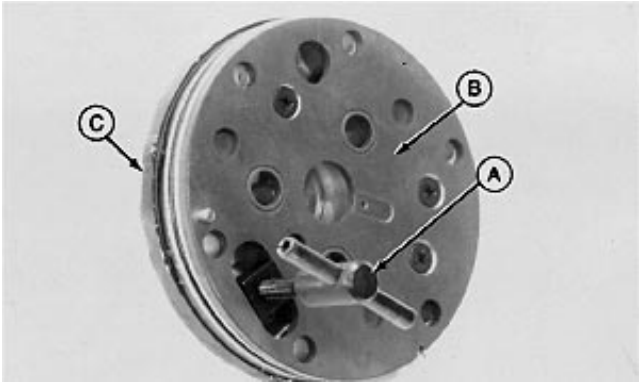
T52,1830,K184 –19–23AUG97–13/26

18. Turn compressor over and remove rear head by prying on the small tabs cast into the head. Pry lightly around circumference of head.


**Continued on next page**

T52,1830,K184 –19–23AUG97–14/26

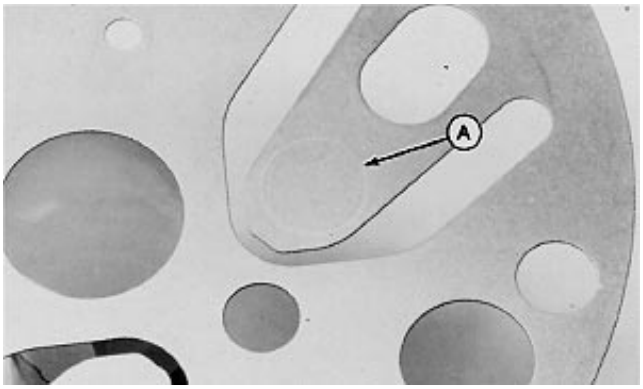
19. Remove inlet reed valve from valve plate.
20. Install valve plate remover (A) and carefully pull valve plate (B) from head (C).




**A—Valve Plate Remover**
**B—Valve Plate**
**C—Compressor Head**

T52,1830,K184 –19–23AUG97–15/26

21. Inspect valve plate side of inlet reed valves for a complete circular wear pattern (A).
22. If wear pattern has any voids in it, replace reed valve.



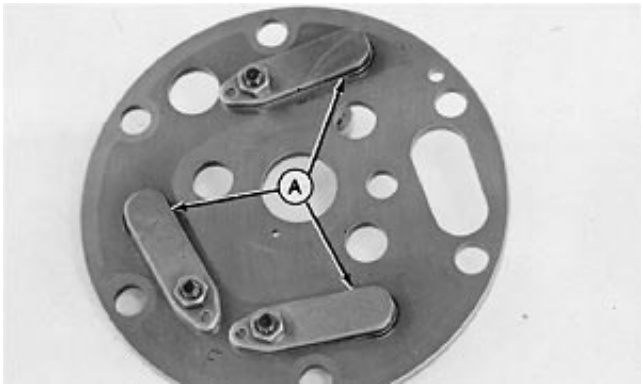

**A—Circular Wear Pattern**

**Continued on next page**

T52,1830,K184 –19–23AUG97–16/26

23. Inspect discharge valve for general condition. Valves (A) should have slight pressure against valve plate.

24. Hold valve plate up to light and verify that valve is against its seat. If condition is doubtful, replace valve plate.



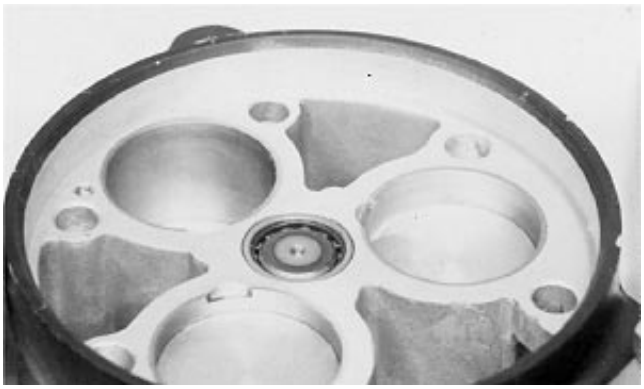

RW10001 –UN–07DEC88

**A—Discharge Valve**

T52,1830,K184 –19–23AUG97–17/26

25. Inspect cylinders for scoring or excessive wear. If cylinders are scored or damaged, replace compressor.

*NOTE: Some cylinder scuffing (light scratches) is normal.*



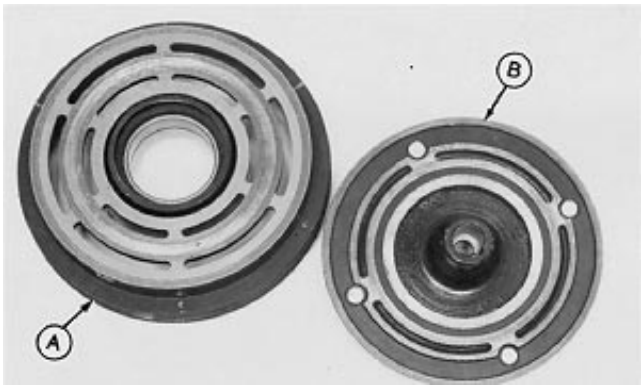
RW3667 –UN–23JAN89

T52,1830,K184 –19–23AUG97–18/26

26. Inspect surfaces of clutch pulley (A) and clutch hub (B). If pulley is more than 0.3 mm (0.012 in.) from flat, replace pulley and clutch hub.

27. Rotate bearing in pulley. If pulley is rough or has evidence of loss of lube, replace bearing.

28. Clean as necessary.




RW3677 –UN–23JAN89

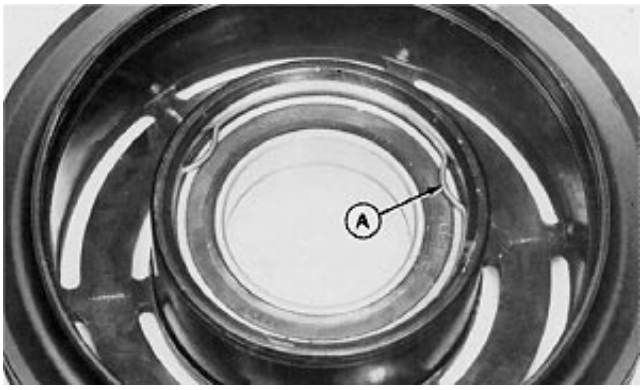
**A—Clutch Pulley**
**B—Clutch Hub**

18
1830
27

**Continued on next page**

T52,1830,K184 –19–23AUG97–19/26

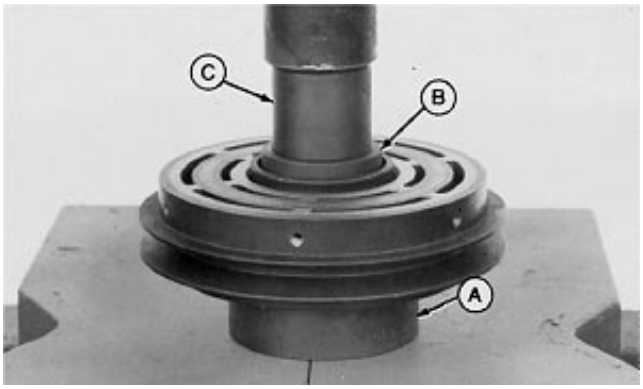
29. Remove retaining ring (A) from pulley bore.




**A—Retaining Ring**

T52,1830,K184 –19–23AUG97–20/26

30. Put pulley on pulley support (A). Press bearing from pulley using bearing adapter (B) and puller adapter (C).




**A—Pulley Support**
**B—Bearing Adapter**
**C—Puller Adapter**

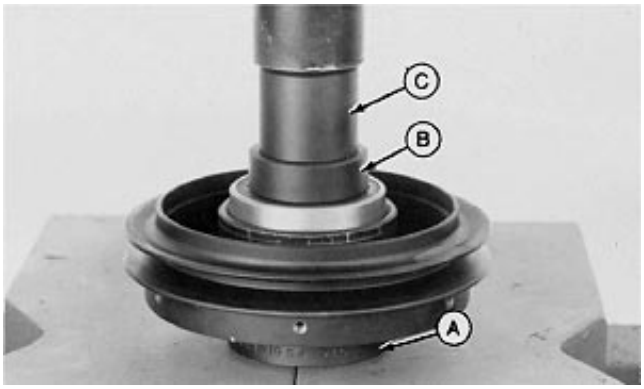
T52,1830,K184 –19–23AUG97–21/26

31. Install dust shield, lip edge facing up, in pulley.


**Continued on next page**

T52,1830,K184 –19–23AUG97–22/26

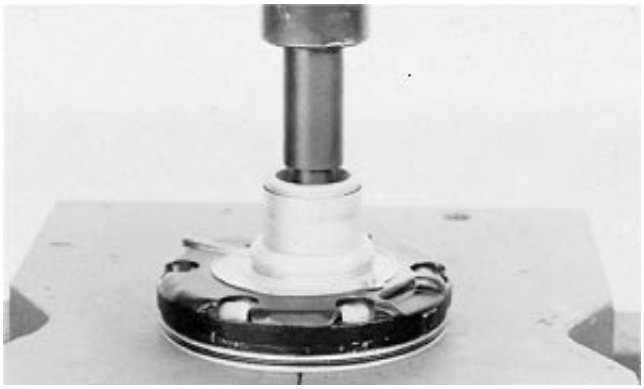
32. Put pulley on pulley bearing support (A). Make sure dust shield seats in support before putting bearing on pulley.
33. Press bearing into pulley until bearing bottoms on dust shield using a bearing adapter (B) and puller adapter.
34. Install bearing retaining ring.




**A—Pulley Bearing Support**
**B—Bearing Adapter**

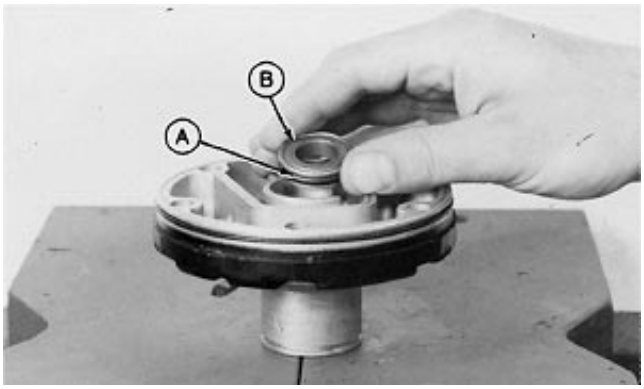
T52,1830,K184 –19–23AUG97–23/26

35. Remove seat from head using a shaft seal seat remover.




T52,1830,K184 –19–23AUG97–24/26

36. Apply a small amount of clean refrigerant oil to O-ring (A).
37. Install seal seat (B) in bore with grooved surface of seat facing up as shown.




**A—O-Ring**
**B—Seal Seat**

18
1830
29

**Continued on next page**

T52,1830,K184 –19–23AUG97–25/26

38. Press seal seat in head until seat bottoms in bore using shaft seal seat installer.


T52,1830,K184 –19–23AUG97–26/26

## ASSEMBLE AIR CONDITIONING COMPRESSOR

1. Remove gaskets from both front and rear heads. Be sure all gasket material is removed. Wash all parts in clean solvent before assembly.

2. Place suction reed valve against compressor side of rear head. Install locating dowel pin to assure that reed valve and valve plate are properly indexed. Set in place in compressor.

3. Carefully install new head gasket. Be sure it is properly in place.

4. Carefully install rear head. Be sure locating dowel pin is correctly positioned in head. Lightly tap head into place.

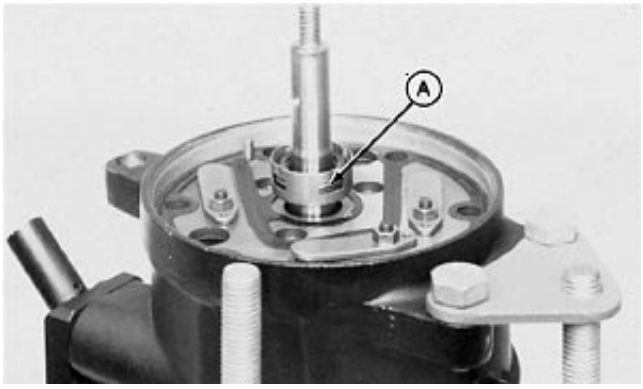
5. Turn compressor over and install suction reed and valve plate. Install new head gasket.

**Continued on next page**

T52,1830,J21 –19–23AUG93–1/6

**IMPORTANT: Draft seal is a two piece seal. Be sure they are properly installed or breakage will occur during assembly of front head.**

6. Install new shaft seal (A) as shown. Be sure slotted rear side of seal engages with flats on compressor shaft.




RW3662 –UN–23JAN89

**A—Shaft Seal**

T52,1830,J21 –19–23AUG93–2/6

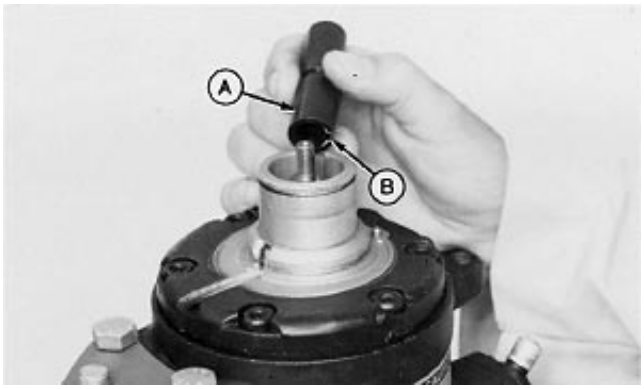
7. Align head with dowel pin and install head. Use six bolts to draw head down EVENLY, then tighten.

**Compressor Head-to-Housing Cap Screw—Specification**

Torque ..... 26 N•m (19 lb-ft)

8. Install new shaft key in key way. Position shaft key installer (A) with slotted area (B) over key.

9. Tap installer with a small hammer until key bottoms in key way.




RW3678 –UN–23JAN89

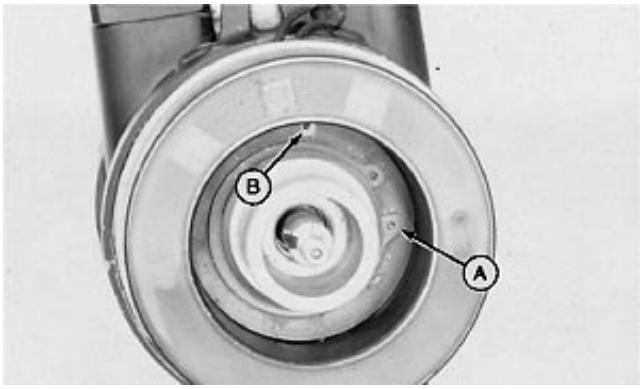
**A—Shaft Key Installer**
**B—Slotted Area**

**Continued on next page**

T52,1830,J21 –19–23AUG93–3/6

18
1830
31

10. Align clutch coil with roll pin (B) in head and install coil. Install snap ring (A) with round edge facing upward.
11. Connect clutch coil wire to ground screw on compressor.

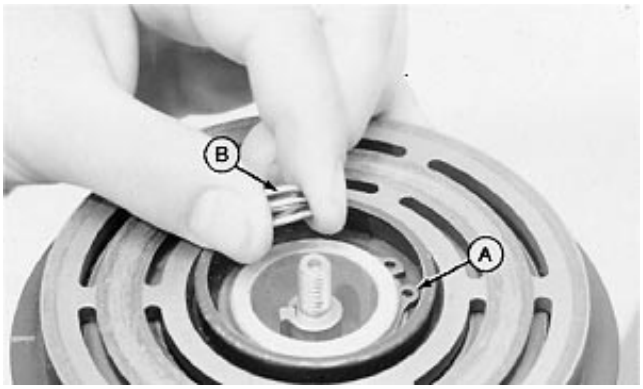



RW3679 –UN–23JAN89

**A—Roll Pin**
**B—Snap Ring**

T52,1830,J21 –19–23AUG93–4/6

12. Install pulley. Slight tap may be needed to properly position pulley on shaft.
13. Install new snap ring (A) with rounded edge of snap ring facing upward. Install removed shims (B) on front head.
14. Align clutch head key way with key and install hub.
15. Tighten nut until clutch hub is tight against shims on compressor shaft shoulder.




RW3684 –UN–23JAN89

**A—Snap Ring**
**B—Shim**

**Continued on next page**

T52,1830,J21 –19–23AUG93–5/6

16. Check pulley-to-hub for clearance in three equally spread locations around hub using a feeler gauge.

**Pulley-to-Hub—Specification**

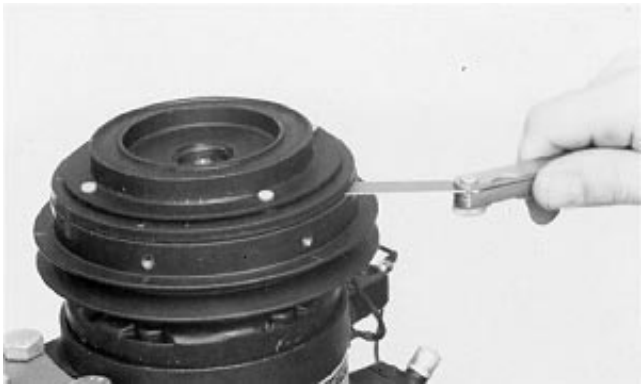
Clearance ..... 0.53—0.91 mm (0.021—0.036 in.)

17. Turn pulley one-half turn (180°) and check clearance in three equally spaced locations. Remove or install shims as necessary for proper clearance.

18. Tighten clutch hub nut.

**Clutch Hub Nut—Specification**

Torque ..... 16 N•m (12 lb-ft)



RW3682 –UN–23JAN89

T52,1830,J21 –19–23AUG93–6/6

## INSPECT AIR CONDITIONING COMPRESSOR MANIFOLDS

1. Recover the refrigerant from the system. (See procedure in this group.)

**IMPORTANT: Do not remove manifolds unless front and rear head cap screws are installed and tightened.**

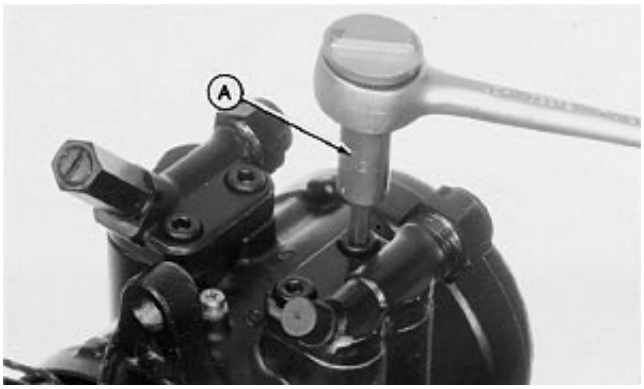
2. Remove cap screws using hex drive (A).

3. Inspect parting surfaces and O-rings.

4. Replace parts as necessary.

5. Install manifolds.

6. Evacuate and charge the system. (See procedures in this group.)




RW4983 –UN–23JAN89

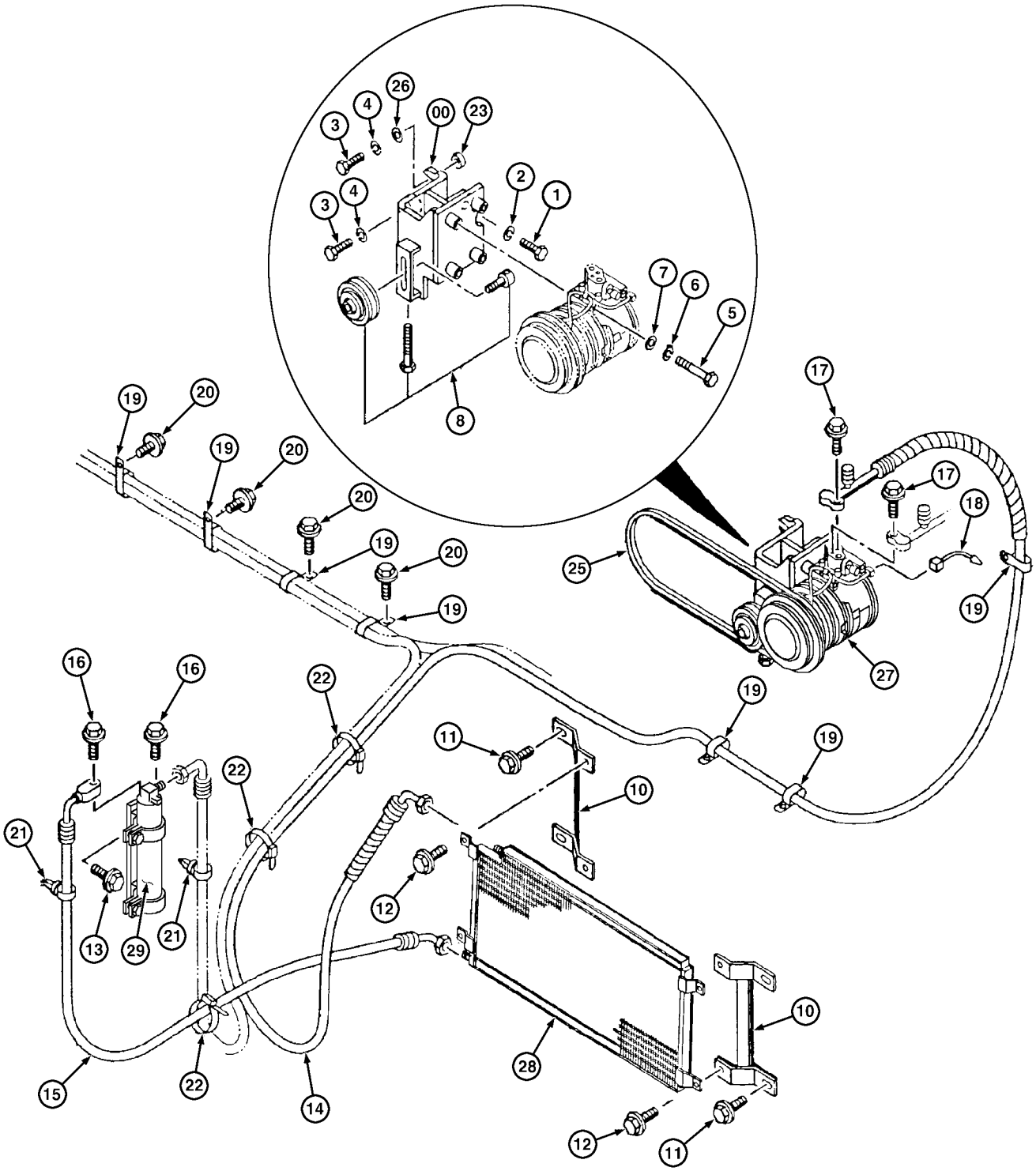
RW4984 –UN–23JAN89

**A—Hex Drive**

18
1830
33

CED,OUOE027,275 –19–29MAY98–1/1

## REMOVE AND INSTALL RECEIVER DRYER




T115655 –UN–17JUN98

Continued on next page

CED,OUOE027,276 –19–29MAY98–1/2

18
1830
34

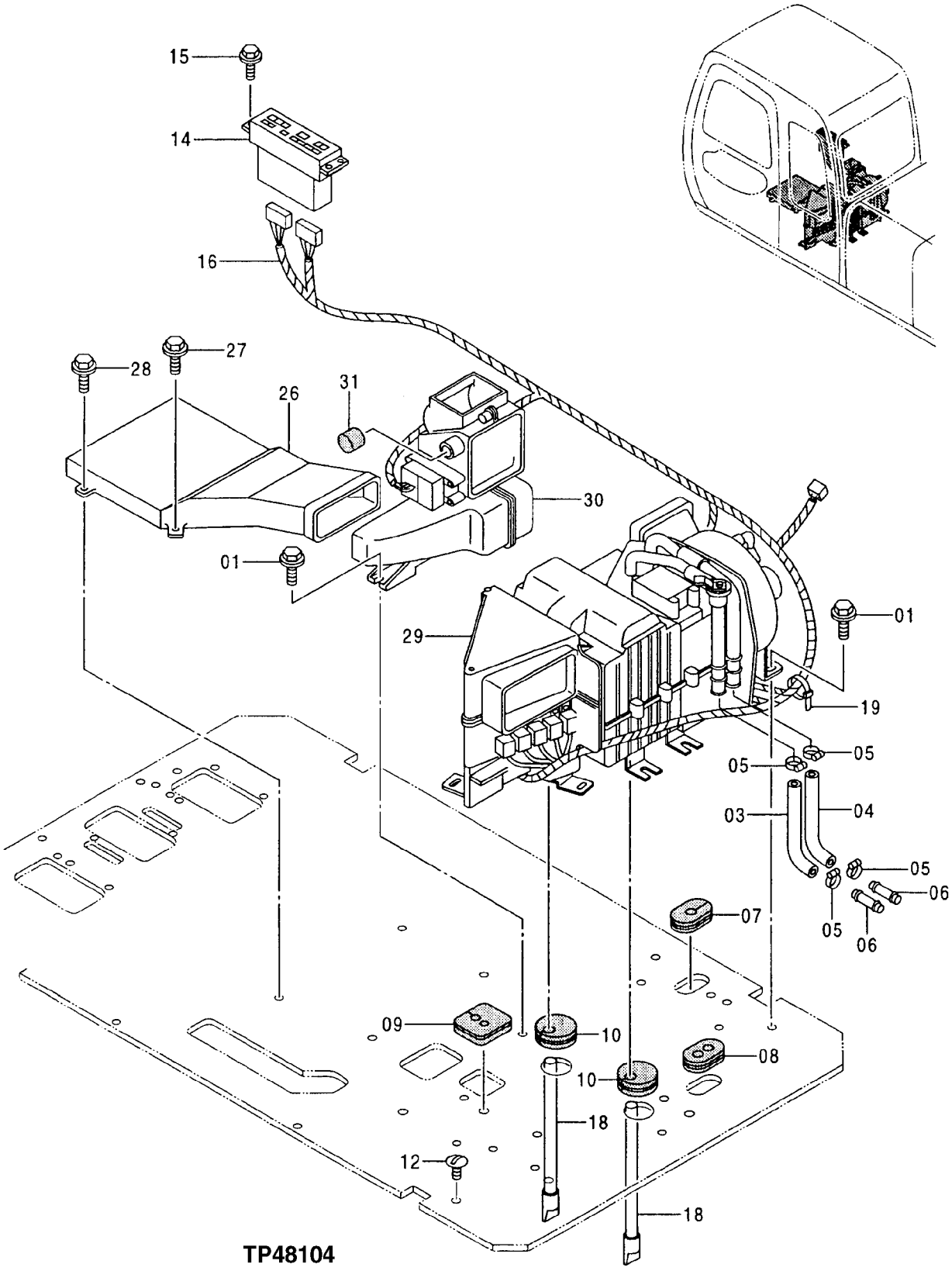
**00—Bracket**
**01—Cap Screw**
**02—Spring Washer**
**03—Cap Screw (2 used)**
**04—Spring Washer (2 used)**
**05—Cap Screw (4 used)**
**06—Spring Washer (4 used)**
**07—Washer (4 used)**
**08—Pulley**
**10—Bracket (2 used)**
**11—Cap Screw (4 used)**
**12—Cap Screw (4 used)**
**13—Cap Screw (2 used)**
**14—Hose**
**15—Hose**
**16—Cap Screw (2 used)**
**17—Cap Screw (2 used)**
**18—Wire Harness**
**19—Clip (7 used)**
**20—Cap Screw (4 used)**
**21—Clip (2 used)**
**22—Clip (3 used)**
**23—Spacer**
**25—V-Belt**
**26—Washer**
**27—Compressor**
**28—Condenser**
**29—Receiver Dryer**

1. Recover the refrigerant from the system. (See procedure in this group.)
2. Remove and install receiver dryer (29).
3. Evacuate and charge the system. (See procedures in this group.)

CED,OUOE027,276 –19–29MAY98–2/2

18
1830
35

## REMOVE AND INSTALL EVAPORATOR

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TP48104 –UN–06AUG96

TX,1830,SB564 –19–10JAN97–1/2

**1—Cap Screw, Lock Washer, Washer (11 used)**
**3—Heater Hose**
**4—Heater Hose**
**5—Hose Clamp (4 used)**
**6—Tube (2 used)**
**7—Bushing**
**8—Grommet**
**9—Bushing**
**10—Grommet (2 used)**
**12—Plug (13 used)**
**14—Control**
**15—Screw (4 used)**
**16—Wiring Harness**
**18—Hose (2 used)**
**19—Tie Band (7 used)**
**26—Air Duct**
**27—Cap Screw, Lock Washer, Washer (2 used)**
**28—Cap Screw and Washer (2 used)**
**29—Air Conditioning Unit**
**30—Housing**
**31—Plug**

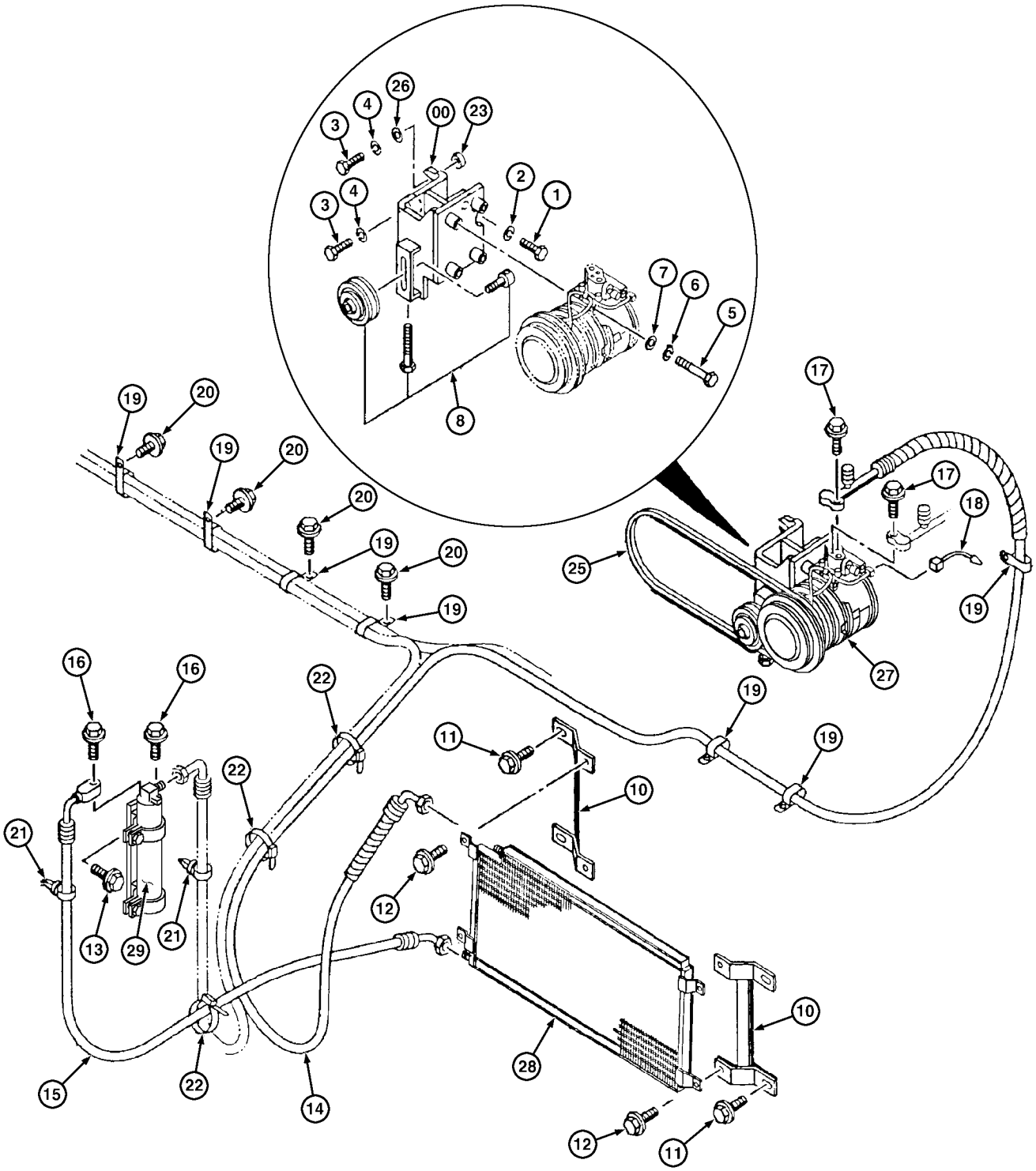
*NOTE: Evaporator is serviced as part of the air conditioning unit.*

1. Recover the refrigerant from the system. (See procedure in this group.)
2. Remove and install air conditioning unit (29).
3. Evacuate and charge the system. (See procedures in this group.)

TX,1830,SB564 –19–10JAN97–2/2

18
1830
37

## REMOVE AND INSTALL CONDENSER




T115655 –UN–17JUN98

Continued on next page

CED,OUOE027,278 –19–29MAY98–1/2

18
1830
38

**00—Bracket**
**01—Cap Screw**
**02—Spring Washer**
**03—Cap Screw (2 used)**
**04—Spring Washer (2 used)**
**05—Cap Screw (4 used)**
**06—Spring Washer (4 used)**
**07—Washer (4 used)**
**08—Pulley**
**10—Bracket (2 used)**
**11—Cap Screw (4 used)**
**12—Cap Screw (4 used)**
**13—Cap Screw (2 used)**
**14—Hose**
**15—Hose**
**16—Cap Screw (2 used)**
**17—Cap Screw (2 used)**
**18—Wire Harness**
**19—Clip (7 used)**
**20—Cap Screw (4 used)**
**21—Clip (2 used)**
**22—Clip (3 used)**
**23—Spacer**
**25—V-Belt**
**26—Washer**
**27—Compressor**
**28—Condenser**
**29—Receiver Dryer**

1. Recover the refrigerant from the system. (See procedure in this group.)
2. Remove and install condenser (28) as shown.
3. Evacuate and charge the system. (See procedures in this group.)

CED,OUOE027,278 –19–29MAY98–2/2

18
1830
39

**BLANK**

# CHAPTER 18

# SECTION 04

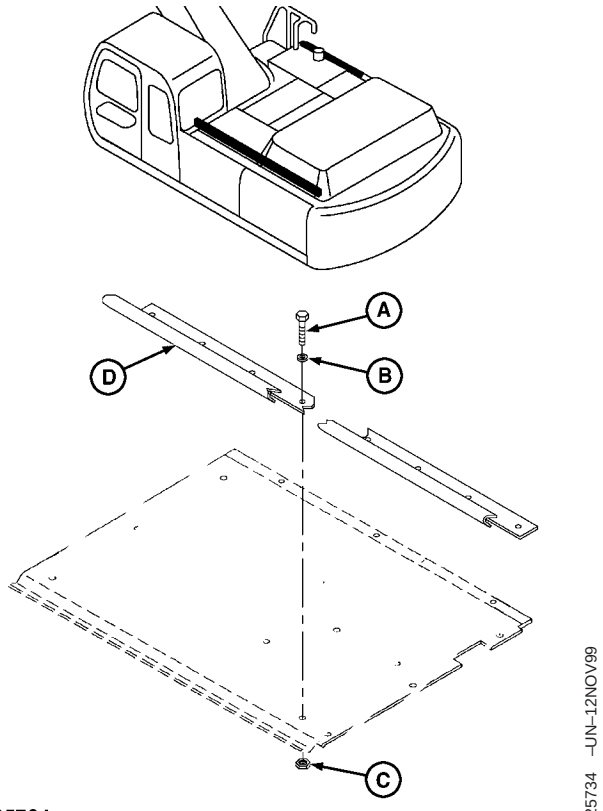
# ENGINE REPAIR

**BLANK**

## REMOVE AND INSTALL HAND RAILS

*NOTE: Procedure is the same for both left and right hand rails; left hand rail is shown.*

Remove cap screws (A), washers (B), nuts (C) and hand rail (D).




T125734

T125734 –UN–12NOV99

**A—Cap Screw (6 used)**
**B—Washer (6 used)**
**C—Nut (6 used)**
**D—Hand Rail**

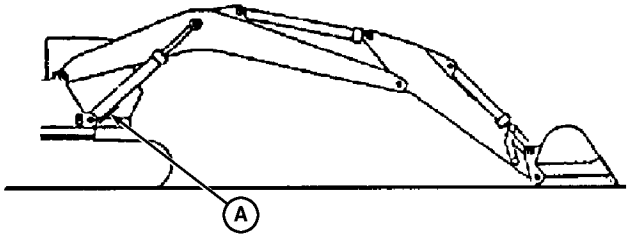
CED,OUOE003,2 –19–12NOV99–1/1

18
1910
1

# Group 1919
# Boom Cylinder Guard

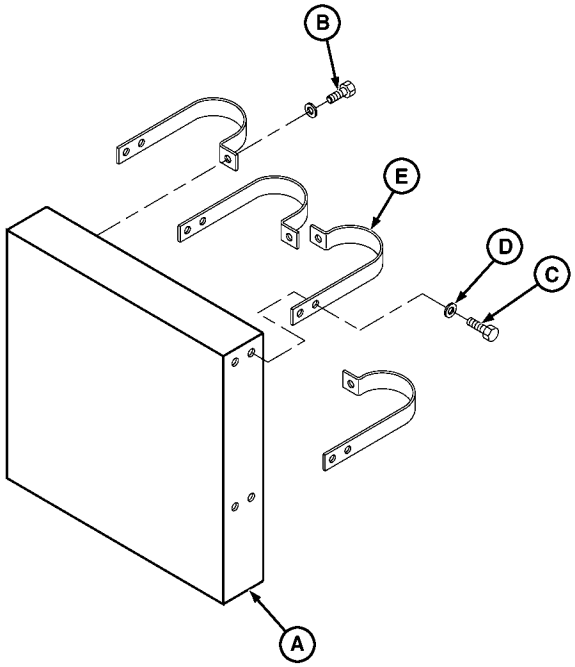
## REMOVE AND INSTALL BOOM CYLINDER GUARD

1. Park machine on a firm, level surface.
2. Retract arm and bucket cylinders. Lower boom so bucket is on ground.
3. Stop engine.
4. Remove bolts (B and C), washers (D), clamps (E), and guard (A).




T125732 –UN–12NOV99

T125732




T125733 –UN–12NOV99

T125733

**A—Boom Cylinder Guard**
**B—Bolt (4 used)**
**C—Bolt (8 used)**
**D—Washer (12 used)**
**E—Clamp (4 used)**

CED,OUOE003,3 –19–12NOV99–1/1

18
1919
1

# CHAPTER 19

# SECTION 33

# EXCAVATOR REPAIR

**BLANK**

# Group 3302
# Buckets



## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| | Multi-Purpose Grease | Apply to pivot joints for removal and installation of bucket. |

CED,OUOE003,326 –19–13APR98–1/1

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Tooth Shank | Preheat Temperature<br>Fillet Weld<br>Distance | 204—316°C (400—600°F)<br>12.7 mm (0.5 in.)<br>25 ± 6 mm (0.98 ± 0.24 in.) from weld edge |
| Bucket | Weight | 1230 kg (2710 lb) approximate |
| Pin-to-Retainer M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) |
| Bucket Pivot Bushing-to-Arm | Clearance | As close to but not less than 0.5 mm (0.020 in.) |
| Bucket Pivot Shim-to-Plate Cap Screw | Torque | 88 N•m (65 lb-ft) |

CED,OUOE003,1169 –19–07JUL98–1/1

## REPLACE BUCKET TOOTH

33
3302
2

**CAUTION: Guard against injury from flying pieces of metal; wear goggles or safety glasses.**

**IMPORTANT: Hold the drift at an angle towards the bucket to avoid damaging the rubber pin lock.**

1. Use a hammer and drift to drive out locking pin. Hold drift at an angle toward bucket.

*NOTE: Alternate buckets may use different tooth assemblies.*

2. Remove tooth.

T95784 –UN–10NOV88

TX,33,GG2393 –19–13DEC96–1/3

3. Inspect rubber pin lock (A) for damage. Replace if necessary.

4. If rubber pin lock has moved, reposition in slot in adapter tooth shank.


T95785 –UN–10NOV88

**A—Rubber Pin Lock**

**Continued on next page**

TX,33,GG2393 –19–13DEC96–2/3

5. Install new tooth over tooth shank.
6. Drive locking pin into hole fully.

*NOTE: Check bucket teeth periodically so that wear does not extend to the bucket tooth shank.*

T95786 –UN–10NOV88



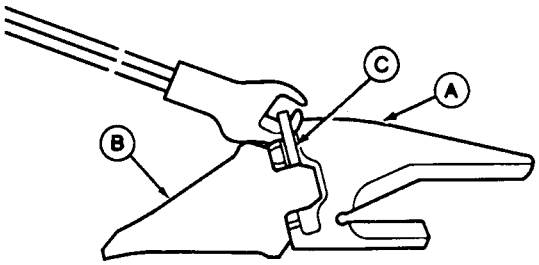
TX,33,GG2393 –19–13DEC96–3/3

## REPLACE BUCKET TOOTH TIP—HEAVY-DUTY BUCKET

1. Clean tooth (A) and tooth tip (B).
2. Insert lock removal tool under U-shaped pin (C).

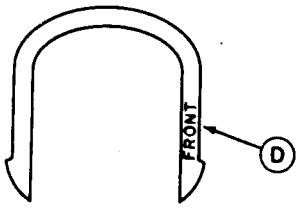
**CAUTION: Avoid possible injury. Pin may fly after it is released from tooth tip. Keep a firm grip on pin to prevent injury.**

3. Remove pin.
4. Turn tooth tip counterclockwise and pull it towards you to remove.
5. Clean tooth shank.
6. Replace U-shaped pin at same time you replace tooth tip.
7. Insert tooth tip on shank turning tip clockwise.
8. Install U-shaped pin. Side of pin marked “FRONT” (D) must be towards tooth tip. Make sure pin is firmly engaged over tooth tip.




T6879EE

T6879EE –UN–06DEC88




T7527DO –UN–27JUN91

**A—Tooth**
**B—Tooth Tip**
**C—Pin**
**D—“Front” Mark**

TX,33,GG2395 –19–13DEC96–1/1

## WELDING ON MACHINE

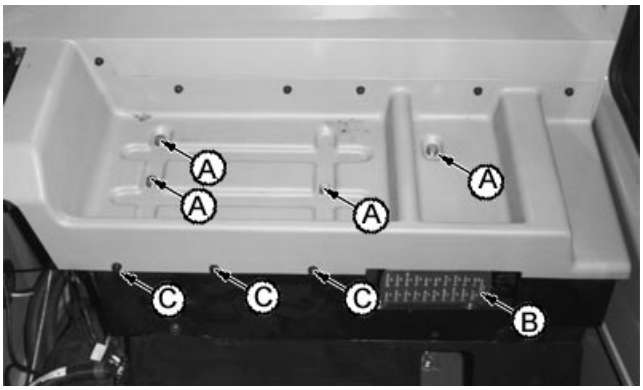
33
3302
4

**IMPORTANT: Electrical current traveling from the welder through the machine electrical system may damage the machine electrical system, including battery, EPC controller. Disconnect battery ground cable and EPC electrical connectors before welding on the machine.**

Before welding on the machine, follow the steps listed below to protect the machine electrical system.

TX,16,UU3320 –19–07JUL98–1/3

1. Inside the cab, remove four cap screws (A and C) and the fuse box cover (B) to remove the rear console cover.
2. Disconnect the battery ground and positive cables.




T107932B –UN–07MAR97

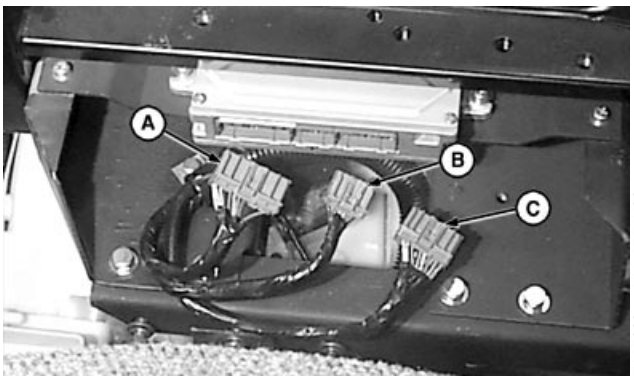
**A—Cap Screw (4 used)**
**B—Fuse Box Cover**
**C—Cap Screw (3 used)**

**Continued on next page**

TX,16,UU3320 –19–07JUL98–2/3

3. Disconnect the engine and pump controller electrical connectors.

   After reconnecting batteries, engine speeds must be recalibrated.




**A—EPC Connector**
**B—EPC Connector**
**C—EPC Connector**

33
3302
5

TX,16,UU3320 –19–07JUL98–3/3

## REMOVE AND INSTALL TOOTH SHANK

**IMPORTANT: Electrical current traveling from the welder through the machine's electrical system may damage the electrical system, including the battery, and the engine and pump controller. Before welding on the machine, the battery ground cable and wiring harness connectors to the engine and pump controller must be disconnected to protect the machine's electrical system.**

1. Disconnect battery ground strap and wiring harness connectors from engine and pump controller. (See Welding on Machine in this group.)

**Continued on next page**

TX,33,GG2396 –19–13DEC96–1/4

33
3302
6

2. Being careful not to cut into cutting edge, remove weld using a cutting torch or air arc equipment to remove shank.

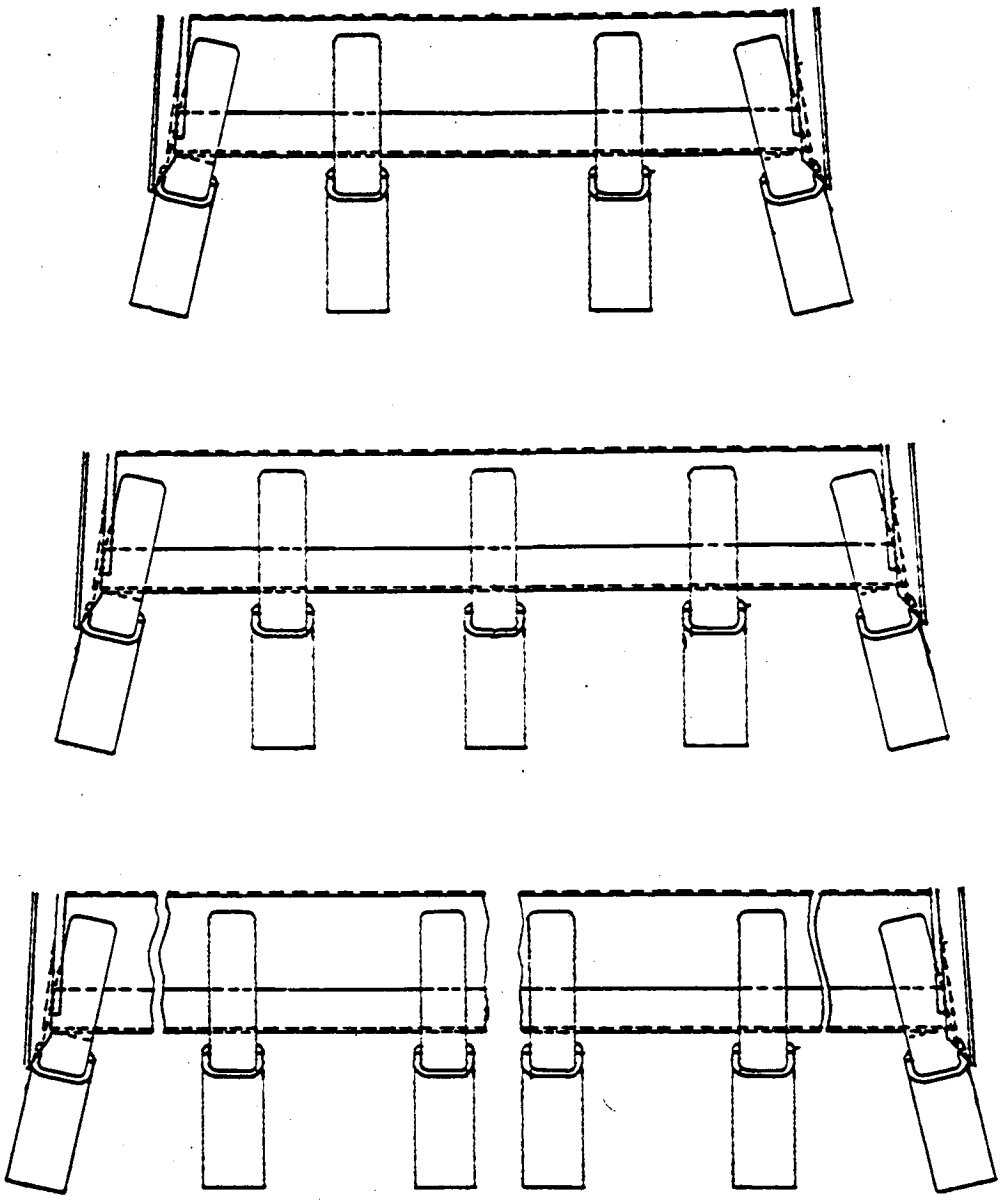
3. Grind all surfaces smooth.

T92509 –UN–31OCT88

T92510 –UN–31OCT88

**Continued on next page**

TX,33,GG2396 –19–13DEC96–2/4



T5985AQ –UN–31OCT89

**IMPORTANT: Good welds are important. Have only a qualified welder do the welding. Before welding, clean all dirt and paint from weld area. Connect the welder ground clamp as close to each weld area as possible so electrical current does not pass through any bearings or bushings.**

4. Before welding shank, remove tooth tip so rubber pin lock is not damaged by heat.
5. Install shank into corner so it is tight against bevel edge and side of bucket.

   Install center shanks so they are tight against bevel edge and spaced equally across width of bucket.
6. Tack weld at top rear center to hold it in position.

   Use E7018 electrodes for welding or Lincoln Electric Co. gasless flux core process electrode type NS3M. 3/32 or 1/8 in. rod may be used.

**Continued on next page**

7. Preheat shank and cutting edge. Check temperature using a temperature stick to be sure correct temperature is obtained.

**Tooth Shank—Specification**

Preheat Temperature ..... 204—316°C (400—600°F)

**IMPORTANT: All weld beads must be continuous starting at rear center, around the corner and along the side for a good strong weld joint. DO NOT start or stop welding at a corner.**

8. Weld shank to cutting edge using 12.7 mm (0.5 in.) fillet weld (1).

**Tooth Shank—Specification**

Fillet Weld..... 12.7 mm (0.5 in.)

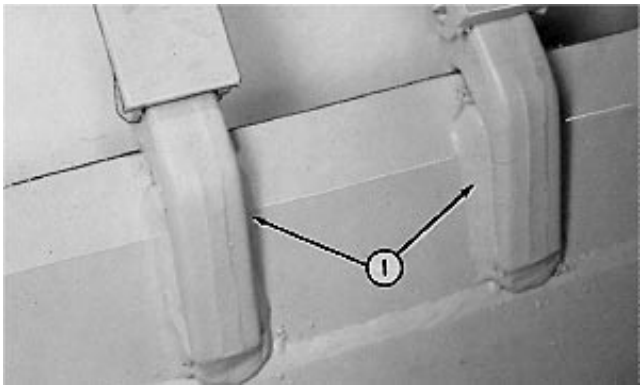
Starting at rear center of shank, weld a continuous bead across end, around corner, and along side, stopping from edge of cutting edge as specified.

**Tooth Shank—Specification**

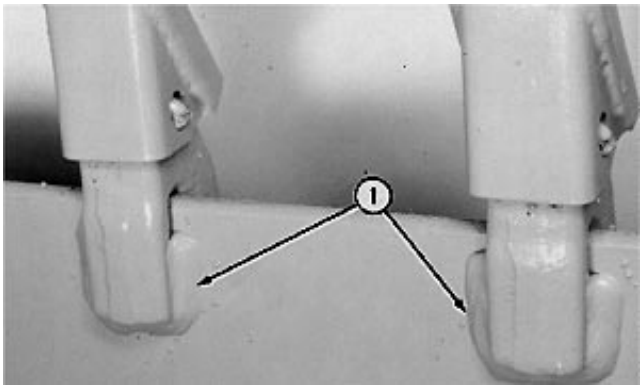
Distance..... 25 ± 6 mm (0.98 ± 0.24 in.) from weld edge

Alternating from side to side, make as many passes as necessary to get the specified bead size.

9. Allow weld area to cool slowly at room temperature.




T82798 –UN–31OCT88




T82799 –UN–31OCT88

**1—Fillet Weld**

TX,33,GG2396 –19–13DEC96–4/4

## REPLACE WELDED CUTTING EDGE



**IMPORTANT: Electrical current traveling from the welder through the machine's electrical system may damage the electrical system, including the battery, and the engine and pump controller. Before welding on the machine, the battery ground cable and wiring harness connectors to the engine and pump controller must be disconnected to protect the machine's electrical system.**

1. Disconnect battery ground strap and wiring harness connectors to engine and pump controller. (See Welding on Machine in this group.)

2. Perform welding in an environment with a minimum ambient temperature of 10°C (50°F).

3. Clean all joints to be welded of all foreign matter such as dirt, rust, mill scale, oil, etc. with grinders and/or solvents.

4. Use dry AWS-E7018 low hydrogen electrodes or either of the following equivalent low hydrogen wire feed electrodes: gas metal arc welding ($CO_2$ or argon $CO_2$) AWS-E70S6 or flux cored arc welding AWS-E70T1.

5. Preheat parts to be welded (both tack and final welds) to minimum of 204°C (400°F). PREHEAT TEMPERATURE MUST BE THROUGHOUT THE ENTIRE THICKNESS OF THE PARTS JOINED AND AT LEAST 51 mm (2 in.) BACK FROM THE JOINT. Maintain preheat throughout the entire welding operation. Tempilstiks should be used if possible.

6. Tack weld preheated plates starting at center of bucket and working towards the outside ends.

7. Final weld preheated plates starting at the center of front edge of bucket backing plate and working towards the outside ends.

   Repeat this operation at back edge of plates.

   Tack welds may be incorporated into the final weld, providing they have been made with electrodes that meet the requirements of the final welds and no cracking has occurred in the weld metal. Tack welds not meeting these requirements must be completely removed by grinding or air arc gouging just prior to making the final weld in that area.

8. Do not remove bucket from welding environment until weld metal temperature has dropped to the ambient temperature. Do not force cooling rate of weld metal.

TX,33,GG2397 –19–14DEC96–1/1

## REPAIR CRACKED CUTTING EDGE

33
3302
10

**IMPORTANT: Electrical current traveling from the welder through the machine's electrical system may damage the electrical system, including the battery, and the engine and pump controller. Before welding on the machine, the battery ground cable and wiring harness connectors to the engine and pump controller must be disconnected to protect the machine's electrical system.**

1. Disconnect battery ground strap and wiring harness connectors to engine and pump controller. (See Welding on Machine in this group.)
2. For any crack in cutting edge, clean the area to find end of crack.
3. Drill a small hole at end of crack to prevent spreading.
4. Grind a V-groove along crack on top and bottom of cutting edge.
5. Preheat the cracked area to approximately 149—260°C (300—500°F).
6. Fill the V-grooves with weld. Use E7018 electrodes. Extend the weld approximately 13 mm (0.5 in.) beyond end of crack.

TX,33,GG2398 –19–14DEC96–1/1

## DISASSEMBLE AND ASSEMBLE BUCKET

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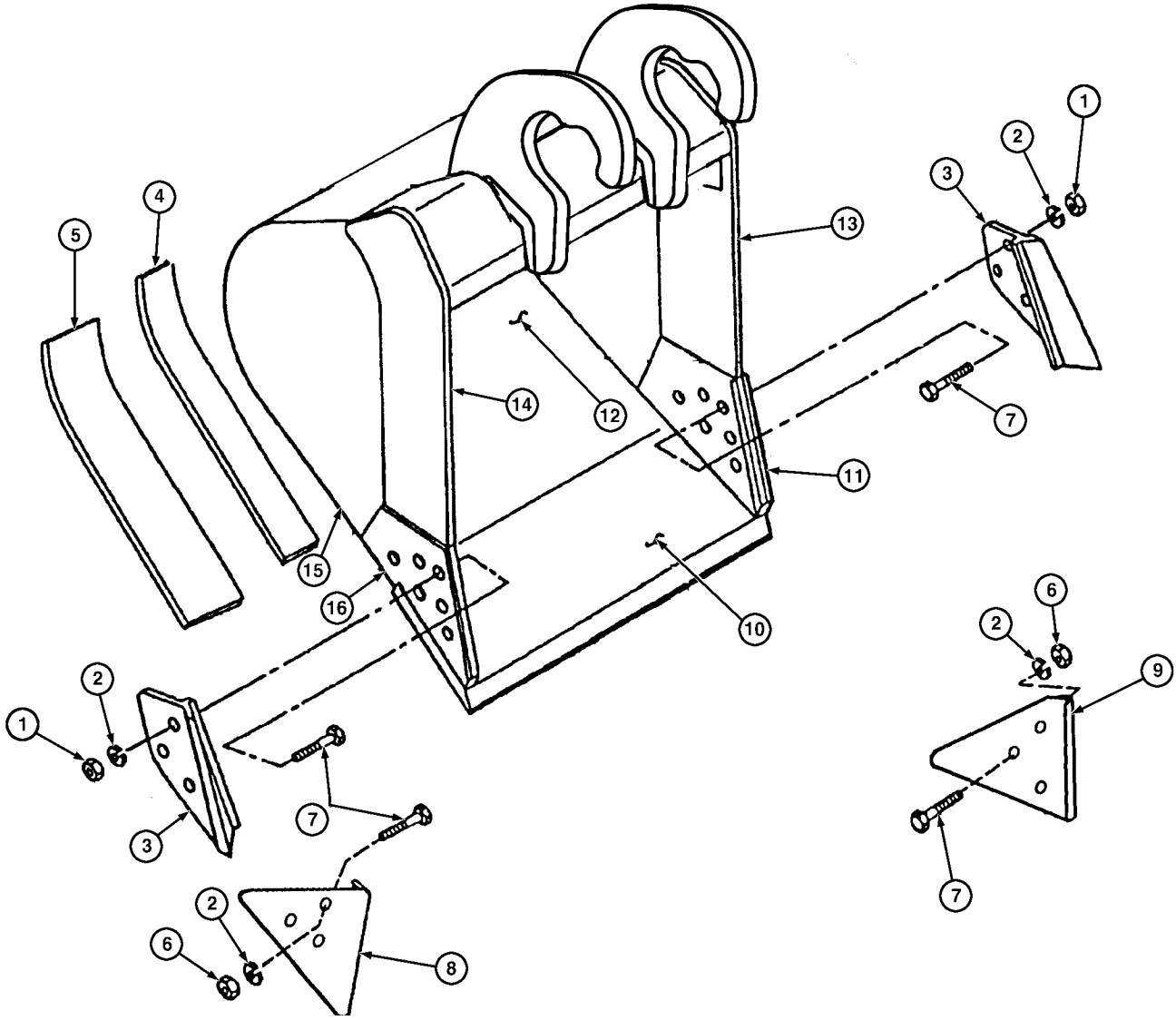
3302
11




T120767 –UN–14APR99

T120767

| | | | |
|---|---|---|---|
| 1—Nut (6 used) | 5—Outer Wear Bar (2 used) | 9—Wear Shroud | 13—Upper Vertical Cutter |
| 2—Lock Washer (6 used) | 6—Nut (6 used) | 10—Cutting Edge | 14—Upper Vertical Cutter |
| 3—Cutting Edge | 7—Lock Washer (3 used) | 11—Insert Vertical Cutter | 15—Plate |
| 4—Inner Wear Bar | 8—Wear Shroud | 12—Moldboard | 16—Insert Vertical Cutter |

Inspect parts for wear or damage; replace as necessary.

To repair cracks, see Repair Cracked Cutting Edge in this group.

Continued on next page

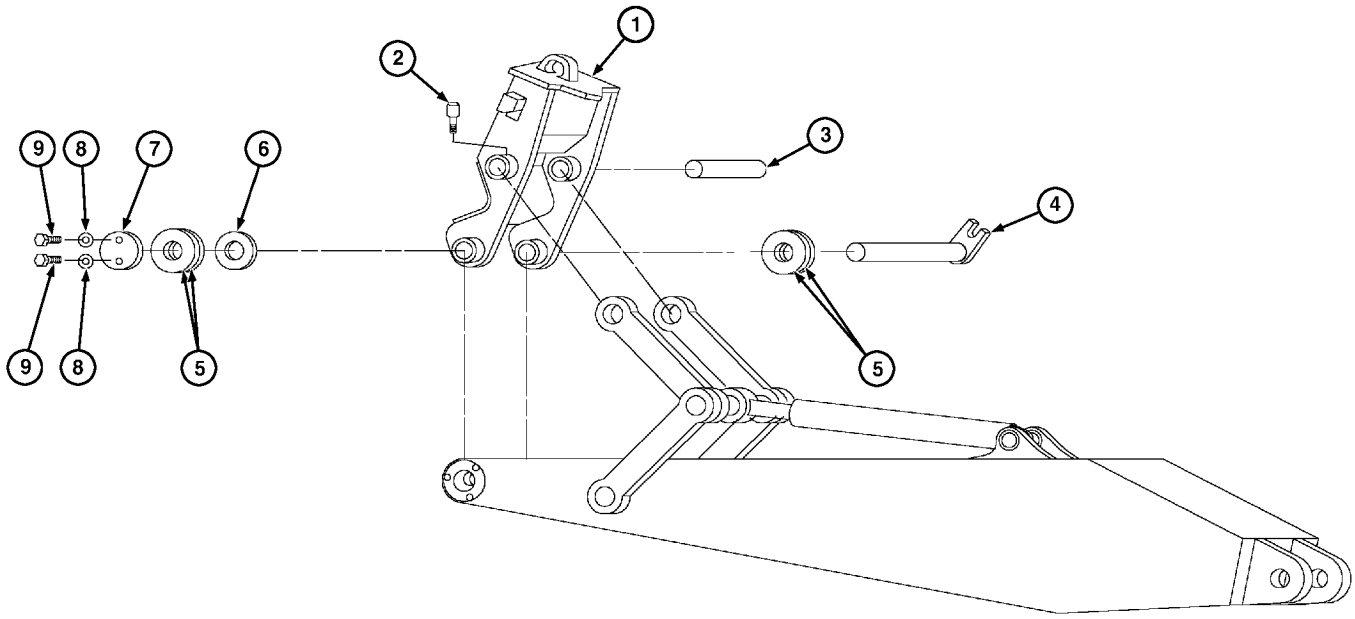
CED,OUOE042,56 –19–19MAR99–1/2

To replace cutting edges, see Replace Welded Cutting Edge in this group.

33
3302
12

CED,OUOE042,56 –19–19MAR99–2/2

## REMOVE AND INSTALL QUICK-DISCONNECT HITCH




T121189 –UN–20APR99

**T121189**

**1—Quick-Disconnect Hitch**
**2—Cap Screw**
**3—Pin**
**4—Pin**
**5—Shims (use as required)**
**6—Spacer**
**7—Retainer Plate**
**8—Lock washer (2 used)**
**9—Cap Screws (2 used)**

1. Park machine on a firm, level surface.
2. Remove attachment from quick-disconnect hitch.

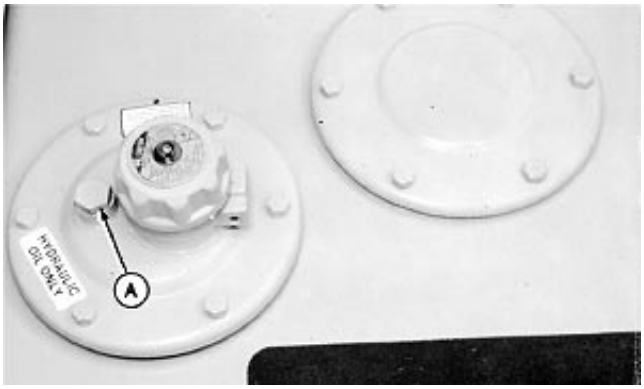
**CAUTION: The approximate weight of the quick-disconnect hitch is 384 kg (846 lb).**

**Continued on next page**

CED,OUOE042,5069 –19–16APR99–1/3

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

3. Loosen vent plug (A) to release air pressure from hydraulic tank.

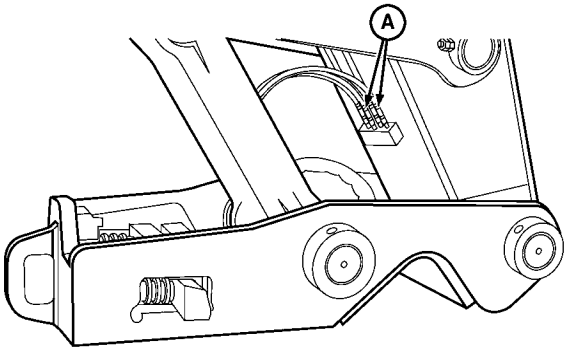



T7869AT –UN–12NOV92

**A—Vent Plug**

CED,OUOE042,5069 –19–16APR99–2/3

4. Slowly loosen rod supply lines (A) and disconnect.
5. Remove cap screws (2) from left side of pin (3).
6. Remove pin (3).
7. Remove cap screws (9), washers (8), and retaining plate (7) from pin (4).
8. Remove pin (4). Take note of location and quantity of any shims.
9. Raise arm to separate from the quick-disconnect hitch (1) out of the way.
10. Replace parts as necessary.
11. Position arm into the quick-disconnect hitch into position on the arm. Align the pin bores.
12. Install pin (4), shims (5) and spacer (6).
13. Install retaining plate (7) and cap screws (9) and lock washers (5).
14. Install pin (3) and set screw (2).
15. Install hydraulic lines (A).




T121192

T121192 –UN–28OCT99

**A—Hydraulic Lines (2 used)**

CED,OUOE042,5069 –19–16APR99–3/3

## DISASSEMBLE QUICK-DISCONNECT HITCH

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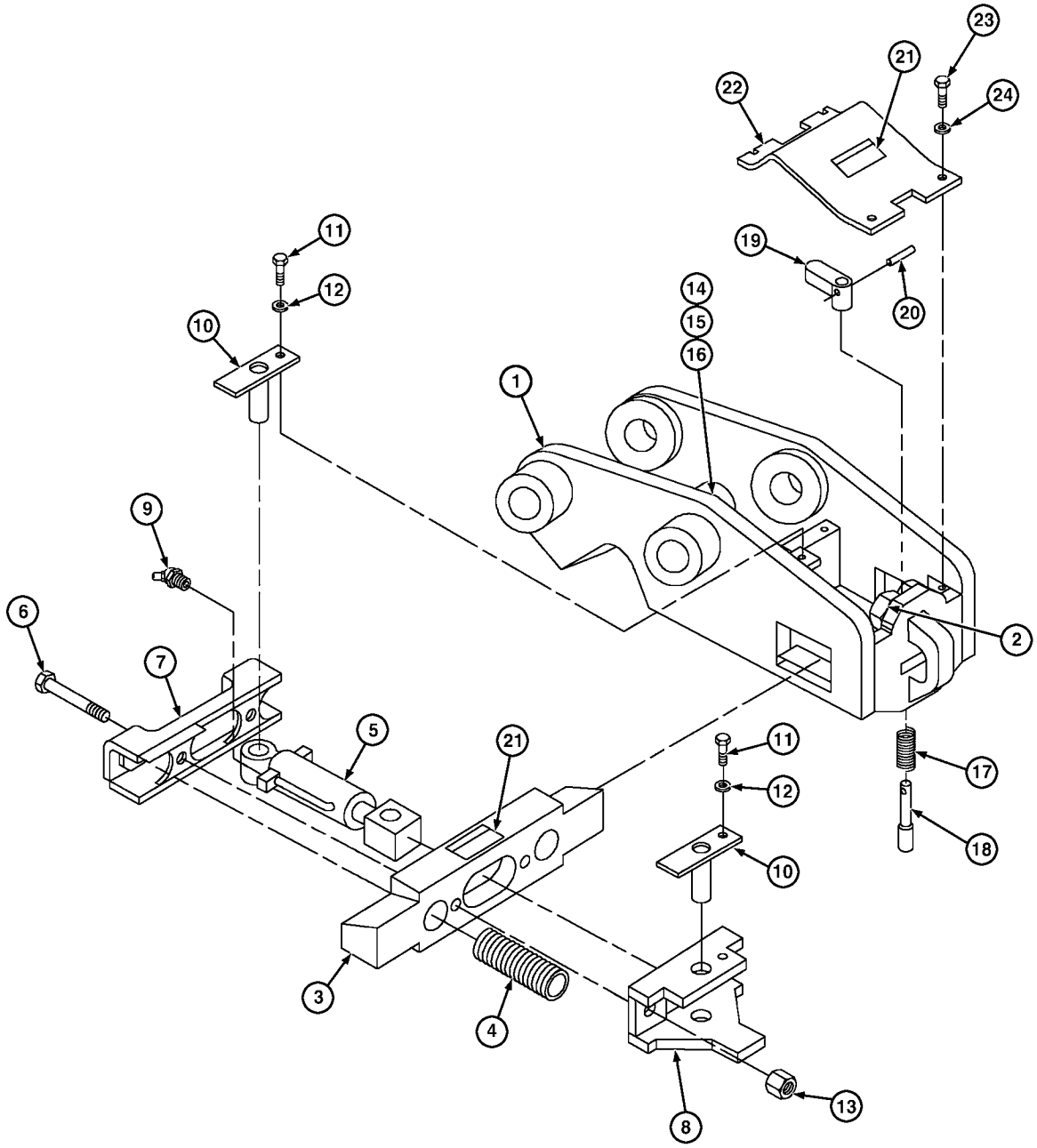
3302
14




T120511

T120511 –UN–25MAR99

Continued on next page

CED,OUOE042,5070 –19–16APR99–1/2

**1—Quick-Latch Frame Assembly**
**2—Grease Fitting**
**3—Wedge Bar**
**4—Spring**
**5—Hydraulic Cylinder**
**6—Cap Screw (2 used)**
**7—Spring Mounting Bracket**
**8—Cylinder Mounting Bracket**
**9—Elbow**
**10—Pin Assembly**
**11—Cap Screw (2 used)**
**12—Lock Washer (2 used)**
**13—Nut (2 used)**
**14—Hose Clamp**
**15—Cover Plate**
**16—Cap Screw**
**17—Spring**
**18—Pin**
**19—Handle Assembly**
**20—Roll Pin**
**21—Decal**
**22—Cover**
**23—Cap Screw (4 used)**
**24—Lock Washer (4 used)**
**25—Cap Screw (2 used)**

**IMPORTANT: The quick-disconnect hitch must be in latch mode.**

1. Remove cap screws (23), washers (24) and cover (22).
2. Remove cap screw (16), cover plate (15) and hose clamp (14).
3. Slowly remove cap screws (6) and nuts (13) in order to release tension of springs (4).
4. Remove the cylinder rod mounting bracket (8), wedge bar (3) and spring mounting bracket (7).
5. Remove hydraulic cylinder (5).
6. Block up pin (18) with a shim through slot in the back plate of frame.
7. Remove roll pin (20) and remove handle (19).

**CAUTION: Assembly is under spring tension. Remove shim carefully.**

8. Slowly remove blocking shim and remove pin (18) and spring (17).

CED,OUOE042,5070 –19–16APR99–2/2

## ASSEMBLE QUICK-DISCONNECT HITCH

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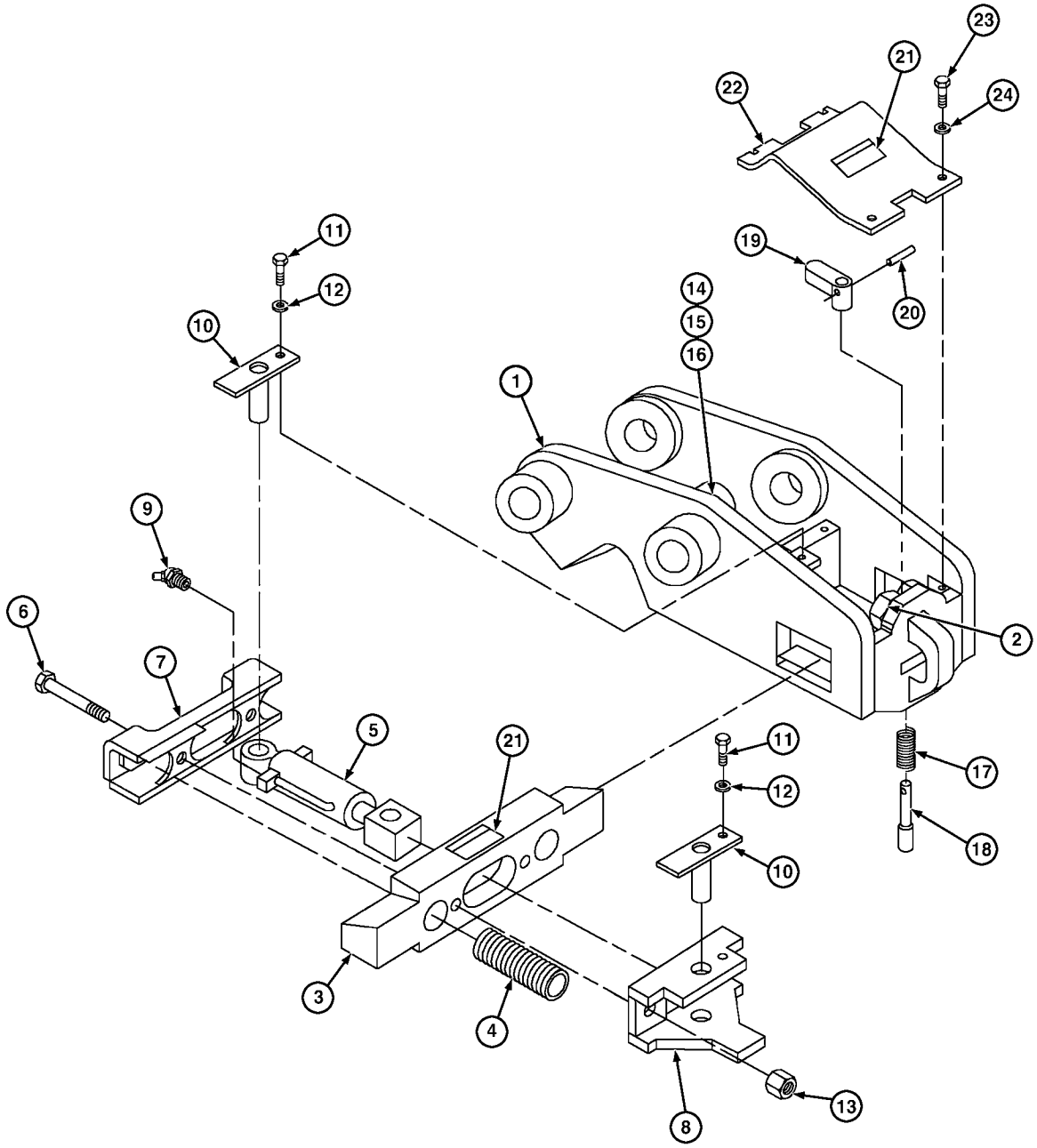
3302
16




T120511

T120511 –UN–25MAR99

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CED,OUOE042,5071 –19–16APR99–1/3

*Buckets*



**1—Quick-Latch Frame Assembly**
**2—Grease Fitting**
**3—Wedge**
**4—Spring**
**5—Hydraulic Cylinder**
**6—Cap Screw (2 used)**
**7—Spring Mounting Bracket**
**8—Cylinder Mounting Bracket**
**9—Elbow**
**10—Pin Assembly**
**11—Cap Screw (2 used)**
**12—Lock Washer (2 used)**
**13—Nut (2 used)**
**14—Hose Clamp**
**15—Cover Plate**
**16—Cap Screw**
**17—Spring**
**18—Pin**
**19—Handle Assembly**
**20—Roll Pin**
**21—Decal**
**22—Cover**
**23—Cap Screw (4 used)**
**24—Lock Washer (4 used)**
**25—Cap Screw (2 used)**

1. Slide spring (17) over pin (18) and push them up through the hole in the rear of the latch frame.
2. Block in the pin with a shim using the slot in the back plate of the frame.
3. Slide handle assembly onto the pin and align the pin bores.
4. Insert roll pin (20) through pin bore and remove the shim.
5. Rotate wedge bar (3) 90 degrees and slide it into the latch frame (1). The wedge taper should be on the top and angled down towards the link pin when the wedge bar is routed back to it's upright position.
6. Tilt the top of wedge bar back about 30 degrees. Slide the two compression springs (4) into the holes in the wedge bar.
7. While the wedge bar is still tilted up, slide the hydraulic cylinder (5) into the center hole of the wedge bar. Slide the cylinder inward eye first and with the rod port on the right hand side.
8. Install the two cap screws (6) into the spring mounting bracket (7) and place the bracket on the end of the two compression springs (4). Rotate the all the parts downward into the latch frame (1).
9. Install the two 45 degree elbows (9) with the ends oriented downwards.
10. Install the cylinder rod eye mounting bracket (8) in the frame on the rearward side of the wedge.
11. Route the two hydraulic lines through the holes in the latch frame cross member. Connect the lines to the elbows (9).
12. Assemble hydraulic cylinder base side pin (10) and rod side pin (10) with mounting hardware (11) and (12). Torque cap screws to 45 lb-ft. Tighten nuts (13).

**Side Pin Cap Screw—Specification**

Torque..... 45 lb-ft

13. Slide the two cap screws (6) through the wedge bar (3) and rod eye mounting bracket (8). Install the two nuts (13) and tighten to 200 lb-ft. This will draw the cylinder rod eye mounting bracket, wedge bar, and spring mounting bracket together. This will also apply a spring pre-load to the wedge bar.

**Wedge Bar Nuts—Specification**

Torque..... 200 lb-ft

14. Route the hydraulic lines so they clear the arm link. Anchor the lines with hose clamps (14) and mounting hardware (15) and (16).
15. Install cover (22) to the quick-disconnect hitch with cap screws (23) and lock washers (24). Torque the cap screws (24) to 80 lb-ft.

**Continued on next page**

CED,OUOE042,5071 –19–16APR99–2/3

*Buckets*

**Cover Cap Screws—Specification**

33 3302 18

Torque..... 80 lb-ft

CED,OUOE042,5071 –19–16APR99–3/3

## 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.*

CED,OUOE003,331 –19–16APR98–1/5

Lifting Bracket . . . . . .JT01748

Use with a hoist to lift components.

CED,OUOE003,331 –19–16APR98–2/5

Floor Stand

To support load of boom and boom cylinder.

CED,OUOE003,331 –19–16APR98–3/5

Bushing, Bearing, and Seal Driver Set

Use with puller set to remove and install bushings in boom and arm.

CED,OUOE003,331 –19–16APR98–4/5

17-1/2 and 30 Ton Puller Set

To remove and install bushings in boom and arm.

CED,OUOE003,331 –19–16APR98–5/5

*Frames*

## OTHER MATERIAL

33
3340
2

| Number | Name | Use |
|---|---|---|
| | Multi-Purpose Grease | Apply to pivot joints for removal and installation of bucket links. |

CED,OUOE003,328 –19–13APR98–1/1

*Frames*

## SPECIFICATIONS



| Item | Measurement | Specification |
|---|---|---|
| Bucket Links: | | |
| Pin-to-Retainer M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Arm: | | |
| Arm | Weight | 1020 kg (2250 lb) approximate |
| Bucket Cylinder | Weight | 261 kg (575 lb) approximate |
| Boom-to-Arm Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Arm-to-Arm Cylinder Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Bucket Cylinder Head End-to-Arm Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Bucket Cylinder Rod End-to-Link Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Boom: | | |
| Boom | Weight | 2280 kg (5030 lb) approximate |
| Boom Cylinder | Weight | 324 kg (714 lb) approximate |
| Arm Cylinder | Weight | 493 kg (1087 lb) approximate |
| Boom-to-Frame Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Boom Cylinder-to-Boom Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Boom Cylinder Head End Pins and Bushings: | | |
| Pin | OD<br>OD | 110.0 mm (4.33 in.) nominal<br>109.0 mm (4.30 in.) limit of use |

Continued on next page

*Frames*

33
3340
4

| Item | Measurement | Specification |
|---|---|---|
| Boss, Frame or Boom | ID<br>ID | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Bushing, Cylinder | ID<br>ID | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Boom Cylinder Rod End Pins and Bushings: | | |
| Pin | OD<br>OD | 110.0 mm (4.33 in.) nominal<br>109.0 mm (4.30 in.) limit of use |
| Boss, Frame and Boom | OD<br>OD | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in) limit of use |
| Bushing, Cylinder | OD<br>OD | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Boom-to-Frame Joint Pins and Bushings: | | |
| Pin | OD<br>OD | 110.0 mm (4.33 in.) nominal<br>109.0 mm (4.30 in.) limit of use |
| Bushing, Boom | ID<br>ID | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Boom-to-Arm Joint Pins and Bushings: | | |
| Pin | OD<br>OD | 110.0 mm (4.33 in.) nominal<br>109.0 mm (4.30 in.) limit of use |
| Bushing, Arm | ID<br>ID | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Arm Cylinder Head or Rod End Pins and Bushings: | | |
| Pin | OD<br>OD | 110.0 mm (4.33 in.) nominal<br>109.0 mm (4.30 in.) limit of use |
| Boss, Boom or Arm | ID<br>ID | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |

**Continued on next page**

*Frames*

| Item | Measurement | Specification |
|---|---|---|
| Bushing, Cylinder | ID<br>ID | 110.0 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Bucket Cylinder Head End Pins and Bushings: | | |
| Pin | OD<br>OD | 90.0 mm (3.54 in.) nominal<br>89.0 mm (3.50 in.) limit of use |
| Boss, Arm | ID<br>ID | 90.0 mm (3.54 in.) nominal<br>91.5 mm (3.60 in.) limit of use |
| Bushing, Cylinder | ID<br>ID | 90.0 mm (3.54 in.) nominal<br>91.5 mm (3.60 in.) limit of use |
| Bucket Cylinder Rod End Pins and Bushings: | | |
| Pin | OD<br>OD | 100.0 mm (3.94 in.) nominal<br>99.0 mm (3.90 in.) limit of use |
| Bushing, Link | ID<br>ID | 100.0 mm (3.94 in.) nominal<br>101.5 mm (4.00 in.) limit of use |
| Bushing, Cylinder | ID<br>ID | 100.0 mm (3.94 in.) nominal<br>101.5 mm (4.00 in.) limit of use |
| Link-to-Arm Joint Pins and Bushings: | | |
| Pin | OD<br>OD | 90.0 mm (3.54 in.) nominal<br>89.0 mm (3.50 in.) limit of use |
| Bushing, Arm | ID<br>ID | 90.0 mm (3.54 in.) nominal<br>91.5 mm (3.60 in.) limit of use |
| Link-to-Bucket Joint Pins and Bushings: | | |
| Pin | OD<br>OD | 100.0 mm (3.94 in.) nominal<br>99.0 mm (3.90 in.) limit of use |
| Bushing, Link | ID<br>ID | 100.0 mm (3.94 in.) nominal<br>101.5 mm (4.00 in.) limit of use |

Continued on next page

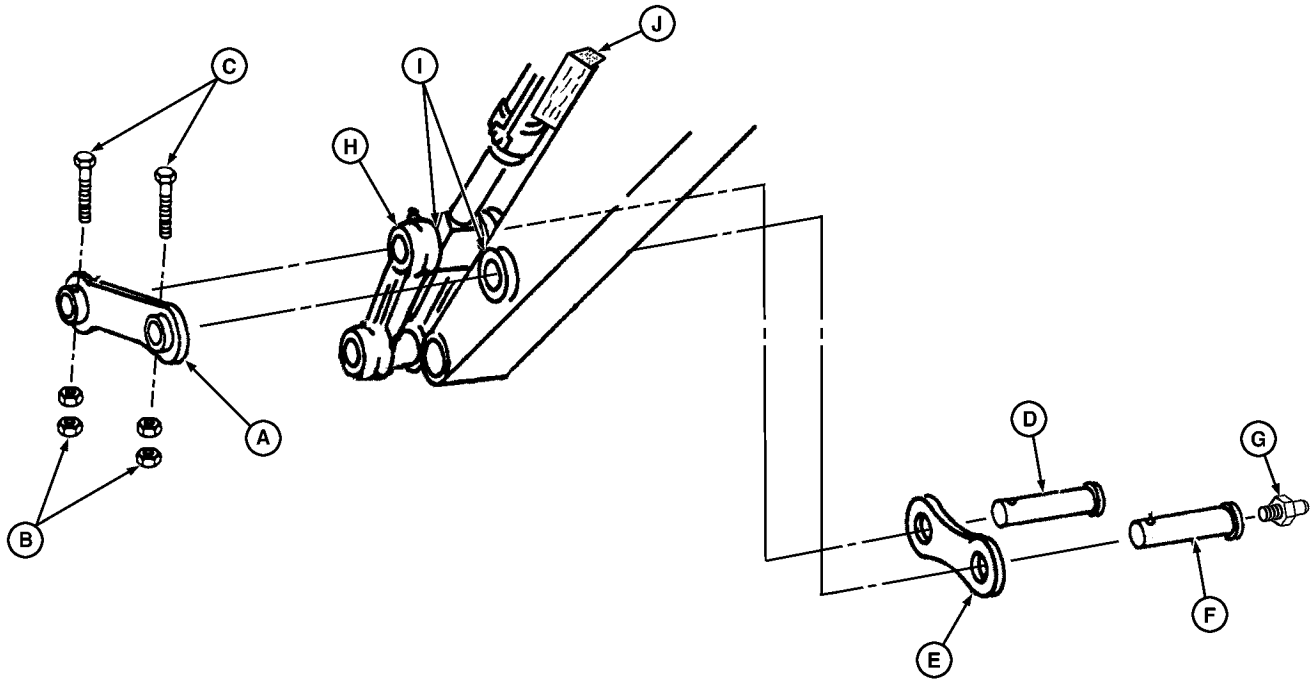
*Frames*

| Item | Measurement | Specification |
|---|---|---|
| 33 3340 6 Bucket-to-Arm Joint Pins and Bushings: | | |
| Pin | OD | 100.0 mm (3.94 in.) nominal |
| | OD | 99.0 mm (3.90 in.) limit of use |
| Bushing, Arm | ID | 100.0 mm (3.94 in.) nominal |
| | ID | 101.5 mm (4.00 in.) limit of use |

CED,OUOE020,48 –19–13APR99–4/4

## REMOVE AND INSTALL BUCKET LINKS






T115112 –UN–01JUL98

T115112

**A—Left Side Link**
**B—M20 Nut (4 used)**
**C—M20 Cap Screw (2 used)**
**D—Links-to-Bucket Cylinder Pin**
**E—Right Side Link**
**F—Links-to-Arm Pin**
**G—Lubrication Fitting (2 used)**
**H—Center Link**
**I—Washer (As Required)**
**J—Wooden Block**

*NOTE: Removal of bucket is not necessary for the removal of just the bucket links. Remove the bucket if the arm is also being removed. (See Remove and Install Bucket in Group 3302.)*

1. Connect center link (H) to a hoist using a lifting bracket. Put a wooden block (J) between bucket cylinder and arm to hold cylinder up when links-to-bucket cylinder pin (D) is removed.
2. Remove nuts (B) and cap screws (C).

   As links-to-bucket cylinder pin (D) is removed, lower left (A) and right (E) side links to ground.

**Continued on next page**

CED,OUOE027,253 –19–18MAY98–1/2

3. Inspect bushings (L and M) and dust seals (K). (See Inspect Arm and Boom Pins and Bushings in this group.)

   Replace parts as necessary.

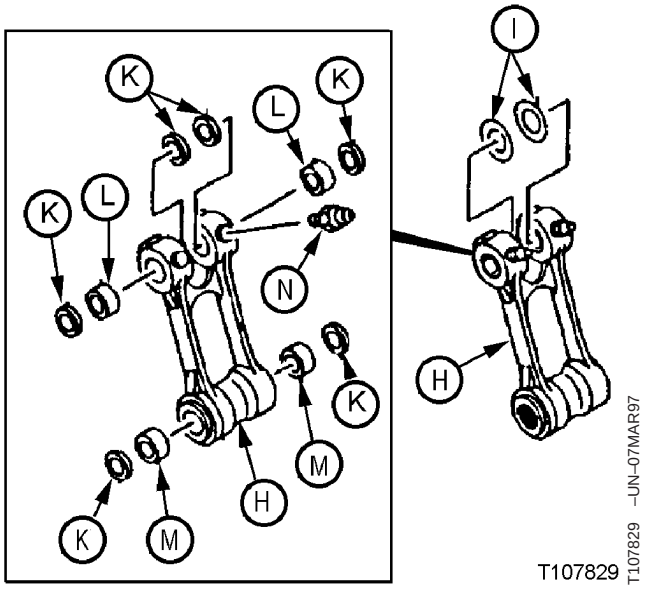
4. Before installing pins, align pin bores so as not to damage dust seal when pins are installed.

5. Tighten nuts (B) against each other, not the retainer. Cap screw (C) must be free to turn in hole.

**Pin-to-Retainer M20 Cap Screw Nut—Specification**

| | |
|---|---|
| Torque ..... | 540 N•m (400 lb-ft) tighten nuts against each other, not the retainer |

6. Apply grease to pivot joints. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in Fuels and Lubricants, Group 0004.)




**H—Center Link**
**I—Washer (As Required)**
**J—Lubrication Fitting (2 used)**
**K—Dust Seal (6 used)**
**L—Bushing (2 used)**
**M—Bushing (2 used)**
**N—Lubrication Fitting (2 used)**

CED,OUOE027,253 –19–18MAY98–2/2

## REMOVE AND INSTALL ARM

1. Remove bucket. (See Remove and Install Bucket in Group 3302.)

2. Retract arm cylinder.

3. Put a floor stand under end of boom so load is on boom, not on arm cylinder.

4. Extend arm cylinder just enough to put end of arm on ground.

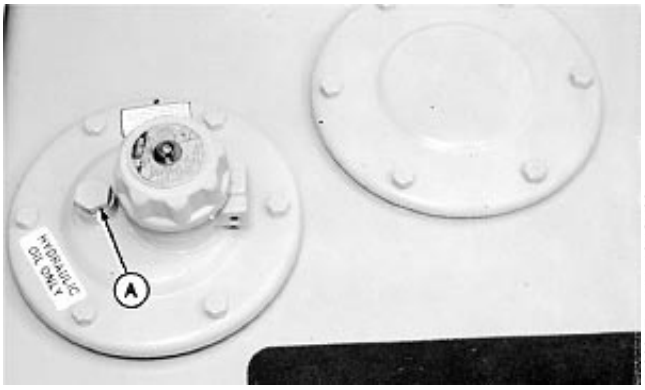
5. Stop engine.

**Continued on next page**

CED,OUOE020,47 –19–13APR99–1/4

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

6. Loosen vent plug (A) to release air pressure in hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE020,47 –19–13APR99–2/4

33
3340
10

**CAUTION: The approximate weight of 2.66 m (8 ft 7 in.) arm is 1020 kg (2250 lb).**

**The approximate weight of bucket cylinder is 261 kg (575 lb).**

**Arm—Specification**

Weight..... 1020 kg (2250 lb) approximate

**Bucket Cylinder—Specification**

Weight..... 261 kg (575 lb) approximate

7. Remove arm without bucket cylinder or with bucket cylinder installed.

*NOTE: The bucket end of arm is the heavy end when hoist is connected to mounting boss for the bucket cylinder.*

8. Attach hoist to mounting boss for bucket cylinder.

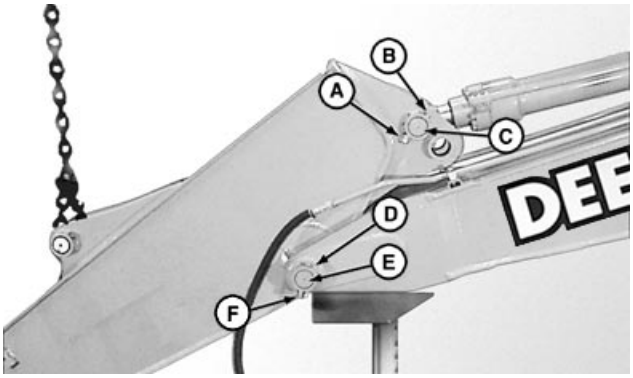
9. Remove bucket cylinder and links. (See procedure in this group and Group 3360.)

10. Remove nuts (A and F) and cap screws (B and D).

11. Put a wooden block between arm cylinder and boom to hold cylinder up when arm-to-arm cylinder pin (C) is removed.

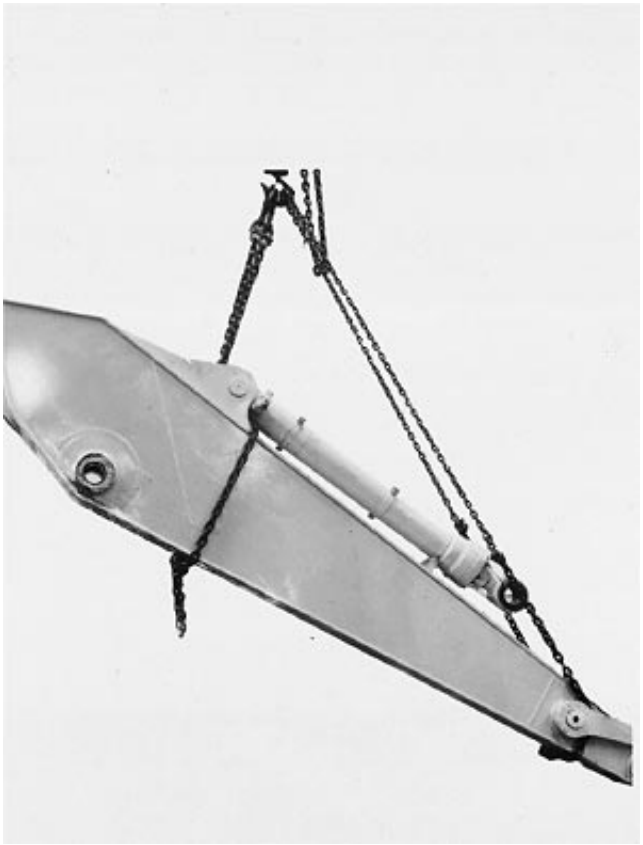
12. Inspect bushings and dust seals. (See Inspect Arm and Boom Pins and Bushings in this group.)

13. Repair or replace parts as necessary. (See Remove and Install Bushings and Seals in this group.)




T114376 –UN–25MAR98

*Arm Without Bucket Cylinder*



T6626JC –UN–31OCT88

*Arm With Bucket Cylinder*

**A—M20 Nut (2 used)**
**B—M20 Cap Screw**
**C—Arm-to-Arm Cylinder Pin**
**D—M20 Cap Screw**
**E—Arm-to-Boom Pin**
**F—M20 Nut (2 used)**

**Continued on next page**

CED,OUOE020,47 –19–13APR99–3/4

14. Install washers (G) equally on each side of arm to get minimal amount of clearance at boom-to-arm joint.

*NOTE: There must be some clearance between boom and arm.*

15. Before installing pins (E and F), align pin bores so as not to damage dust seal when pins are installed.

16. Tighten M20 nuts (A and B) against each other, not the retainer. Cap screws (C) must be free to turn in hole.

**Boom-to-Arm Pin M20 Cap Screw Nut—Specification**

Torque ..... 540 N•m (400 lb-ft) tighten nuts against each other, not the retainer

**Arm-to-Arm Cylinder Pin M20 Cap Screw Nut—Specification**

Torque ..... 540 N•m (400 lb-ft) tighten nuts against each other, not the retainer

17. For bucket cylinder, install washers equally on each side of cylinder head and rod end to get minimal amount of clearance in joints.

*NOTE: There must be some clearance in joints.*

18. Tighten M20 nuts against each other, not the retainer. Cap screws (C) must be free to turn in hole

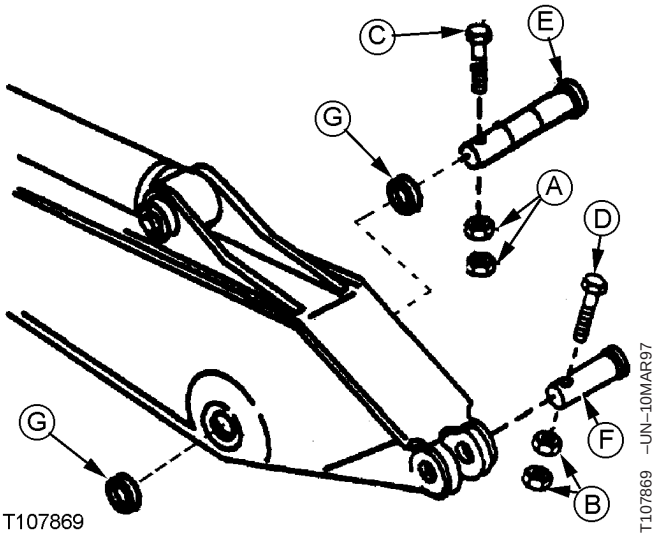
**Bucket Cylinder Head End-to-Arm Pin M20 Cap Screw Nut—Specification**

Torque ..... 540 N•m (400 lb-ft) tighten nuts against each other, not the retainer

**Bucket Cylinder Rod End-to-Link M20 Cap Screw Nut—Specification**

Torque ..... 540 N•m (400 lb-ft) tighten nuts against each other, not the retainer

19. Apply grease to all pivot joints. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in Fuels and Lubricants, Group 0004.)




**A—M20 Nut (2 used)**
**B—M20 Nut (2 used)**
**C—M20 Cap Screw**
**D—M20 Cap Screw**
**E—Arm-to-Boom Pin**
**F—Arm-to-Arm Cylinder Pin**
**G—Washer (As Required)**

CED,OUOE020,47 –19–13APR99–4/4

## REMOVE AND INSTALL BOOM

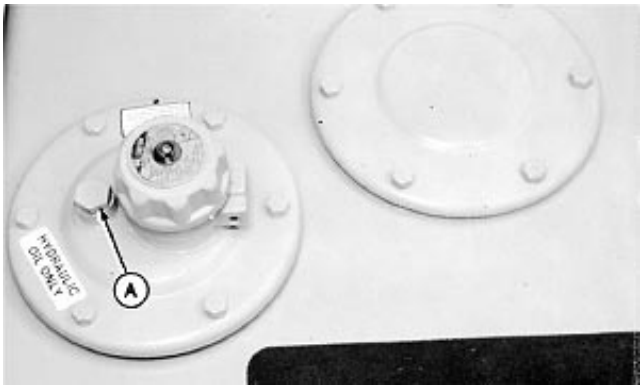
33
3340
12

1. Remove bucket and arm. (See procedures in Group 3302 and in this group.)
2. Lower boom to the ground.
3. Stop engine.

CED,OUOE027,255 –19–18MAY98–1/7

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

4. Loosen vent plug (A) to release air pressure in hydraulic oil tank.
5. Disconnect wiring harness.
6. Disconnect lubrication lines at boom cylinders.



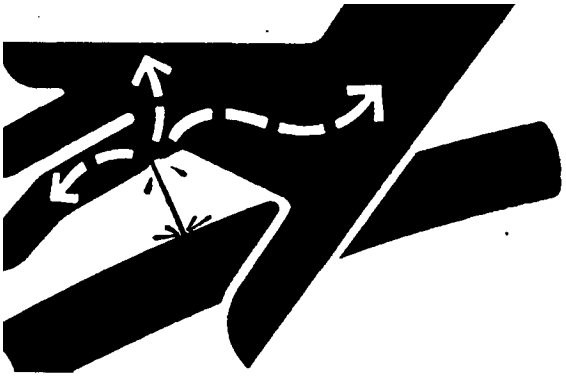

T7869AT –UN–12NOV92

**A—Vent Plug**

CED,OUOE027,255 –19–18MAY98–2/7

**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

7. Remove arm cylinder only if necessary to repair boom. (See Remove and Install Arm Cylinder in Group 3360.)
8. Disconnect arm and bucket lines at frame end of boom.



X9811 –UN–23AUG88

**Continued on next page**

CED,OUOE027,255 –19–18MAY98–3/7

**CAUTION: The approximate weight of boom cylinder is 324 kg (714 lb).**

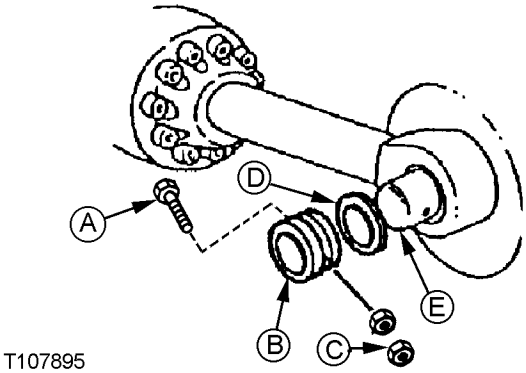
**Boom Cylinder—Specification**

Weight..... 324 kg (714 lb) approximate

9. Attach boom cylinder (F) to hoist using a lifting bracket.
10. Remove nuts (C), cap screw (A), retainers (B), and shims (D).
11. Push boom cylinder-to-boom pin (E) into boom.

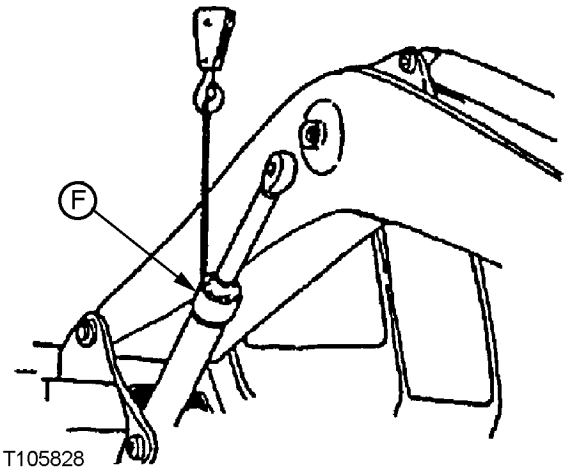
    Lower boom cylinder (F) on floor stand.

    Do procedure again for the second boom cylinder.




T107895

T107895 –UN–10MAR97




T105828

T105828 –UN–30DEC96

**A—Cap Screw (2 used)**
**B—Retainer (2 used)**
**C—Nut (4 used)**
**D—Shim (Washer) (As Required)**
**E—Boom Cylinder-to-Boom Pin**
**F—Boom Cylinder (2 used)**

**Continued on next page**

CED,OUOE027,255 –19–18MAY98–4/7

33
3340
14

**CAUTION: The approximate weight of boom is 2280 kg (5030 lb).**

**The approximate weight of arm cylinder is 493 kg (1089 lb).**

**Boom—Specification**

Weight..... 2280 kg (5030 lb) approximate

**Arm Cylinder—Specification**

Weight..... 493 kg (1087 lb) approximate

12. Attach boom to hoist. Use protective covering to prevent damage to pin if a chain is used.

*NOTE: The arm end of boom is the heavy end with arm cylinder installed. The frame end is the heavy end when the arm cylinder is removed.*


T6626JW –UN–31OCT88

**Continued on next page**

CED,OUOE027,255 –19–18MAY98–5/7

13. Remove nuts (C) and cap screw (A).

14. Remove pin (D) using a slide hammer and adapter. Remove any washers (B) between frame and boom.

15. Inspect bushings and dust seals. (See Inspect Arm and Boom Pins and Bushings in this group.)

    Repair or replace parts as necessary. (See Remove and Install Bushings and Seals in this group.)

16. Install washer (B) equally on each side of boom to get minimal amount of clearance between boom and frame.

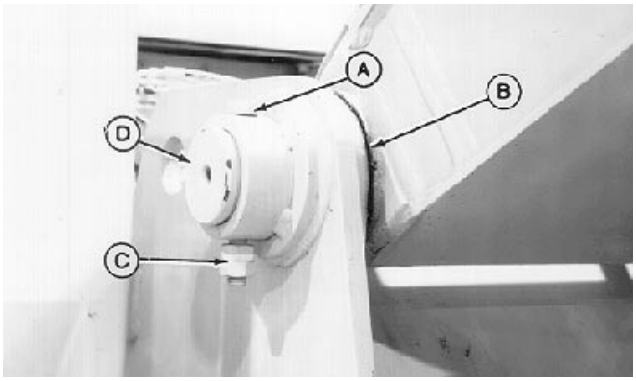
*NOTE: There must be some clearance between boom and frame.*

17. Before installing pin (D), align pin bores so as not to damage dust seal when pins are installed.

    Tighten nuts (C) against each other, not the retainer. Cap screw (A) must be free to turn in hole.

**Boom-to-Frame Pin M20 Cap Screw Nut—Specification**

| | |
|---|---|
| Torque ..... | 540 N•m (400 lb-ft) tighten nuts against each other, not the retainer |




T105736 –UN–17DEC96

**A—M20 Cap Screw**
**B—Shim (Washer) (As Required)**
**C—M20 Nut (2 used)**
**D—Frame-to-Boom Pin**

**Continued on next page**

CED,OUOE027,255 –19–18MAY98–6/7

33
3340
16

18. Install boom cylinders to boom.

    Install shims (D) equally on each side to get minimum amount of clearance between boom and cylinder rod end.

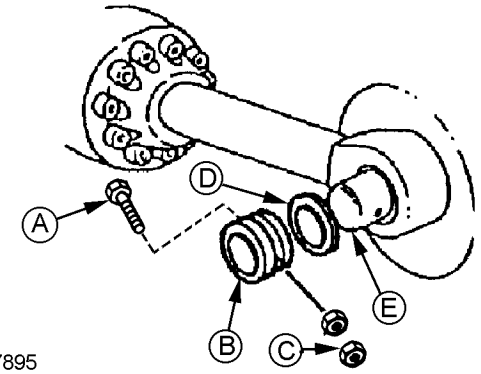
*NOTE: There must be some clearance between boom and cylinder rod end.*

19. Tighten nuts (C) against each other, not the retainer. Cap screw (A) must be free to turn in hole.

**Boom Cylinder-to-Boom Pin M20 Cap Screw Nut—Specification**

| | |
|---|---|
| Torque ..... | 540 N•m (400 lb-ft) tighten nuts against each other, not the retainer |

20. Apply grease to all pivot joints. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in Group 0004.)




T107895

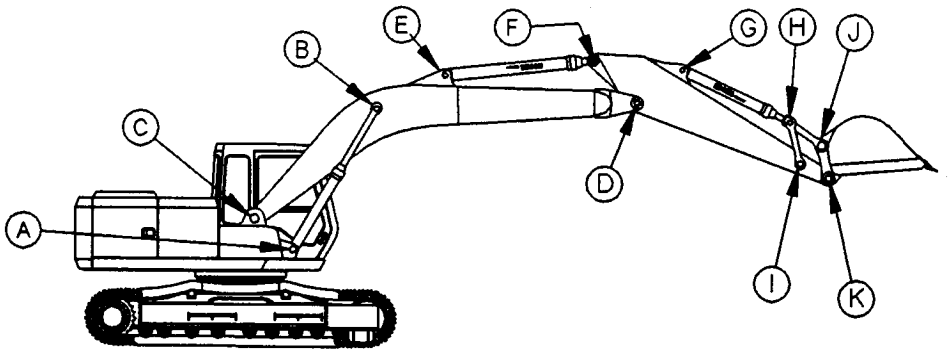
T107895 –UN–10MAR97

**A—M20 Cap Screw (2 used)**
**B—Retainer (2 used)**
**C—M20 Nut (4 used)**
**D—Shim (Washer) (As Required)**
**E—Boom Cylinder-to-Boom Pin**

CED,OUOE027,255 –19–18MAY98–7/7

## INSPECT ARM AND BOOM PINS AND BUSHINGS






T7779AC (CV)

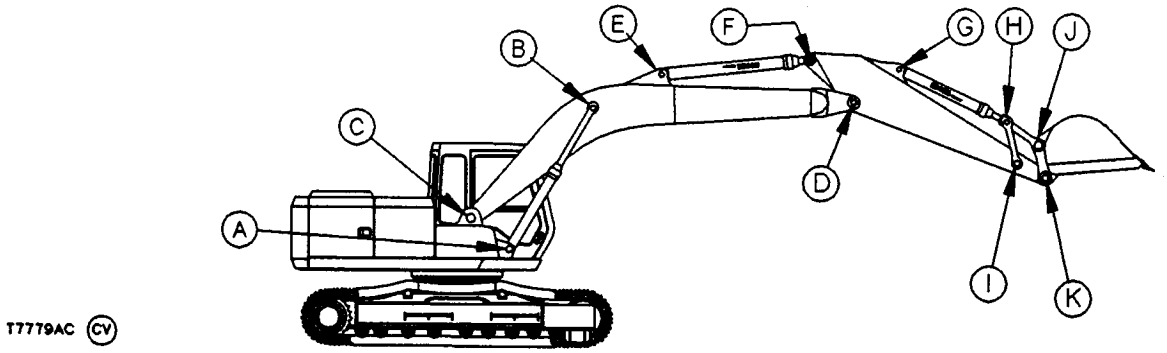
T7779AC –UN–11JUN92

**A—Boom Cylinder Head End**
**B—Boom Cylinder Rod End**
**C—Boom-to-Frame Joint**
**D—Boom-to-Arm Joint**
**E—Arm Cylinder Head End**
**F—Arm Cylinder Rod End**
**G—Bucket Cylinder Head End**
**H—Bucket Cylinder Rod End**
**I—Link-to-Arm Joint**
**J—Link-to-Bucket Joint**
**K—Bucket-to-Arm Joint**

| PIN OD AND BUSHING ID SPECIFICATIONS | | |
|---|---|---|
| **Part Name** | **Nominal Dimension** | **Limit of Use** |
| **Boom Cylinder Head End (A)** | | |
| Pin | 110.0 mm (4.33 in.) | 109.0 mm (4.30 in.) |
| Boss, frame and boom | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |
| Bushing, cylinder | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |
| **Boom Cylinder Rod End (B)** | | |
| Pin | 110.0 mm (4.33 in.) | 109.0 mm (4.30 in.) |
| Boss, frame and boom | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |
| Bushing, cylinder | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |
| **Boom-to-Frame Joint (C)** | | |
| Pin | 110.0 mm (4.33 in.) | 109.0 mm (4.30 in.) |
| Bushing, boom | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |
| **Boom-to-Arm Joint (D)** | | |
| Pin | 110.0 mm (4.33 in.) | 109.0 mm (4.30 in.) |
| Bushing, arm | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |
| **Arm Cylinder Head End (E) or Rod End (F)** | | |
| Pin | 110.0 mm (4.33 in.) | 109.0 mm (4.30 in.) |
| Boss, boom or arm | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |
| Bushing, cylinder | 110.0 mm (4.33 in.) | 111.5 mm (4.40 in.) |

**Continued on next page**

CED,OUOE027,256 –19–19MAY98–1/2




T7779AC –UN–11JUN92

**A—Boom Cylinder Head End**
**B—Boom Cylinder Rod End**
**C—Boom-to-Frame Joint**
**D—Boom-to-Arm Joint**
**E—Arm Cylinder Head End**
**F—Arm Cylinder Rod End**
**G—Bucket Cylinder Head End**
**H—Bucket Cylinder Rod End**
**I—Link-to-Arm Joint**
**J—Link-to-Bucket Joint**
**K—Bucket-to-Arm Joint**

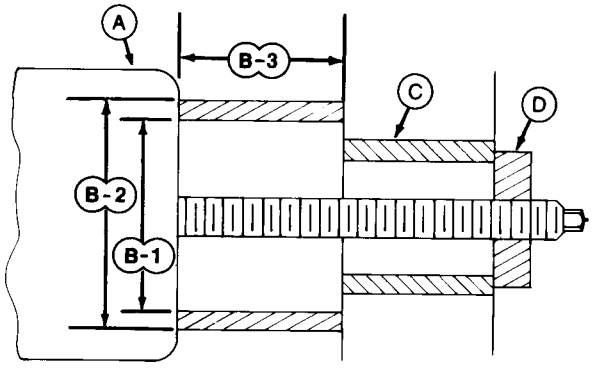
| Part Name | Nominal Dimension | Limit of Use |
|---|---|---|
| **Bucket Cylinder Head End (G)** | | |
| Pin | 90.0 mm (3.54 in.) | 89.0 mm (3.50 in.) |
| Boss, arm | 90.0 mm (3.54 in.) | 91.5 mm (3.60 in.) |
| Bushing, cylinder | 90.0 mm (3.54 in.) | 91.5 mm (3.60 in.) |
| **Bucket Cylinder Rod End (H)** | | |
| Pin | 100.0 mm (3.94 in.) | 99.0 mm (3.90 in.) |
| Bushing, link | 100.0 mm (3.94 in.) | 101.5 mm (4.00 in.) |
| Bushing, cylinder | 100.0 mm (3.94 in.) | 101.5 mm (4.00 in.) |
| **Link-to-Arm Joint (I)** | | |
| Pin | 90.0 mm (3.54 in.) | 89.0 mm (3.50 in.) |
| Bushing, arm | 90.0 mm (3.54 in.) | 91.5 mm (3.60 in.) |
| **Link-to-Bucket Joint (J)** | | |
| Pin | 100.0 mm (3.94 in.) | 99.0 mm (3.90 in.) |
| Bushing, link | 100.0 mm (3.94 in.) | 101.5 mm (4.00 in.) |
| **Bucket-to-Arm Joint (K)** | | |
| Pin | 100.0 mm (3.94 in.) | 99.0 mm (3.90 in.) |
| Bushing, arm | 100.0 mm (3.94 in.) | 101.5 mm (4.00 in.) |

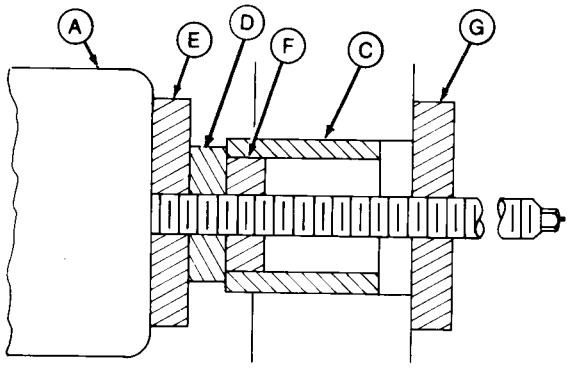
CED,OUOE027,256 –19–19MAY98–2/2

## REMOVE AND INSTALL BUSHINGS AND SEALS

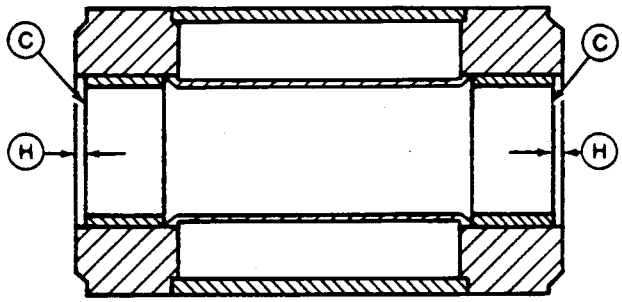
*NOTE: Bushing can also be removed by welding three to five weld beads on the inside of bushing. Bushing will shrink enough to permit removal using a hammer.*

1. Remove and install bushings (C) and dust seals using bushing, bearing, and seal driver set.
2. Install bushings with lubrication hole aligned with lubrication passage in pivot.
3. Install bushing to a depth equal to thickness of dust seal (H).
4. Install dust seals with lip toward outside of component.




T95237 –UN–01NOV88




T6641CW –UN–31OCT88

**A—Hydraulic Ram**
**B1—Pipe—Minimum ID to Clear Bushing OD**
**B2—Pipe—Maximum OD**
**B3—Pipe—Length of Bushing**
**C—Bushing**
**D—Disk**
**E—Bushing Stop (Disk)**
**F—Pilot (Disk)**
**G—Ram Stop (Disk)**
**H—Thickness of Dust Seal**

TX,33,GG2320 –19–25NOV96–1/1

## 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.*

CED,OUOE003,1107 –19–10SEP98–1/2

T7782AH –UN–19JUN92

Spanner Wrench . . . . . JDG911

To remove and install bearing nut from drive shaft for hydraulic pump.


CED,OUOE003,1107 –19–10SEP98–2/2

## SERVICE EQUIPMENT AND TOOLS

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

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CED,OUOE003,1109 –19–10SEP98–1/19

Portable Filter Caddy

To transfer and clean hydraulic oil.

**Continued on next page**

CED,OUOE003,1109 –19–10SEP98–2/19

*Hydraulic System*

3658 mm (12 ft) x 3/4 in. I.D. 100R1 Hoses with 3/4 M NPT Ends (2 used)

33
3360
2

Use with portable filter caddy to transfer and clean hydraulic oil.

CED,OUOE003,1109 –19–10SEP98–3/19

M12-1.75 Metric Lifting Eyebolts (3 used). . . . . JT05550

Used to remove hydraulic pump.

CED,OUOE003,1109 –19–10SEP98–4/19

Lifting Bracket . . . . . JT01748

Use with a hoist to lift components.

CED,OUOE003,1109 –19–10SEP98–5/19

Ring Compressor

To align bearings on drive shaft.

CED,OUOE003,1109 –19–10SEP98–6/19

Hydraulic Pump Torque Adapter. . . . . DF1037[1]

Used to check rolling drag torque on hydraulic pump shaft.

[1]*Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

**Continued on next page**

CED,OUOE003,1109 –19–10SEP98–7/19

*Hydraulic System*

M8-1.25 Cap Screw (2 used)

To temporarily hold plate on top of dig function pilot controller while removing and installing the U-joint.

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3360
3

CED,OUOE003,1109 –19–10SEP98–8/19

M16-2.0 Cap Screw

To pull plate from the bottom of dig function pilot controller.

CED,OUOE003,1109 –19–10SEP98–9/19

Cylinder Service Stand . . . . . JT30043

To disassemble and assemble hydraulic cylinders.

CED,OUOE003,1109 –19–10SEP98–10/19

Wrench . . . . . JT05794

Loosen and tighten cylinder nut.

CED,OUOE003,1109 –19–10SEP98–11/19

105 mm Adapter Plate . . . . . JT05794

Loosen and tighten cylinder nut on bucket cylinder.

CED,OUOE003,1109 –19–10SEP98–12/19

120 mm Adapter Plate . . . . . JT07332

Loosen and tighten cylinder nut on boom cylinder.

**Continued on next page**

CED,OUOE003,1109 –19–10SEP98–13/19

*Hydraulic System*

125 mm Adapter Plate . . . . . JT05798

33
3360
4

Loosen and tighten cylinder nut on arm cylinder.

CED,OUOE003,1109 –19–10SEP98–14/19

Installer. . . . . JDG945

To expand cap seal as it is pushed on the boom cylinder piston.

CED,OUOE003,1109 –19–10SEP98–15/19

Installer. . . . . JDG843-1

To expand cap seal as it is pushed on the bucket cylinder piston.

CED,OUOE003,1109 –19–10SEP98–16/19

Installer. . . . . JDG901-1

To expand cap seal as it is pushed on the arm cylinder piston.

CED,OUOE003,1109 –19–10SEP98–17/19

Pusher . . . . . JDG901-3

To push cap seal on cylinder pistons.

**Continued on next page**

CED,OUOE003,1109 –19–10SEP98–18/19

*Hydraulic System*

Hydraulic Cylinder Repair Stand. . . . . .JT30043

To disassemble and assemble hydraulic cylinders.



CED,OUOE003,1109 –19–10SEP98–19/19

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| TY9375 (U.S.)<br>TY9480 (Canadian)<br>592 (LOCTITE®) | Pipe Sealant | Apply to drain plug for pump drive gearbox. |
| TY16285 (U.S.)<br>TY9485 (Canadian)<br>7649 (LOCTITE®) | Cure Primer | To clean and cure surface prior to application of adhesives or sealants. |
| T43512 (U.S.)<br>TY9473 (Canadian)<br>242 (LOCTITE®) | Thread Lock and Sealer (Medium Strength) | Apply to threads of pin-to-servo piston set screw.<br>Apply to threads of U-joint in dig function pilot controller. |
| T43513 (U.S.)<br>TY9474 (Canadian)<br>271 (LOCTITE®) | Thread Lock and Sealer (High Strength) | Apply to special cap screws on valve spool. |
| | Multi-Purpose Grease | Apply to inside of housing and O-ring groove.<br>Apply to lips of oil seals for installation.<br>Apply to pin and ball.<br>Apply to backup rings and O-rings.<br>Apply to end of plungers. |
| T43514 (U.S.)<br>TY9475 (Canadian)<br>277 (LOCTITE®) | Plastic Gasket | Apply to mounting surface for pilot pump on pump splitter drive. |

*LOCTITE is a trademark of Loctite Corp.*

CED,OUOE003,1106 –19–10SEP98–1/1

## SPECIFICATIONS

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3360
6

| Item | Measurement | Specification |
|---|---|---|
| Lower Boom (with Engine Stopped): | | |
| Boom Manual Lower Needle Valve-to-Housing | Torque | 5.9—9.8 N•m (4.4—7.2 lb-ft) (53—86 lb-in.) |
| Boom Manual Lower Needle Valve-to-Housing Nut | Torque | 35—47 N•m (25.8—34.7 lb-ft) (310—416 lb-in.) |
| Hydraulic Oil Cleanup Procedure: | | |
| Hydraulic Oil Tank Filtering | Capacity<br>Time | 159 L (42 gal) approximate<br>14 minutes approximate |
| Hydraulic System Filtering | Capacity<br>Time | 322 L (85 gal) approximate<br>51 minutes approximate |
| Hydraulic Pump: | | |
| Hydraulic Pump | Weight | 68 kg (150 lb) approximate |
| Pump-to-Splitter Drive Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Rotor Bore-to Piston | Clearance<br>Clearance | 0.044 mm (0.0031 in.) nominal<br>0.08 mm (0.0017 in.) limit of use |
| Piston-to-Connecting Rod | Play<br>Play | 0.100 mm (0.0039 in.) nominal<br>0.400 mm (0.0016 in.) limit of use |
| Center Shaft-to-Valve Plate Bushing | Clearance<br>Clearance | 0.081 mm (0.0032 in.) nominal<br>0.300 mm (0.0118 in.) limit of use |
| Drive Shaft Oil Seal Contact Surface | OD<br>OD | 60 mm (2.36 in.) nominal<br>59.8 mm (2.35 in.) limit of use |
| Piston Connecting Rod Ball End-to-Drive Shaft Socket | Play<br>Play | 0.060 mm (0.0024 in.) nominal<br>0.400 mm (0.0157 in.) limit of use |

**Continued on next page**

*Hydraulic System*



| Item | Measurement | Specification |
|---|---|---|
| Servo Piston-to-Cylinder Head Bore | Clearance<br>Clearance | 0.089 mm (0.0035 in.) nominal<br>0.200 mm (0.0079 in.) limit of use |
| Servo Piston Pin-to-Valve Plate Bore | Clearance<br>Clearance | 0.051 mm (0.0020 in.) nominal<br>0.300 mm (0.0118 in.) limit of use |
| Servo Piston-to-Pin Set Screw | Torque | 25 N•m (220 lb-in.) |
| Valve Cover (Stop)-to-Cylinder Head Cap Screw | Torque | 20 N•m (175 lb-in.) |
| Drive Shaft Bearing Cone | Temperature | 80—100°C (176—212°F) |
| Drive Shaft | Torque | 2.5—3.5 N•m (22—30 lb-in.) starting |
| Cylinder Head-to-Pump Housing Cap Screw | Torque | 108 N•m (80 lb-ft) |
| Pump Regulator-to-Pump Housing Cap Screw | Torque | 49 N•m (36 lb-ft) |
| End Plate and Cover-to-Housing Cap Screw | Torque | 19.6 N•m (175 lb-in.) |
| Housing-to-Pump Housing Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Air Bleed Plug-to-Housing | Torque | 78 N•m (58 lb-ft) |
| Pilot Pump: | | |
| Pump-to-Splitter Drive Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Cover-to-Flange Cap Screw | Torque | 41 N•m (31 lb-ft) |
| Pilot Pressure Regulating Valve and Filter: | | |
| Pilot Filter Element Housing-to-Filter Head | Torque | 25 N•m (220 lb-in.) |

**Continued on next page**

CED,OUOE003,1114 –19–10SEP98–2/9

| Item | Measurement | Specification |
|---|---|---|
| Regulating Valve Housing-to-Filter Head Cap Screw | Torque | 20 N•m (175 lb-in.) |
| Filter Head-to-Support Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Plug-to-Regulating Valve Housing | Torque | 49 N•m (36 lb-ft) |
| Pilot Shut-Off Valve: | | |
| Head-to-Support Pilot Shut-Off Valve Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Pilot Shut-Off Valve Lever-to-Cap Screw Head | Clearance | 1.5 ± 0.5 mm (0.06 ± 0.02 in.) |
| Lever-to-Spool Pin Cap Screw | Torque | 44 N•m (33 lb-ft) |
| Proportional Solenoid Valve: | | |
| Solenoid Valve Manifold-to-Control Valve Mounting Bracket Cap Screw | Torque | 20 N•m (16 lb-ft) |
| Solenoid Valve Housing-to-Manifold Cap Screw | Torque | 3 N•m (24 lb-in.) |
| Dig Function Pilot Controller: | | |
| Bottom Plate-to-Housing Cap Screw | Torque | 49 N•m (36 lb-ft) |
| U-Joint-to-Housing | Torque | 24 N•m (216 lb-in.) |
| Cam-to-Pushers | Clearance | 0—0.20 mm (0—0.008 in.) |
| Coupling-to-Cam and U-Joint | Torque | 78 N•m (58 lb-ft) |
| Propel Pilot Controller: | | |
| Controller-to-Cap Platform Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Propel Pedal-to-Lever Cap Screw | Torque | 49 N•m (36 lb-ft) |

**Continued on next page**

*Hydraulic System*



| Item | Measurement | Specification |
|---|---|---|
| Holder-to-Housing Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Plug-to-Housing | Torque | 34 N•m (25 lb-ft) |
| Flow Regulator Valve: | | |
| Spool-to-Housing Plug | Torque | 49 N•m (36 lb-ft) |
| Check Valve Ball-to-Housing Plug | Torque | 10 N•m (86 lb-in.) |
| Orifice-to-Housing | Torque | 10 N•m (86 lb-in.) |
| Control Valve: | | |
| Control Valve | Weight | 240 kg (529 lb) approximate |
| Mounting Bracket-to-Valve Housing Cap Screw | Torque | 205 N•m (151 lb-ft) |
| Arm Reduced Leakage Pilot Valve-to-Left Spring Cover Cap Screw | Torque | 12 N•m (9 lb-ft) |
| Boom Reduced Leakage Pilot Valve and Boom Manual Lower Valve-to-Right Spring Cover Cap Screw | Torque | 12 N•m (9 lb-ft) |
| Lower Pilot Caps-to-Control Valve Housing Cap Screw | Torque | 29 N•m (21 lb-ft) |
| Special Cap Screw-to-Spool | Torque | 16 N•m (12 lb-ft) |
| Upper Pilot Caps Cap Screw | Torque | 29 N•m (21 lb-ft) |
| Arm Head End Reduced Leakage Pilot and Relief Valve Housing Plug | Torque | 74 N•m (55 lb-ft) |
| Arm Head End Reduced Leakage Pilot and Relief Valve Housing Plug | Torque | 137 N•m (101 lb-ft) |

**Continued on next page**

*Hydraulic System*

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| Item | Measurement | Specification |
|---|---|---|
| Arm Head End Reduced Leakage Check Valve Housing Plug | Torque | 390 N•m (288 lb-ft) |
| Arm Head End Reduced Leakage Pilot and Relief Valve Housing-to-Arm Head End Reduced Leakage Check Valve Housing Cap Screw | Torque | 12 N•m (9 lb-ft) |
| Arm Head End Reduced Leakage Check Valve Adapter Cap Screw | Torque | 108 N•m (80 lb-ft) |
| Arm Head End Reduced Leakage Check Valve Housing-to-Adapter Plate Cap Screw | Torque | 108 N•m (80 lb-ft) |
| Circuit Relief and Anti-Cavitation Valves-to-Housing | Torque | 73 N•m (54 lb-ft) |
| Rear Pump Control Valve-to-Housing | Torque | 73 N•m (54 lb-ft) |
| Check Valve Plug | Torque | 245 N•m (181 lb-ft) |
| Flange Cap Screw | Torque | 57 N•m (42 lb-ft) |
| Cover Cap Screw | Torque | 57 N•m (42 lb-ft) |
| Propel Flow Control Valve-to-Housing Cap Screw | Torque | 162 N•m (119 lb-ft) |
| Boom Reduced Leakage Check Valve Plug | Torque | 245 N•m (181 lb-ft) |
| Orifice and Bucket Power Passage Lift Check Valve Plug | Torque | 73 N•m (54 lb-ft) |
| Boom I Power Passage Lift Check Valve and Arm II Neutral Passage Lift Check Valve Plug | Torque | 245 N•m (181 lb-ft) |
| Bucket Flow Control Valve Cap Screw | Torque | 57 N•m (42 lb-ft) |

**Continued on next page**

*Hydraulic System*



| Item | Measurement | Specification |
|---|---|---|
| Circuit Relief and Anti-Cavitation Valve-to-Housing | Torque | 73 N•m (54 lb-ft) |
| Front Pump Control Valve-to-Housing | Torque | 73 N•m (54 lb-ft) |
| Flow Combiner Valve Orifice | Torque | 9 N•m (7 lb-ft) |
| Flow Combiner Valve Plug | Torque | 15 N•m (11 lb-ft) |
| Flow Combiner Valve Spool-to-Housing Plug | Torque | 74 N•m (54 lb-ft) |
| System Relief and Power Boost Valve-to-Housing | Torque | 74 N•m (55 lb-ft) |
| System Relief Valve Isolation Check Valve Plug | Torque | 245 N•m (181 lb-ft) |
| Hydraulic Oil Tank: | | |
| Hydraulic Oil Tank | Weight | 150 kg (331 lb) approximate |
| Frame-to-Oil Tank Cap Screw | Torque | 205 N•m (151 lb-ft) |
| Return Line-to-Oil Tank Coupling Nut | Torque | 11.0 N•m (97 lb-in.) |
| Hose-to-Oil Tank Elbow Suction Line T-Bolt Type Clamp | Torque | 4.0 N•m (35 lb-in.) |
| Cover-to-Oil Tank Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Rod and Suction Strainer | Length | 702 mm (27.6 in.) from end of rod to bottom of suction strainer |
| | Distance | 20 mm (0.79 in.) from end of rod to top nut |
| Rod-to-Suction Strainer Nut | Torque | 17 N•m (153 lb-in.) |
| Return Filter Cover-to-Hydraulic Oil Tank Cap Screw | Torque | 49 N•m (36 lb-ft) |

**Continued on next page**

*Hydraulic System*

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| Item | Measurement | Specification |
|---|---|---|
| Cover-to-Hydraulic Oil Tank Cap Screw | Torque | 49 N•m (36 lb-ft) |
| Restriction Valve: | | |
| Coupling T-Bolt Type Hose Clamp | Torque | 4.4 N•m (40 lb-in.) |
| Oil Cooler Bypass Valve: | | |
| Control Valve-to-Hydraulic Oil Tank Coupling Cap Screw and Nut | Torque | 11.4 N•m (100 lb-in.) |
| Boom Cylinder: | | |
| Boom Cylinder | Weight | 324 kg (714 lb) approximate |
| Boom Cylinder-to-Frame Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Boom Cylinder-to-Boom Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Boom Ring | Width<br>Width | 9.60—9.80 mm (0.377—0.386 in.) nominal<br>9.55 mm (0.376 in.) limit of use |
| Boom Cylinder Rod End Bushing | ID<br>ID | 110 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Boom Cylinder Head End Bushing | ID<br>ID | 110 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Boom Rod | Curvature | 0.5 mm per 1 m (0.020 in. per 3.25 ft) |
| Boom Rod Allowable Scratch | Depth | 0.1 mm (0.004 in.) (enough to detect by a fingernail) |
| Boom Rod | OD | 105.0 + 0.036 - 0.090 mm (4.1339 + 0.0014 - 0.0035 in.) |
| Boom Cylinder Piston-to-Rod Nut | Torque | 9810 N•m (7230 lb-ft) |
| Nut-to-Rod Set Screw | Torque | 64 N•m (47 lb-ft) |

**Continued on next page**

*Hydraulic System*



| Item | Measurement | Specification |
|---|---|---|
| Boom Cylinder Rod Guide-to-Barrel Cap Screw | Torque | 830 N•m (615 lb-ft) |
| Arm Cylinder: | | |
| Arm Cylinder | Weight | 493 kg (1087 lb) approximate |
| Arm Cylinder-to-Boom Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Arm Cylinder-to-Arm Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Arm Ring | Width<br>Width | 9.60—9.80 mm (0.377—0.386 in.) nominal<br>9.55 mm (0.376 in.) limit of use |
| Arm Cylinder Rod End Bushing | ID<br>ID | 110 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Arm Cylinder Head End Bushing | ID<br>ID | 110 mm (4.33 in.) nominal<br>111.5 mm (4.40 in.) limit of use |
| Arm Rod | Curvature | 0.5 mm per 1 m (0.020 in. per 3.25 ft) |
| Arm Rod Allowable Scratch | Depth | 0.1 mm (0.004 in.) (enough to detect by a fingernail) |
| Arm Rod | OD | 115.0 + 0.036 - 0.090 mm (4.5276 + 0.0014 - 0.0035 in.) |
| Arm Cylinder Piston-to-Rod Nut | Torque | 22 050 N•m (16,270 lb-ft) |
| Nut-to-Rod Set Screw | Torque | 64 N•m (47 lb-ft) |
| Arm Cylinder Rod Guide-to-Barrel Cap Screw | Torque | 1230 N•m (905 lb-ft) |
| Bucket Cylinder: | | |
| Bucket Cylinder | Weight | 261 kg (575 lb) approximate |

**Continued on next page**

*Hydraulic System*

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| Item | Measurement | Specification |
|---|---|---|
| Bucket Cylinder-to-Arm Pin M20 Cap Screw | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Bucket Cylinder-to-Link Pin M20 Cap Screw Nut | Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |
| Bucket Ring | Width | 9.60—9.80 mm (0.377—0.386 in.) nominal |
| | Width | 9.55 mm (0.376 in.) limit of use |
| Bucket Cylinder Head End Bushing | ID | 90 mm (3.54 in.) nominal |
| | ID | 91.5 mm (3.60 in.) limit of use |
| Bucket Cylinder Rod End Bushing | ID | 100 mm (3.94 in.) nominal |
| | ID | 101.5 mm (4.00 in.) limit of use |
| Bucket Rod | Curvature | 0.5 mm per 1 m (0.020 in. per 3.25 ft) |
| Bucket Rod Allowable Scratch | Depth | 0.1 mm (0.004 in.) (enough to detect by a fingernail) |
| Bucket Rod | OD | 95.0 + 0.036 - 0.090 mm (3.7402 + 0.0014 - 0.0035 in.) |
| Bucket Cylinder Piston-to-Rod Nut | Torque | 10 000 N•m (7380 lb-ft) |
| Nut-to-Rod Set Screw | Torque | 64 N•m (47 lb-ft) |
| Bucket Cylinder Rod Guide-to-Barrel Cap Screw | Torque | 830 N•m (615 lb-ft) |

CED,OUOE003,1114 –19–10SEP98–9/9

## CONTROL LEVER PATTERN CONVERSION



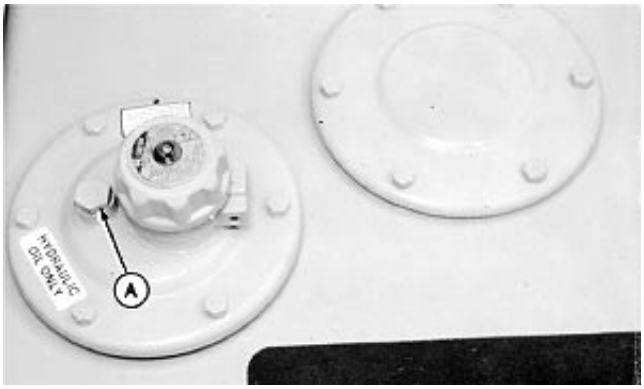
To change your machine pilot control levers from the standard pattern to a John Deere pattern:

1. Lower bucket to ground.
2. Turn auto-idle switch off.
3. Run engine with engine rpm dial at 1/3 position without load for 2 minutes.
4. Turn engine rpm dial to slow idle position and turn key switch to OFF to stop engine. Remove key from switch.
5. Pull pilot control shut-off lever to LOCK position.

CED,OUOE027,290 –19–02JUN98–1/3

**CAUTION: High pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Release air pressure by loosening vent plug.**

6. Release air pressure from hydraulic oil tank by loosening vent plug (A).
7. Open door on storage compartment behind cab and remove cover above flow regulator.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE027,290 –19–02JUN98–2/3

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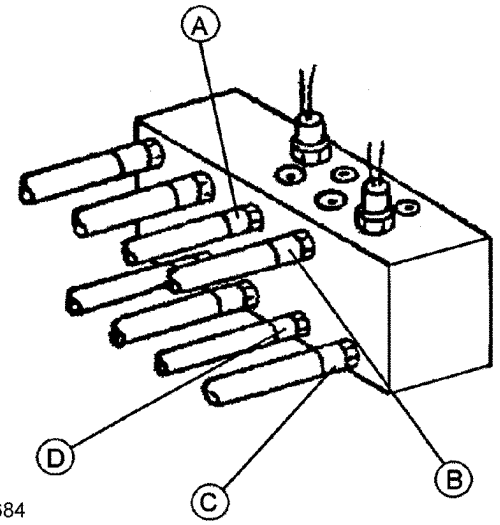
*NOTE: Do not use manufacturer's identification tags or markings on line ends to identify lines for this conversion procedure. The conversion must be done on the side of flow regulator valve that is connected to the pilot controllers (toward front of cab).*

8. Hoses are switched in an X pattern.

   - Switch hose (A) with hose (C).
   - Switch hose (B) with hose (D).

**CAUTION: Prevent injury from unexpected control lever function. Install new decals on control consoles.**

9. Install new decals (black on yellow) on control consoles near base of control levers. Decals are enclosed in Operator Manual package. Additional decals can be purchased from your John Deere dealer.




T102684

T102684 –UN–07AUG96

**A—Hose**
**B—Hose**
**C—Hose**
**D—Hose**

CED,OUOE027,290 –19–02JUN98–3/3

## HYDRAULIC SYSTEM WARM-UP PROCEDURE

| SPECIFICATIONS | |
|---|---|
| Hydraulic Oil Temperature | 50 ± 5°C (120 ± 10°F) |

| SERVICE EQUIPMENT AND TOOLS |
|---|
| JT05800 Digital Thermometer |

**IMPORTANT: If the machine temperature is below -18 degrees C (0°F), start the engine with the speed control in the idle position. If the unit has been prepared for arctic operation with the MIL-L-46167 hydraulic oil, the suction strainer in the hydraulic tank should also have been changed to the coarser strainer for use in arctic conditions. Failure to do this could cause the hydraulic pump to cavitate which can cause pump failure. Operate engine at idle speed for at least 10 minutes before increasing the speed to half. Cover the radiator and oil cooler debris screens to restrict the air flow for faster warmup.**

Below -18°C (0°F) an extended warm-up period may be necessary. Hydraulic function will move slowly and lubrication of parts may not be adequate with cold oil. Do not attempt normal machine operation until hydraulic functions move at or close to normal cycle times.

Operate functions slowly and avoid sudden movements until engine and hydraulic oils are thoroughly warmed. Operate a function by moving it a short distance in each direction. Continue operating the function increasing the distance traveled in each cycle until full stroke is reached.

For faster warm-up, restrict air flow through oil cooler using cardboard or other similar material. Use correct viscosity oil to minimize warm-up period. (See Hydraulic Oil in Fuels and Lubricants Group.)

1. Connect digital thermometer. Install temperature probe on hydraulic tank-to-pump inlet line.

**CAUTION: Avoid possible serious injury from machine movement during warm-up procedure. Clear the area of all bystanders before doing the warm-up procedure.**

2. Clear the area of all bystanders to allow for machine movement.

3. Start engine. Run engine at 1/2 speed for approximately 5 minutes before operating any functions. Do not run engine at fast or slow idle.

4. Check that work mode is in Dig Mode and power mode is in Standard Mode (no buttons pushed down, indicators off). Push auto-idle switch to turn off auto-idle function (auto-idle indicator off).

5. Slowly turn upperstructure so boom is to the side.

**CAUTION: Avoid possible serious injury from machine sliding backwards. Keep angle between boom and arm at 90—110°**

6. Keeping the angle between boom and arm at 90—110°, lower boom to raise one track off the ground.

7. Operate propel function for approximately 5 minute.

8. Once oil temperature is above -18°C (0°F), increase engine speed to fast idle.

**Continued on next page**

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**IMPORTANT: Holding a function over relief for more than 10 seconds can cause damage from hot spots in the control valve.**

9. Operate the propel function (side with track off the ground). Also operate the bucket curl function over relief for 10 seconds and then stop for 5 seconds. Repeat the cycle until oil is heated to specifications.

10. Stop periodically and operate all hydraulic functions to distribute the heated oil.

11. Continue procedure until oil temperature is within specifications.

**Hydraulic Oil—Specification**

Temperature ..... 50 ± 5°C (120 ± 10°F)

TX,25,GG2232 –19–20NOV97–2/2

## LOWER BOOM WITH ENGINE STOPPED (USING BOOM CYLINDER LOAD LOWERING VALVE)

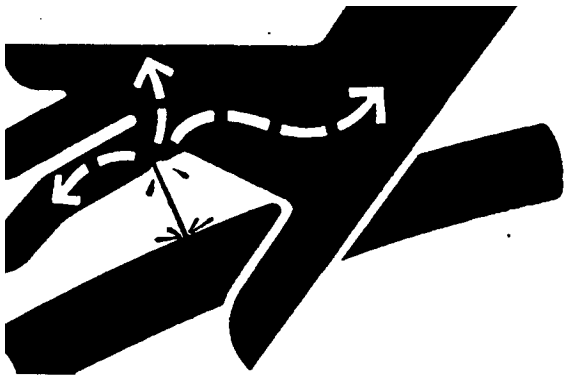
When an engine stops during operation, the boom cannot be lowered using the pilot controller because there is no pilot pressure oil to move the boom valve spool or to unlatch the boom load lowering valves.

**Continued on next page**

CED,OUOEBAS,6 –19–24JAN00–1/2

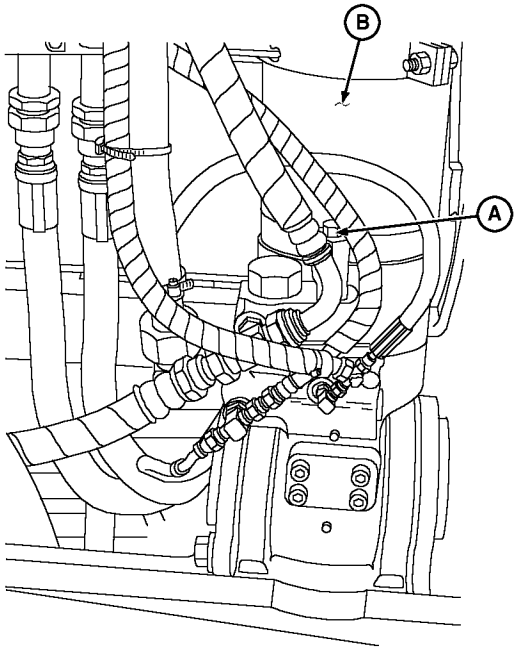
**CAUTION: To avoid injury from escaping fluid under pressure, never loosen boom manual lower needle valve more than 4 turns from closed position as valve may come out of housing. Tighten valve and nut before applying pressure.**

**Prevent possible injury from unexpected machine movement. Clear all persons from the area before lowering the boom with the engine stopped.**



X9811 –UN–23AUG88

1. Check that the area is clear of all persons before lowering boom.
2. Loosen jam nut on relief valve (A). Back off relief valve set screw, counting number of turns, until boom starts to lower slowly.
3. After bucket is on ground, reset relief valve (A) by turning set screw clockwise the same number of turns noted in step 2 and lock jam nut.




T127542 –UN–19JAN00

**T127542**

**A—Relief Valve**
**B—Boom Cylinder**

CED,OUOEBAS,6 –19–24JAN00–2/2

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## LOWER BOOM WITH ENGINE STOPPED (WHEN NOT EQUIPPED WITH BOOM CYLINDER LOAD LOWERING VALVE)

When an engine stops during operation, the boom cannot be lowered using the pilot controller because there is no pilot pressure oil to move the boom valve spool.

**CAUTION: To avoid injury from escaping fluid under pressure, never loosen boom manual lower needle valve more than 4 turns from closed position, as valve may come out of housing. Tighten valve and nut before applying pressure.**

**Prevent possible injury from unexpected machine movement. Clear all persons from the area around machine before lowering boom with engine stopped.**

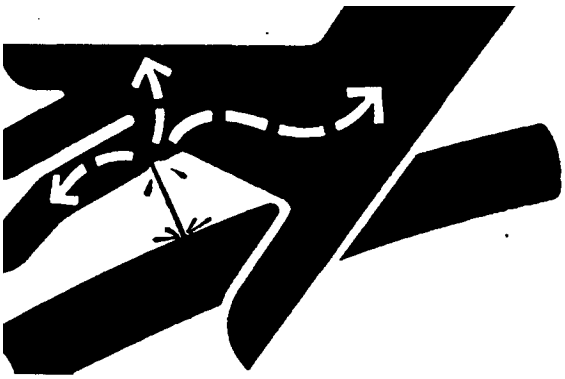
1. Remove the control valve access cover.
2. Loosen nut (C).
3. Check that area around machine is clear of all persons before lowering boom.

   Slowly, loosen boom manual lower needle valve (B) 1/2—1 turn. The boom will start to lower.

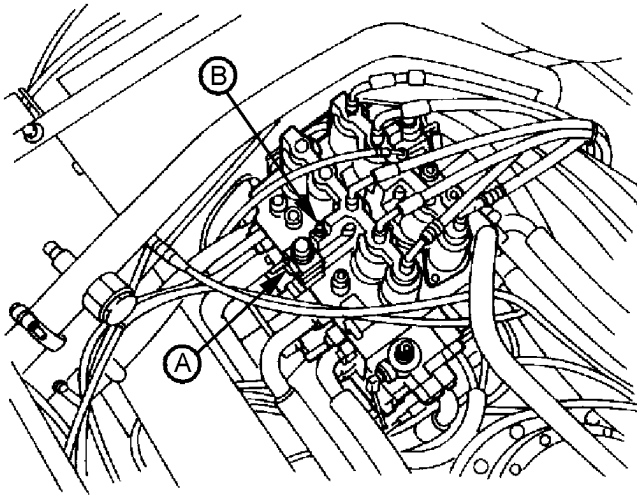
   Turn needle valve out more to increase boom lowering speed or in to decrease lowering speed. Remember, no more than 4 turns from the closed position.
4. After bucket is on the ground, first tighten needle valve (B) then nut (C).

**Boom Manual Lower Needle Valve-to-Housing—Specification**

Torque ..... 5.9—9.8 N•m (4.4—7.2 lb-ft) (53—86 lb-in.)

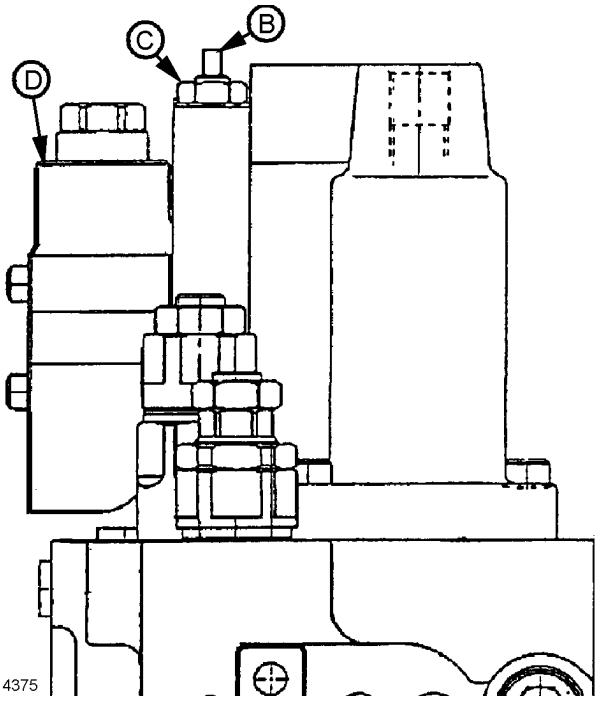


X9811 –UN–23AUG88




T114374

T114374 –UN–01APR98




T114375

T114375 –UN–25MAR98

**A—Boom I Section**
**B—Boom Manual Lower Needle Valve**
**C—Nut**
**D—Boom Reduced Leakage Valve**

**Continued on next page**

CED,OUOEBAS,8 –19–25JAN00–1/2

**Boom Manual Lower Needle Valve-to-Housing Nut—Specification**

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Torque ..... 35—47 N•m (25.8—34.7 lb-ft)
(310—416 lb-in.)

*NOTE: Leakage may result if the boom manual needle valve and nut are not tightened to specification.*

CED,TX14740,6037 –19–24MAR98–2/2

## HYDRAULIC OIL CLEANUP PROCEDURE USING PORTABLE FILTER CADDY

1. Install new return filter elements.

*NOTE: For a failure that creates a lot of debris, remove access cover from hydraulic oil tank. Drain the tank. Connect filter caddy suction line to drain port. Add a minimum of 19 L (5 gal) of oil to the tank. Operate filter caddy and wash out the tank.*

**IMPORTANT: The minimum ID for a connector is 1/2 in. to prevent cavitation of filter caddy pump.**

2. Put filter caddy suction and discharge wands into the tank filler hole so ends are as far apart as possible to obtain a thorough cleaning of oil.

3. Start filter caddy. Check to be sure oil is flowing through filters.

   Operate filter caddy until all oil in tank has been circulated through filter a minimum of four times.

**Hydraulic Oil Tank Filtering—Specification**

Capacity ..... 159 L (42 gal) approximate
Time ..... 14 minutes approximate

*NOTE: Filtering time for hydraulic oil tank is 0.089 minute x number of liters (0.33 minutes x number of gallons).*

4. Leave filter caddy operating for next step.

5. Start engine and run at fast idle.

**IMPORTANT: For the most effective results, cleaning procedure must start with the smallest capacity circuit then proceed to the next larger capacity circuit.**

6. Starting with smallest capacity circuit, operate each function through a complete cycle.

   Repeat procedure until total system capacity has circulated through filter caddy seven times. Each function must go through a minimum of three complete cycles for a thorough cleaning of oil.

**Hydraulic System Filtering—Specification**

Capacity ..... 322 L (85 gal) approximate
Time ..... 51 minutes approximate

*NOTE: Filtering time for complete hydraulic system is 0.158 minute x number of liters (0.6 minute x number of gallons). Filtering time for machines with auxiliary hydraulic functions must be increased because system capacity is larger.*

7. Stop engine. Remove filter caddy.

8. Install new return filter elements.

9. Check oil level in tank and add oil if necessary. (See Hydraulic Oil in Group 0004.)

CED,OUOE027,294 –19–03JUN98–1/1

## REMOVE AND INSTALL HYDRAULIC PUMP

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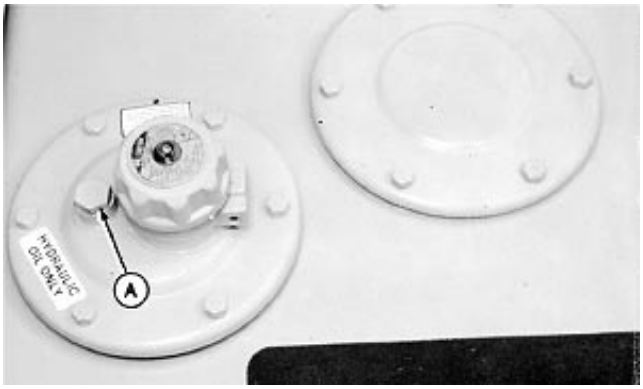
**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

*NOTE: Procedure is the same for front or rear pumps.*

1. Loosen vent plug (A) to release air pressure in hydraulic oil tank.
2. Drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).
3. Drain splitter drive. Approximate oil capacity is 1.0 L (1.06 qt).




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

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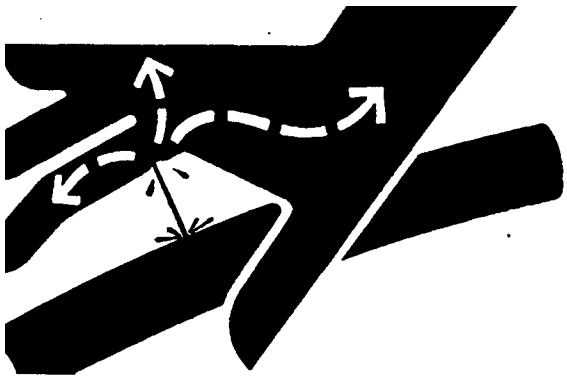
**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

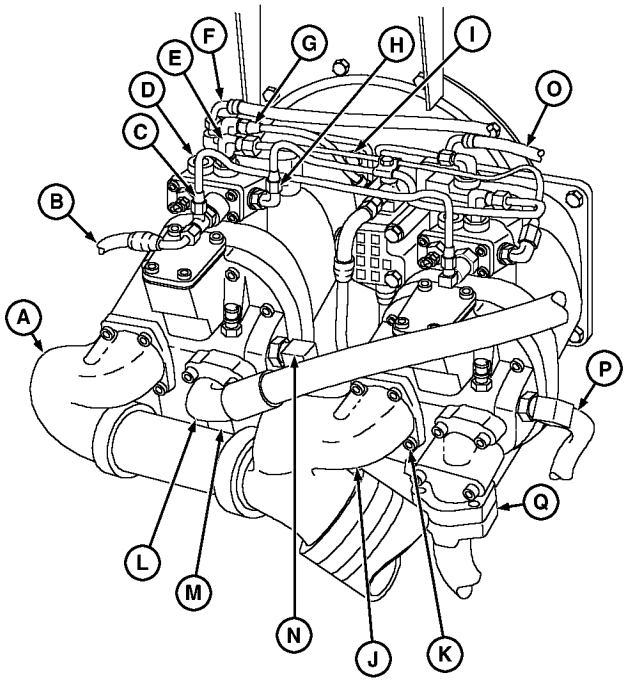


X9811 –UN–23AUG88

4. Disconnect lines (B, C, E—H, L and N).

   Disconnect wiring harness connector from pump pressure sensor (M).

5. Remove cap screws (K) and elbows (A and J).




T115512 –UN–01SEP98

T115512

**A—Rear Pump Inlet Port-to-Hydraulic Oil Tank Elbow**
**B—Rear Pump Regulator Speed Sense Signal Port-to-Speed Solenoid Valve**
**C—Rear Pump Regulator Speed Sense Signal Port-to-Front Pump Regulator Speed Sense Signal Port**
**D—Air Bleed Plug**
**E—Rear Pump Regulator Top Port-to-Front Pump Regulator Side Port**
**F—Rear Pump Regulator No. 2 Port-to-Rear Pump Control Valve in Left Control Valve**
**G—Rear Pump Regulator E (Inlet) Port-to-Pilot Pump Outlet**
**H—Rear Pump Regulator Side Port-to-Front Pump Regulator Top Port**
**I—Cap Screw (4 used)**
**J—Front Pump Inlet Port-to-Hydraulic Oil Tank Elbow**
**K—Cap Screw (8 used)**
**L—Rear Pump Discharge Port-to-Left Control Valve**
**M—Pump Pressure Sensor (2 used)**
**N—Rear Pump Attenuator Line**
**O—Front Pump Regulator No. 2 Port-to-Front Pump Control Valve in Right Control Valve**
**P—Front Pump Attenuator Line**
**Q—Front Pump Discharge Port-to-Right Left Control Valve**

**Continued on next page**

CED,OUOE027,295 –19–03JUN98–2/3

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**CAUTION: The approximate weight of hydraulic pump is 68 kg (150 lb).**

**Hydraulic Pump—Specification**

Weight..... 68 kg (150 lb) approximate

6. Install M12-1.75 metric lifting eyebolt, such as JT05550 Metric Lifting Eyebolts, in tapped holes in air bleed plug (D). Connect a hoist and lifting bracket to eyebolt.

7. Remove pump-to-splitter drive cap screws (I) to remove pump. Repair or replace pump as necessary.

8. Install pump.

9. Tighten pump-to-splitter drive cap screws (I).

**Pump-to-Splitter Drive Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

10. Connect hydraulic lines.

11. Install elbows (A and J) and cap screws (K).

12. Apply pipe sealant to drain plug threads.

**IMPORTANT: Hydraulic pump and splitter drive will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new pump or splitter drive is installed or oil has been drained from the pump, splitter drive or hydraulic oil tank.**

13. Fill pump housing and splitter drive with oil. (See Hydraulic Pump and Splitter Drive Start-Up Procedure in this group.)

14. Check pump regulator adjustments. (See Hydraulic Pump Regulator Test and Adjustments in Group 9025-25.)

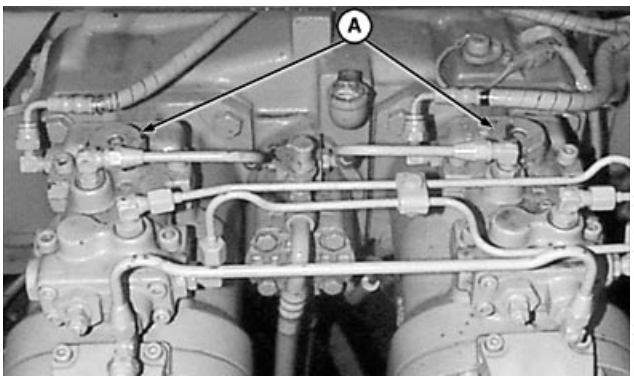
CED,OUOE027,295 –19–03JUN98–3/3

## HYDRAULIC PUMP AND SPLITTER DRIVE START-UP PROCEDURE

**IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new hydraulic pump is installed or oil has been drained from the pump or hydraulic oil tank.**

Procedure is to ensure the pumps are filled with oil and air is bled from suction side of pumps to prevent cavitation.

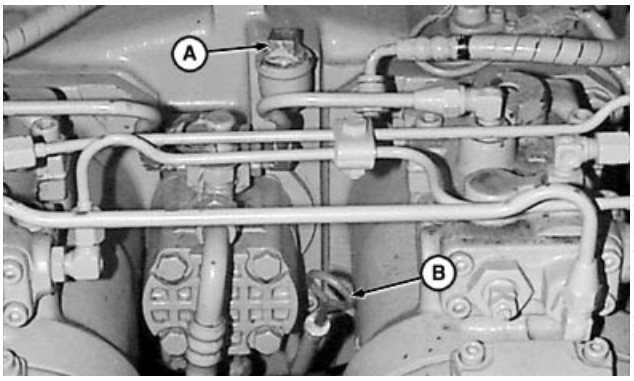
1. Add oil until it is between marks on hydraulic oil tank sight glass. (See Hydraulic Oil in Group 0004.)
2. Remove air bleed plugs (A) from top of pump regulators to allow housing to fill with oil from hydraulic oil tank and let air escape.
3. When pump housing is full of oil, install plugs.
4. Check oil level in hydraulic oil tank. Add oil as necessary. Tighten hydraulic oil tank cap. Tighten vent plug.




**A—Air Bleed Plug (2 used)**

CED,OUOE027,296 –19–03JUN98–1/2

5. Remove plastic cap from fill plug (A). Remove fill plug.
6. Fill pump and splitter drive with oil through filler pipe so oil level is approximately halfway between “H” (level) mark and end of dipstick. (See Diesel Engine and Pump Gearbox Oils in Group 0004.)
7. Start engine and run at slow idle. Slowly raise boom to full height and then lower to pressurize hydraulic oil tank.
8. Purge air from hydraulic system by slowly operating each function through three cycles. Air in pilot circuits is purged automatically.




**A—Fill Plug**
**B—Dipstick**

CED,OUOE027,296 –19–03JUN98–2/2

## DISASSEMBLE MAIN HYDRAULIC PUMP

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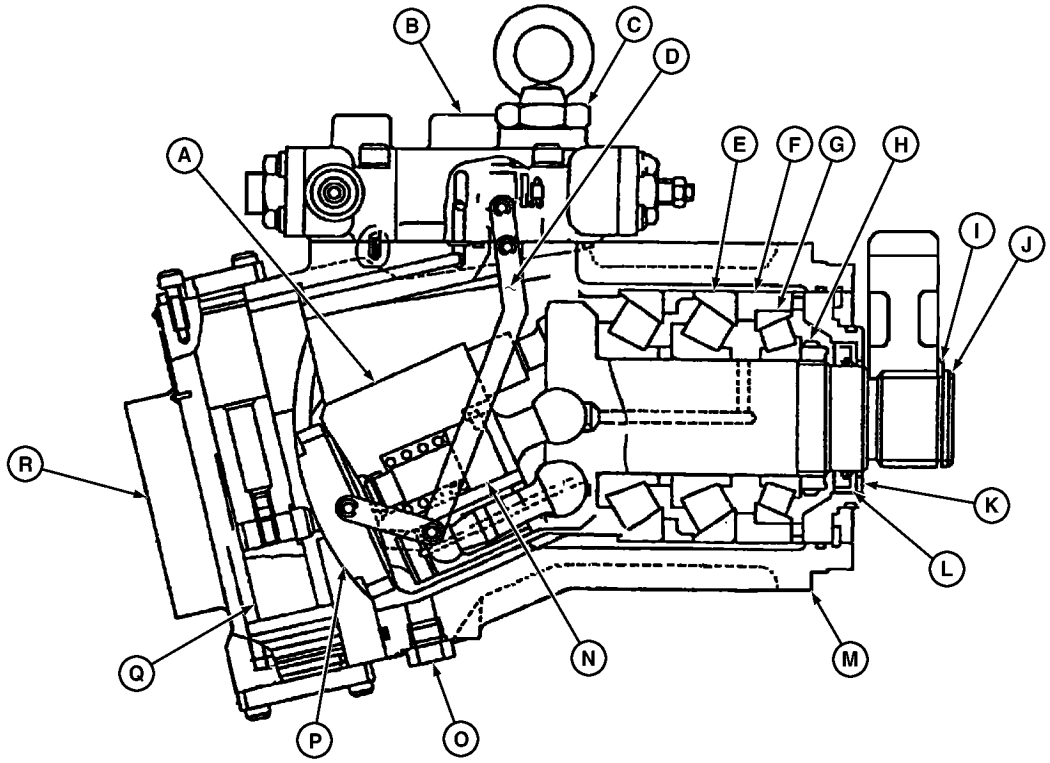
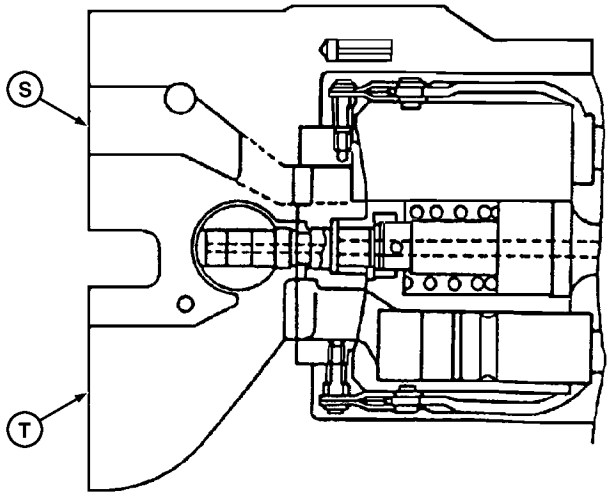



T115528

T115528 –UN–01JUL98




T115529

T115529 –UN–01JUL98

A—Rotor (Cylinder Block)
B—Pump Regulator
C—Air Bleed Plug
D—Feedback Link
E—Roller Bearing
F—Spacer
G—Roller Bearing
H—Nut
I—Snap Ring
J—Drive Shaft
K—Cover
L—Oil Seal
M—Pump Housing
N—Center Shaft
O—Plug
P—Valve Plate
Q—Servo Piston
R—Cylinder Head
S—Discharge Port
T—Inlet Port

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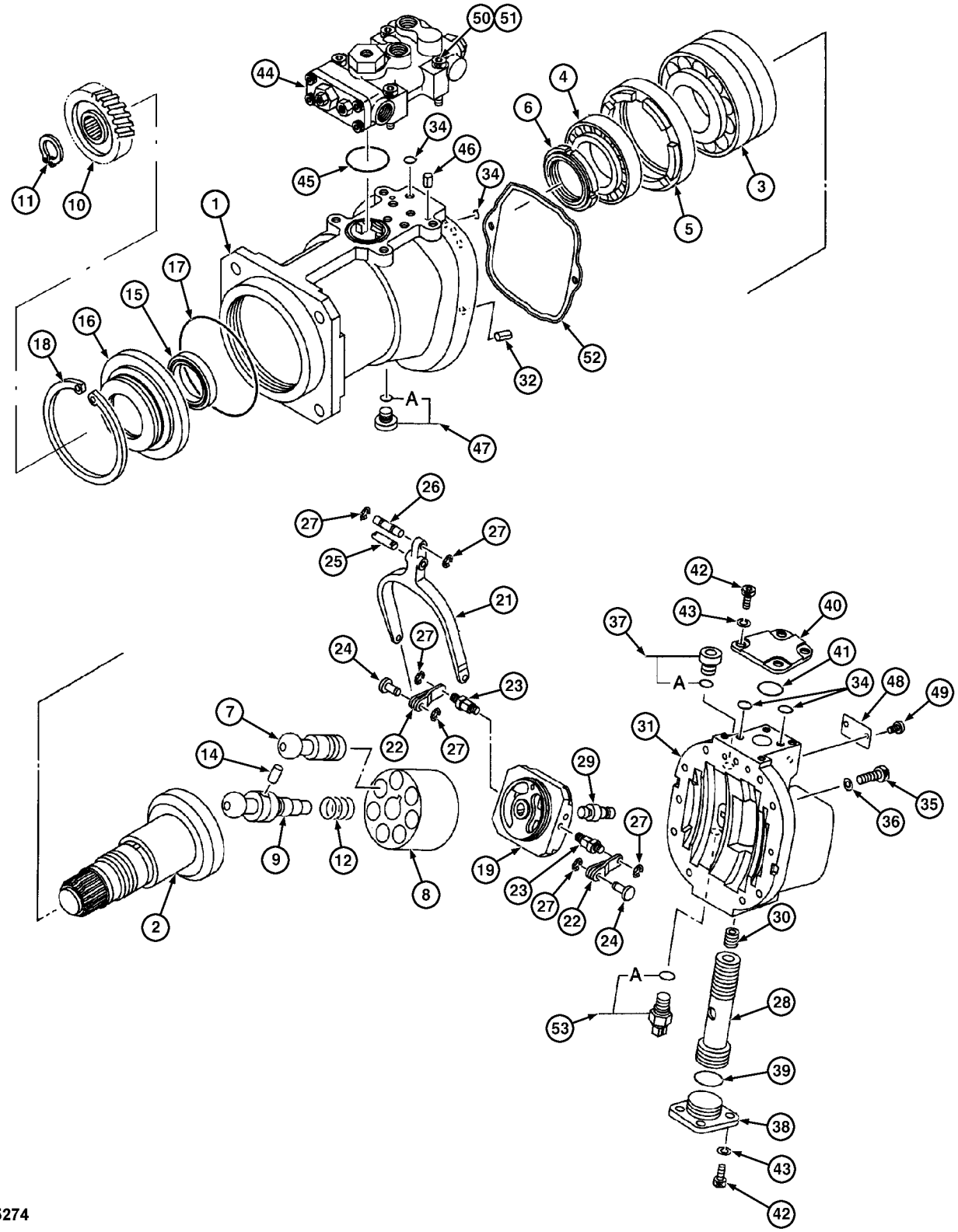
CED,OUOE027,297 –19–03JUN98–1/15




T115274

T115274 –UN–01JUL98

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CED,OUOE027,297 –19–03JUN98–2/15

*Hydraulic System*



**1—Pump Housing**
**2—Drive Shaft**
**3—Roller Bearing**
**4—Roller Bearing**
**5—Spacer**
**6—Bearing Nut**
**7—Piston (7 used)**
**8—Rotor (Cylinder Block)**
**9—Center Shaft**
**10—Gear**
**11—Snap Ring**
**12—Spring**
**14—Pin**
**15—Oil Seal**
**16—Cover**
**17—O-Ring**
**18—Snap Ring**
**19—Valve Plate**
**21—Feedback Link**
**22—Lever (2 used)**
**23—Pin (2 used)**
**24—Pin (2 used)**
**25—Pin**
**26—Pin**
**27—Snap Ring (6 used)**
**28—Servo Piston**
**29—Pin**
**30—Set Screw**
**31—Cylinder Head**
**32—Spring Pin**
**34—O-Ring (4 used)**
**35—Cap Screw (10 used)**
**36—Lock Washer (10 used)**
**37—Plug**
**37A—O-Ring**
**38—Valve Cover (Stop)**
**39—O-Ring**
**40—Valve Cover (Stop)**
**41—O-Ring**
**42—Cap Screw (8 used)**
**43—Lock Washer (8 used)**
**44—Pump Regulator**
**45—O-Ring**
**46—Spring Pin**
**47—Plug**
**47A—O-Ring**
**48—Plate**
**49—Screw (2 used)**
**50—Cap Screw (4 used)**
**51—Lock Washer (4 used)**
**52—Packing**
**53—Pump Pressure Sensor**
**53A—O-Ring**

**Continued on next page**

CED,OUOE027,297 –19–03JUN98–3/15

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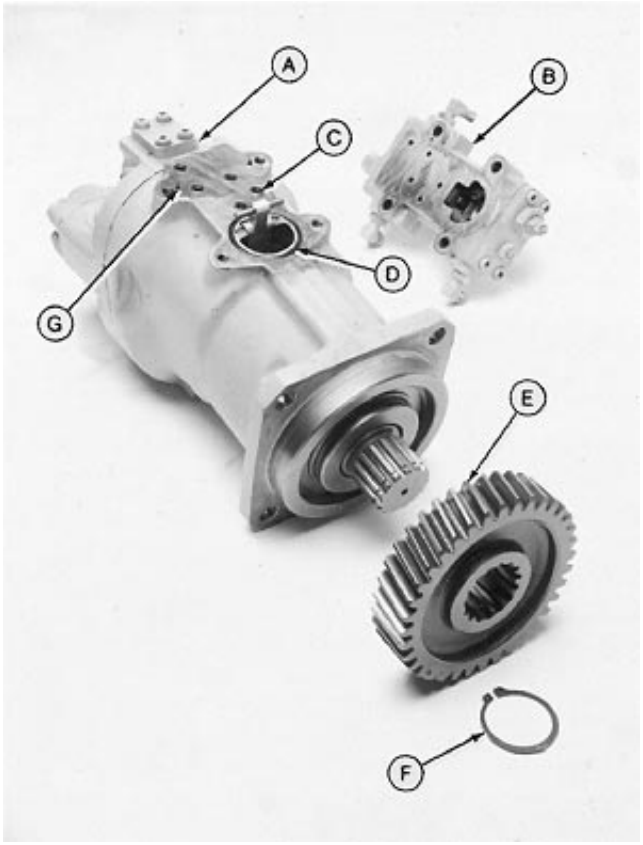
**CAUTION: The approximate weight of hydraulic pump is 68 kg (150 lb).**

**Hydraulic Pump—Specification**

Weight..... 68 kg (150 lb) approximate

1. Remove parts (A—G).




T6557FB –UN–18OCT88

**A—Cylinder Head**
**B—Pump Regulator**
**C—O-Ring (5 used)**
**D—O-Ring**
**E—Gear**
**F—Snap Ring**
**G—Spring Pin (2 used)**

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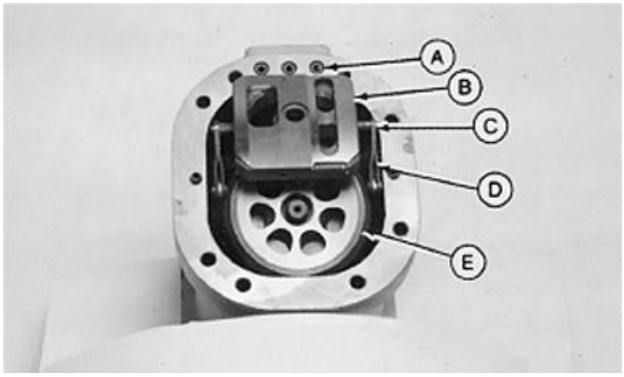
CED,OUOE027,297 –19–03JUN98–4/15

2. Remove parts (A—E). Protect surface of valve plate from damage.




**A—O-Ring (3 used)**
**B—Valve Plate**
**C—Snap Ring (2 used)**
**D—Feedback Link**
**E—Rotor (Cylinder Block)**

**Continued on next page**

CED,OUOE027,297 –19–03JUN98–5/15

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3. Remove spring (A).

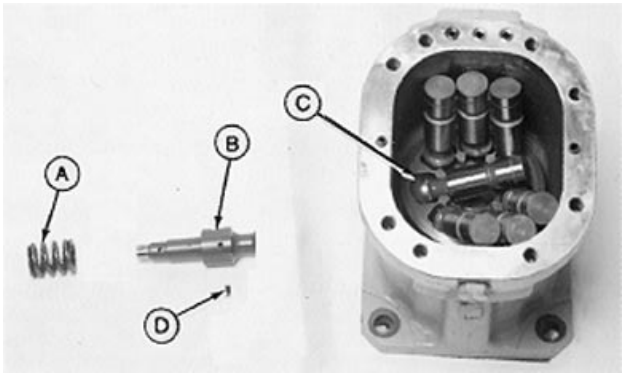
4. Lift center shaft (B) straight up to remove. Do not lose pin (D).

5. Tip pistons (C) toward center of drive shaft to remove.

6. Measure rotor piston bore ID. Measure OD of piston. Subtract piston OD from bores ID for clearance between them.

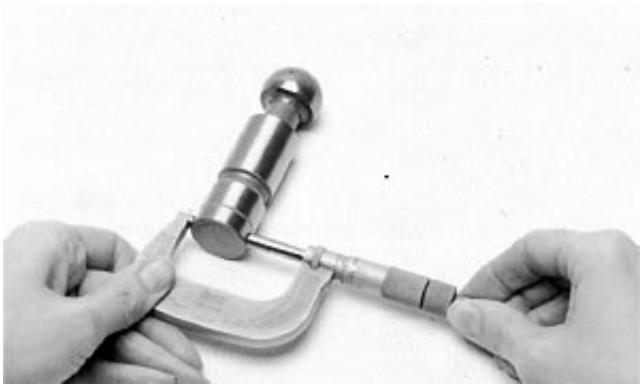
**Rotor Bore-to Piston—Specification**

Clearance ..... 0.044 mm (0.0031 in.) nominal
Clearance ..... 0.08 mm (0.0017 in.) limit of use




T117001 –UN–01SEP98

T6557EM –UN–18OCT88



T6557EN –UN–18OCT88

**A—Spring**
**B—Center Shaft**
**C—Piston (7 used)**
**D—Pin**

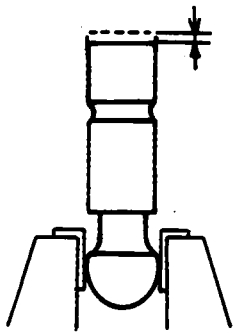
**Continued on next page**

CED,OUOE027,297 –19–03JUN98–6/15

7. Place piston in a vise with soft-jaw faces. Measure play between piston and connecting rod ball.

**Piston-to-Connecting Rod—Specification**

Play..... 0.100 mm (0.0039 in.) nominal
Play..... 0.400 mm (0.0016 in.) limit of use



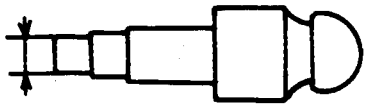
T6557EK –UN–18OCT88

CED,OUOE027,297 –19–03JUN98–7/15

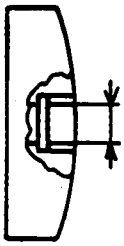
8. Measure OD of center shaft. Measure ID of valve plate bushing. Subtract shaft OD from bushing ID for the clearance between them.

**Center Shaft-to-Valve Plate Bushing—Specification**

Clearance ..... 0.081 mm (0.0032 in.) nominal
Clearance ..... 0.300 mm (0.0118 in.) limit of use



T6557EP –UN–18OCT88



T6557EQ –UN–18OCT88

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CED,OUOE027,297 –19–03JUN98–8/15

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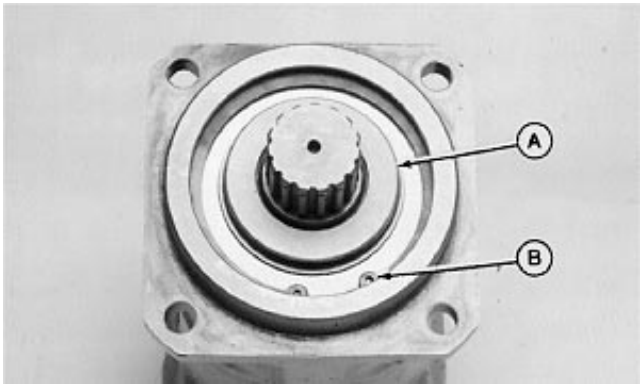
9. Remove snap ring (B).

   Remove cover (A) using two prybars.



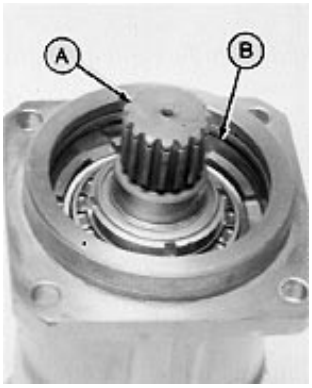

T6557FE –UN–18OCT88

**A—Cover**
**B—Snap Ring**

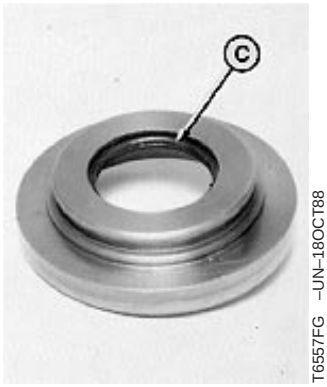
CED,OUOE027,297 –19–03JUN98–9/15

10. Remove O-ring (B) and seal (C).

11. Remove drive shaft (A) and bearings from housing using a press.




T6557FF –UN–20OCT88




T6557FG –UN–18OCT88

**A—Drive Shaft**
**B—O-Ring**
**C—Seal**

**Continued on next page**

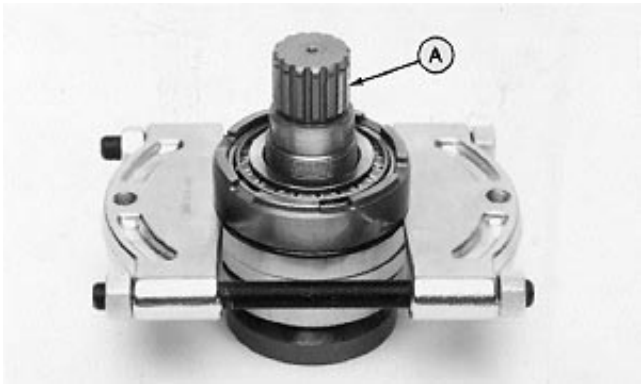
CED,OUOE027,297 –19–03JUN98–10/15

12. Remove nut (E) using the JDG911 Spanner Wrench.
13. Remove parts (B—D and F—H) using a puller.

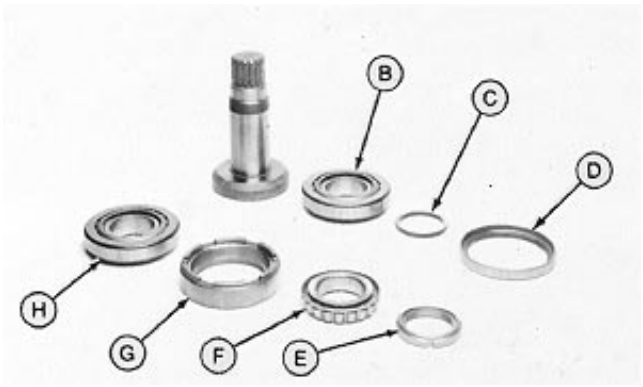
    Bearings and spacers are a press fit.
14. Measure diameter of oil seal contact surface on drive shaft.

**Drive Shaft Oil Seal Contact Surface—Specification**

OD ..... 60 mm (2.36 in.) nominal
OD ..... 59.8 mm (2.35 in.) limit of use




T6557FH –UN–18OCT88




T6557FI –UN–18OCT88

T6557EJ –UN–18OCT88

**A—Drive Shaft**
**B—Roller Bearing**
**C—Spacer**
**D—Spacer**
**E—Bearing Nut**
**F—Roller Bearing**
**G—Spacer**
**H—Roller Bearing**

**Continued on next page**

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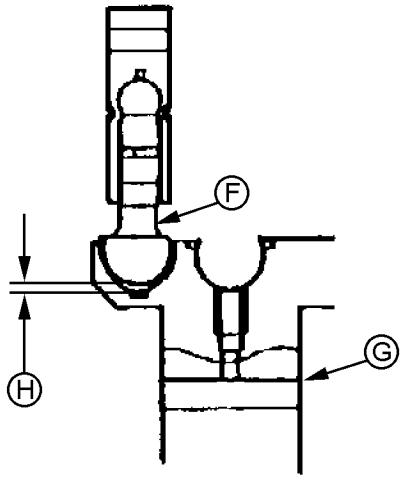
15. Measure play (H) between piston connecting rod (F) ball end and drive shaft socket. Subtract the play reading for piston-to-connecting rod if included.

**Piston Connecting Rod Ball End-to-Drive Shaft Socket—Specification**

Play..... 0.060 mm (0.0024 in.) nominal
Play..... 0.400 mm (0.0157 in.) limit of use




T105726

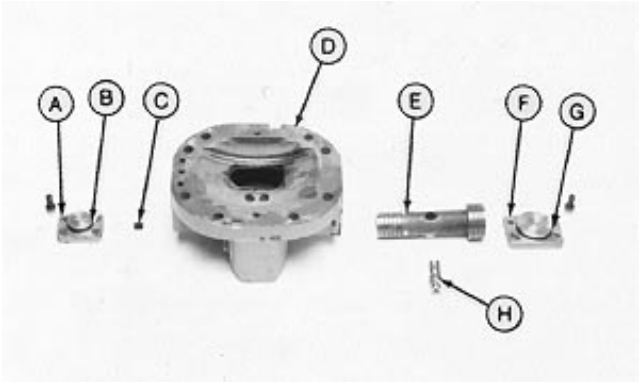
T105726 –UN–09JAN97

**F—Piston Connecting Rod**
**G—Drive Shaft**
**H—Play**

CED,OUOE027,297 –19–03JUN98–12/15

16. Remove valve covers (A and F). Remove O-rings (B and G).

17. Remove set screw (C) from servo piston (E) using a 5 mm hex key wrench. If necessary, heat the set screw to loosen the thread lock and sealer (medium strength). Remove piston and pin (H).




T6557FJ –UN–18OCT88

**A—Valve Cover (Stop)**
**B—O-Ring**
**C—Set Screw**
**D—Cylinder Head**
**E—Servo Piston**
**F—Valve Cover (Stop)**
**G—O-Ring**
**H—Pin**

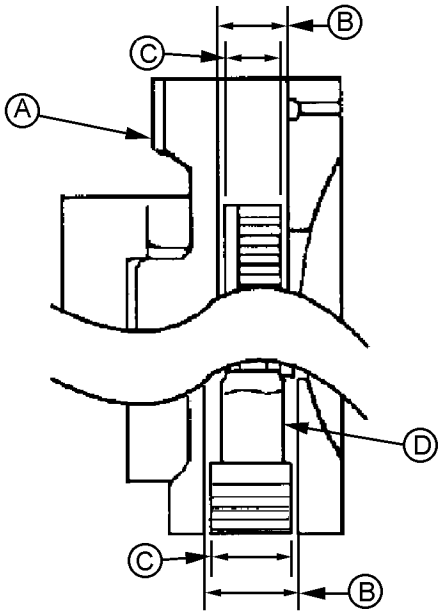
**Continued on next page**

CED,OUOE027,297 –19–03JUN98–13/15

18. Measure OD (C) of small and large end of servo piston (D). Measure ID (B) of small and large end of bore in cylinder head (A). Subtract the OD from the ID for clearances.

**Servo Piston-to-Cylinder Head Bore—Specification**

Clearance ..... 0.089 mm (0.0035 in.) nominal
Clearance ..... 0.200 mm (0.0079 in.) limit of use




T105727

T105727 –UN–19DEC96

**A—Cylinder Head**
**B—ID**
**C—OD**
**D—Servo Piston**

**Continued on next page**

CED,OUOE027,297 –19–03JUN98–14/15

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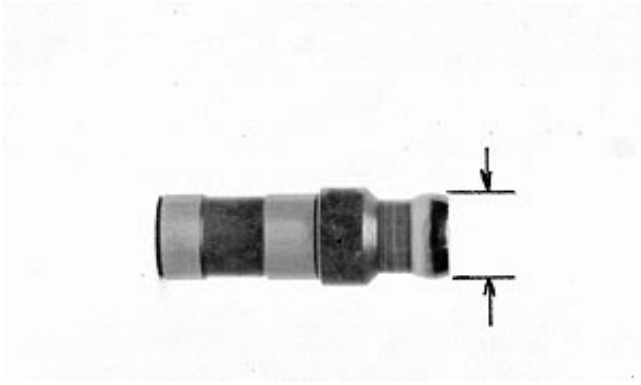
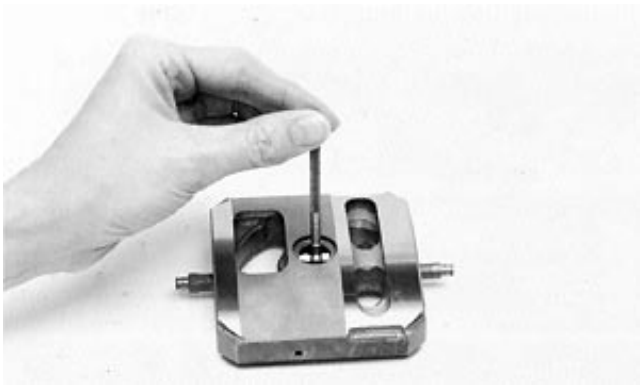
19. Measure OD of servo piston pin. Measure ID of valve plate bore. Subtract OD from ID for clearance between them.

**Servo Piston Pin-to-Valve Plate Bore—Specification**

Clearance ..... 0.051 mm (0.0020 in.) nominal
Clearance ..... 0.300 mm (0.0118 in.) limit of use



T6557EV –UN–18OCT88



T6557EW –UN–18OCT88

CED,OUOE027,297 –19–03JUN98–15/15

## ASSEMBLE MAIN HYDRAULIC PUMP

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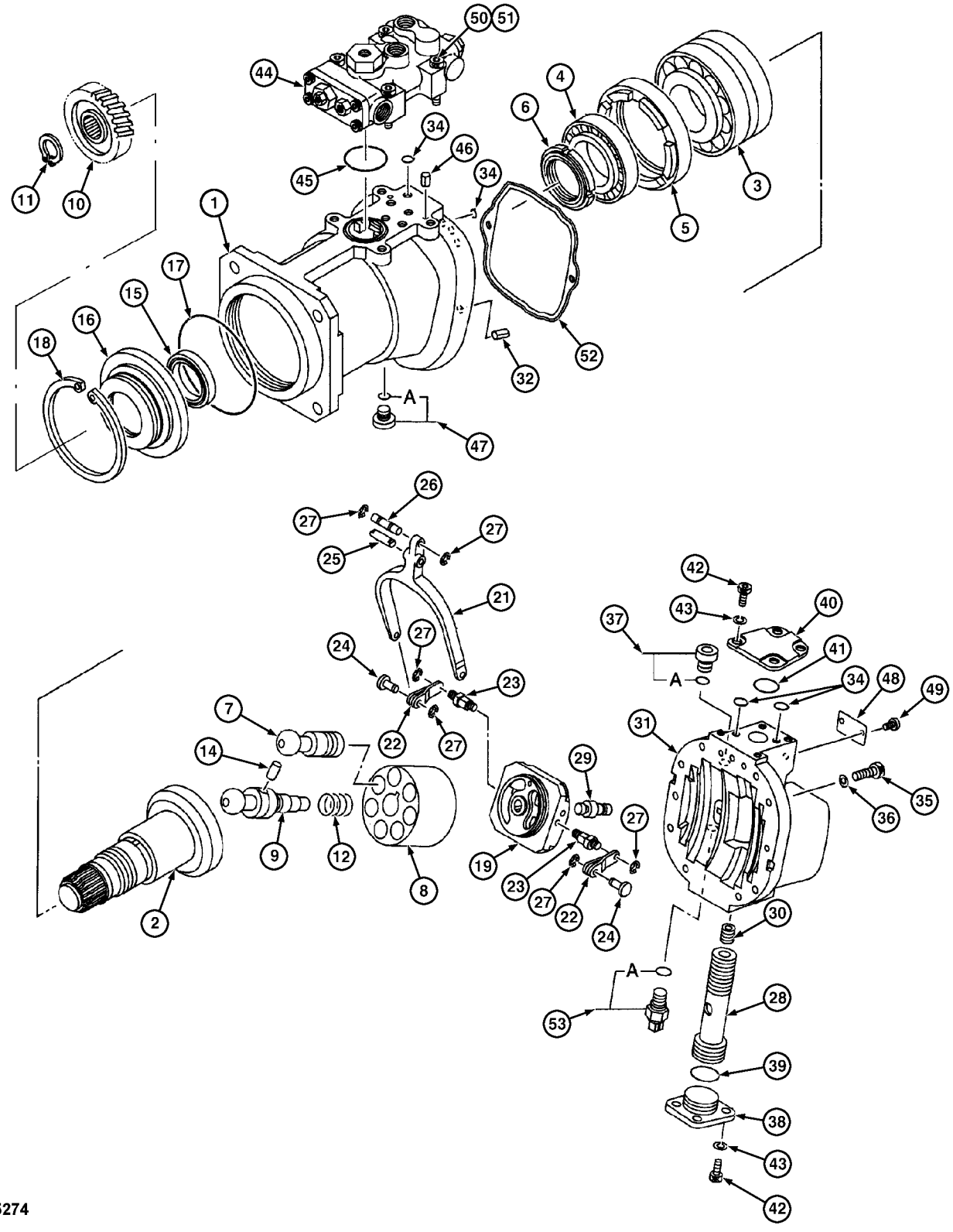


T115274

T115274 –UN–01JUL98

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CED,OUOE027,299 –19–04JUN98–1/14

**1—Pump Housing**
**2—Drive Shaft**
**3—Roller Bearing**
**4—Roller Bearing**
**5—Spacer**
**6—Bearing Nut**
**7—Piston (7 used)**
**8—Rotor (Cylinder Block)**
**9—Center Shaft**
**10—Gear**
**11—Snap Ring**
**12—Spring**
**14—Pin**
**15—Oil Seal**
**16—Cover**
**17—O-Ring**
**18—Snap Ring**
**19—Valve Plate**
**21—Feedback Link**
**22—Lever (2 used)**
**23—Pin (2 used)**
**24—Pin (2 used)**
**25—Pin**
**26—Pin**
**27—Snap Ring (6 used)**
**28—Servo Piston**
**29—Pin**
**30—Set Screw**
**31—Cylinder Head**
**32—Spring Pin**
**34—O-Ring (4 used)**
**35—Cap Screw (10 used)**
**36—Lock Washer (10 used)**
**37—Plug**
**37A—O-Ring**
**38—Valve Cover (Stop)**
**39—O-Ring**
**40—Valve Cover (Stop)**
**41—O-Ring**
**42—Cap Screw (8 used)**
**43—Lock Washer (8 used)**
**44—Pump Regulator**
**45—O-Ring**
**46—Spring Pin**
**47—Plug**
**47A—O-Ring**
**48—Plate**
**49—Screw (2 used)**
**50—Cap Screw (4 used)**
**51—Lock Washer (4 used)**
**52—Packing**
**53—Pump Pressure Sensor**
**53A—O-Ring**



CED,OUOE027,299 –19–04JUN98–2/14

1. Clean threads of set screw (C) using cure primer. Apply thread lock and sealer (medium strength) to threads.

2. Install servo piston (E) and pin (H). Install set screw (C) and tighten.

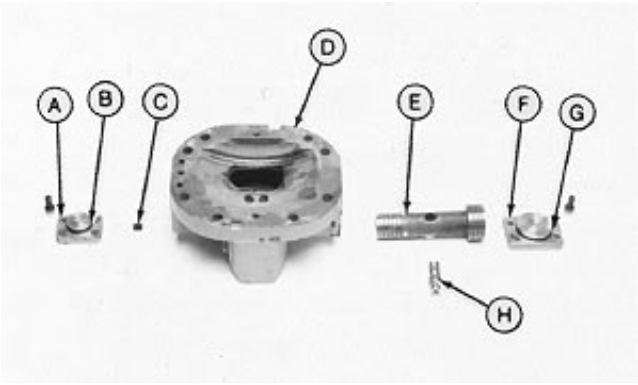
**Servo Piston-to-Pin Set Screw—Specification**

Torque ..... 25 N•m (220 lb-in.)

3. Install parts (A, B, F and G). Tighten cap screws.

**Valve Cover (Stop)-to-Cylinder Head Cap Screw—Specification**

Torque ..... 20 N•m (175 lb-in.)




T6557FJ –UN–18OCT88

**A—Valve Cover (Stop)**
**B—O-Ring**
**C—Set Screw**
**D—Cylinder Head**
**E—Servo Piston**
**F—Valve Cover (Stop)**
**G—O-Ring**
**H—Pin**

**Continued on next page**

CED,OUOE027,299 –19–04JUN98–3/14

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**CAUTION: DO NOT heat oil over 182°C (360°F). Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer. DO NOT allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.**

TS227 –UN–23AUG88

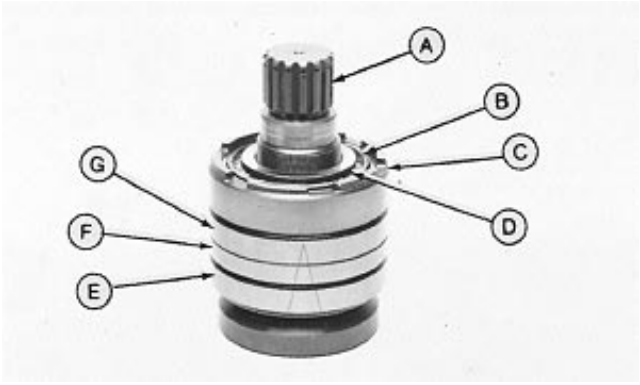
4. Heat bearings cones (B, E and G).

**Drive Shaft Bearing Cone—Specification**

Temperature ..... 80—100°C (176—212°F)

5. Apply clean hydraulic oil to parts (A—G).

6. Install parts (B—G).



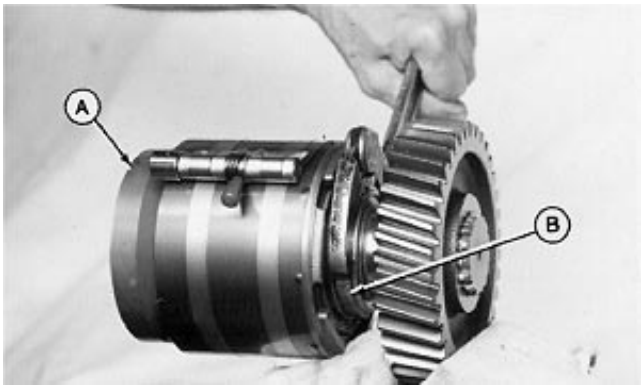

T6557FK –UN–18OCT88

**A—Drive Shaft**
**B—Roller Bearing**
**C—Spacer**
**D—Spacer**
**E—Roller Bearing**
**F—Spacer**
**G—Roller Bearing**

**Continued on next page**

CED,OUOE027,299 –19–04JUN98–4/14

7. Apply clean hydraulic oil to threads of bearing nut (B). Install nut.
8. Install a ring compressor to align bearings on drive shaft (A).
9. Tighten nut (B) until nut is tight against roller bearing. Turn drive shaft back and forth several times to seat the roller bearings.




T6557FL –UN–18OCT88

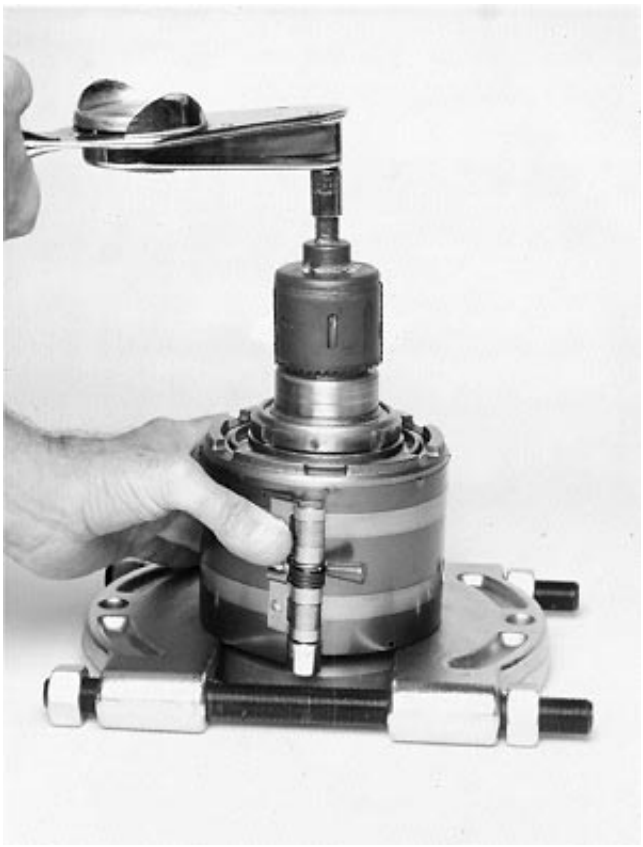
**A—Drive Shaft**
**B—Bearing Nut**

CED,OUOE027,299 –19–04JUN98–5/14

10. Place drive shaft with attached parts on knife-edged puller. Be sure ring compressor holds the weight of the assembly.
11. Install DF1037 Hydraulic Pump Torque Adapter on spline of drive shaft. Make a record of the starting torque. Starting torque must be as specified. (See Section 99 for instructions to make tool.)

**Drive Shaft—Specification**

| | |
|---|---|
| Torque ..... starting | 2.5—3.5 N•m (22—30 lb-in.) |

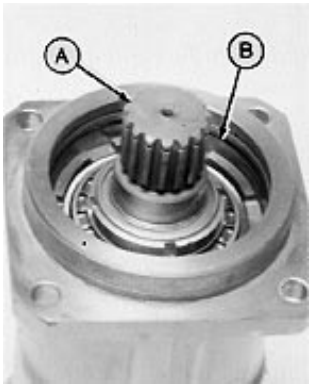


T6557FM –UN–18OCT88

**Continued on next page**

CED,OUOE027,299 –19–04JUN98–6/14

12. Heat housing to 80—100°C (176—270°F). Apply multi-purpose grease to inside of housing and to O-ring groove.
13. Install drive shaft (A).
14. Apply multi-purpose grease to O-ring (B) and install O-ring in housing.
15. Install oil seal (C) in cover.



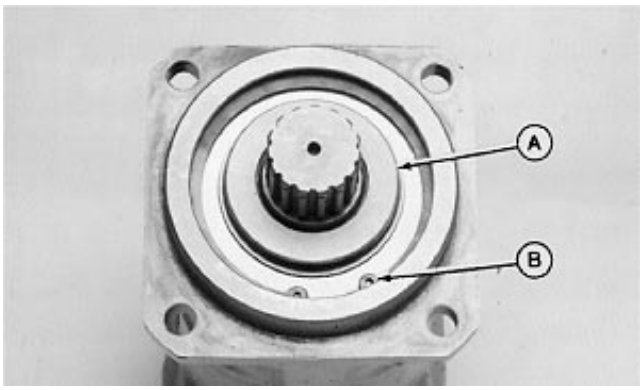
T6557FF –UN–20OCT88

T6557FG –UN–18OCT88

**A—Drive Shaft**
**B—O-Ring**
**C—Oil Seal**

CED,OUOE027,299 –19–04JUN98–7/14

16. Install cover (A) and snap ring (B). Make sure snap ring is installed properly in snap ring groove.



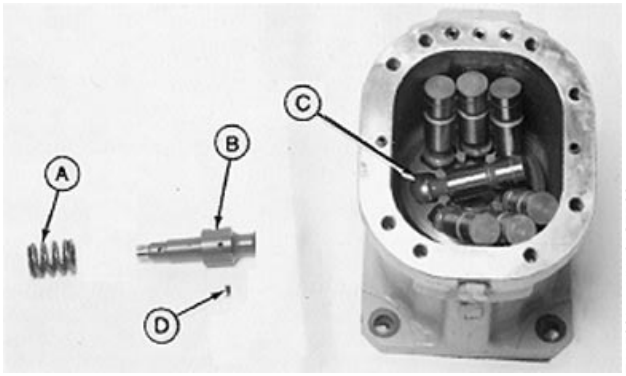
T6557FE –UN–18OCT88

**A—Cover**
**B—Snap Ring**

**Continued on next page**

CED,OUOE027,299 –19–04JUN98–8/14

17. Apply clean hydraulic oil to pistons (C). Place pistons horizontally against drive shaft and install pistons.
18. Apply multi-purpose grease to pin (D). Install pin on center shaft (B).
19. Install parts (A and B).



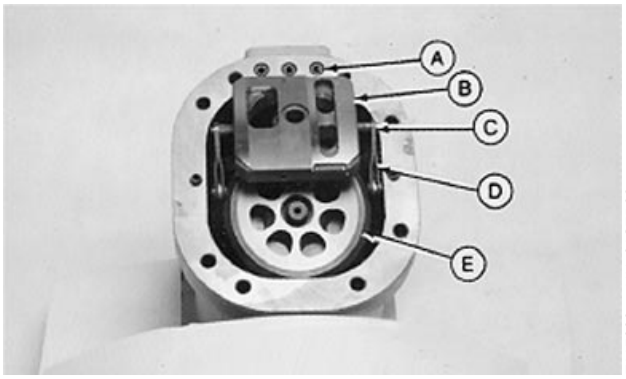

T117001 –UN–01SEP98

**A—Spring**
**B—Center Shaft**
**C—Piston (7 used)**
**D—Pin**

CED,OUOE027,299 –19–04JUN98–9/14

20. Install link feedback (D) into housing.
21. Install dowel pin into slot in housing. Dowel pin is a snug fit.
22. Install rotor (E), aligning holes with center shaft and pistons, and slot with pin in center shaft.
23. Apply clean hydraulic oil to rotor (E) and valve plate (B). Install valve plate (B) and snap rings (C).

    Install O-rings (A) and housing-to-cover packing.




T117000 –UN–01SEP98

**A—O-Ring (3 used)**
**B—Valve Plate**
**C—Snap Ring (2 used)**
**D—Feedback Link**
**E—Rotor (Cylinder Block)**

**Continued on next page**

CED,OUOE027,299 –19–04JUN98–10/14

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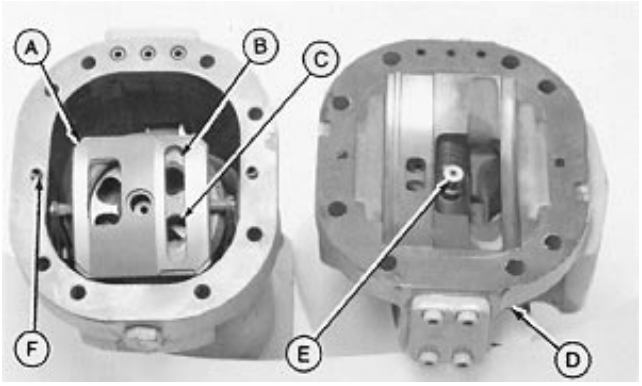
44

24. Position valve plate (A) and rotor (B) as shown. Be sure outlet port (C) is positioned as shown.

25. Install cylinder head (D), aligning pin (E) with center shaft bore in valve plate (A) and holes with spring pins (F).




T6557FN –UN–18OCT88

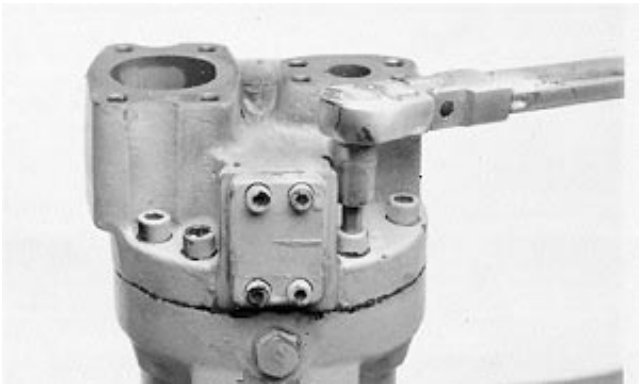
**A—Valve Plate**
**B—Rotor**
**C—Outlet Port**
**D—Cylinder Head**
**E—Pin**
**F—Spring Pin (2 used)**

CED,OUOE027,299 –19–04JUN98–11/14

26. Install washers and cap screws and tighten.

**Cylinder Head-to-Pump Housing Cap Screw—Specification**

Torque ..... 108 N•m (80 lb-ft)



T6557FO –UN–18OCT88

**Continued on next page**

CED,OUOE027,299 –19–04JUN98–12/14

27. Install O-rings (E and D).

*NOTE: Grooves (B) are shown out of assembly position for clarity of photograph.*

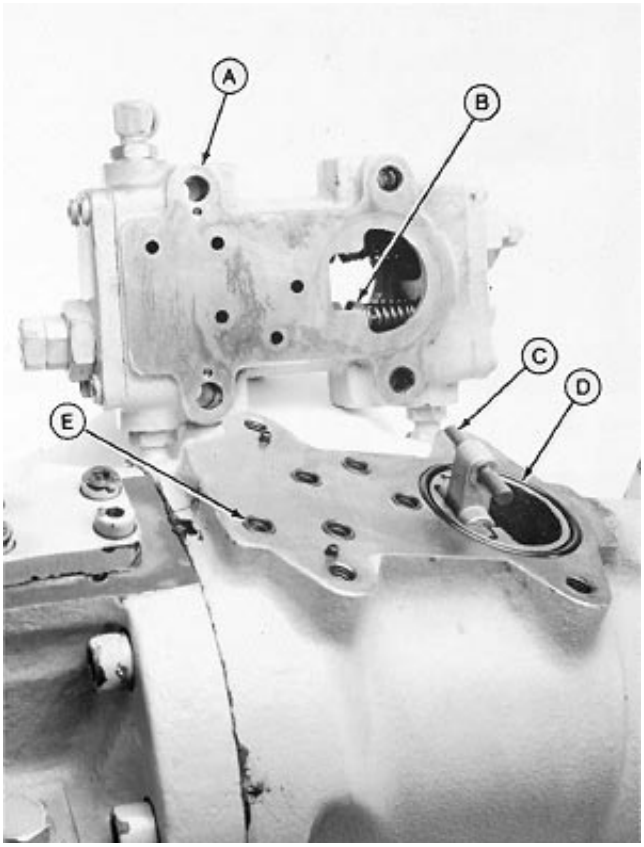
28. Remove air bleed plugs from pump regulator (A). Install regulator making sure groove (B) in remote control sleeve and load sleeve engage dowel pin (C) in feedback link. Check through hole that groove in sleeves engage dowel pin.

29. Tighten cap screws.

**Pump Regulator-to-Pump Housing Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

30. Install air bleed plug.




T6557FP –UN–18OCT88

**A—Pump Regulator**
**B—Grove**
**C—Dowel Pin**
**D—O-Ring**
**E—O-Ring (5 used)**

**Continued on next page**

CED,OUOE027,299 –19–04JUN98–13/14

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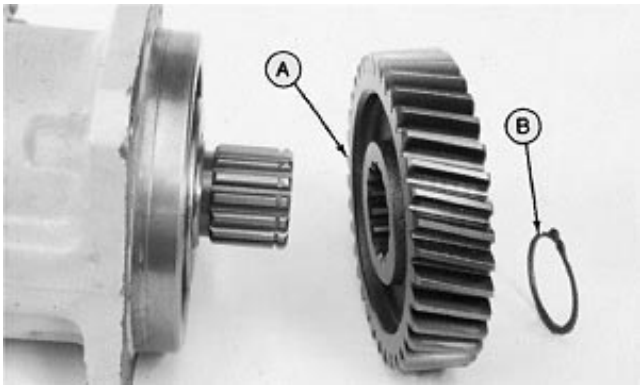
3360
46

31. Install gear (A) and snap ring (B).




T6557FR –UN–18OCT88

**A—Gear**
**B—Snap Ring**

CED,OUOE027,299 –19–04JUN98–14/14

## DISASSEMBLE AND ASSEMBLE HYDRAULIC PUMP REGULATOR

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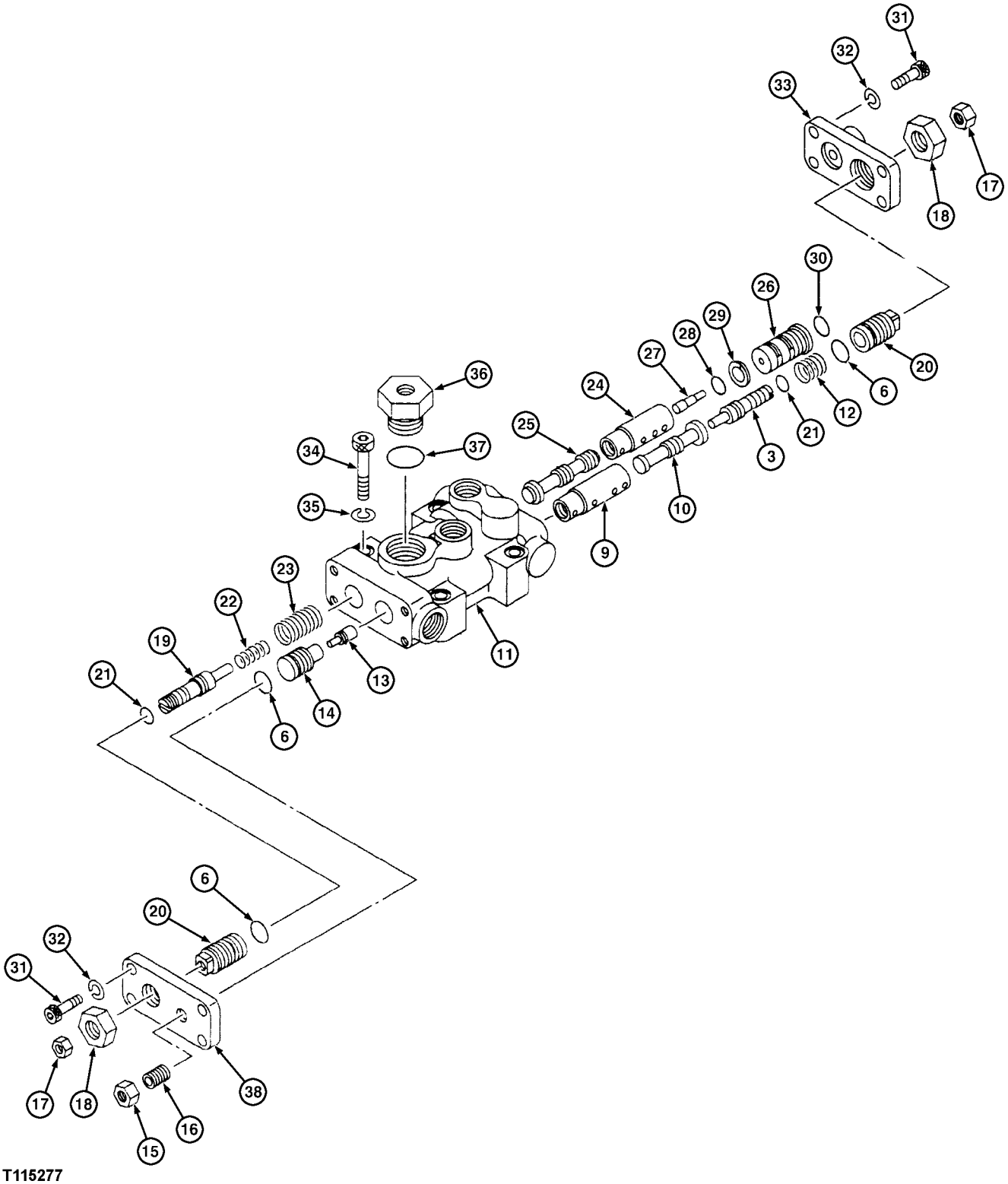


T115277

T115277 –UN–01JUL98

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CED,OUOE027,300 –19–05JUN98–1/4

**3—Maximum Flow Adjusting Screw (Stop)**
**6—O-Ring (3 used)**
**9—Remote Control Sleeve**
**10—Remote Control Spool**
**11—Housing**
**12—Spring**
**13—Piston**
**14—Cylinder**
**15—Nut**
**16—Minimum Flow Adjusting Screw**
**17—Nut (2 used)**
**18—Nut (2 used)**
**19—Load Adjusting Screw (Stop)**
**20—Load Adjusting Cartridge (Stop)**
**—Flow Adjusting Cartridge (Stop)**
**21—O-Ring (2 used)**
**22—Inner Spring**
**23—Outer Spring**
**24—Load Sleeve**
**25—Load Spool**
**26—Cylinder**
**27—Load Piston**
**28—O-Ring**
**29—Backup Ring**
**30—O-Ring**
**31—Cap Screw (8 used)**
**32—Lock Washer (8 used)**
**33—End Plate**
**34—Cap Screw (4 used)**
**35—Lock Washer (4 used)**
**36—Air Bleed Plug**
**37—O-Ring**
**38—Cover**

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**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug to release air pressure in hydraulic oil tank.
2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).
3. Remove cap screw (34) and lock washers (35) to remove pump regulator.

**IMPORTANT: Removal of adjusting screws (3, 16 and 19) and cartridges (20) from end plate (33) and cover (38) will require the adjustment of pump regulator. Only remove parts from end plate and cover if replacement is necessary.**

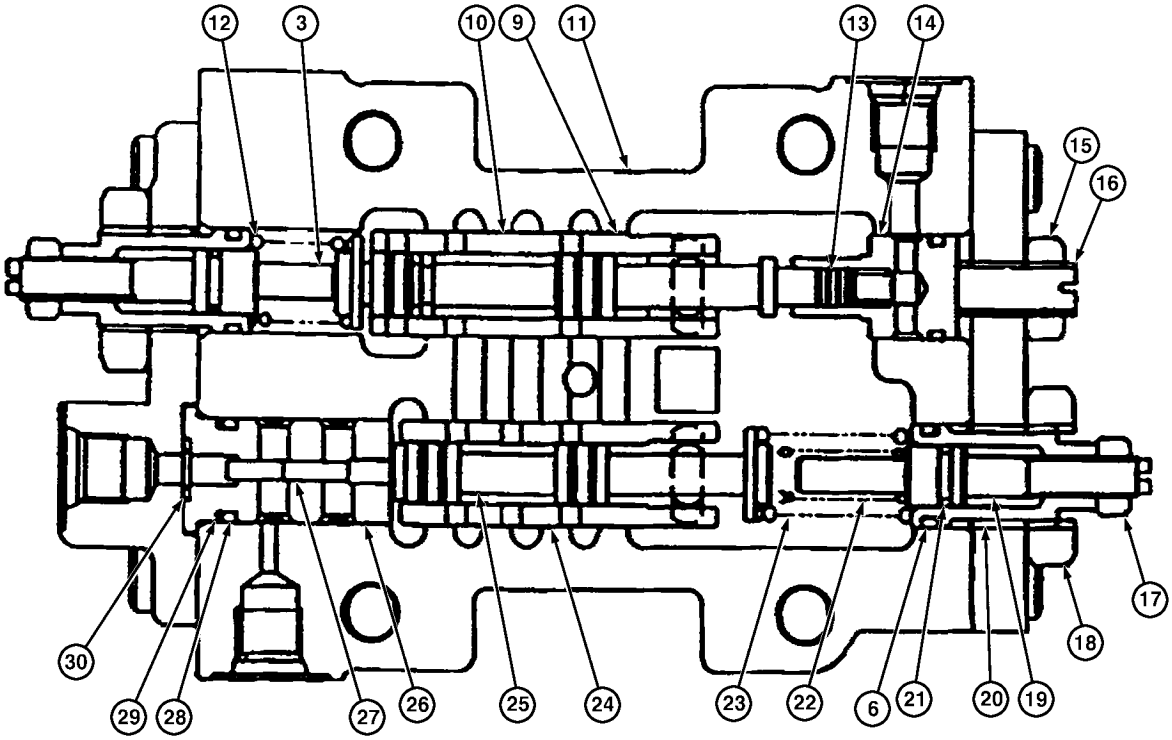
4. Remove end plate (33) and cover (38) with adjusting screws and cartridges installed.
5. Repair or replace parts as necessary.
6. Tighten cap screws (31).

**End Plate and Cover-to-Housing Cap Screw—Specification**

Torque..... 19.6 N•m (175 lb-in.)

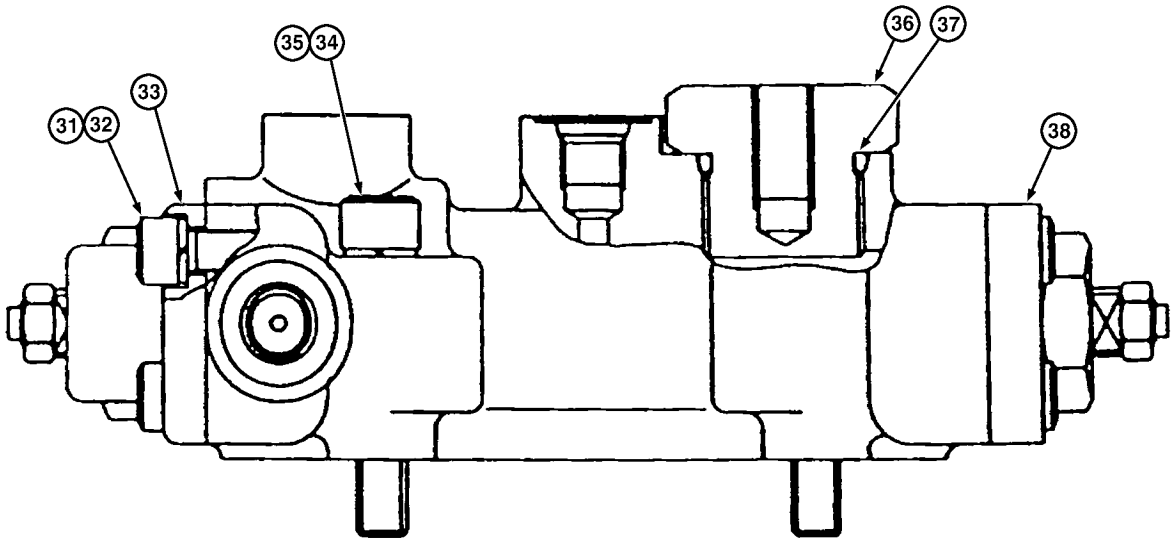
**Continued on next page**

CED,OUOE027,300 –19–05JUN98–2/4




T115551

T115551 –UN–01JUL98




T115552

T115552 –UN–01JUL98

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CED,OUOE027,300 –19–05JUN98–3/4

**3—Maximum Flow Adjusting Screw (Stop)**
**6—O-Ring (3 used)**
**9—Remote Control Sleeve**
**10—Remote Control Spool**
**11—Housing**
**12—Spring**
**13—Piston**
**14—Cylinder**
**15—Nut**
**16—Minimum Flow Adjusting Screw**
**17—Nut (2 used)**
**18—Nut (2 used)**
**19—Load Adjusting Screw (Stop)**
**20—Load Adjusting Cartridge (Stop)**
**—Flow Adjusting Cartridge (Stop)**
**21—O-Ring (2 used)**
**22—Inner Spring**
**23—Outer Spring**
**24—Load Sleeve**
**25—Load Spool**
**26—Cylinder**
**27—Load Piston**
**28—O-Ring**
**29—Backup Ring**
**30—O-Ring**
**31—Cap Screw (8 used)**
**32—Lock Washer (8 used)**
**33—End Plate**
**34—Cap Screw (4 used)**
**35—Lock Washer (4 used)**
**36—Air Bleed Plug**
**37—O-Ring**
**38—Cover**

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7. Remove air bleed plugs from pump regulator. Install regulator making sure groove in remote control sleeve (9) and load sleeve (24) engage dowel pin in feedback link. Check through hole that groove in sleeves engage dowel pin.

   Tighten cap screws (34).

**Housing-to-Pump Housing Cap Screw—Specification**

Torque..... 49 N•m (36 lb-ft)

Tighten air bleed plug.

**Air Bleed Plug-to-Housing—Specification**

Torque..... 78 N•m (58 lb-ft)

**IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting engine. Procedure must be performed whenever a new pump is installed or oil has been drained from the pump or hydraulic oil tank.**

8. Fill pump housing with oil. (See Hydraulic Pump and Splitter Drive Start-Up Procedure in this group.)

9. Check pump regulator adjustments. (See Hydraulic Pump Regulator Test and Adjustments in Group 9025-25.)

CED,OUOE027,300 –19–05JUN98–4/4

## REMOVE AND INSTALL PILOT PUMP

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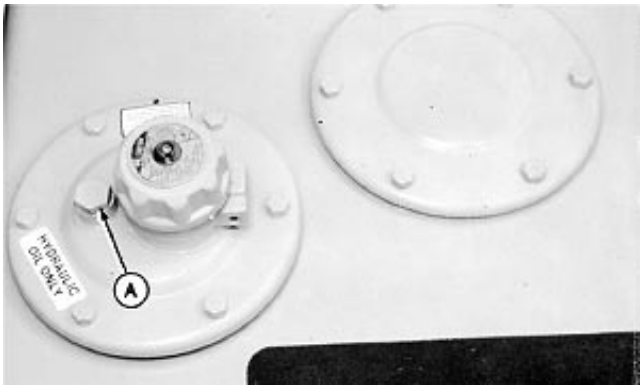
**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure in hydraulic oil tank.
2. Remove drain plug (H) to drain splitter drive. Approximate oil capacity is 1.0 L (1.3 qt).
3. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).
4. Disconnect lines (B—D and I).
5. Remove cap screws (G) and pilot pump (J).
6. Replace parts as necessary. (See Disassemble and Assemble Pilot Pump in this group.)
7. Apply plastic gasket to mounting surface for pilot pump.
8. Install pilot pump (J). Tighten cap screw.

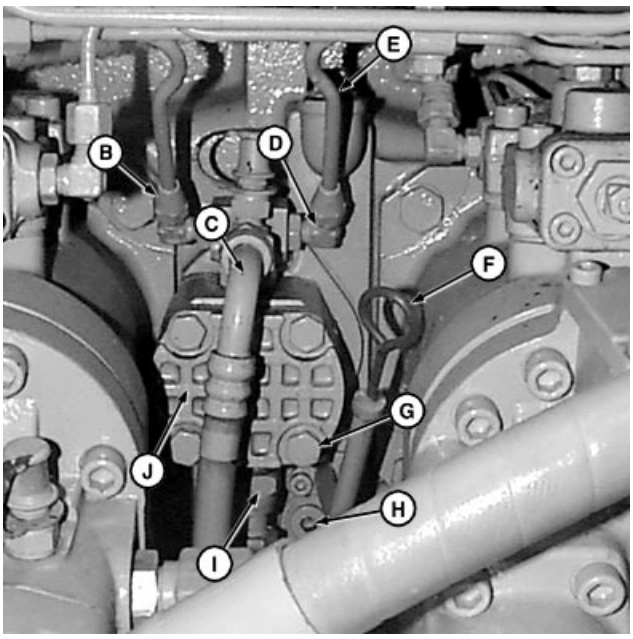
**Pump-to-Splitter Drive Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

9. Connect lines (B—D and I).
10. Fill splitter drive with oil through filler pipe so oil level is approximately halfway between “H” (level) mark and end of dipstick. (See Diesel Engine and Pump Gearbox Oils in Group 0004.)




T7869AT –UN–12NOV92




T115556 –UN–01JUL98

**A—Vent Plug**
**B—Rear Pump Regulator Port E Line**
**C—Pilot Pressure Regulating Valve**
**D—Front Pump Regulator Port E Line**
**E—Filler Pipe**
**F—Dipstick**
**G—Cap Screw, Washer and Lock Washer (4 used)**
**H—Drain Plug**
**I—Hydraulic Oil Tank Line**
**J—Pilot Pump**

CED,OUOE027,303 –19–05JUN98–1/1

## DISASSEMBLE AND ASSEMBLE PILOT PUMP

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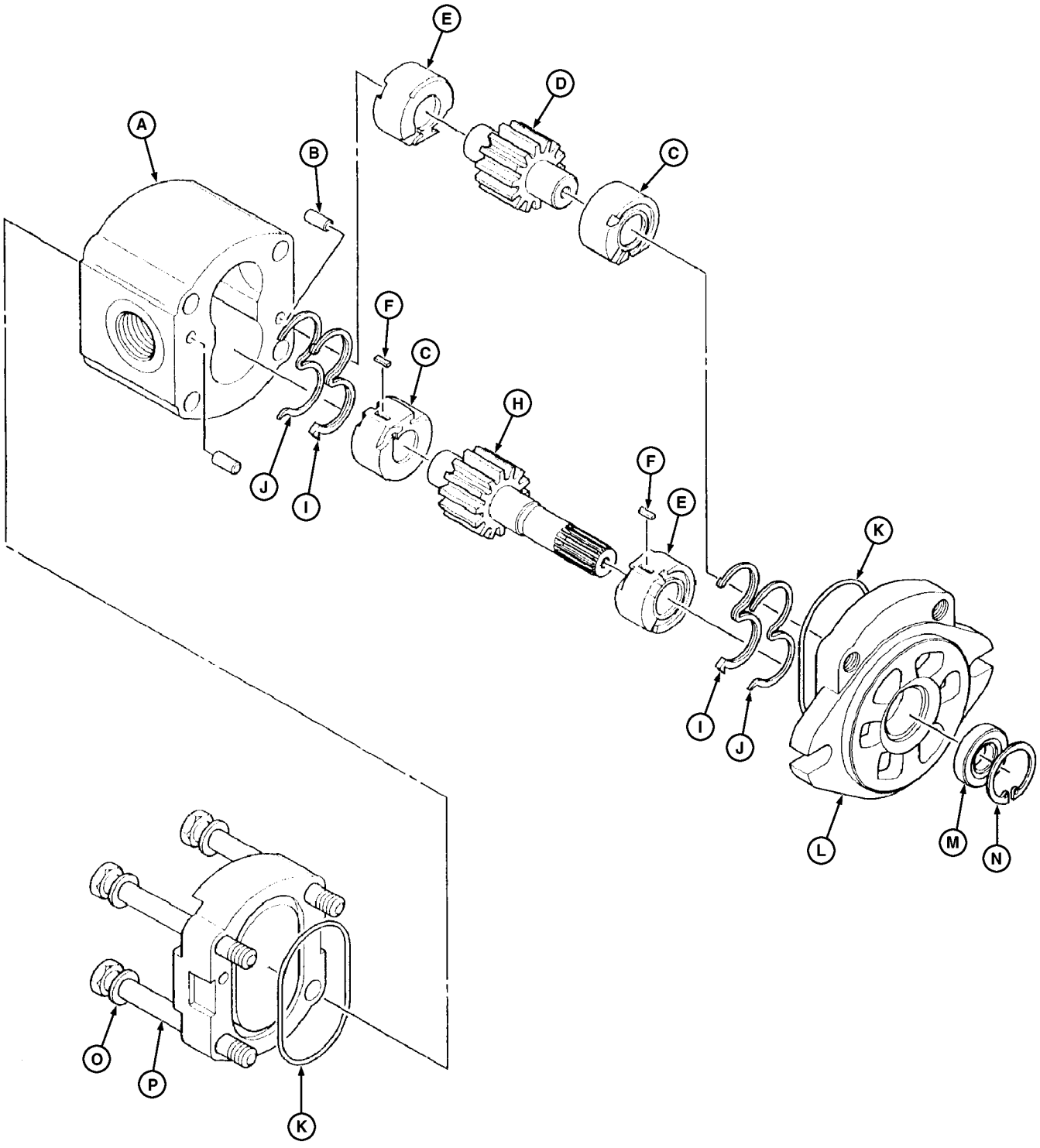


T115271

T115271 –UN–01JUL98

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CED,OUOE027,304 –19–05JUN98–1/3

**A—Pump Housing**
**B—Pin (2 used)**
**C—Bushing (2 used)**
**D—Gear**
**E—Bushing (2 used)**
**F—Key (2 used)**
**H—Gear**
**I—Seal (2 used)**
**J—Backup Retainer (2 used)**
**K—O-Ring (2 used)**
**L—Flange**
**M—Oil Seal**
**N—Snap Ring**
**O—Washer (4 used)**
**P—Cap Screw (4 used)**



1. Remove cap screws (P) and washers (O) to remove end plate and flange (L) from pump housing (A).

CED,OUOE027,304 –19–05JUN98–2/3

2. Remove drive gear (A), driven gear (C), bushings (D) and keys (B).

3. Check bushings (D). If inside diameter and surface toward gear are rough or worn, replace pump.

4. Check gears (A and C) and housing. If gear teeth, shaft, and inside of housing is rough or worn, replace pump.

**IMPORTANT: Apply clean hydraulic oil to all parts. Pump failure can result if pump is assembled dry.**

5. Apply clean hydraulic oil to all parts.

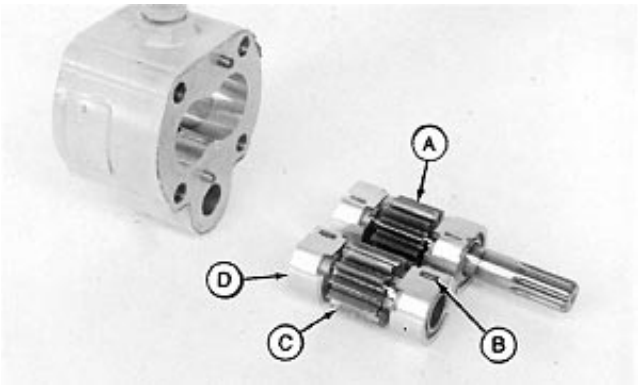
6. Apply grease to lip of oil seal. Install oil seal with lip (spring side) toward inside of housing.

7. Install cap screws (P) and washers (O) and tighten.

**Cover-to-Flange Cap Screw—Specification**

Torque ..... 41 N•m (31 lb-ft)

8. Do Pilot Pressure Regulating Valve Test and Adjustment to check pressure setting. (See procedure in Group 9025-25.)




T7685IX –UN–13MAY92

**A—Drive Gear**
**B—Key (4 used)**
**C—Driven Gear**
**D—Bushing (4 used)**

CED,OUOE027,304 –19–05JUN98–3/3

## REMOVE AND INSTALL PILOT PRESSURE REGULATING VALVE AND FILTER

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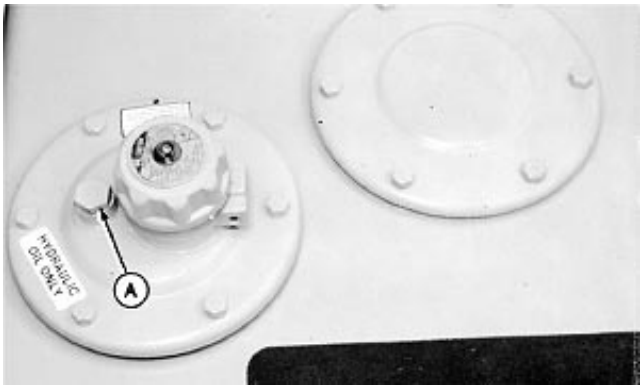
**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure in hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE027,305 –19–05JUN98–1/2

2. Disconnect lines (A, B, E and J).
3. Remove cap screws and lock washers (G) to remove pilot pressure regulating valve and pilot filter.
4. Replace parts as necessary.
5. Install new pilot filter element.

   Tighten filter element housing.

**Pilot Filter Element Housing-to-Filter Head—Specification**

Torque ..... 25 N•m (220 lb-in.)

6. Tighten cap screws (C).

**Regulating Valve Housing-to-Filter Head Cap Screw—Specification**

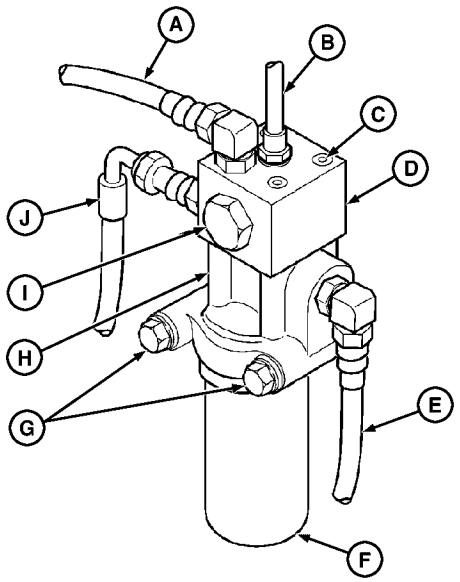
Torque ..... 20 N•m (175 lb-in.)

7. Tighten cap screws (G).

**Filter Head-to-Support Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

8. Connect lines.
9. Do Pilot Pressure Regulating Valve Test and Adjustment to check pressure setting. (See procedure in Group 9025-25.)




T115302 –UN–01JUL98

**T115302**

**A—From Pilot Pressure Regulating Valve Top Front Port-to-Hydraulic Oil Tank Return Manifold Line**
**B—From Pilot Pressure Regulating Valve Top Rear Port-to-System Relief Valve Manifold Block**
**C—Cap Screw (4 used)**
**D—Pilot Pressure Regulating Valve Housing**
**E—From Filter Head Left Side Port-to-Pilot Pump Line**
**F—Pilot Filter**
**G—Cap Screw and Lock Washer (2 used)**
**H—Filter Head**
**I—Plug**
**J—From Filter Head Right Side Port-to-Pilot Shut-Off Valve Line**

CED,OUOE027,305 –19–05JUN98–2/2

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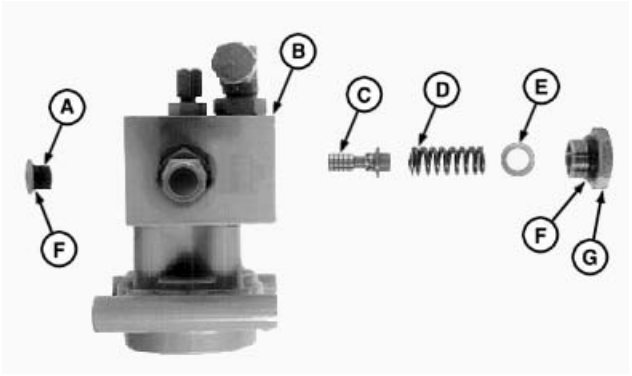
## DISASSEMBLE AND ASSEMBLE PILOT PRESSURE REGULATING VALVE AND FILTER

1. Remove plugs (A and G).
2. Push poppet (C) and spring (D) to right to remove.
3. Inspect and clean parts.
4. Check that poppet (C) slides smoothly in pilot pressure regulating valve housing (B).
5. Tighten plugs (A and G).

**Plug-to-Regulating Valve Housing—Specification**

Torque ..... 49 N•m (36 lb-ft)




T113770 –UN–07APR98

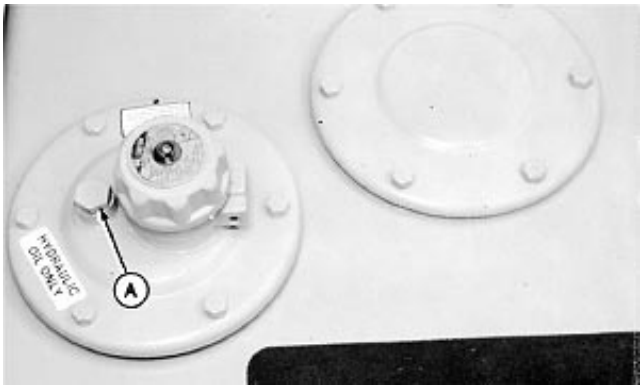
**A—Plug**
**B—Pilot Pressure Regulating Valve Housing**
**C—Poppet**
**D—Spring**
**E—Shim (As Required)**
**F—O-Ring**
**G—Plug**

CED,OUOE027,306 –19–05JUN98–1/1

## REMOVE AND INSTALL PILOT SHUT-OFF VALVE

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure in hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

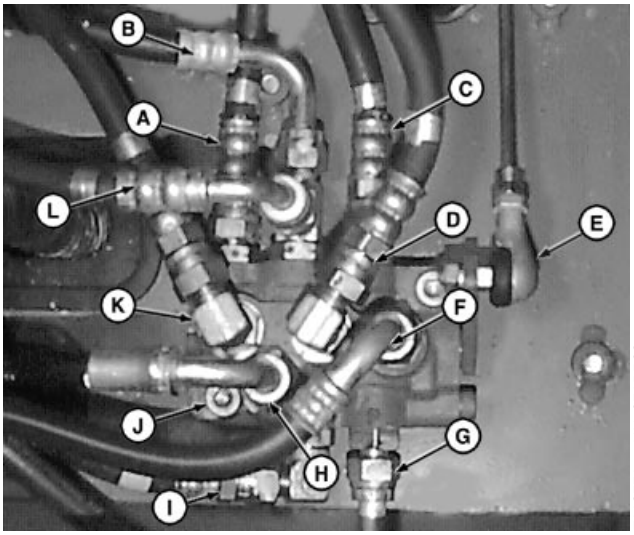
CED,OUOE027,307 –19–05JUN98–1/2

2. Turn upperstructure 90° to tracks.
3. Remove bottom cover under rear of cab.
4. Disconnect pilot shut-off valve linkage (E).
5. Mark lines to aid assembly.
6. Disconnect lines (A—D, F—I, K and L).
7. Remove cap screws (J) to remove pilot shut-off valve.
8. Repair or replace valve as necessary.
9. Install valve. Tighten cap screws.

**Head-to-Support Pilot Shut-Off Valve Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

10. Connect lines.
11. Connect linkage. Check pilot shut-off valve linkage adjustment. (See procedure in this group.)




T113771 –UN–07APR98

**A—To Right Pilot Controller P Port**
**B—To Propel Pilot Controller P Port**
**C—To Left Pilot Controller P Port**
**D—From Left Pilot Controller T Port**
**E—Pilot Shut-Off Valve Linkage**
**F—To Flow Regulator Valve**
**G—From Pilot Pressure Regulating Valve**
**H—From Propel Pilot Controller T Port**
**I—To Solenoid Valve Manifold DD Port**
**J—Cap Screw (2 used)**
**K—From Right Pilot Controller T Port**
**L—To Solenoid Valve Manifold PF Port**

CED,OUOE027,307 –19–05JUN98–2/2

## PILOT SHUT-OFF VALVE LINKAGE ADJUSTMENT

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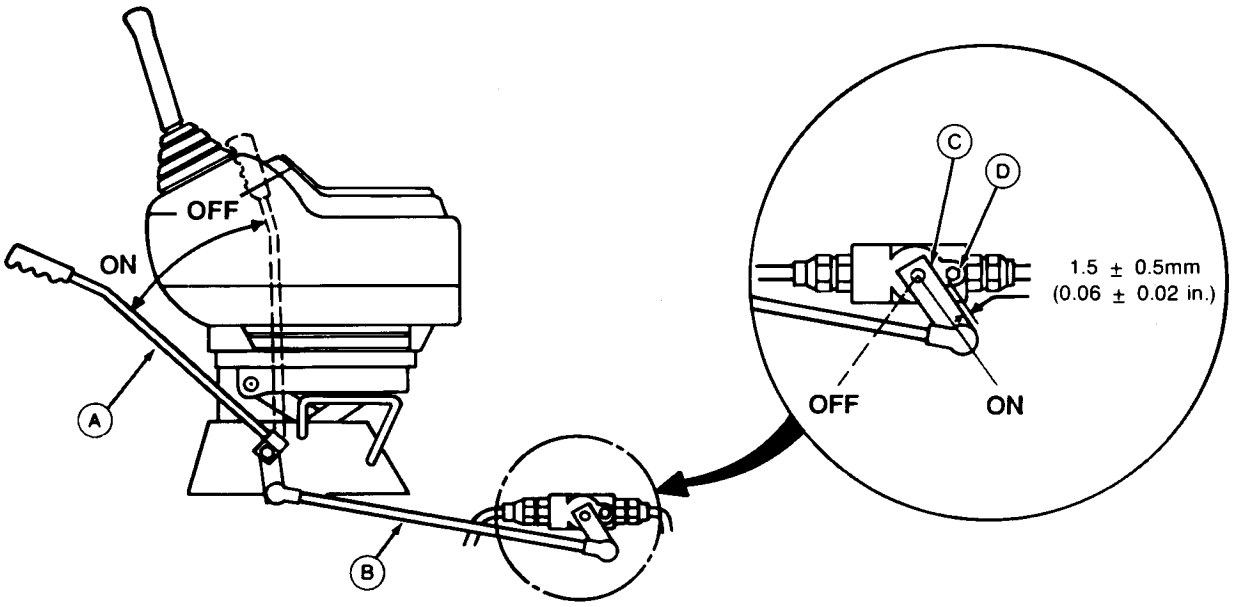



T113840

T113840 –UN–07APR98

**A—Pilot Shut-Off Lever** **B—Rod** **C—Valve Lever** **D—Cap Screw Head**

1. Stop engine.
2. Remove cover underneath operator's station.
3. Push pilot shut-off lever (A) forward to ON position. Check that lever is against front stop.
4. Adjust ball joints on rod (B) to get specified clearance between valve lever (C) and head of cap screw (D).

**Pilot Shut-Off Valve Lever-to-Cap Screw Head—Specification**

Clearance..... 1.5 ± 0.5 mm (0.06 ± 0.02 in.)

5. Pull pilot shut-off lever to OFF position. Check that lever is against rear stop.

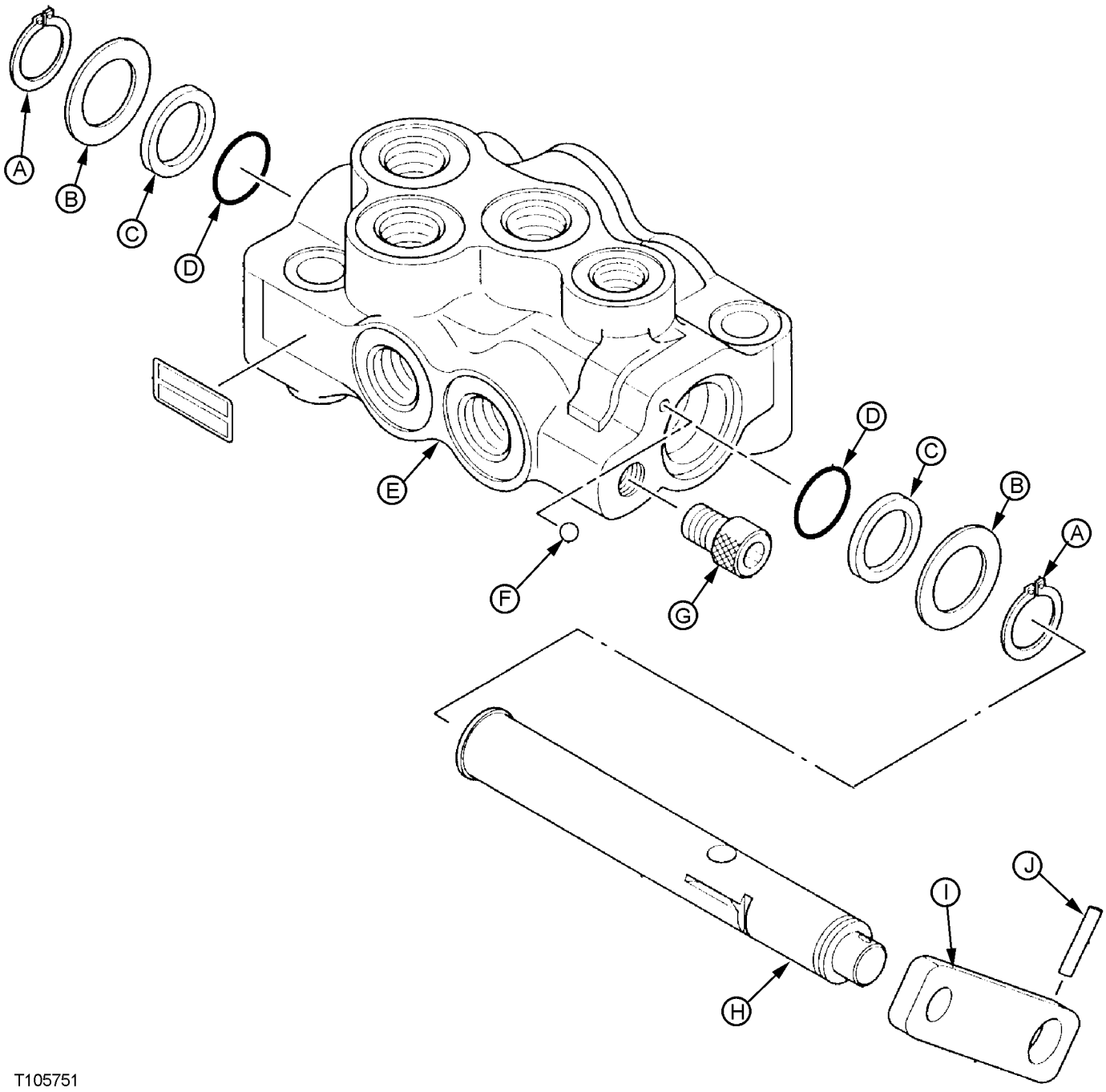
**CAUTION: Machine may move if adjustment is incorrect. Before checking pilot shut-off lever adjustment, make sure the area around machine is clear.**

6. Start engine. Run engine at slow idle. Actuate hydraulic functions. Hydraulic functions must not move with pilot shut-off lever in OFF position. If hydraulic functions move, repeat adjustment procedure.

CED,OUOE027,308 –19–05JUN98–1/1

## DISASSEMBLE AND ASSEMBLE PILOT SHUT-OFF VALVE



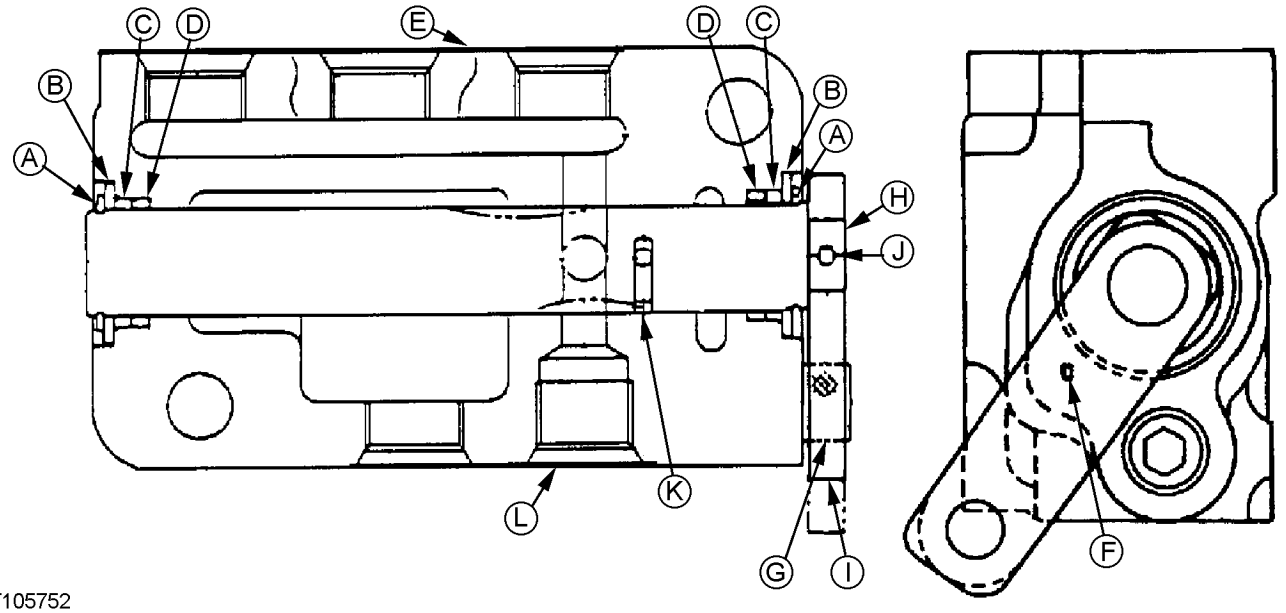



T105751

**A—Snap Ring (2 used)**
**B—Washer (2 used)**
**C—Backup Ring (2 used)**
**D—O-Ring (2 used)**
**E—Housing**
**F—Steel Ball**
**G—Cap Screw (Lever Stop)**
**H—Spool**
**I—Lever**
**J—Spring Pin**

1. Make a mark on spool (H) and lever (I) with respect to housing (E) to aid assembly.

**Continued on next page**




T105752

T105752 –UN–30DEC96

**A—Snap Ring (2 used)**
**B—Washer (2 used)**
**C—Backup Ring (2 used)**
**D—O-Ring (2 used)**
**E—Housing**
**F—Steel Ball**
**G—Cap Screw (Lever Stop)**
**H—Spool**
**I—Lever**
**J—Spring Pin**
**K—Slot**
**L—Inlet Port**

2. Remove snap ring (A) to remove parts (B—D and H).
3. Inspect and replace parts as necessary.
4. Apply grease to backup rings (C) and O-rings (D). Apply clean oil to spool (H).
5. Install spool (H) so slot (K) is toward inlet port (L).
6. Install parts (A—D).
7. Install lever (I) and spring pin (J).
8. Torque cap screw (G).

**Lever-to-Spool Pin Cap Screw—Specification**

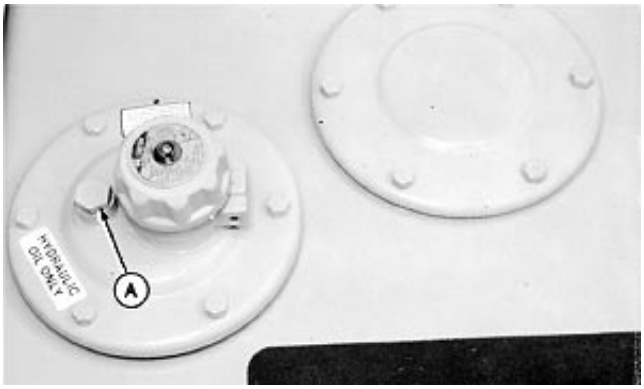
Torque..... 44 N•m (33 lb-ft)

TX,33,GG2391 –19–22JUL98–2/2

## REMOVE AND INSTALL PROPORTIONAL SOLENOID VALVE MANIFOLD

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release hydraulic pressure in hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

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**Continued on next page**

CED,OUOE026,55 –19–26JUN98–1/4

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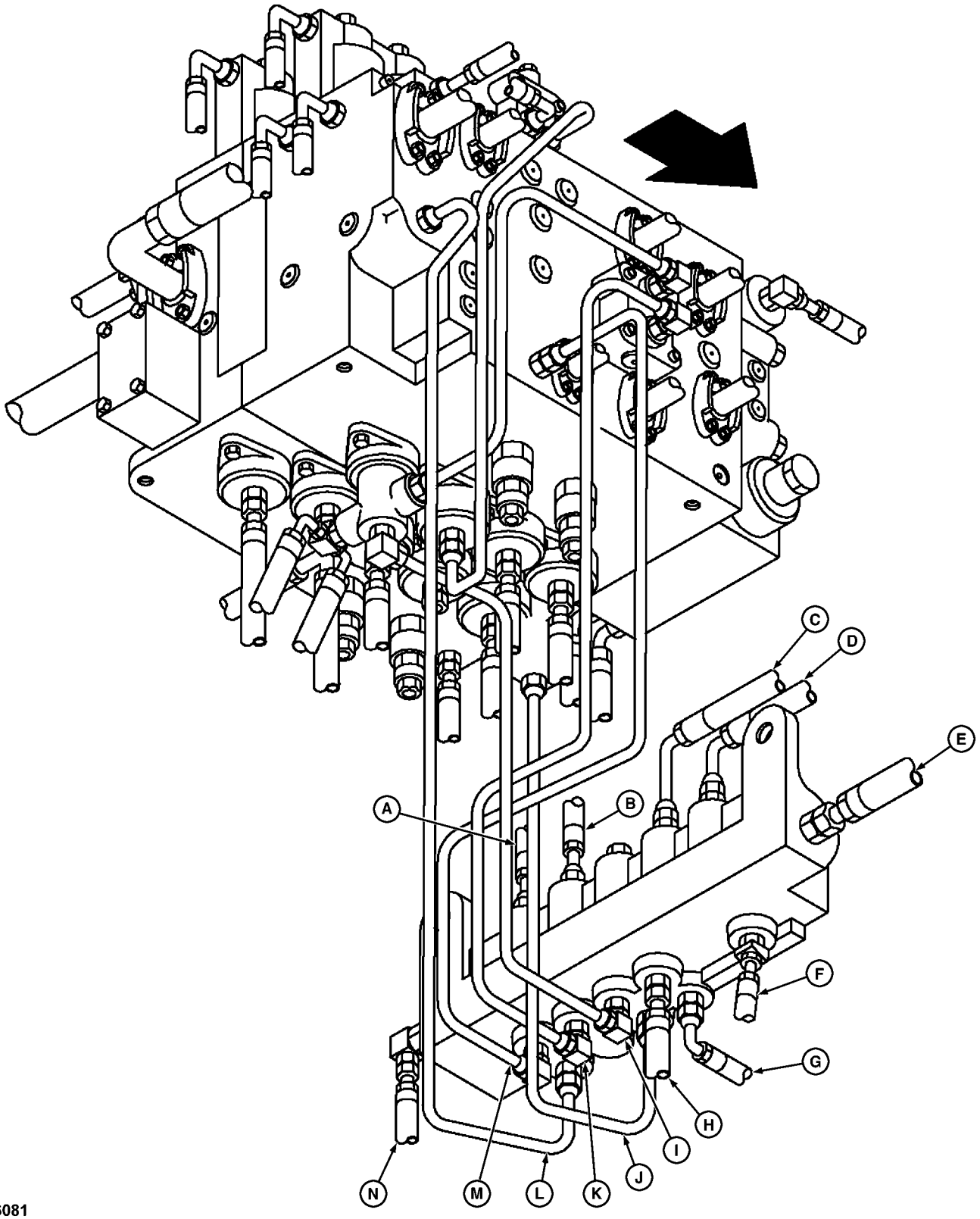


*Solenoid Valve Manifold—Right Rear View*

Continued on next page

CED,OUOE026,55 –19–26JUN98–2/4

**A—Arm Regenerative Solenoid Valve-to-Arm Regenerative Valve Port Line**
**B—Speed Sensing Solenoid Valve-to-Rear Pump Regulator Speed Sensing Port Line**
**C—Propel Speed Change Solenoid Valve-to-Rotary Manifold Port Line**
**D—Power Boost Solenoid Valve-to-Shuttle Valve Port Line**
**E—Solenoid Valve Manifold PS Port-to-Hydraulic Oil Tank Port Line**
**F—Pilot Shut-Off Valve-to-Solenoid Valve Manifold DP Port Line**
**G—Solenoid Valve Manifold PG Port-to-Swing Park Brake Release Valve PG Port Line**
**H—Arm Head End Reduced Leakage Valve DR Port-to-Solenoid Valve Manifold DG Port Line**
**I—Bucket Flow Control Pilot Valve A-to-Solenoid Valve Manifold DH Port Line**
**J—Solenoid Valve Manifold PH Port-to-Rear Pump Control Valve Port line**
**K—Bucket Flow Control Pilot Valve B-to-Solenoid Valve Manifold DE Port Line**
**L—Solenoid Valve Manifold PE Port-to-Front Pump Control Valve Port Line**
**M—Arm Regenerative Valve-to-Solenoid Valve manifold DD Port Line**
**N—Pilot Shut-Off Valve-to-Solenoid Valve Manifold PF Port Line**

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*NOTE: The individual proportional solenoid valves can be removed with manifold on the machine.*

2. Disconnect lines (A—N).

**Continued on next page**

CED,OUOE026,55 –19–26JUN98–3/4

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3. Disconnect wiring harness connectors at each solenoid valve (C—F).

4. Remove cap screws (A) to remove solenoid valve manifold block (B). Repair or replace part as necessary.

5. Install solenoid valve manifold (B) using two cap screws (A). Tighten cap screws.

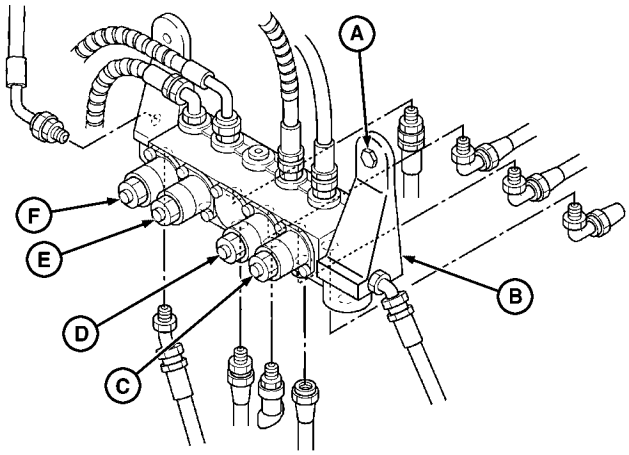
**Solenoid Valve Manifold-to-Control Valve Mounting Bracket Cap Screw—Specification**

Torque ..... 20 N•m (16 lb-ft)

6. Connect wiring harness connectors.

7. Connect lines.

8. Check pressure setting of proportional solenoid valves. (See Proportional Solenoid Valve Test and Adjustment in Group 9025-25.)




T115393 –UN–01JUL98

**T115393**

**A—Cap Screw (2 used)**
**B—Solenoid Valve Manifold**
**C—Arm Regenerative Solenoid Valve (BLU/WHT and BLU/ORN Wiring Leads)**
**D—Speed Sensing Solenoid Valve (RED/WHT and RED/YEL Wiring Leads)**
**E—Propel Speed Change Solenoid Valve (LGRN/RED and LGRN/BLK Wiring Leads)**
**F—Power Boost Solenoid Valve (BLK/RED and BLK/BLU Wiring Leads)**

CED,OUOE026,55 –19–26JUN98–4/4

## DISASSEMBLE AND ASSEMBLE PROPORTIONAL SOLENOID VALVE

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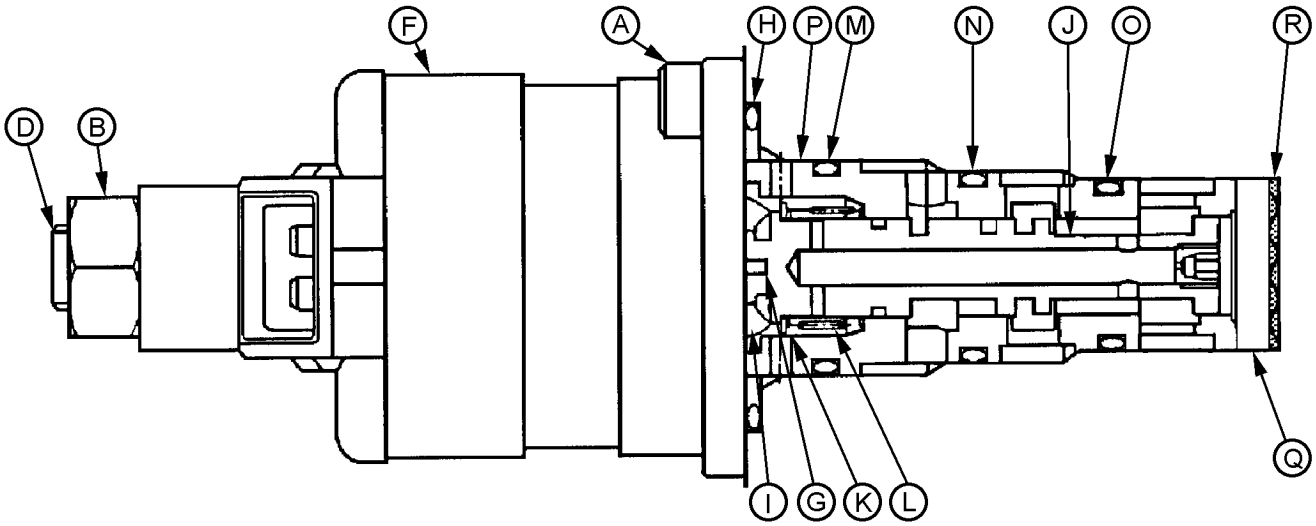
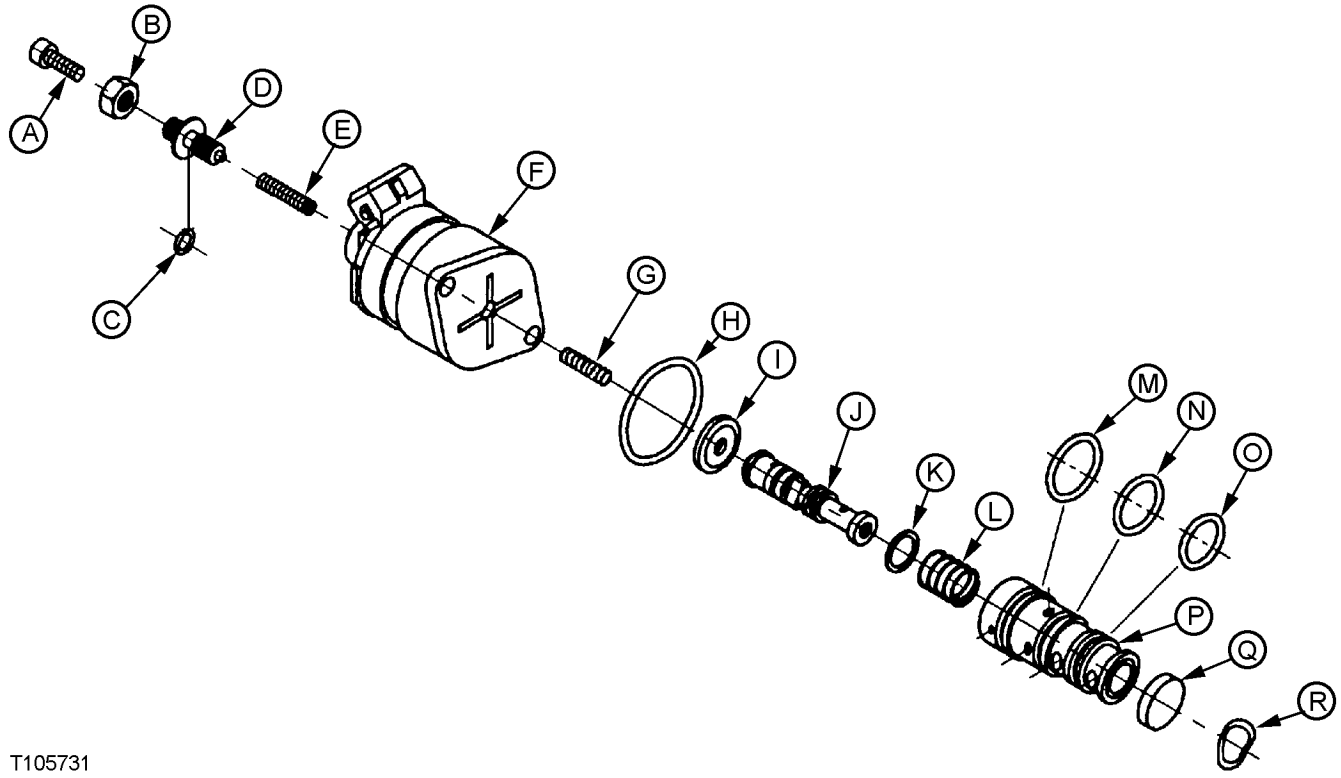



T105732

T105732 –UN–02JAN97




T105731

T105731 –UN–02JAN97

**A—Cap Screw (4 used)**
**B—Lock Nut**
**C—O-Ring**
**D—Adjusting Screw**
**E—Spring**
**F—Solenoid Coil**
**G—Spring**
**H—O-Ring**
**I—Diaphragm**
**J—Spool**
**K—Washer**
**L—Spring**
**M—O-Ring**
**N—O-Ring**
**O—O-Ring**
**P—Sleeve**
**Q—Plate**
**R—Washer**

**Continued on next page**

TX,33,GG2414 –19–17DEC96–1/5

1. Keep parts for each solenoid valve together.

   When removing solenoid coil (F), do not lose spring (G).

   Only remove lock nut (B) and adjusting screw (D) if replacement of O-ring (C) is necessary. Pressure setting of proportional solenoid valve will need to be adjusted. (See Proportional Solenoid Valve Test and Adjustment in Group 9025-25.)

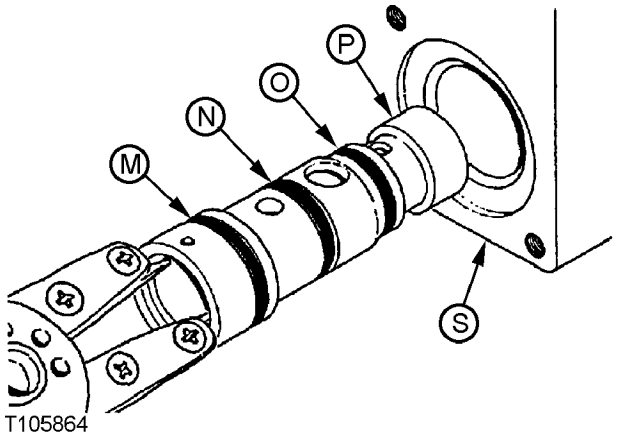
2. Repair or replace parts as necessary.

3. Install washer (R) and plate (Q).

TX,33,GG2414 –19–17DEC96–2/5

4. Apply clean oil to sleeve (P) and O-rings (M, N and O).

5. Install sleeve so ports align with ports in manifold (S).



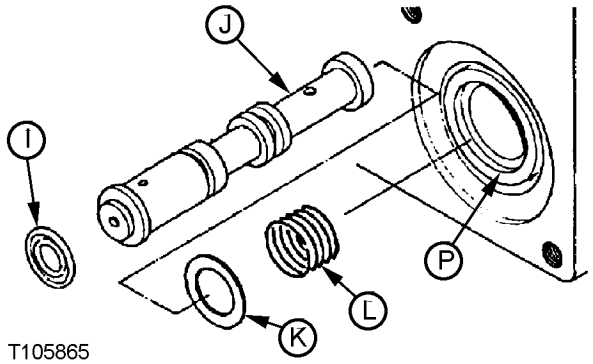

**M—O-Ring**
**N—O-Ring**
**O—O-Ring**
**P—Sleeve**
**S—Manifold**

**Continued on next page**

TX,33,GG2414 –19–17DEC96–3/5

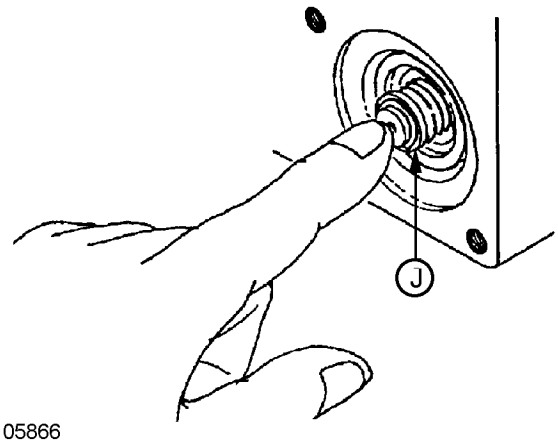
6. Apply clean oil to spool (J).
7. Install washer (K) and spring (L) on spool. Install spool.

   After installing spool, push spool against spring to check that spool slides smoothly in sleeve.




T105865

T105865 –UN–30DEC96




T105866

T105866 –UN–30DEC96

**I—Diaphragm**
**J—Spool**
**K—Washer**
**L—Spring**
**P—Sleeve**

**Continued on next page**

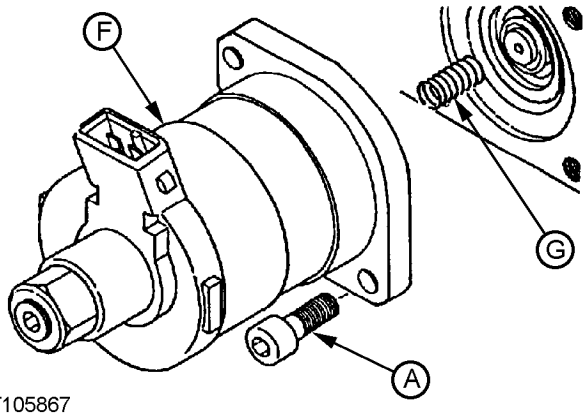
TX,33,GG2414 –19–17DEC96–4/5

8. Check to be sure spring (G) remains in position when installing solenoid coil (F).

9. Tighten cap screws (A).

**Solenoid Valve Housing-to-Manifold Cap Screw—Specification**

Torque ..... 3 N•m (24 lb-in.)




T105867

T105867 –UN–30DEC96

**A—Cap Screw (2 used)**
**F—Solenoid Coil**
**G—Spring**

TX,33,GG2414 –19–17DEC96–5/5

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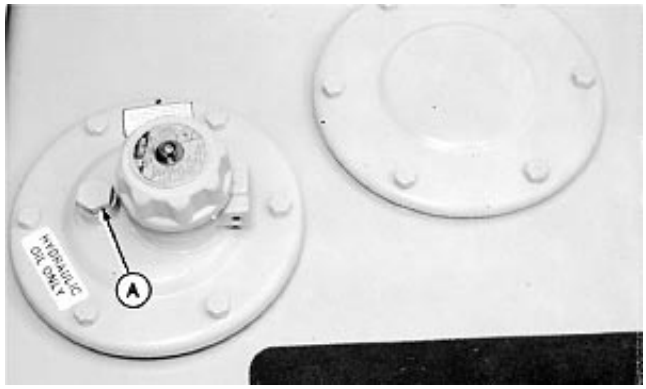
## REMOVE AND INSTALL DIG FUNCTION PILOT CONTROLLER

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE027,310 –19–05JUN98–1/6

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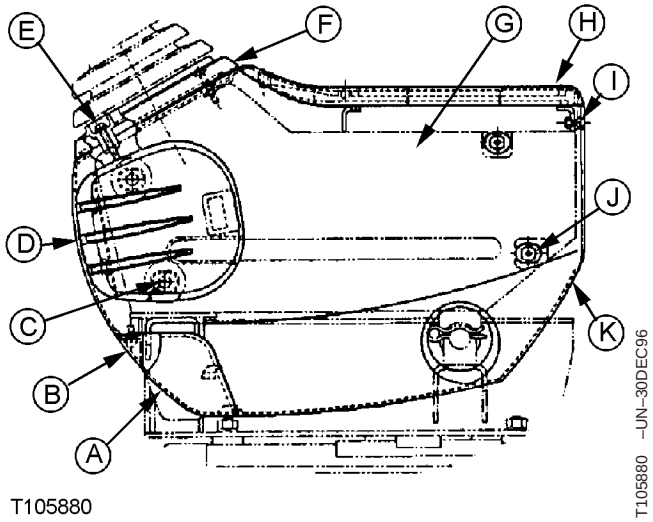
2. Remove cover (D) by pulling at front edge.

3. Remove all covers (A, G, and H) from console (K). Remove tie bands to disconnect wiring harness.

4. Remove screws (E) to lift up boot (F).



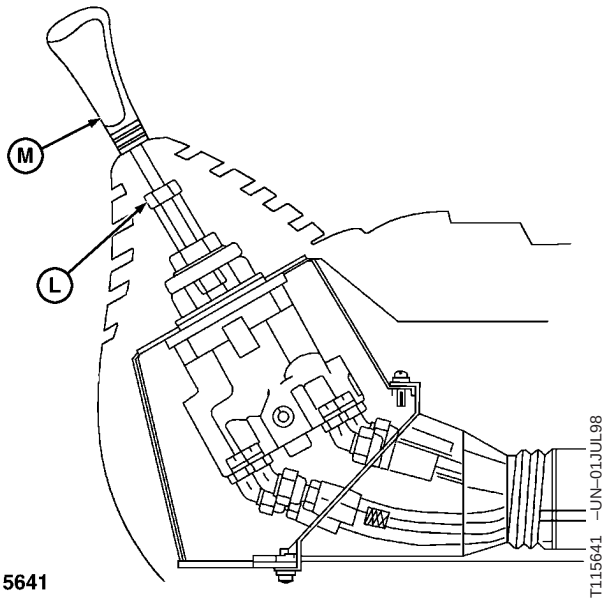

*Left Console Shown*

**A—Cover**
**B—Screw (2 used)**
**C—Screw (2 used)**
**D—Cover**
**E—Screw (4 used)**
**F—Boot**
**G—Cover**
**H—Cover**
**I—Screw (4 used)**
**J—Screw (2 used)**
**K—Console**

**Continued on next page**

CED,OUOE027,310 –19–05JUN98–2/6

5. Loosen nut (L) and carefully remove lever (M) along with wiring harness.



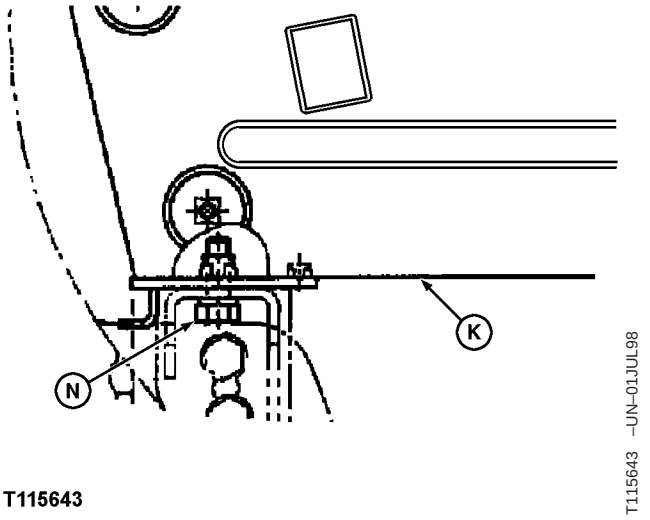

T115641

**L—Nut**
**M—Lever**

CED,OUOE027,310 –19–05JUN98–3/6

6. Pull seat and consoles as far forward as possible.

7. Remove cap screws (N) so that console (K) can be tipped back.




T115643

**K—Console**
**N—Cap Screw (4 used)**

**Continued on next page**

CED,OUOE027,310 –19–05JUN98–4/6

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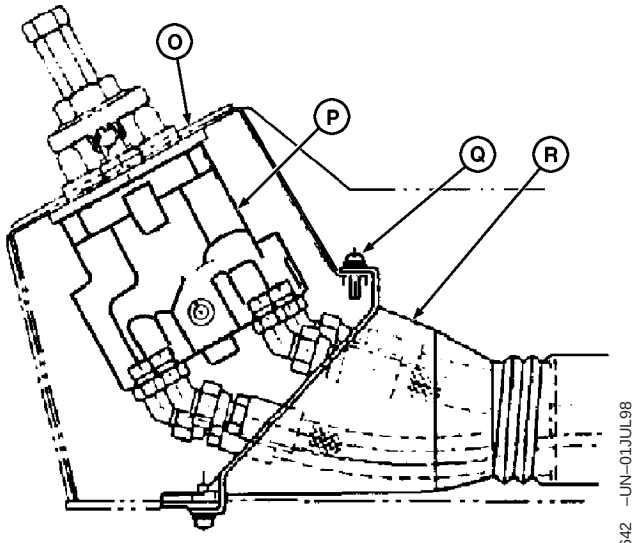
8. Remove screws (Q) to disconnect hose boot (R) from console.

9. Remove cap screws (O) to remove pilot controller (P) from console.




**T115642**

**O—Cap Screw (4 used)**
**P—Pilot Controller**
**Q—Cap Screw (2 used)**
**R—Hose Boot**

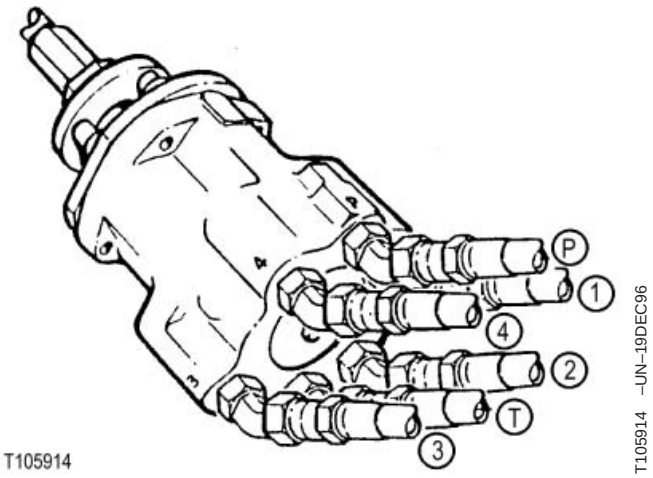
**Continued on next page**

CED,OUOE027,310 –19–05JUN98–5/6

10. Disconnect lines (P, T, and 1—4) from pilot controller. Identify lines by numbers and letters stamped on controller housing.

    Install caps and plugs to close all openings.

11. After pilot controller is installed, check operation of all functions to be sure they operate as shown on decal on console.




**P—Hydraulic Line**
**T—Hydraulic Line**
**1—Hydraulic Line**
**2—Hydraulic Line**
**3—Hydraulic Line**
**4—Hydraulic Line**

CED,OUOE027,310 –19–05JUN98–6/6

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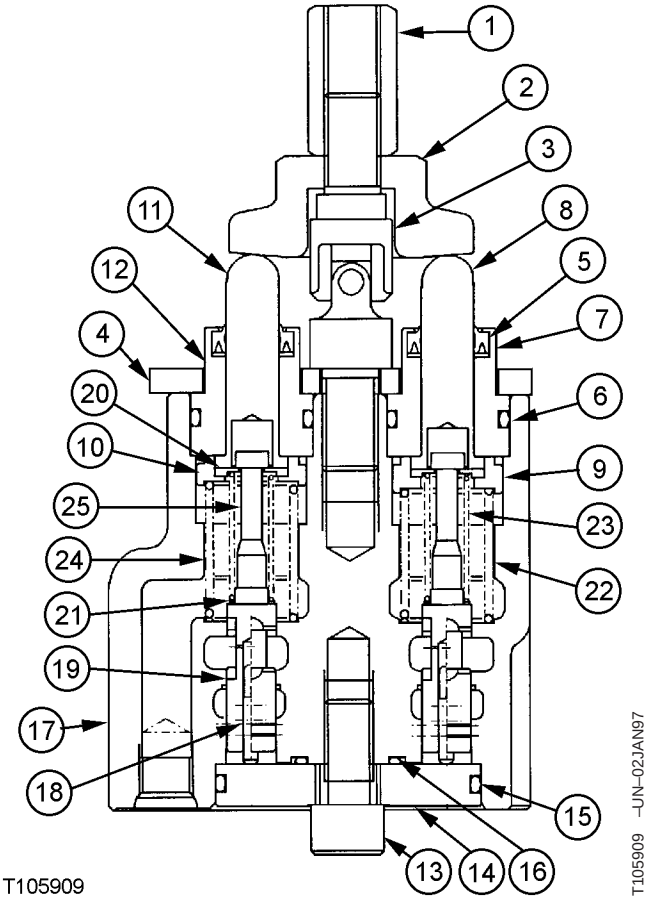
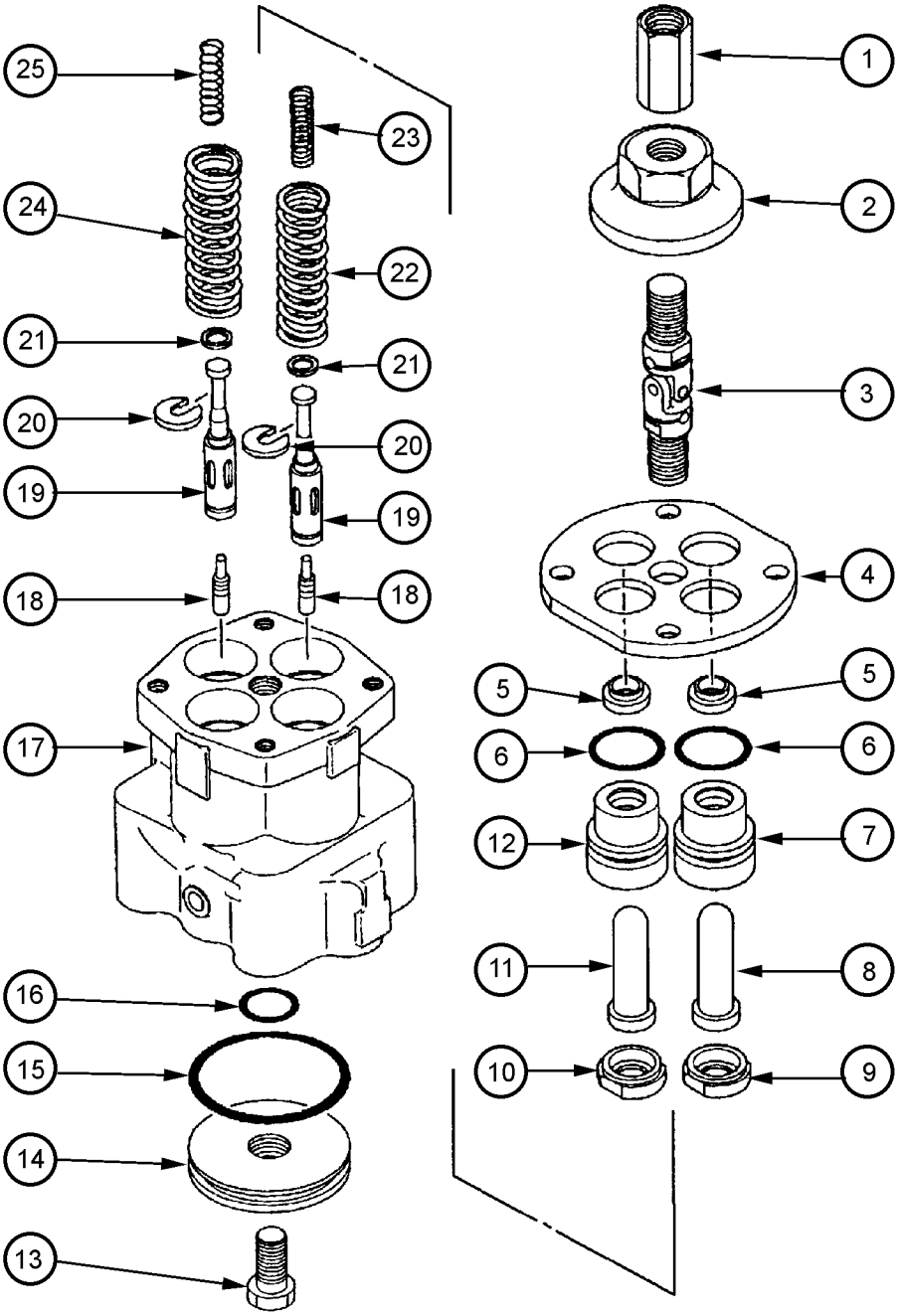
## DISASSEMBLE AND ASSEMBLE DIG FUNCTION PILOT CONTROLLER




**1—Coupling**
**2—Cam**
**3—U-Joint**
**4—Plate**
**5—Oil Seal (4 used)**
**6—O-Ring (4 used)**
**7—Bushing (2 used)**
**8—Pusher (2 used)**
**9—Spring Guide (2 used)**
**10—Spring Guide (2 used)**
**11—Pusher (2 used)**
**12—Bushing (2 used)**
**13—Cap Screw**
**14—Plate**
**15—O-Ring**
**16—Seal**
**17—Housing**
**18—Piston (4 used)**
**19—Spool (4 used)**
**20—Spacer (Retainer) (4 used)**
**21—Shim (20 used)**
**22—Return Spring (2 used)**
**23—Balance Spring (2 used)**
**24—Return Spring (2 used)**
**25—Balance Spring (2 used)**

**Continued on next page**

TX,33,GG2416 –19–09SEP98–1/3




T105881

T105881 –UN–03JAN97

**1—Coupling**
**2—Cam**
**3—U-Joint**
**4—Plate**
**5—Oil Seal (4 used)**
**6—O-Ring (4 used)**
**7—Bushing (2 used)**
**8—Pusher (2 used)**
**9—Spring Guide (2 used)**
**10—Spring Guide (2 used)**
**11—Pusher (2 used)**
**12—Bushing (2 used)**
**13—Cap Screw**
**14—Plate**
**15—O-Ring**
**16—Seal**
**17—Housing**
**18—Piston (4 used)**
**19—Spool (4 used)**
**20—Spacer (Retainer) (4 used)**
**21—Shim (20 used)**
**22—Return Spring (2 used)**
**23—Balance Spring (2 used)**
**24—Return Spring (2 used)**
**25—Balance Spring (2 used)**

1. Remove coupling (1) and cam (2).

**Continued on next page**

TX,33,GG2416 –19–09SEP98–2/3

**IMPORTANT: The housing (17) and spools (19) are replaced as an assembly because the spools are select fitted to bores in housing.**

**Some of the parts from ports 1 and 3 are different than parts from ports 2 and 4. Parts for each port must be kept together and installed into the same port from which it was removed. The port numbers are stamped on the housing.**

2. Temporarily install M8-1.25 cap screws to hold plate (4) on housing.

   Remove U-joint (3).

3. Remove cap screw (13).

   Pull plate (14) from housing using a M16-2.0 cap screw.

4. Remove pistons (18). These pistons must be removed first and installed last.

5. Slowly loosen cap screws to release spring force of return springs on plate.

6. Remove parts from housing. Remember to keep parts removed from each port together. Identify each group of parts by port numbers stamped on housing.

7. Repair or replace parts as necessary.

8. Install same number of shims (21) on each spool (19) as were removed.

   Push balance springs (23 and 25) down and then install spacer (retainer) (20) so that recess side is against spring.

9. Apply grease to oil seals (5).

10. Install parts into housing.

    Temporarily install M8-1.25 cap screws to hold plate (4) on housing.

11. Install pistons (18), small end first, into the spools.

12. Install plate (14). Tighten cap screw (13).

**Bottom Plate-to-Housing Cap Screw—Specification**

Torque..... 49 N•m (36 lb-ft)

13. Apply thread lock and sealer (medium strength) to threads on one end of U-joint (3).

    Tighten U-joint into housing.

**U-Joint-to-Housing—Specification**

Torque..... 24 N•m (216 lb-in.)

Remove temporarily installed cap screws.

14. Apply grease to end of each pusher (8 and 11) and to joint of U-joint.

15. Install cam on U-joint. Adjust clearance between pushers and cam to specification.

**Cam-to-Pushers—Specification**

Clearance..... 0—0.20 mm (0—0.008 in.)

Hold cam and tighten coupling (1).

**Coupling-to-Cam and U-Joint—Specification**

Torque..... 78 N•m (58 lb-ft)

TX,33,GG2416 –19–09SEP98–3/3

## REMOVE AND INSTALL PROPEL PILOT CONTROLLER

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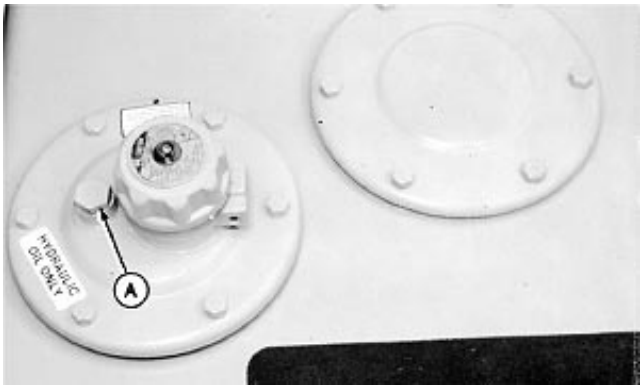
**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

TX,33,GG2557 –19–12SEP98–1/2

2. Disconnect lines (C—H). Install plugs and caps.
3. Remove cap screws to remove pedals (K), levers, and damper brackets.
4. Remove cap screws (I) to remove propel pilot controller (J).
5. Repair or replace parts as necessary.
6. Tighten cap screws (I).

**Controller-to-Cap Platform Cap Screw—Specification**

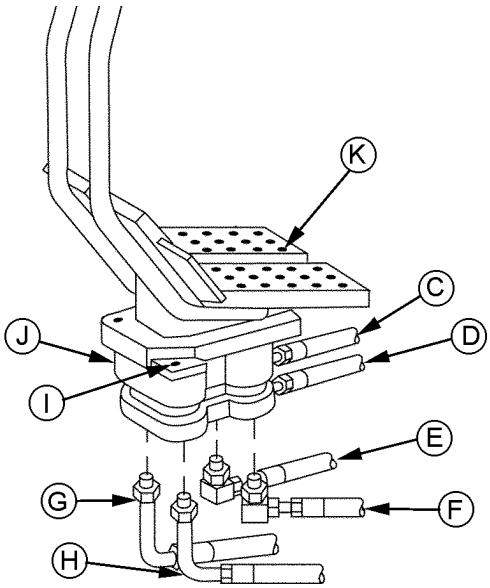
Torque ..... 49 N•m (36 lb-ft)

7. Tighten pedal-to-lever cap screws.

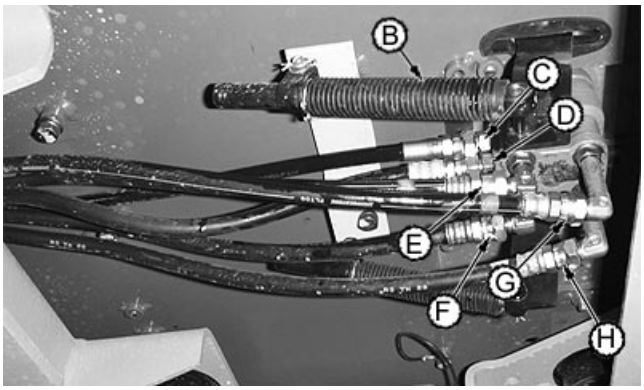
**Propel Pedal-to-Lever Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

8. After propel pilot controller is installed, check operation of all functions to be sure they operate correctly.




T108085 –UN–11MAR97




T108073B –UN–11MAR97

**B—Propel Pedal Dampener**
**C—To Pilot Shut-Off Valve**
**D—From Pilot Shut-Off Valve**
**E—To Right Propel Reverse Top Pilot Cap**
**F—To Left Propel Reverse Top Pilot Cap**
**G—To Right Propel Forward Bottom Pilot Cap**
**H—To Left Propel Forward Bottom Pilot Cap**
**I—Cap Screw (2 used)**
**J—Propel Pilot Controller**
**K—Pedal, Lever and Bracket**

TX,33,GG2557 –19–12SEP98–2/2

## DISASSEMBLE AND ASSEMBLE PROPEL PILOT CONTROLLER

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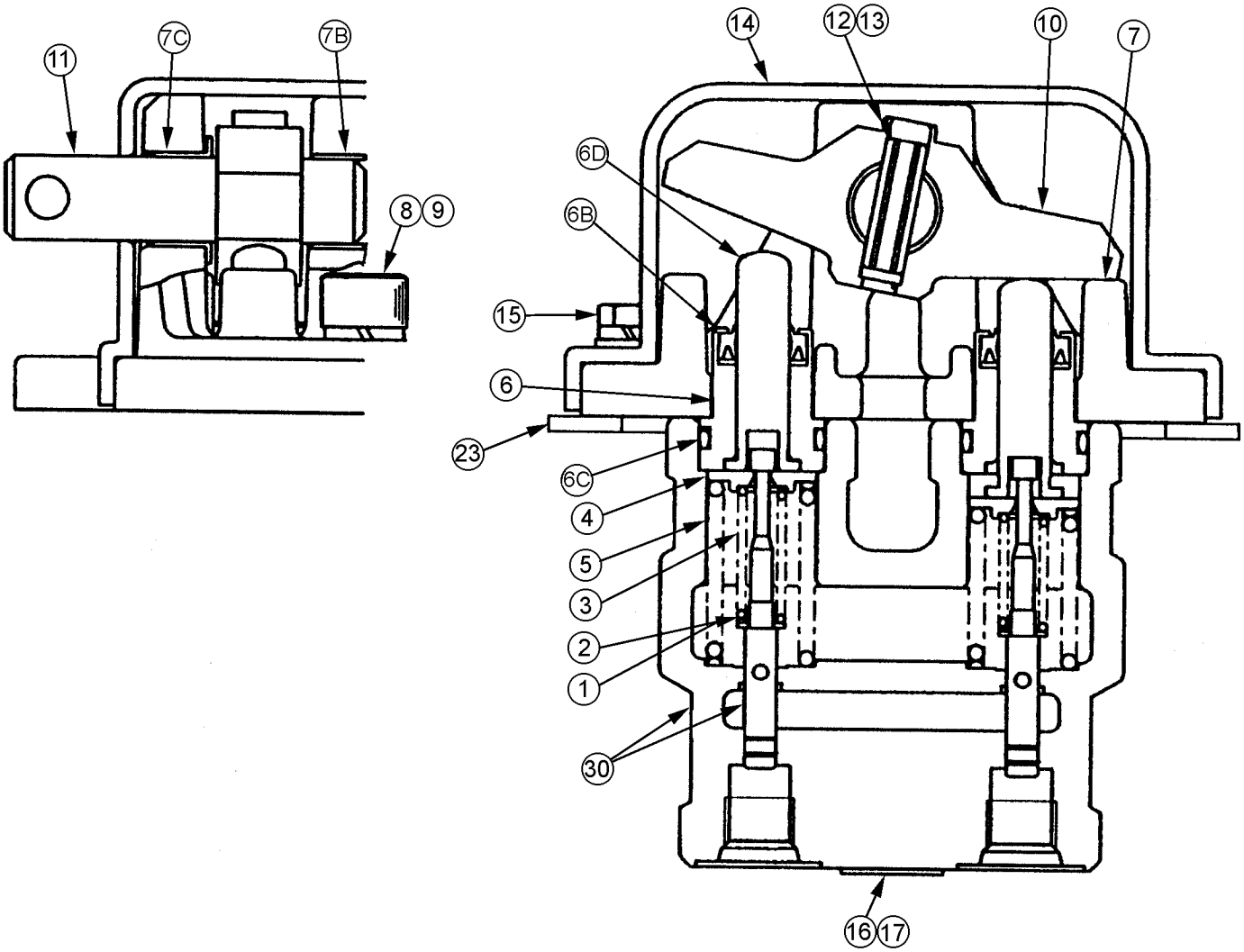


T108098

T108098 –UN–12MAR97

**0—Propel Pilot Controller**
**1—Spacer (4 used)**
**2—Shim (12 used)**
**3—Balance Spring (4 used)**
**4—Spring Guide (4 used)**
**5—Return Spring (4 used)**
**6—Plunger (4 used)**
**6B—Seal (4 used)**
**6C—O-Ring (4 used)**
**6D—Plunger (4 used)**
**7—Holder**
**7B—Bushing (2 used)**
**7C—Bushing (2 used)**
**8—Cap Screw (2 used)**
**9—Lock Washer (2 used)**
**10—Cam (2 used)**
**11—Pin (2 used)**
**11A—Bushing (4 used)**
**12—Spring Pin (2 used)**
**13—Spring Pin (2 used)**
**14—Cover**
**15—Cap Screw, Lock Washer, Washer (2 used)**
**16—Plug**
**17—O-Ring**
**23—Plate**
**30—Housing and Spools**

**IMPORTANT: The housing and spools (30) are replaced as an assembly because the spools are select fitted to bores in housing. Spools must be installed into the same ports from which they were removed.**

1. Remove cover (14).
2. Slowly loosen cap screws (8) to release spring force of balance spring (3) and return springs (5) on holder (7).

**Continued on next page**

3. Remove cams (10) only if replacement of parts is necessary.

   To remove, drive inner spring pin (13) out first. Then drive outer spring pin (12) out through top of cam so that pin is against shoulder at bottom of cam. After spring pins are installed, bend part of flange over pins to prevent them from coming out.

4. Remove parts from housing. Remember to keep parts removed from each port together. Identify each group of parts by port numbers stamped on housing. Take note of the number of spacers (1) and shims (2) on each spool.

5. Remove plug (16).

6. Repair or replace parts as necessary.



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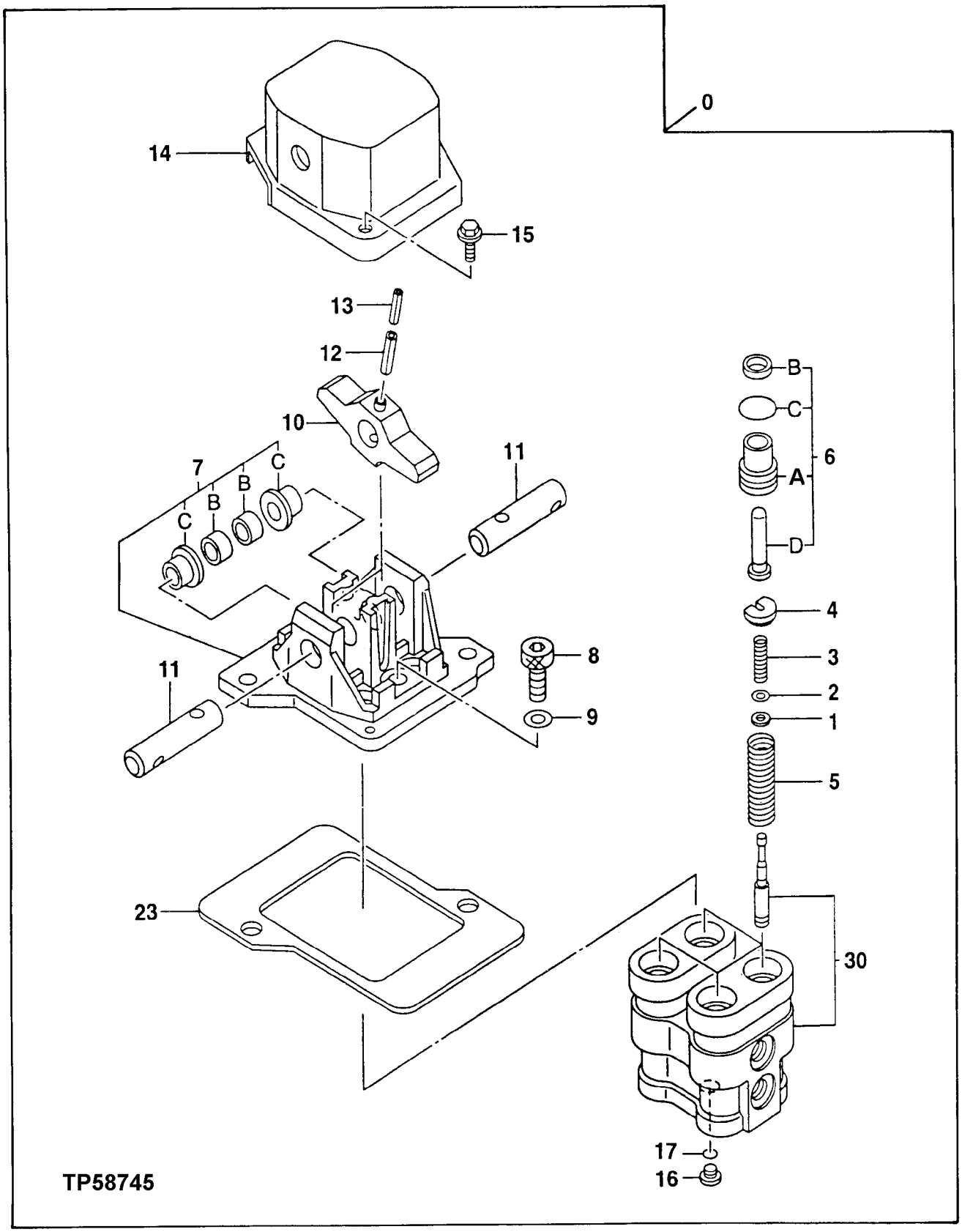


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TX,33,GG2558 –19–11MAR97–3/4

**0—Propel Pilot Controller**
**1—Spacer (4 used)**
**2—Shim (12 used)**
**3—Balance Spring (4 used)**
**4—Spring Guide (4 used)**
**5—Return Spring (4 used)**
**6—Plunger (4 used)**
**6B—Seal (4 used)**
**6C—O-Ring (4 used)**
**6D—Plunger (4 used)**
**7—Holder**
**7B—Bushing (2 used)**
**7C—Bushing (2 used)**
**8—Cap Screw (2 used)**
**9—Lock Washer (2 used)**
**10—Cam (2 used)**
**11—Pin (2 used)**
**11A—Bushing (4 used)**
**12—Spring Pin (2 used)**
**13—Spring Pin (2 used)**
**14—Cover**
**15—Cap Screw, Lock Washer, and Washer (2 used)**
**16—Plug**
**17—O-Ring**
**23—Plate**
**30—Housing and Spools**

7. Install same number of spacers (1) and shims (2) on each spool as were removed.

   Push balance spring (3) down and then install spring guide (4) so that concave side is against spring.

8. Apply grease to oil seals (6B) and O-rings (6C).

9. Install parts into housing. Remember to install spools into same ports from which they were removed.

   Slowly push holder down to compress springs and push parts into housing.

   Tighten cap screws (6).

**Holder-to-Housing Cap Screw—Specification**

Torque..... 49 N•m (36 lb-ft)

10. Tighten plug (16).

**Plug-to-Housing—Specification**

Torque..... 34 N•m (25 lb-ft)

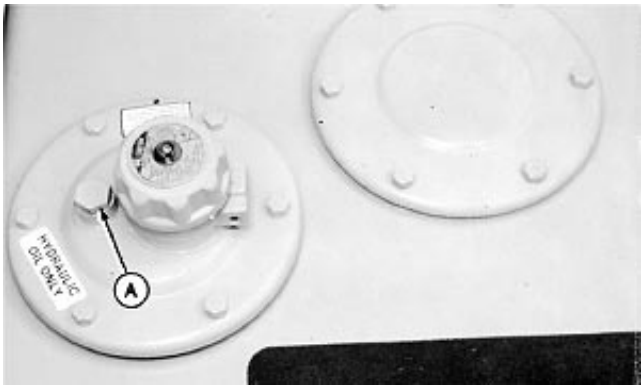
11. Apply grease to the end of plungers (6D).

TX,33,GG2558 –19–11MAR97–4/4

## REMOVE AND INSTALL FLOW REGULATOR VALVE

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE027,269 –19–28MAY98–1/2

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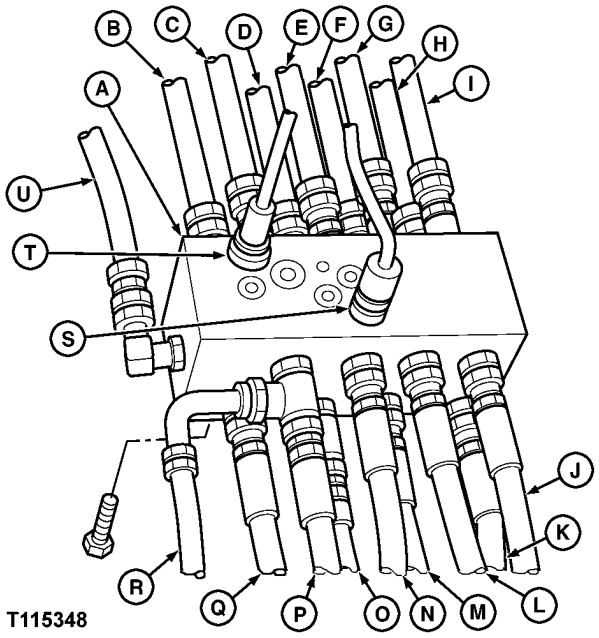
2. After lines are connected to flow regulator valve, check operation of all functions to be sure they operate as shown on decal on console.




**A—Flow Regulator Valve**
**B—From Port D-to-Left Pilot Controller Port 1 Line**
**C—From Port C-to-Left Pilot Controller Port 3 Line**
**D—From Port B-to-Right Pilot Controller Port 2 Line**
**E—From Port A-to-Right Pilot Controller Port 4 Line**
**F—From Port G-to-Right Pilot Controller Port 3 Line**
**G—From Port H-to-Right Pilot Controller Port 1 Line**
**H—From Port F-to-Left Pilot Controller Port 2 Line**
**I—From Port E-to-Left Pilot Controller Port 4 Line**
**J—From Port 5-to-Swing Left, Bottom Pilot Cap Line**
**K—From Port 6-to-Swing Right Top Pilot Cap Line**
**L—From Port 8-to-Bucket Out Bottom Pilot Cap Line**
**M—From Port 7-to-Bucket In Top Pilot Cap Line**
**N—From Port 1-to-Boom Up Bottom Pilot Cap Line**
**O—From Port 2-to-Boom Down Top Pilot Cap Line**
**P—From Port 3-to-Arm Out Bottom Pilot Cap Line**
**Q—From Port 4-to-Arm In Top Pilot Cap Line**
**R—From Port 3 Tee-to-Main Control Valve PL Port Line**
**S—Boom Up Pilot Pressure Switch**
**T—Arm In Pilot Pressure Sensor**
**U—From Port A4-to-Pilot Shut-Off Valve Line**

CED,OUOE027,269 –19–28MAY98–2/2

## DISASSEMBLE AND ASSEMBLE FLOW REGULATOR VALVE

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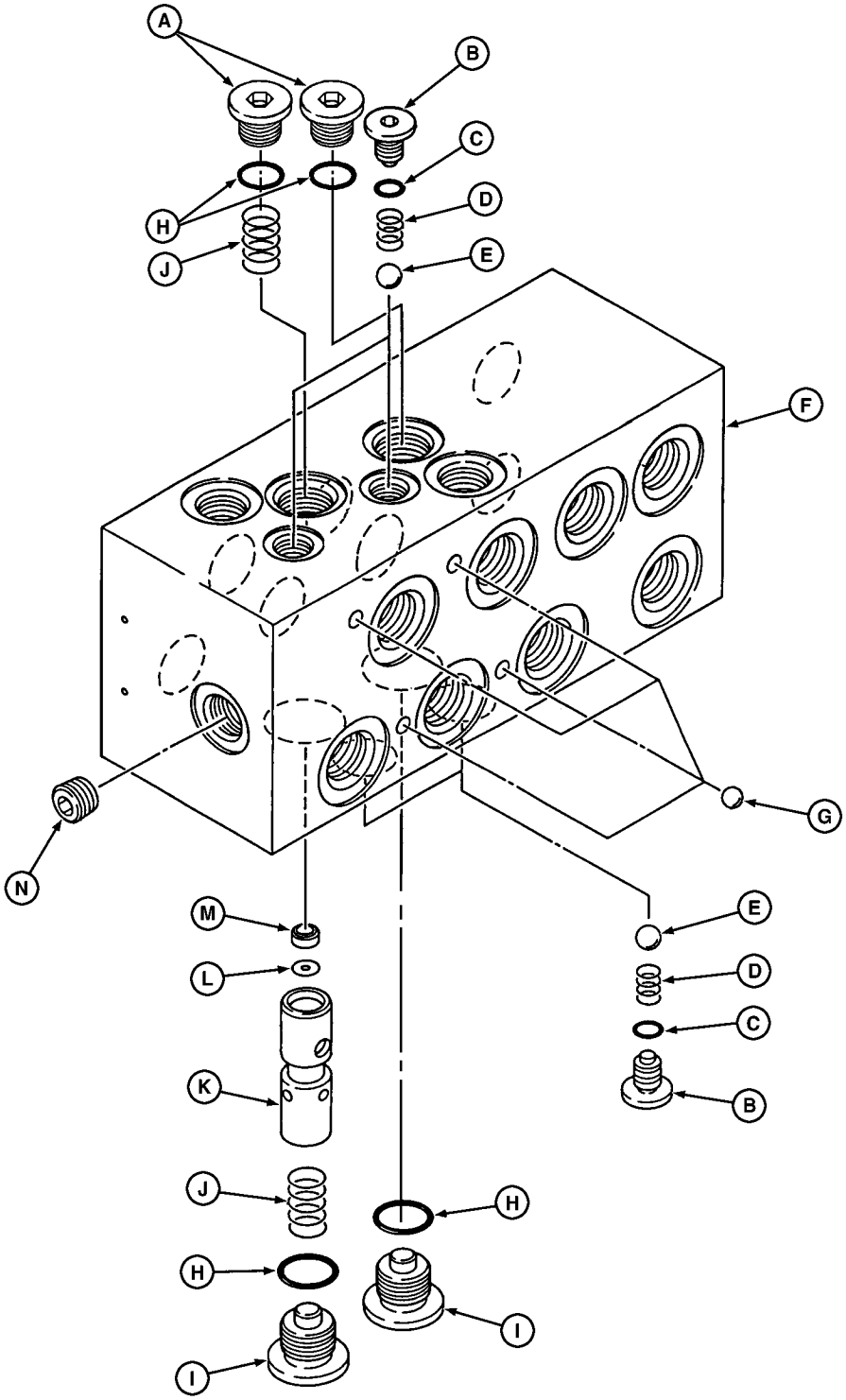


T115343

T115343 –UN–01JUL98

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CED,OUOE027,270 –19–29MAY98–1/2

**A—Plug (2 used)**
**B—Plug (2 used)**
**C—O-Ring (2 used)**
**D—Spring (2 used)**
**E—Ball (4 used)**
**F—Flow Regulator Valve Housing**
**G—Ball (4 used)**
**H—O-Ring (4 used)**
**I—Plug (2 used)**
**J—Spring (2 used)**
**K—Spool**
**L—Ring**
**M—Orifice**
**N—Orifice**



**IMPORTANT: The size of orifice (M) in spool (K) is unique to this machine. Spool with the correct orifice must be used for proper operation.**

1. Check that spool (K) slides smoothly in bore. Check that orifice (M) in spool is clean.

   Tighten plugs (A and I).

**Spool-to-Housing Plug—Specification**

Torque..... 49 N•m (36 lb-ft)

2. Check seats in housing for check valve balls (E). Tighten plug (B).

**Check Valve Ball-to-Housing Plug—Specification**

Torque..... 10 N•m (86 lb-in.)

3. Check that orifice (N) is clean. Tighten orifice.

**Orifice-to-Housing—Specification**

Torque..... 10 N•m (86 lb-in.)

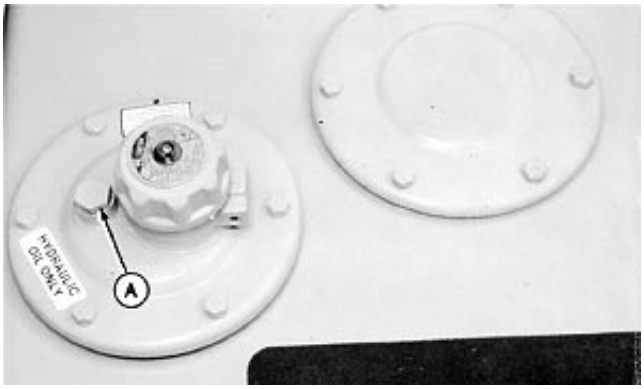
CED,OUOE027,270 –19–29MAY98–2/2

## REMOVE AND INSTALL CONTROL VALVE

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.

2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).




T7869AT –UN–12NOV92

**A—Vent Plug**

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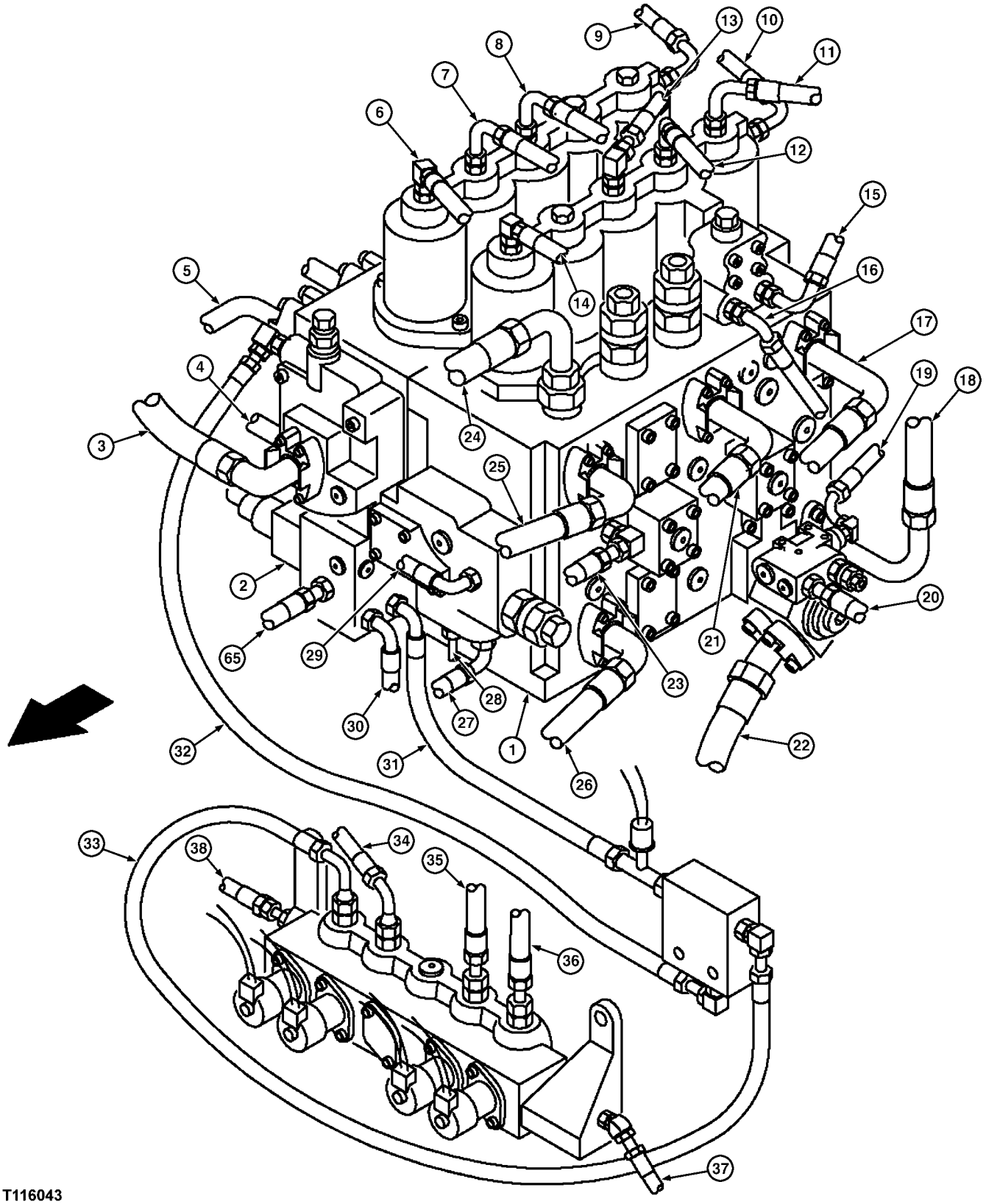
TX,33,GG2561 –19–12MAR97–1/9




*Control Valve—Left Front Line Identification*

T116043 –UN–01JUL98

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TX,33,GG2561 –19–12MAR97–2/9

**1—Left Control Valve**
**2—Right Control Valve**
**3—Front Pump Outlet-to-Right Control Valve Inlet Port Line**
**4—Right Propel Forward Work Port-to-Rotary Manifold Right Front Port Line**
**5—Right Propel Reverse Work Port-to-Rotary Manifold Right Rear Port Line**
**6—Propel Pilot Controller Port 4-to-Right Propel Forward Pilot cap Line**
**7—Right Pilot Controller Port 1-to-Bucket Dump Pilot Cap Line**
**8—Flow Regulator Valve Port 1-to-Boom Up (Boom II) Pilot Cap Line**
**9—Right Pilot Cap Warm-Up and Air Bleed Circuit-to-Hydraulic Oil Tank Line**
**10—Left Pilot Cap Warm-Up and Air Bleed Circuit-to-Hydraulic Oil Tank Line**
**11—Flow Regulator Valve Port 6-to-Swing Right Pilot Cap Line**
**12—Flow Regulator Valve Port 3-to-Arm Out (Arm I) Pilot Cap Port Line**
**13—Boom Up Pilot Cap-to-Bucket Flow Control Pilot Valve A Port Line**
**14—Propel Pilot Controller Port 1-to-Left Propel Forward Pilot Cap Port Line**
**15—Arm Rod End Reduced Leakage Pilot Valve-to-Orifice and Hydraulic Oil Tank**
**16—Arm In (Arm I) Pilot Cap-to-Arm Rod End Reduced Leakage Pilot Valve Port Line**
**17—Swing Left Work Port-to-Swing Motor Front Port Line**
**18—Swing Right Work Port-to-Swing Motor Rear Port Line**
**19—Arm Head End Reduced Leakage Valve DR Port-to-Solenoid Valve Manifold DG Port Line**
**20—Flow Regulator Valve Port 3 Tee Fitting-to-Arm Head End Reduced Leakage Valve PL Port Line**
**21—Arm Out Work Port-to-Arm Cylinder Rod End Port Line**
**22—Arm In Work Port-to-Arm Cylinder Head End Port Line**
**23—Propel Flow Control Valve-to-Bucket Flow Control Pilot Valve A Port Line**
**24—Control Valve-to-Swing Motor Oil Make-Up Port Line**
**25—Left Propel Reverse Work Port-to-Rotary Manifold Left Front Port Line**
**26—Left Propel Forward Work Port-to-Rotary Manifold Left Rear Port Line**
**27—Rear Pump Control Valve-to-Rear Pump Pressure Sensor and Pump Regulator Port Line**
**28—Solenoid Valve Manifold PH port-to-Rear Pump Control Valve Port Line**
**29—Rear Pump Control Valve-to-Hydraulic Oil Tank Port Line**
**30—Pilot Pressure Regulating Valve-to-Control Valve Pilot Pressure Signal Passage Port Line**
**31—Propel Pilot Signal Passage-to-Shuttle Valve Port Line**
**32—Shuttle Valve-to-System Relief and Power Boost Valve Port Line**
**33—Power Boost Solenoid Valve-to-Shuttle Valve Port Line**
**34—Propel Speed Change Solenoid Valve-to-Rotary Manifold Port Line**
**35—Speed Sensing Solenoid Valve-to-Rear Pump Regulator Speed Sensing Port Line**
**36—Arm Regenerative Solenoid Valve-to-Arm Regenerative Valve Port Line**
**37—Pilot Shut-Off Valve-to-Solenoid Valve Manifold PF Port Line**
**38—Solenoid Valve Manifold DS Port-to-Hydraulic Oil Tank Port Line**
**39—System Relief Valve Bottom Port-to-Tee on Swing Park Brake Release Valve HS Port Line**

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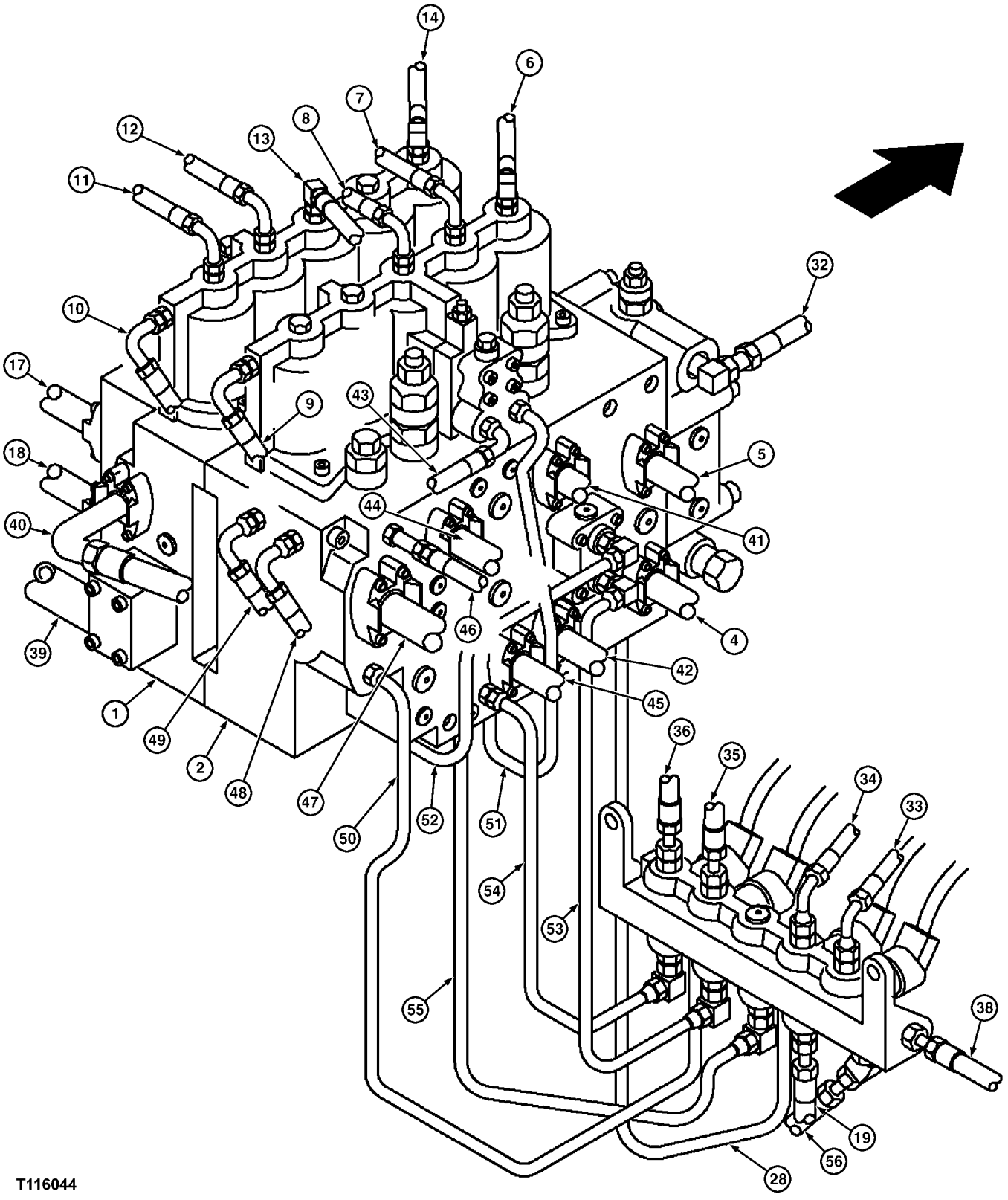


T116044 –UN–01JUL98

*Control Valve—Right Rear Line Identification*

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TX,33,GG2561 –19–12MAR97–4/9

**1—Left Control Valve**
**2—Right Control Valve**
**4—Right Propel Forward Work Port-to-Rotary Manifold Right Front Port Line**
**5—Right Propel Reverse Work Port-to-Rotary Manifold Right Rear Port Line**
**6—Propel Pilot Controller Port 4-to-Right Propel Forward Pilot Cap Port Line**
**7—Right Pilot Controller Port 1-to-Bucket Dump Pilot Cap Port Line**
**8—Flow Regulator Valve Port 1-to-Boom Up (Boom II) Pilot Cap Port Line**
**9—Right Pilot Cap Warm-Up and Air Bleed Circuit-to-Hydraulic Oil Tank Port Line**
**10—Left Pilot Cap Warm-Up and Air Bleed Circuit-to-Hydraulic Oil Tank Port Line**
**11—Flow Regulator Valve Port 6-to-Swing Right Cap Port Line**
**12—Flow Regulator Valve Port 3-to-Arm Out (Arm I) Pilot Cap Port Line**
**13—Boom Up Pilot Cap-to-Bucket Flow Control Pilot Valve A Port Line**
**14—Propel Pilot Controller Port 1-to-Left Propel Forward Pilot Cap Port Line**
**17—Swing Left Work Port-to-Swing Motor Front Port Line**
**18—Swing Right Work Port-to-Swing Motor Rear Port Line**
**19—Arm Head End Reduced Leakage Valve DR Port-to-Solenoid Valve Manifold DG Port Line**
**28—Solenoid Valve Manifold PH Port-to-Rear Pump Control Valve Port Line**
**32—Shuttle Valve-to-System Relief and Power Boost Valve Port Line**
**33—Power Boost Solenoid Valve-to-Shuttle Valve Port Line**
**34—Propel Speed Change Solenoid Valve-to-Rotary Manifold Port Line**
**35—Speed Sensing Solenoid Valve-to-Rear Pump Regulator Speed Sensing Port line**
**36—Arm Regenerative Solenoid Valve-to-Arm Regenerative Valve Port Line**
**38—Solenoid Valve Manifold DS Port-to-Hydraulic Oil Tank Port Line**
**39—Control Valve Return Passage-to-Oil Cooler Port Line**
**40—Rear Pump Outlet-to-Left Control Valve Inlet Port Line**
**41—Bucket Dump Work Port-to-Bucket Cylinder Rod End Port Line**
**42—Bucket Load Work Port-to-Bucket Cylinder Head End Port Line**
**43—Boom Reduced Leakage Pilot Valve-to-Orifice and Hydraulic Oil Tank Port Line**
**44—Boom Up Work Port-to-Boom Cylinder Head End Port Line**
**45—Boom Down Work Port-to-Boom Cylinder Rod End Port Line**
**46—Front Pump Control Valve-to-Hydraulic Oil Tank Port Line**
**47—Control Valve-to-Hydraulic Oil Tank Port Line**
**48—Front Pump Control Valve-to-Front Pump Pressure Sensor and Pump Regulator Port Line**
**49—Arm Regenerative Solenoid Valve-to-Arm Regenerative Valve Port Line**
**50—Solenoid Valve Manifold PE Port-to-Front Pump Control Valve Port Line**
**51—Boom Down (Boom I) Pilot Cap-to-Boom Reduced Leakage Pilot Valve Port Line**
**52—Bucket Flow Control Pilot Valve A-to-Bucket Flow Control Pilot Valve B Port Line**
**53—Bucket Flow Control Pilot Valve B-to-Solenoid Valve Manifold DE Port Line**
**54—Arm Regenerative Valve-to-Solenoid Valve Manifold DD Port Line**
**55—Bucket Flow Control Pilot Valve A-to-Solenoid Valve Manifold DH Port Line**
**56—Pilot Shut-Off Valve-to-Solenoid Valve Manifold DP Port Line**

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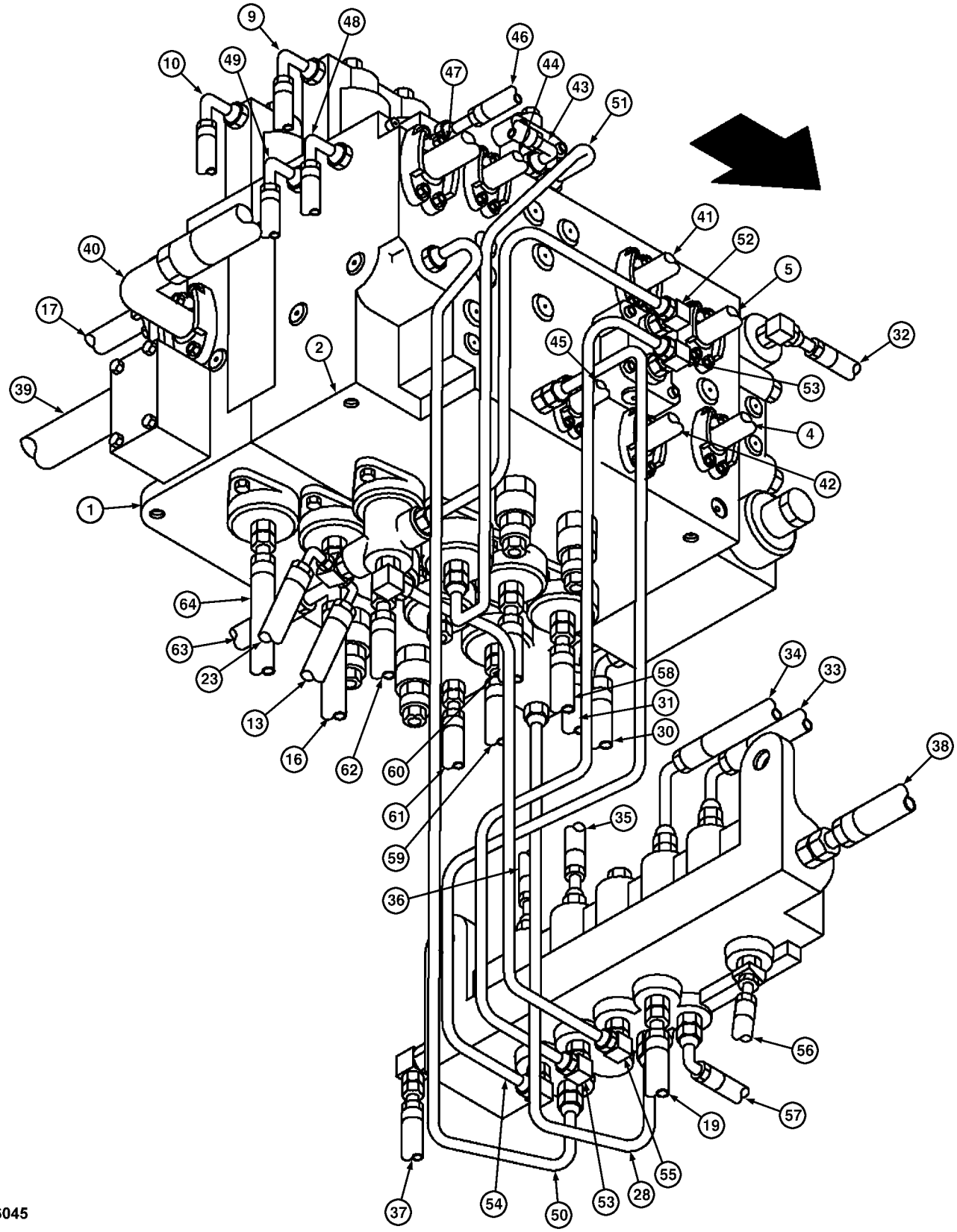


T116045 –UN–01JUL98

*Control Valve—Bottom Line Identification*

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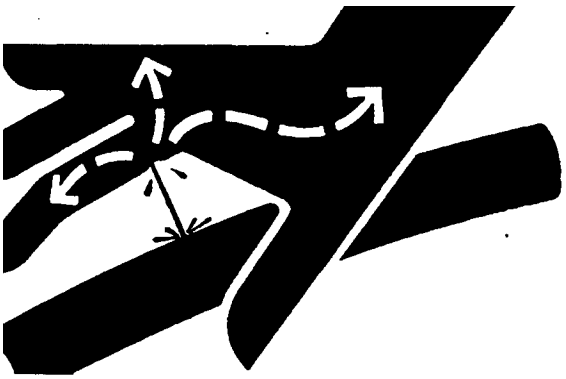
**1—Left Control Valve**
**2—Right Control Valve**
**4—Right Propel Forward Work Port-to-Rotary Manifold Right Front Port Line**
**5—Right Propel Reverse Work Port-to-Rotary Manifold Right Rear Port Line**
**9—Right Pilot Cap Warm-Up and Air Bleed Circuit-to-Hydraulic Oil Tank Port Line**
**10—Left Pilot Cap Warm-Up and Air Bleed Circuit-to-Hydraulic Oil Tank Port Line**
**13—Boom Up Pilot Cap-to-Bucket Flow Control Pilot Valve A Port Line**
**16—Arm In (Arm I) Pilot Cap-to-Arm Rod End Reduced Leakage Pilot Valve Port Line**
**17—Swing Left Work Port-to-Swing Motor Front Port Line**
**19—Arm Head End Reduced Leakage Valve DR Port-to-Solenoid Valve Manifold DG Port Line**
**28—Solenoid Valve Manifold PH Port-to-Rear Pump Control Valve Port Line**
**30—Pilot Pressure Regulating Valve-to-Control Valve Pilot Pressure Signal Passage Port Line**
**31—Propel Pilot Signal Passage-to-Shuttle Valve Port Line**
**32—Shuttle Valve-to-System Relief and Power Boost Valve Port Line**
**33—Power Boost Solenoid Valve-to-Shuttle Valve Port Line**
**34—Propel Speed Change Solenoid Valve-to-Rotary Manifold Port Line**
**35—Speed Sensing Solenoid Valve-to-Rear Pump Regulator Speed Sensing Port Line**
**36—Arm Regenerative Solenoid Valve-to-Arm Regenerative Valve Port Line**
**37—Pilot Shut-Off Valve-to-Solenoid Valve Manifold PF Port Line**
**38—Solenoid Valve Manifold DS Port-to-Hydraulic Oil Tank Port Line**
**39—Control Valve Return Passage-to-Oil Cooler Port Line**
**40—Rear Pump Outlet-to-Left Control Valve Port Line**
**41—Bucket Dump Work Port-to-Bucket Cylinder Rod End Port Line**
**42—Bucket Load Work Port-to-Bucket Cylinder Head End Port Line**
**43—Boom Reduced Leakage Pilot Valve Port-to-Orifice and Hydraulic Oil Tank Port Line**
**44—Boom Up Work Port-to-Boom Cylinder Head End Port Line**
**45—Boom Down Work Port-to-Boom Cylinder Rod End Port Line**
**46—Front Pump Control Valve-to-Hydraulic Oil Tank Port Line**
**47—Control Valve-to-Hydraulic Oil Tank Port Line**
**48—Front Pump Control Valve-to-Front Pump Pressure Sensor and Pump Regulator Port Line**
**49—Arm Regenerative Solenoid Valve-to-Arm Regenerative Valve Port Line**
**50—Solenoid Valve Manifold PE Port-to-Front Pump Control Valve Port Line**
**51—Boom Down (Boom I) Pilot Cap-to-Boom Reduced Leakage Pilot Valve Port Line**
**52—Bucket Flow Control Pilot Valve A-to-Bucket Flow Control Pilot Valve B Port Line**
**53—Bucket Flow Control Pilot Valve B-to-Solenoid Valve Manifold DE Port Line**
**54—Arm Regenerative Valve-to-Solenoid Valve Manifold DD Port Line**
**55—Bucket Flow Control Pilot Valve A-to-Solenoid Valve Manifold DH Port Line**
**56—Pilot Shut-Off Valve-to-Solenoid Valve Manifold DP Port Line**
**57—Solenoid Valve Manifold PG Port-to-Swing Park Brake Release Valve PG Port Line**
**58—Propel Pilot Controller Port 3-to-Right Propel Reverse Pilot Cap Port Line**
**59—Propel Pilot Controller Port 2-to-Left Propel Reverse Pilot Cap Port Line**
**60—Flow Regulator Valve Port 7-to-Bucket Load Pilot Cap Port Line**
**61—Propel Pilot Signal Passage-to-Hydraulic Oil Tank Port Line**
**62—Flow Regulator Valve Port 2-to-Boom II (Boom Down) Pilot Cap Port Line**
**63—Flow Regulator Valve Port 4-to-Arm I (Arm In) Pilot Cap Port Line**
**64—Flow Regulator Valve Port 5-to-Swing Left Pilot Cap Port Line**

**Continued on next page**

TX,33,GG2561 –19–12MAR97–7/9

**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

3. Disconnect lines (3—64). Install caps and plugs.



X9811 –UN–23AUG88

TX,33,GG2561 –19–12MAR97–8/9

**CAUTION: The approximate weight of control valve is 240 kg (529 lb).**

**Control Valve—Specification**

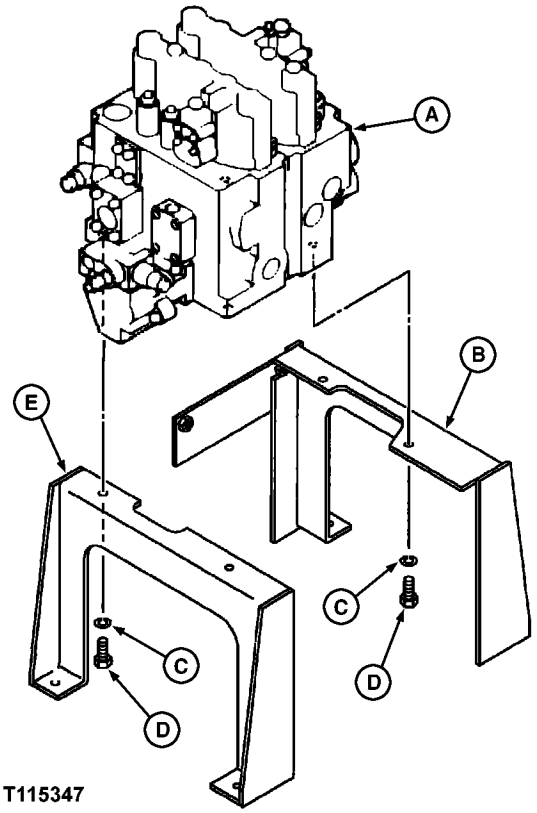
Weight..... 240 kg (529 lb) approximate

4. Remove control valve (A).
5. Repair or replace parts as necessary.
6. Install control valve (A).
7. Tighten cap screws (C).

**Mounting Bracket-to-Valve Housing Cap Screw—Specification**

Torque ..... 205 N•m (151 lb-ft)

8. Check oil level in the hydraulic oil tank. Add oil as necessary. (See Hydraulic Oil in Group 0004.)
9. Do the Hydraulic Pump Start-Up Procedure. (See procedure in this group.)




T115347

T115347 –UN–01JUL98

**A—Control Valve**
**B—Right Side Support Bracket**
**C—Washer (4 used)**
**D—Cap Screw (4 used)**
**E—Left Side Support Bracket**

TX,33,GG2561 –19–12MAR97–9/9

## DISASSEMBLE AND ASSEMBLE CONTROL VALVE

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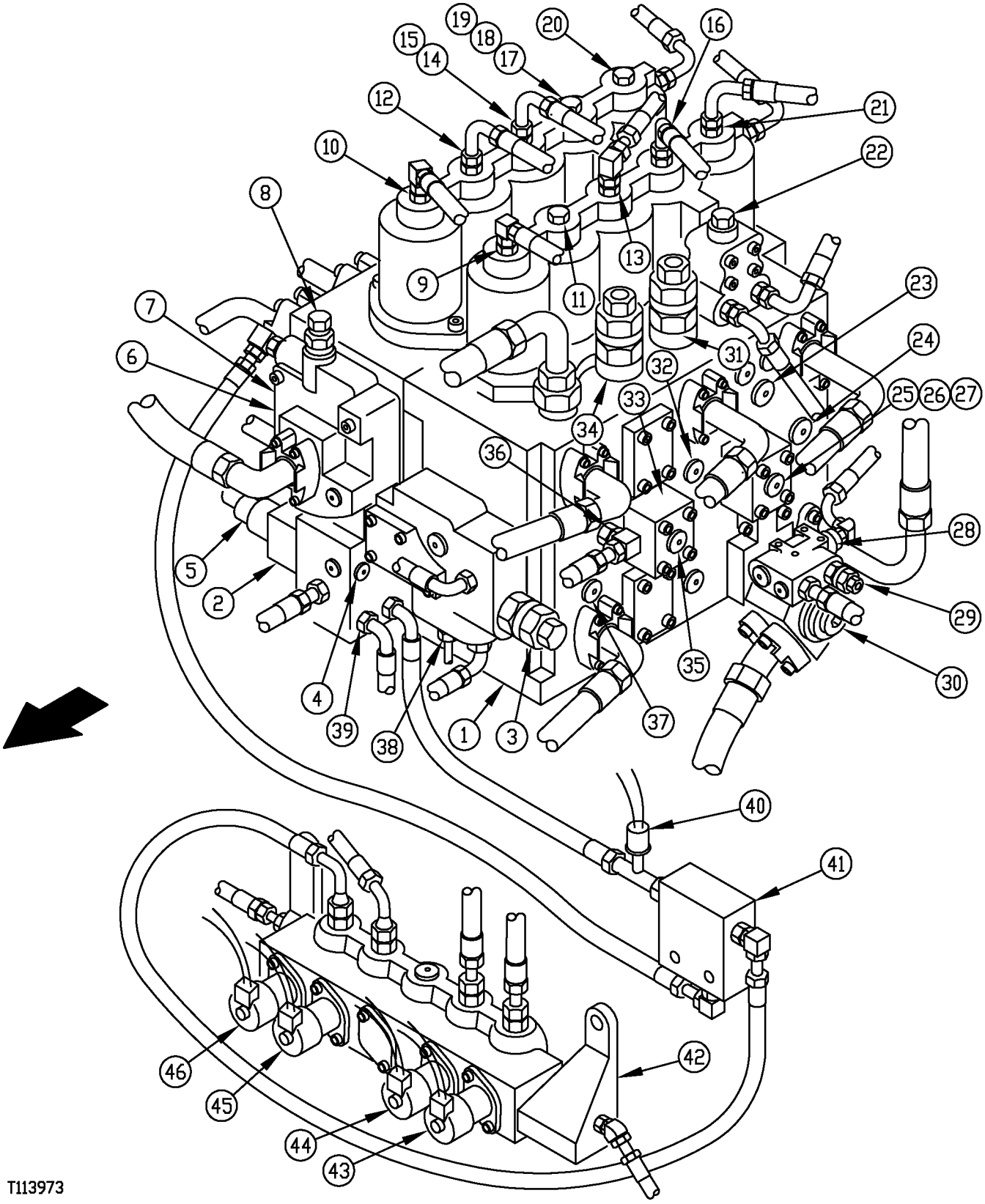


*Control Valve Components—Left Front View*

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**1—Left Control Valve (5-Spool)**
**2—Right Control Valve (4-Spool)**
**3—Rear Pump Control Valve**
**4—Flow Combiner Check Valve**
**5—Flow Combiner Valve**
**6—System Relief Valve Isolation Check Valve**
**7—System Relief Valve Isolation Check Valve**
**8—System Relief and Power Boost Valve**
**9—Left Propel Valve**
**10—Right Propel Valve**
**11—Auxiliary Valve**
**12—Bucket Valve**
**13—Boom II Valve**
**14—Boom I Valve**
**15—Boom Regenerative Valve (in Boom I Spool)**
**16—Arm I Valve**
**17—Arm II Valve**
**18—Arm Regenerative Valve (in Arm II Spool)**
**19—Check Valve and Orifice (in Arm II Spool)**
**20—Bypass Shut-Off Valve**
**21—Swing Valve**
**22—Arm Rod End Reduced Leakage Pilot Valve**
**23—Arm Rod End Reduced Leakage Check Valve**
**24—Swing Lift Check Valve**
**25—Power Passage-to-Arm I Neutral Passage Check Valve**
**26—Arm I Lift Check Valve**
**27—Not Used**
**28—Arm Head End Reduced Leakage Pilot Valve**
**29—Arm Head End Reduced Leakage Relief Valve**
**30—Arm Head End Reduced Leakage Check Valve**
**31—Arm Out Circuit Relief and Anti-Cavitation Valve**
**32—Boom II Power Passage Lift Check Valve**
**33—Auxiliary Power Passage Lift Check Valve**
**34—Auxiliary Circuit Relief and Anti-Cavitation Valve**
**35—Front Pump Bypass Inlet Port**
**36—Propel Flow Control Valve**
**37—Left Propel Neutral Passage Lift Check Valve**
**38—Rear Pump Control Valve Pilot Inlet Filter**
**39—Pilot Pressure Signal Passage Filter**
**40—Propel Pressure Switch**
**41—Shuttle Valve**
**42—Solenoid Valve Manifold**
**43—Arm Regenerative Solenoid Valve**
**44—Speed Sensing Solenoid Valve**
**45—Propel Speed Change Solenoid Valve**
**46—Power Boost Solenoid Valve**

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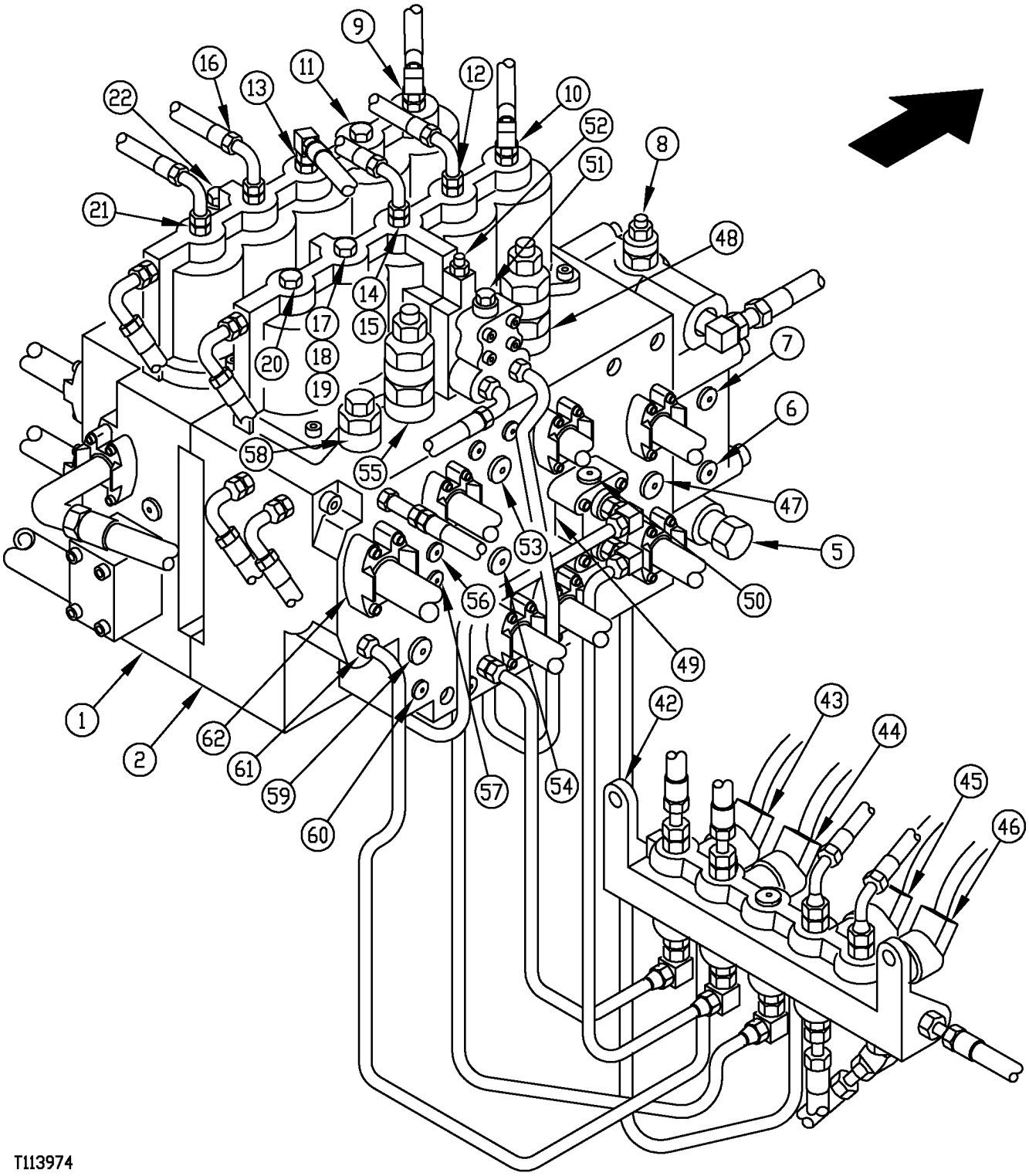


*Control Valve Components—Right Rear View*

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**1—Left Control Valve (5-Spool)**
**2—Right Control Valve (4-Spool)**
**5—Flow Combiner Valve**
**6—System Relief Valve Isolation Check Valve**
**7—System Relief Valve Isolation Check Valve**
**8—System Relief and Power Boost Valve**
**9—Left Propel Valve**
**10—Right Propel Valve**
**11—Auxiliary Valve**
**12—Bucket Valve**
**13—Boom II Valve**
**14—Boom I Valve**
**15—Boom Regenerative Valve (in Boom I Spool)**
**16—Arm I Valve**
**17—Arm II Valve**
**18—Arm Regenerative Valve (in Arm II Spool)**
**19—Check Valve and Orifice (in Arm II Spool)**
**20—Bypass Shut-Off Valve**
**21—Swing Valve**
**22—Arm Rod End Reduced Leakage Pilot Valve**
**42—Solenoid Valve Manifold**
**43—Arm Regenerative Solenoid Valve**
**44—Speed Sensing Solenoid Valve**
**45—Propel Speed Change Solenoid Valve**
**46—Power Boost Solenoid Valve**
**47—Orifice and Bucket Power Passage Lift Check Valve**
**48—Bucket Dump Circuit Relief and Anti-Cavitation Valve**
**49—Bucket Flow Control Poppet Valve**
**50—Bucket Flow Control Pilot Valve B**
**51—Boom Reduced Leakage Valve**
**52—Boom Manual Lower Release Screw**
**53—Boom Reduced Leakage Check Valve**
**54—Boom I Power Passage Lift Check Valve**
**55—Boom Up Circuit Relief and Anti-Cavitation Valve**
**56—Orifice and Arm II Power Passage Lift Check Valve**
**57—Arm II Neutral Passage Lift Check Valve**
**58—Front Pump Control Valve**
**59—Front Pump Bypass Shut-Off Valve Outlet Port**
**60—Bypass Shut-Off Valve Pilot Port**
**61—Front Pump Control Valve Pilot Inlet Filter**
**62—Oil Cooler Bypass Valve**

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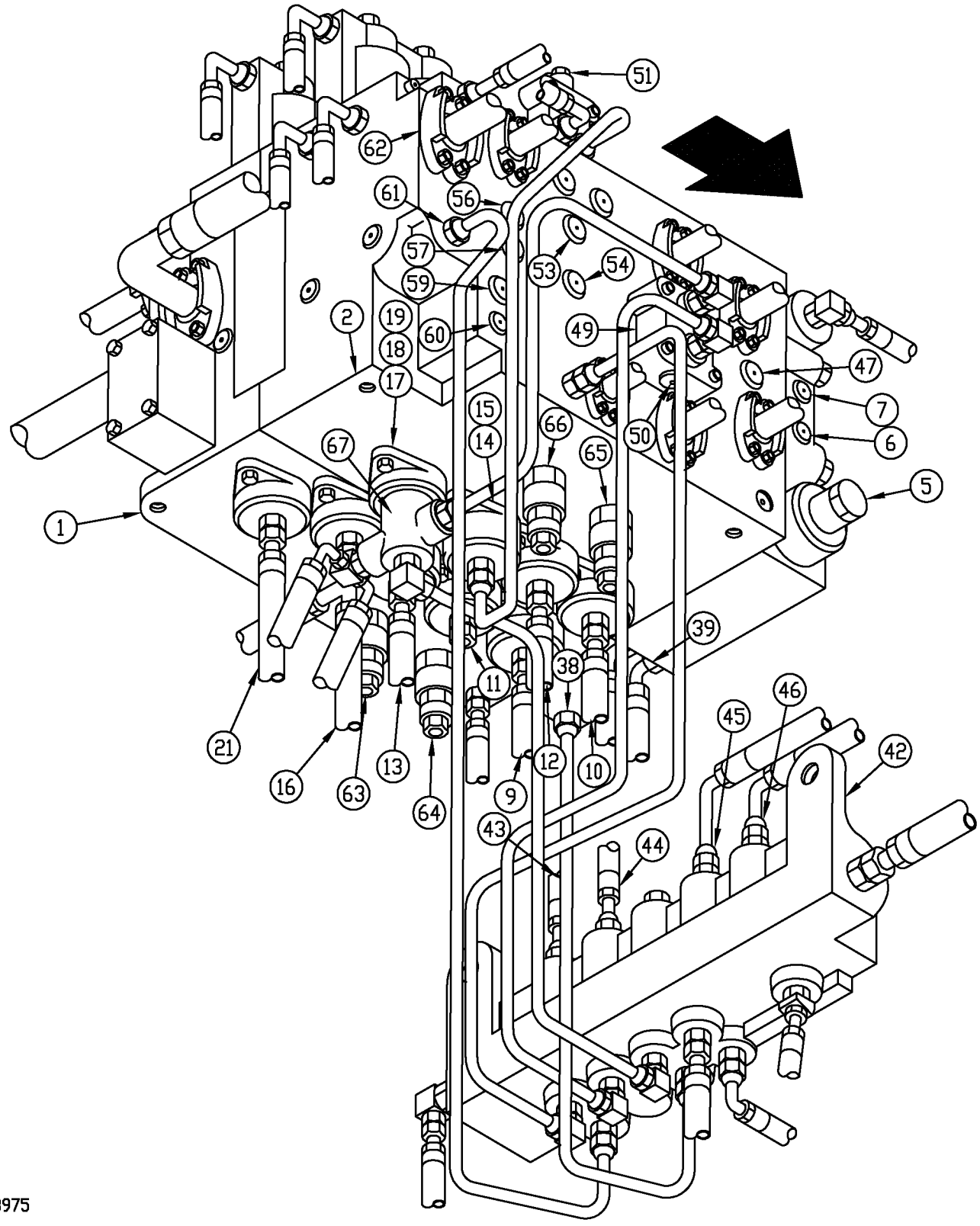


*Control Valve Components—Bottom View*

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**1—Left Control Valve (5-Spool)**
**2—Right Control Valve (4-Spool)**
**5—Flow Combiner Valve**
**6—System Relief Valve Isolation Check Valve**
**7—System Relief Valve Isolation Check Valve**
**9—Left Propel Valve**
**10—Right Propel Valve**
**11—Auxiliary Valve**
**12—Bucket Valve**
**13—Boom II Valve**
**14—Boom I Valve**
**15—Boom Regenerative Valve (in Boom I Spool)**
**16—Arm I Valve**
**17—Arm II Valve**
**18—Arm Regenerative Valve (in Arm II Spool)**
**19—Check Valve and Orifice (in Arm II Spool)**
**21—Swing Valve**
**38—Rear Pump Control Valve Pilot Inlet Filter**
**39—Pilot Pressure Signal Passage Filter**
**42—Solenoid Valve Manifold**
**43—Arm Regenerative Solenoid Valve**
**44—Speed Sensing Solenoid Valve**
**45—Propel Speed Change Solenoid Valve**
**46—Power Boost Solenoid Valve**
**47—Orifice and Bucket Power Passage Lift Check Valve**
**49—Bucket Flow Control Poppet Valve**
**50—Bucket Flow Control Pilot Valve B**
**51—Boom Reduced Leakage Pilot Valve**
**53—Boom Reduced Leakage Check Valve**
**54—Boom I Power Passage Lift Check Valve**
**56—Orifice and Arm II Power Passage Lift Check Valve**
**57—Arm II Neutral Passage Lift Check Valve**
**59—Front Pump Bypass Shut-Off Valve Outlet Port**
**60—Bypass Shut-Off Valve Pilot Port**
**61—Front Pump Control Valve Pilot Inlet Filter**
**62—Oil Cooler Bypass Valve**
**63—Boom Down Circuit Relief and Anti-Cavitation Valve**
**64—Auxiliary Circuit Relief and Anti-Cavitation Valve**
**65—Bucket Load Circuit Relief and Anti-Cavitation Valve**
**66—Arm In Circuit Relief and Anti-Cavitation Valve**
**67—Bucket Flow Control Pilot Valve A**

1. Use three previous illustrations to locate individual components on assembled control valve.

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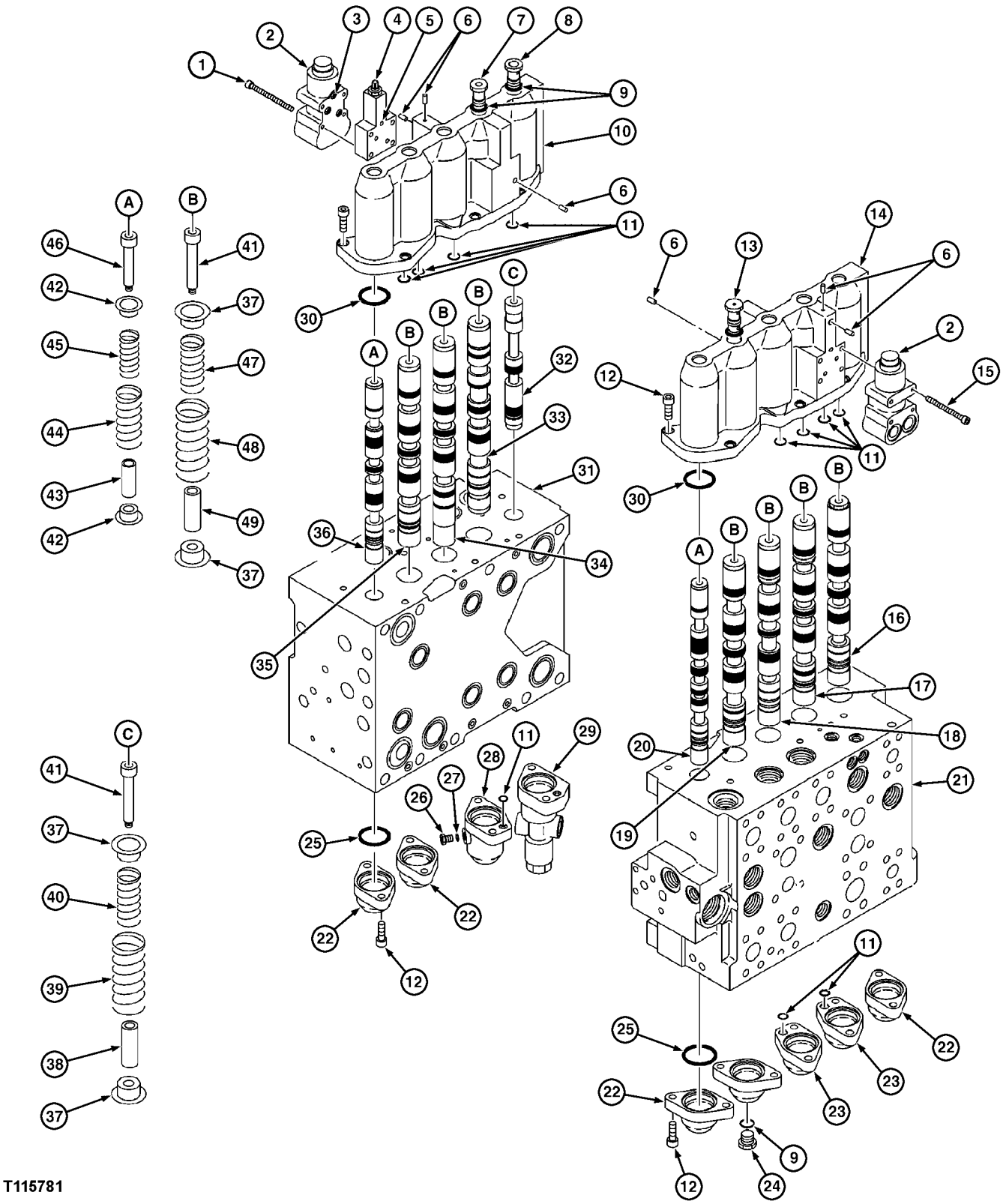


*Control Valve—Exploded View*

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**1—Cap Screw (4 used)**
**2—Reduced Leakage Pilot Valve (2 used)**
**3—O-Ring (6 used)**
**4—Boom Manual Lower Valve**
**5—O-Ring (3 used)**
**6—Plug (6 used)**
**7—Plug**
**8—Plug**
**9—O-Ring (6 used)**
**10—Right Pilot Cap (Cover)**
**11—O-Ring (11 used)**
**12—Cap Screw (32 used)**
**13—Plug**
**14—Left Pilot Cap (Cover)**
**15—Cap Screw (4 used)**
**16—Swing Spool**
**17—Arm I Spool**
**18—Boom II Spool**
**19—Auxiliary Spool**
**20—Left Propel Spool**
**21—Left Control Valve Housing (5-Spool)**
**22—Pilot Cap (Cover) (5 used)**
**23—Pilot Cap (Cover) (2 used)**
**24—Plug**
**25—O-Ring (8 used)**
**26—Plug**
**27—O-Ring**
**28—Boom I Cover**
**29—Arm II Cover**
**30—O-Ring (10 used)**
**31—Right Control Valve Housing (4 Spool)**
**32—Bypass Shut-Off Spool**
**33—Arm II Spool**
**34—Boom I Spool**
**35—Bucket Spool**
**36—Right Propel Spool**
**37—Spring Seat**
**38—Stopper**
**39—Spring**
**40—Spring**
**41—Special Cap Screw (8 used)**
**42—Spring Seat (4 used)**
**43—Stopper (2 used)**
**44—Spring (2 used)**
**45—Spring (2 used)**
**46—Special Cap Screw (2 used)**
**47—Spring (7 used)**
**48—Spring (7 used)**
**49—Stopper (7 used)**

*NOTE: It is not always necessary to remove the control valve to remove individual components.*

*The letters A—E are used in the illustrations to indicate the location of parts in housings.*

2. **Reduced Leakage Pilot Valves and Boom Manual Lower Valve:** Remove cap screws (1). Remove boom manual lower valve (4) and boom reduced leakage pilot valve (2).

   Remove cap screws (15). Remove arm rod end reduced leakage pilot valve (2).

   Install valves (2 and 4). Tighten cap screws.

**Arm Reduced Leakage Pilot Valve-to-Left Spring Cover Cap Screw—Specification**

Torque..... 12 N•m (9 lb-ft)

**Boom Reduced Leakage Pilot Valve and Boom Manual Lower Valve-to-Right Spring Cover Cap Screw—Specification**

Torque..... 12 N•m (9 lb-ft)

3. **Valve Spools:** Disassemble valve for cleaning and inspections only. Valve is serviced as an assembly. Remove cap screws (12). Remove left and right upper pilot caps (10 and 14).

**IMPORTANT: The spools (16—20 and 32—36) are select fitted to bores in housing and are a different design for each function. Spools must be installed into the same bores from which they were removed for proper operation of machine.**

Remove spools (16—20 and 32—36) from control valves (21 and 31).

For spools (20 and 36): Loosen special cap screw (46). Disassemble spring seat (42), springs (44 and 45) and stopper (43).

For spools (16—19 and 33—35): Loosen special cap screw (41). Disassemble spring seat (37), springs (47 and 48) and stopper (49).

For spool (32): Loosen special cap screw (41). Disassemble spring seat (37), springs (39 and 40) and stopper (38).

Remove pilot caps (cover) cap screws (12). Remove pilot caps (cover) (22 and 23), boom I cover (28) and arm II cover (29).

Inspect all parts for wear or damage. Replace as necessary.

Install lower pilot cap screws. Tighten cap screws.

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**Lower Pilot Caps-to-Control Valve Housing Cap Screw—Specification**

Torque..... 29 N•m (21 lb-ft)

Clean threads of special cap screws (41 and 46) using cure primer. Apply thread lock and sealer (high strength) to threads of cap screws.

Install spring seats, springs, stoppers and special cap screws on the respective spools. Tighten special cap screws.

**Special Cap Screw-to-Spool—Specification**

Torque..... 16 N•m (12 lb-ft)

Install spools (16—20 and 32—36).

Install pilot caps (10 and 14). Tighten cap screws (12).

**Upper Pilot Caps Cap Screw—Specification**

Torque..... 29 N•m (21 lb-ft)

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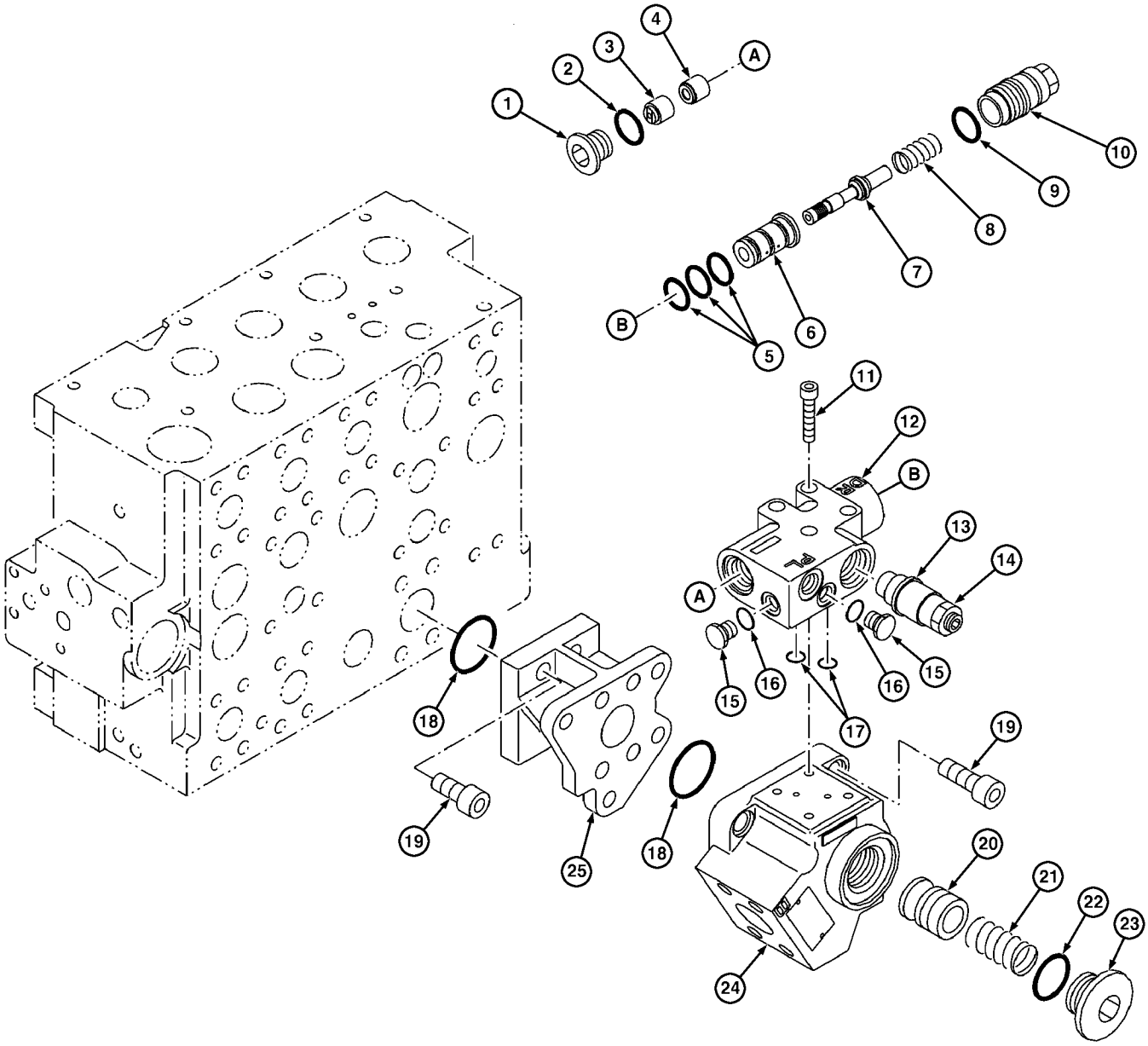


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**1—Plug**
**2—O-Ring**
**3—Piston**
**4—Piston**
**5—O-Ring (3 used)**
**6—Bushing**
**7—Spool**
**8—Spring**
**9—O-Ring**
**10—Plug**
**11—Cap Screw (4 used)**
**12—Arm Head End Reduced Leakage Pilot and Relief Valve Housing**
**13—O-Ring**
**14—Relief Valve**
**15—Plug (2 used)**
**16—O-Ring (2 used)**
**17—O-Ring (2 used)**
**18—O-Ring (2 used)**
**19—Cap Screw (8 used)**
**20—Poppet**
**21—Spring**
**22—O-Ring**
**23—Plug**
**24—Arm Head End Reduced Leakage Check Valve Housing**
**25—Adapter**



4. **Arm Head End Reduced Leakage Check Valve and Relief Valve:** Remove cap screws (19) and remove arm head end reduced leakage check valve housing (24) from adapter (25).

   Remove cap screws (19) and remove adapter (25) from block.

   Remove cap screws (11). Remove arm head end reduced leakage pilot and relief valve housing (12) from arm head end reduced leakage check valve housing (24).

   Remove plug (23). Remove poppet (20) and spring (21) from arm head end reduced leakage check valve housing (24).

   Remove relief valve (14) from arm head end reduced leakage pilot and relief valve housing (12).

   Remove parts (1—4) and (5—10) from arm head end reduced leakage pilot and relief valve housing.

   Inspect parts for wear or damage. Replace as necessary.

   Install parts (5—9).

   Install plug (10) and tighten.

**Arm Head End Reduced Leakage Pilot and Relief Valve Housing Plug—Specification**

Torque..... 74 N•m (55 lb-ft)

Install parts (2—4).

Install plug (1) and tighten.

**Arm Head End Reduced Leakage Pilot and Relief Valve Housing Plug—Specification**

Torque..... 137 N•m (101 lb-ft)

Install relief valve (14) and tighten.

**Arm Head End Reduced Leakage Pilot and Relief Valve Housing Plug—Specification**

Torque..... 74 N•m (55 lb-ft)

Install O-ring (22) onto plug (23).

Install poppet (20) and spring (21) into arm head end reduced leakage check valve housing (24).

Install plug (23) and tighten.

**Arm Head End Reduced Leakage Check Valve Housing Plug—Specification**

Torque..... 390 N•m (288 lb-ft)

Install arm head end reduced leakage pilot and relief valve housing (12) in arm head end reduced leakage check valve housing (24).

Install cap screws (11) and tighten.

**Arm Head End Reduced Leakage Pilot and Relief Valve Housing-to-Arm Head End Reduced Leakage Check Valve Housing Cap Screw—Specification**

Torque..... 12 N•m (9 lb-ft)

Install adapter (25) to valve block.

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Install cap screw (19) and tighten.

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**Arm Head End Reduced Leakage Check Valve Adapter Cap Screw—Specification**

Torque..... 108 N•m (80 lb-ft)

Install arm head end reduced leakage check valve housing (24).

Install cap screws (19) and tighten.

**Arm Head End Reduced Leakage Check Valve Housing-to-Adapter Plate Cap Screw—Specification**

Torque..... 108 N•m (80 lb-ft)

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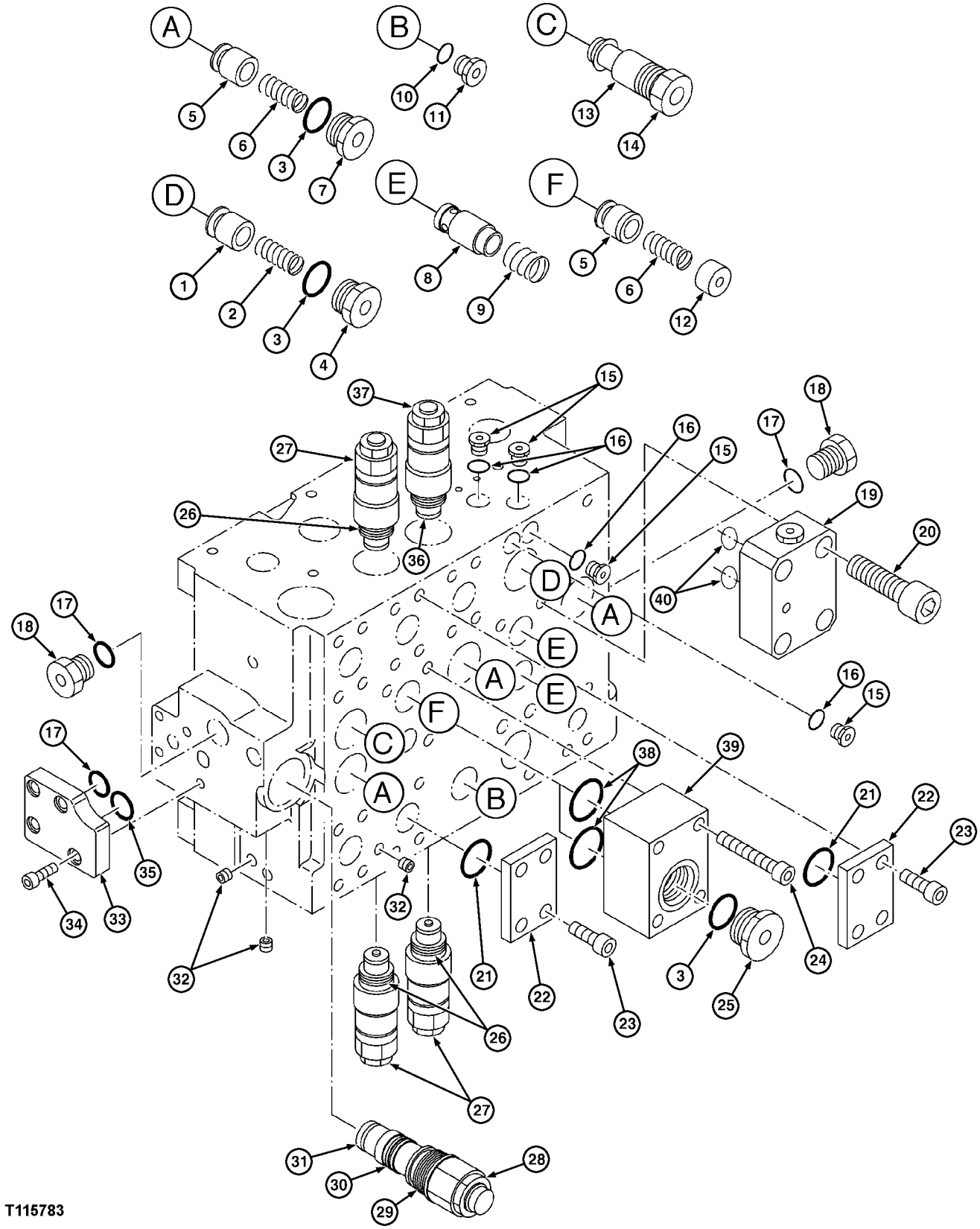


*Left Control Valve—5-Spool*

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**1—Check Valve**
**2—Spring**
**3—O-Ring (5 used)**
**4—Plug**
**5—Check Valve (5 used)**
**6—Spring (4 used)**
**7—Plug (3 used)**
**8—Check Valve (2 used)**
**9—Spring (2 used)**
**10—O-Ring**
**11—Plug**
**12—Spacer**
**13—Propel Flow Control Valve**
**14—O-Ring**
**15—Plug (4 used)**
**16—O-Ring (4 used)**
**17—O-Ring (3 used)**
**18—Plug (2 used)**
**19—Flange**
**20—Cap Screw (4 used)**
**21—O-Ring (2 used)**
**22—Cover**
**23—Cap Screw (8 used)**
**24—Cap Screw (4 used)**
**25—Plug**
**26—O-Ring (3 used)**
**27—Circuit Relief Valve (3 used)**
**28—Valve**
**29—O-Ring**
**30—O-Ring**
**31—O-Ring**
**32—Plug (3 used)**
**33—Cover**
**34—Cap Screw (4 used)**
**35—O-Ring**
**36—O-Ring**
**37—Circuit Relief Valve**
**38—O-Ring (2 used)**
**39—Cover**
**40—O-Ring (2 used)**

5. **Circuit Relief and Anti-Cavitation Valves:** Disassemble valves for cleaning and inspection only. Valves are serviced as assemblies. Remove auxiliary circuit relief and anti-cavitation valves (27) and boom down circuit relief and anti-cavitation valve from left control valve housing.

   Remove arm-out circuit relief and anti-cavitation valve (37) from left control valve housing.

   Inspect valves for wear or damage. Replace as necessary.

   Install valves in housing and tighten.

   **Circuit Relief and Anti-Cavitation Valves-to-Housing—Specification**

   Torque..... 73 N•m (54 lb-ft)

6. **Rear Pump Control Valve (28):** Disassemble valve for cleaning and inspection only. Valve is serviced as an assembly.

   **Rear Pump Control Valve-to-Housing—Specification**

   Torque..... 73 N•m (54 lb-ft)

7. **Check Valves:** Remove cap screws (24). Remove cover (39). Remove spacer (12), spring (6) and auxiliary power passage lift check valve (5).

   Remove cap screws (20). Remove flange (19).

   Remove power passage-to-arm I neutral passage check valve and arm I lift check valve (8) and spring (9).

   Remove plug (4). Remove spring (2) and arm rod end reduced leakage check valve (1).

   Remove lift propel neutral passage, boom II power passage and swing lift check valves. Remove plug (7), spring (6) and poppet (5).

   Install check valves and tighten plugs.

   **Check Valve Plug—Specification**

   Torque..... 245 N•m (181 lb-ft)

   Install flange (19) and cap screws (20).

   **Flange Cap Screw—Specification**

   Torque..... 57 N•m (42 lb-ft)

   Install cover (39) and cap screws (24).

   **Cover Cap Screw—Specification**

   Torque..... 57 N•m (42 lb-ft)

8. **Propel Flow Control Valve (13):** Disassemble valve for cleaning and inspection only. Valve is serviced as an assembly.

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**Propel Flow Control Valve-to-Housing Cap Screw—Specification**

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Torque..... 162 N•m (119 lb-ft)

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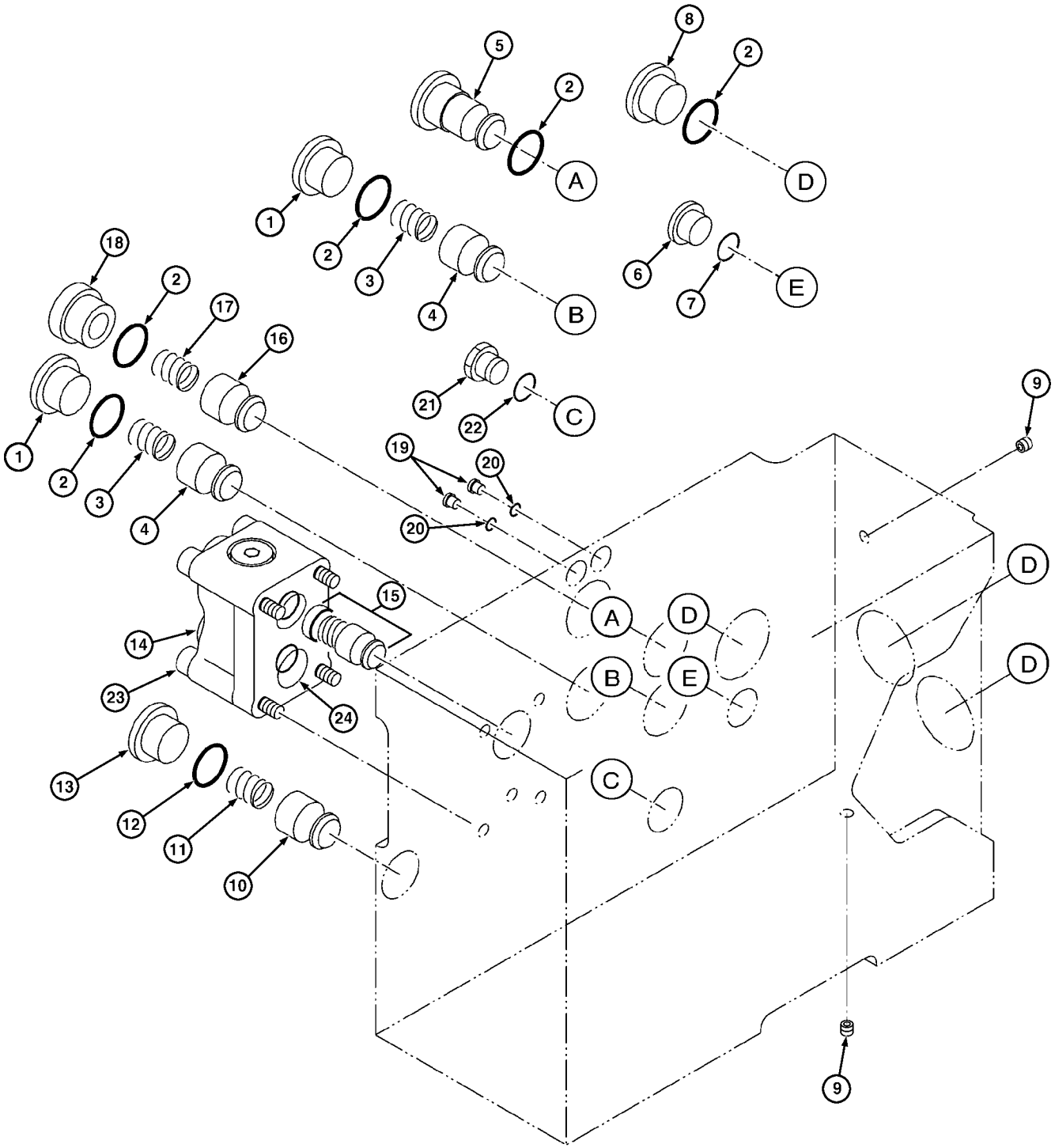


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**1—Plug**
**2—O-Ring**
**3—Spring**
**4—Check Valve**
**5—Valve**
**6—Plug**
**7—O-Ring**
**8—Plug**
**9—Plug**
**10—Check Valve**
**11—Spring**
**12—O-Ring**
**13—Plug**
**14—Valve**
**15—Valve**
**16—Check Valve**
**17—Spring**
**18—Plug**
**19—Plug**
**20—O-Ring**
**21—Plug**
**22—O-Ring**
**23—Cap Screw (4 used)**
**24—O-Ring (2 used)**

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9. **Check Valves:** Remove plug and remove orifice and arm II power passage lift check valve (5) from right control valve housing.

   Remove plugs (1) and springs (3). Remove arm II neutral passage lift check valve and boom I power passage lift check valve (4).

   Remove plug (18). Remove spring (17) and boom reduced leakage check valve (16).

   Remove plug (13). Remove spring (11) and orifice and bucket power passage lift check valve (10).

   Install check valve (16) and spring (17). Install plug (18) and tighten.

**Boom Reduced Leakage Check Valve Plug—Specification**

Torque..... 245 N•m (181 lb-ft)

Install check valve (10) and spring (11). Install plug (13) and tighten.

**Orifice and Bucket Power Passage Lift Check Valve Plug—Specification**

Torque..... 73 N•m (54 lb-ft)

Install check valve (4) and spring (3). Install plugs (1) and tighten.

**Boom I Power Passage Lift Check Valve and Arm II Neutral Passage Lift Check Valve Plug—Specification**

Torque..... 245 N•m (181 lb-ft)

10. **Bucket Flow Control Poppet Valve:** Remove cap screw (23). Remove bucket flow control valve (14). Remove bucket flow control poppet valve (15).

    Install valve (15) and valve (14). Install cap screws (23) and tighten.

**Bucket Flow Control Valve Cap Screw—Specification**

Torque..... 57 N•m (42 lb-ft)

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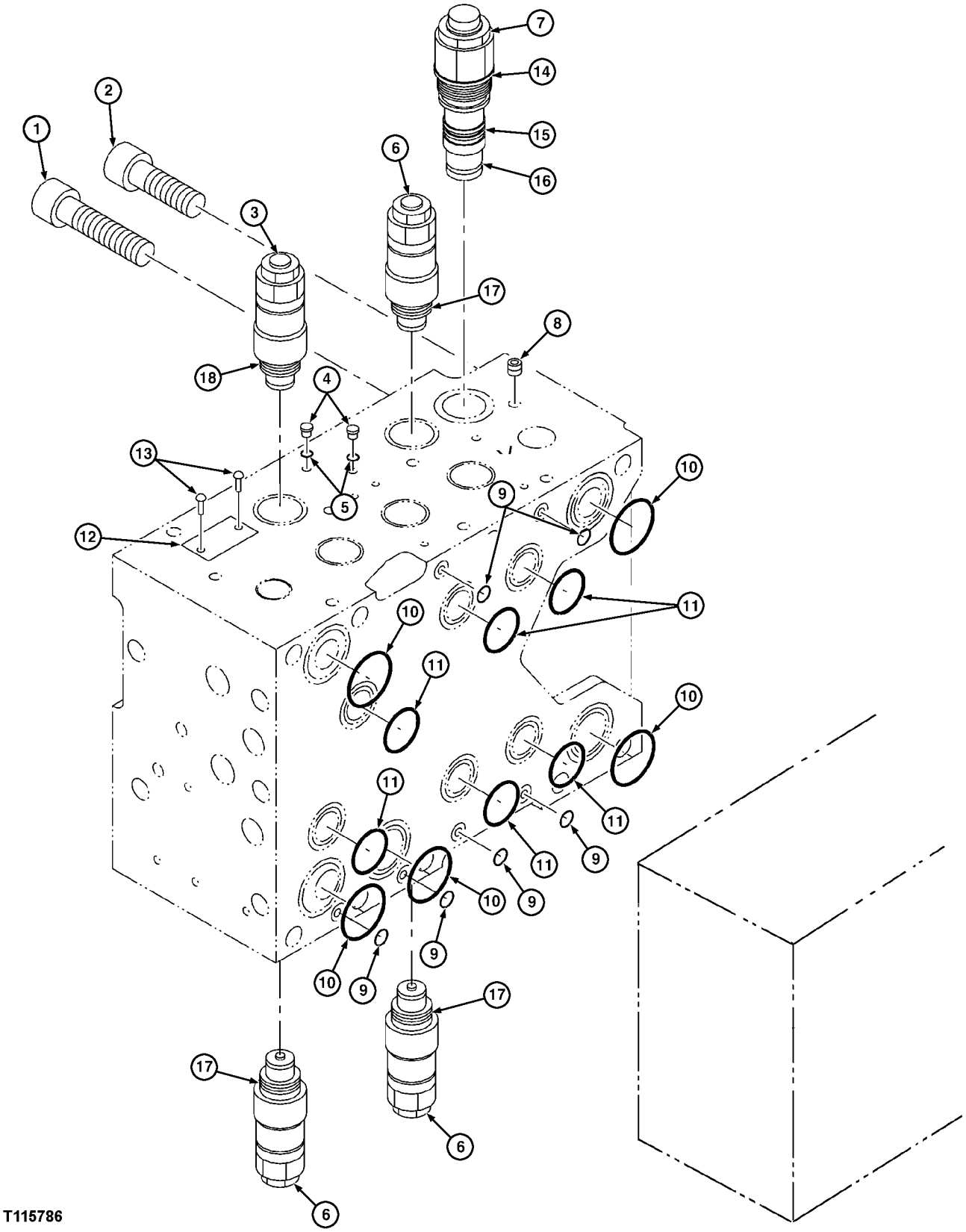


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**1—Cap Screw (8 used)**
**2—Cap Screw**
**3—Circuit Relief Valve**
**4—Plug**
**5—O-Ring**
**6—Circuit Relief Valve**
**7—Valve**
**8—Plug**
**9—O-Ring**
**10—O-Ring**
**11—O-Ring**
**12—Name Plate**
**13—Rivet**
**14—O-Ring**
**15—O-Ring**
**16—O-Ring**
**17—O-Ring (3 used)**
**18—O-Ring**

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11. **Circuit Relief and Anti-Cavitation Valves (3 and 6):** Disassemble valves for cleaning and inspection only. Valves are serviced as assemblies. The right control valve housing contains the boom up, bucket dump, arm in and bucket load circuit relief valves.

    Tighten valves into housing.

**Circuit Relief and Anti-Cavitation Valve-to-Housing—Specification**

Torque..... 73 N•m (54 lb-ft)

12. **Front Pump Control Valve:** Disassemble valves for cleaning and inspection only. Valves are serviced as assemblies.

**Front Pump Control Valve-to-Housing—Specification**

Torque..... 73 N•m (54 lb-ft)

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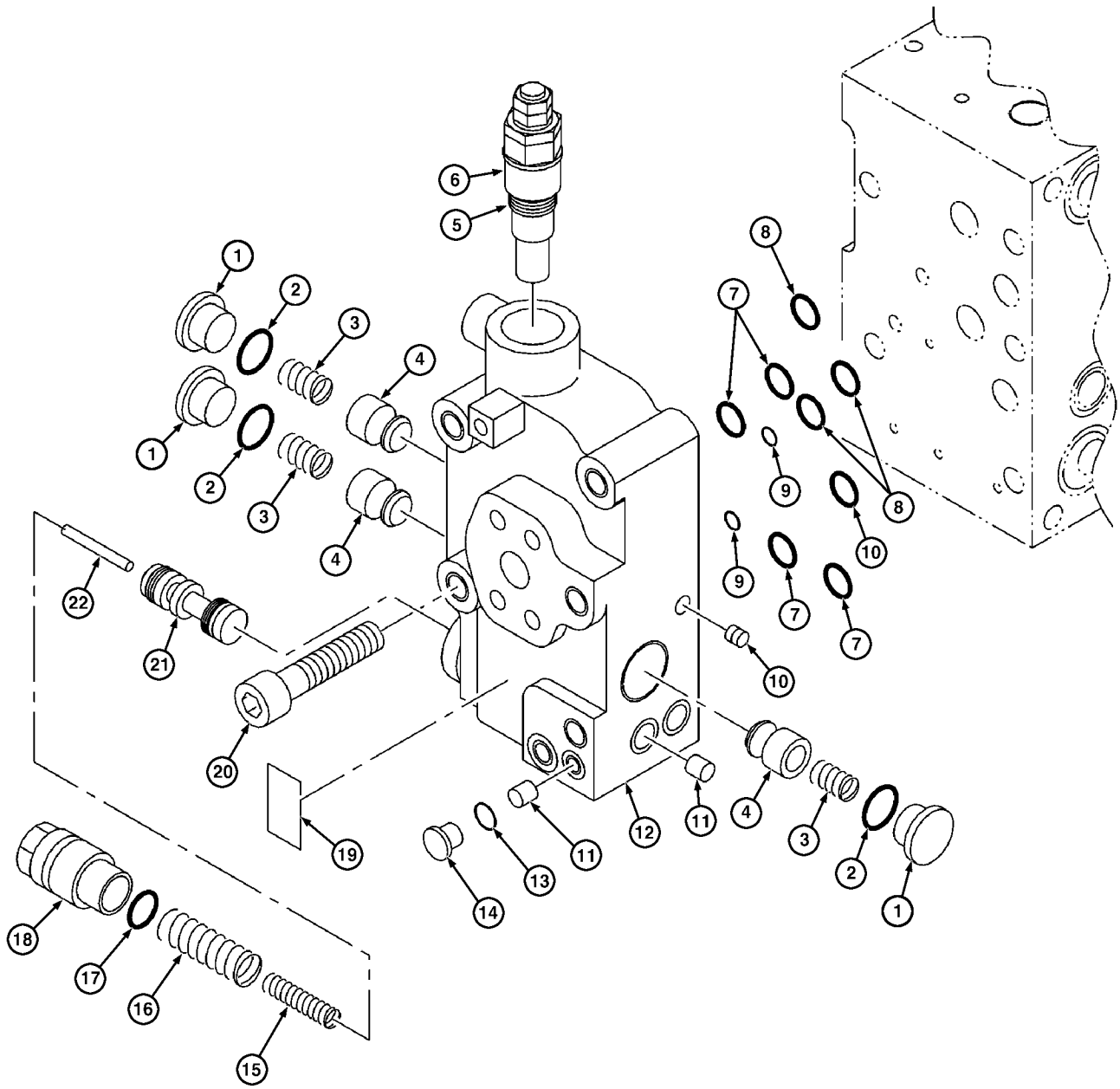


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**1—Plug**
**2—O-Ring**
**3—Spring**
**4—Poppet**
**5—O-Ring**
**6—System Relief and Power Boost Valve**
**7—O-Ring**
**8—O-Ring**
**9—O-Ring**
**10—Plug**
**11—Orifice (2 used)**
**12—Flow Combiner Valve Housing**
**13—O-Ring**
**14—Plug**
**15—Spring**
**16—Spring**
**17—O-Ring**
**18—Plug**
**19—Name Plate**
**20—Cap Screw**
**21—Spool**
**22—Pin**

13. **Flow Combiner Valve:** Remove parts (15—18, 21 and 22) from flow combiner valve housing.

    Remove plug (14). Remove orifices (11).

    Install parts (15—18, 21 and 22) and (11 and 14).

**Flow Combiner Valve Orifice—Specification**

Torque..... 9 N•m (7 lb-ft)

**Flow Combiner Valve Plug—Specification**

Torque..... 15 N•m (11 lb-ft)

**Flow Combiner Valve Spool-to-Housing Plug (18)—Specification**

Torque..... 74 N•m (54 lb-ft)

14. **System Relief and Power Boost Valve:** Disassemble valves for cleaning and inspection only. Valves are serviced as assemblies.

    Tighten valve (6) into flow combiner valve housing.

**System Relief and Power Boost Valve-to-Housing—Specification**

Torque..... 74 N•m (55 lb-ft)

15. **System Relief Valve Isolation Check Valve:** Remove parts (1—4).

    Install parts (2—4). Install plugs (1) and tighten.

**System Relief Valve Isolation Check Valve Plug—Specification**

Torque..... 245 N•m (181 lb-ft)

CED,OUOE026,13 –19–19JUN98–21/21

## REMOVE AND INSTALL HYDRAULIC OIL TANK

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3360
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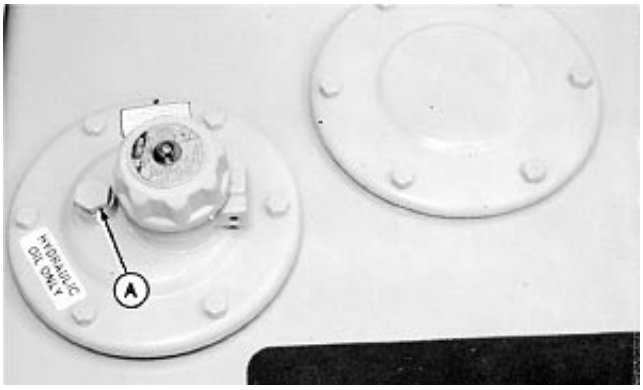
**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure in hydraulic oil tank.
2. Remove covers from bottom and side of hydraulic oil tank.
3. Remove hood and associated hardware.

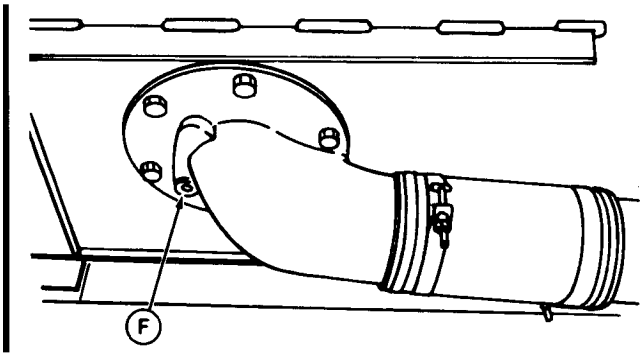



**A—Vent Plug**

CED,OUOE026,2 –19–11JUN98–1/8

*NOTE: It is not necessary to drain and remove the hydraulic oil tank if only the return filter element is being removed. (See procedures in this group.)*

4. Remove drain plug (F) to drain hydraulic oil tank. Approximate oil capacity is 156 L (42 gal).




**F—Drain Plug**

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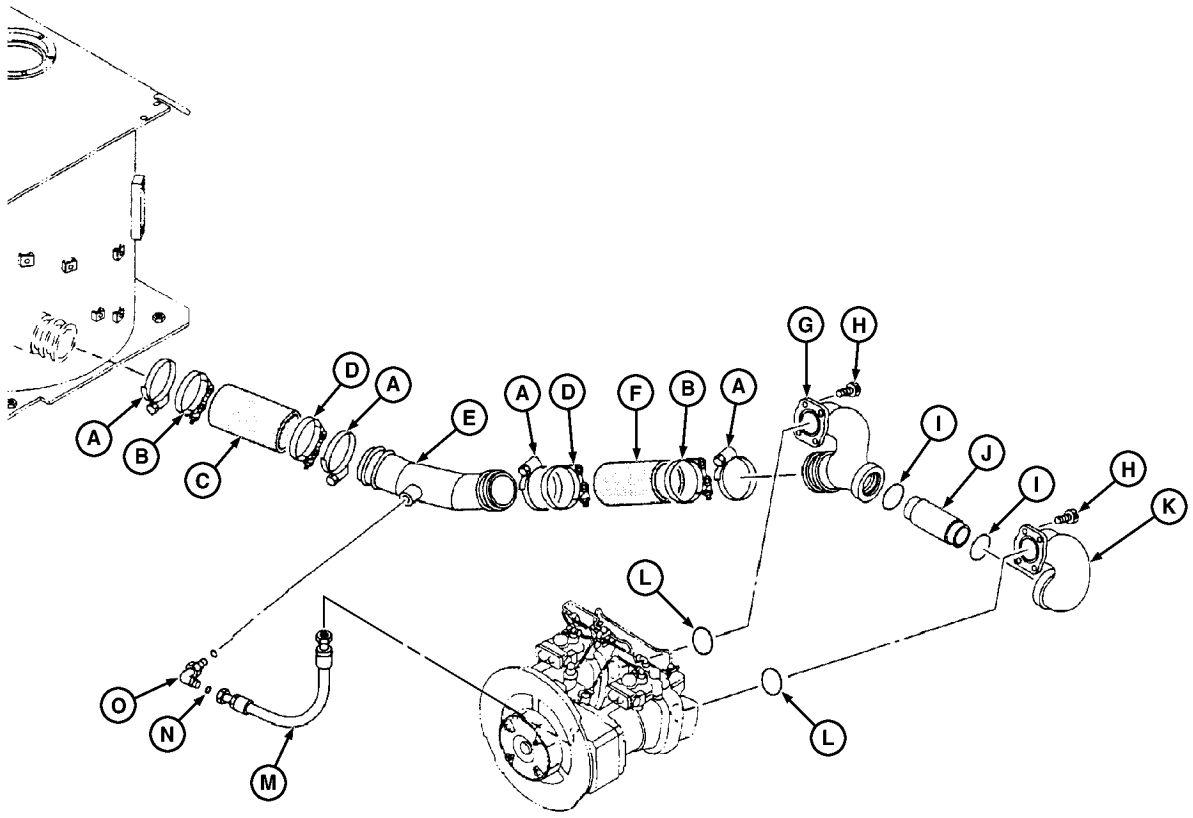
CED,OUOE026,2 –19–11JUN98–2/8




T115425

T115425 –UN–01JUL98

**A—Hose Clamp**
**B—Hose Clamp**
**C—Hose**
**D—Hose Clamp**
**E—Suction Pipe**
**F—Hose**
**G—Pipe Elbow (Manifold)**
**H—Cap Screw (8 used)**
**I—O-Ring**
**J—Hose**
**K—Pipe Elbow (Manifold)**
**L—O-Ring**
**M—Suction Pipe-to-Pilot Pump Line**
**N—O-Ring**
**O—Elbow Fitting**

5. Disconnect line (M) from fitting (O) on suction pipe (E). Install plug.
6. Remove cap screws (H) to disconnect pipe elbows (G and K) from hydraulic pumps.
7. Loosen hose clamps (A and B) at hydraulic tank connection.
8. Remove parts (A—G and I—K).

**Continued on next page**

CED,OUOE026,2 –19–11JUN98–3/8

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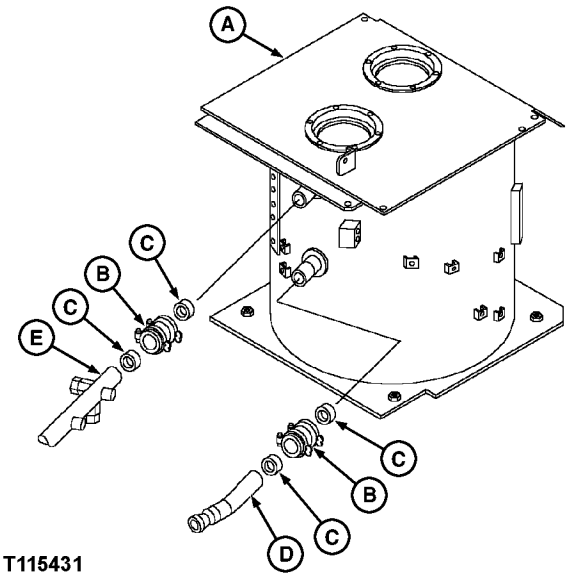
124

9. Loosen nuts on couplings (B). Slide couplings on to return lines (D and E). Install caps and plugs.




T115431

T115431 –UN–01JUL98

**A—Hydraulic Oil Tank**
**B—Coupling**
**C—Seals**
**D—Return Line**
**E—Return Line**

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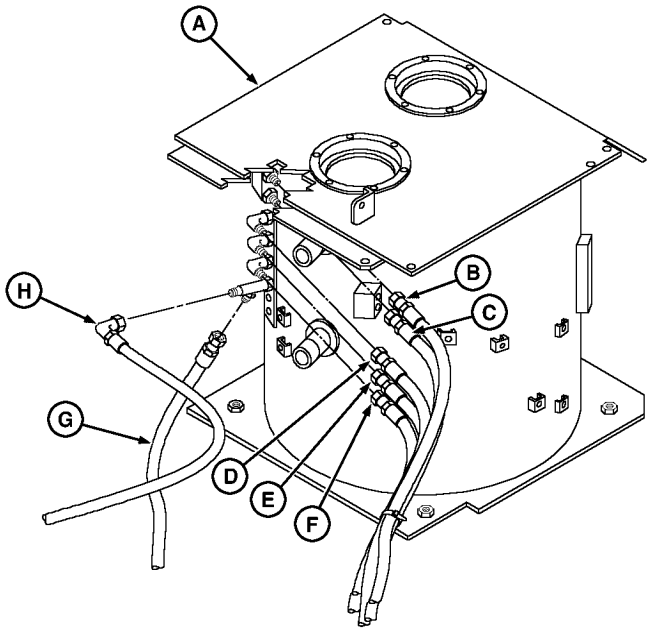
CED,OUOE026,2 –19–11JUN98–4/8




T115430

T115430 –UN–01JUL98

**A—Hydraulic Oil Tank**
**B—Hydraulic Oil Tank-to-Control Valve Arm Rod End Reduced Leakage Pilot Valve Rear Side Port**
**C—Hydraulic Oil Tank-to-Control Valve Boom Reduced Leakage Pilot Valve Rear Side Port**
**D—Hydraulic Oil Tank-to-Control Valve Swing Valve Rear Port**
**E—Hydraulic Oil Tank-to-Control Valve Bypass Shut-Off Valve Rear Port**
**F—Hydraulic Oil Tank-to-Control Valve Rear Pump Control Valve Front Port**
**G—Hydraulic Oil Tank-to-Control Valve Bottom Front Left Port**
**H—Hydraulic Oil Tank-to-Control Valve Rear Right Side Port**

10. Disconnect lines (B—H). Install caps and plugs.

**Continued on next page**

CED,OUOE026,2 –19–11JUN98–5/8

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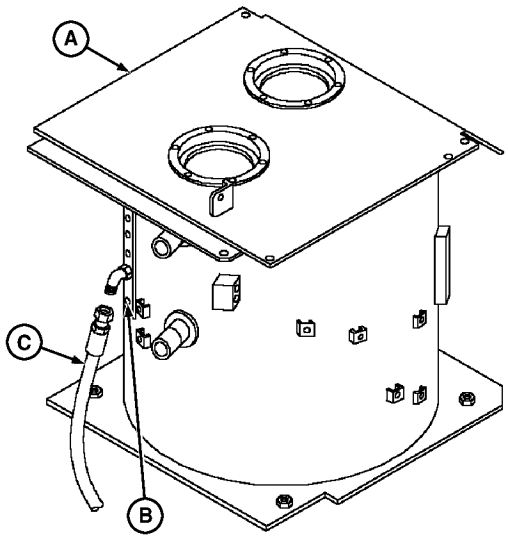
126

11. Disconnect line (C).
12. Disconnect wiring harness for hydraulic oil level switch (B).



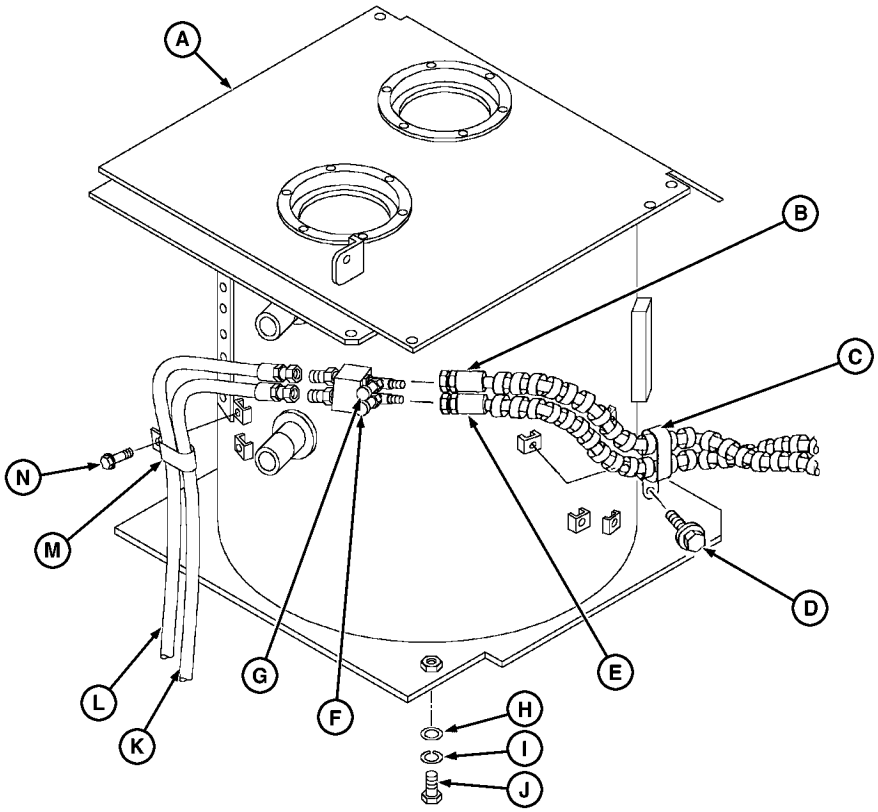

T115429 –UN–01JUL98

**T115429**

**A—Hydraulic Oil Tank**
**B—Hydraulic Oil Level Switch**
**C—Hydraulic Oil Tank-to-Right Side Port of Solenoid Manifold Block**

**Continued on next page**

CED,OUOE026,2 –19–11JUN98–6/8




T115427

T115427 –UN–01JUL98

**A—Hydraulic Oil Tank**
**B—Hydraulic Oil Tank-to-Rear Pump Regulator Side Port**
**C—Clamp**
**D—Cap Screw**
**E—Hydraulic Oil Tank-to-Front Pump Regulator Side Port**
**F—Test Point**
**G—Test Point**
**H—Washer (4 used)**
**I—Lock Washer (4 used)**
**J—Cap Screw (4 used)**
**K—Hydraulic Oil Tank-to-Control Valve Right Side Rear Right Port**
**L—Hydraulic Oil Tank-to-Control Valve Rear Pump Control Valve Bottom Left Port**
**M—Clamp**
**N—Cap Screw**

13. Disconnect lines (B, E, K and L). Install caps and plugs.
14. Disconnect wiring harness from test points (F and G).
15. Remove cap screws (D and N) to remove clamps (L and M).
16. Remove water separator. (See procedure in Group 0560.)
17. Remove harness clamps as needed.
18. Remove cap screws (J), lock washers (I) and washers (H) from bottom of tank.

**CAUTION: The approximate weight of hydraulic oil tank is 150 kg (331 lb).**

**Hydraulic Oil Tank—Specification**

Weight..... 150 kg (331 lb) approximate

19. Remove hydraulic oil tank using a hoist and lifting straps.
20. Repair or replace parts as necessary.
21. Install hydraulic oil tank.

**Continued on next page**

CED,OUOE026,2 –19–11JUN98–7/8

**Frame-to-Oil Tank Cap Screw—Specification**

Torque..... 205 N•m (151 lb-ft)

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3360
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**Return Line-to-Oil Tank Coupling Nut—Specification**

Torque..... 11.0 N•m (97 lb-in.)

**Hose-to-Oil Tank Elbow Suction Line T-Bolt Type Clamp—Specification**

Torque..... 4.0 N•m (35 lb-in.)

21. Connect wiring harness connectors, clamps and oil lines.
22. Add hydraulic oil to tank until it is between marks on sight glass. (See Hydraulic Oil in Group 0004.)

**IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting. Procedure must be performed to fill pump housing whenever oil has been drained from the pump or hydraulic oil tank.**

23. Do Hydraulic Pump Start-Up Procedure. (See procedure in this group.)

CED,OUOE026,2 –19–11JUN98–8/8

## DISASSEMBLE AND ASSEMBLE HYDRAULIC OIL TANK

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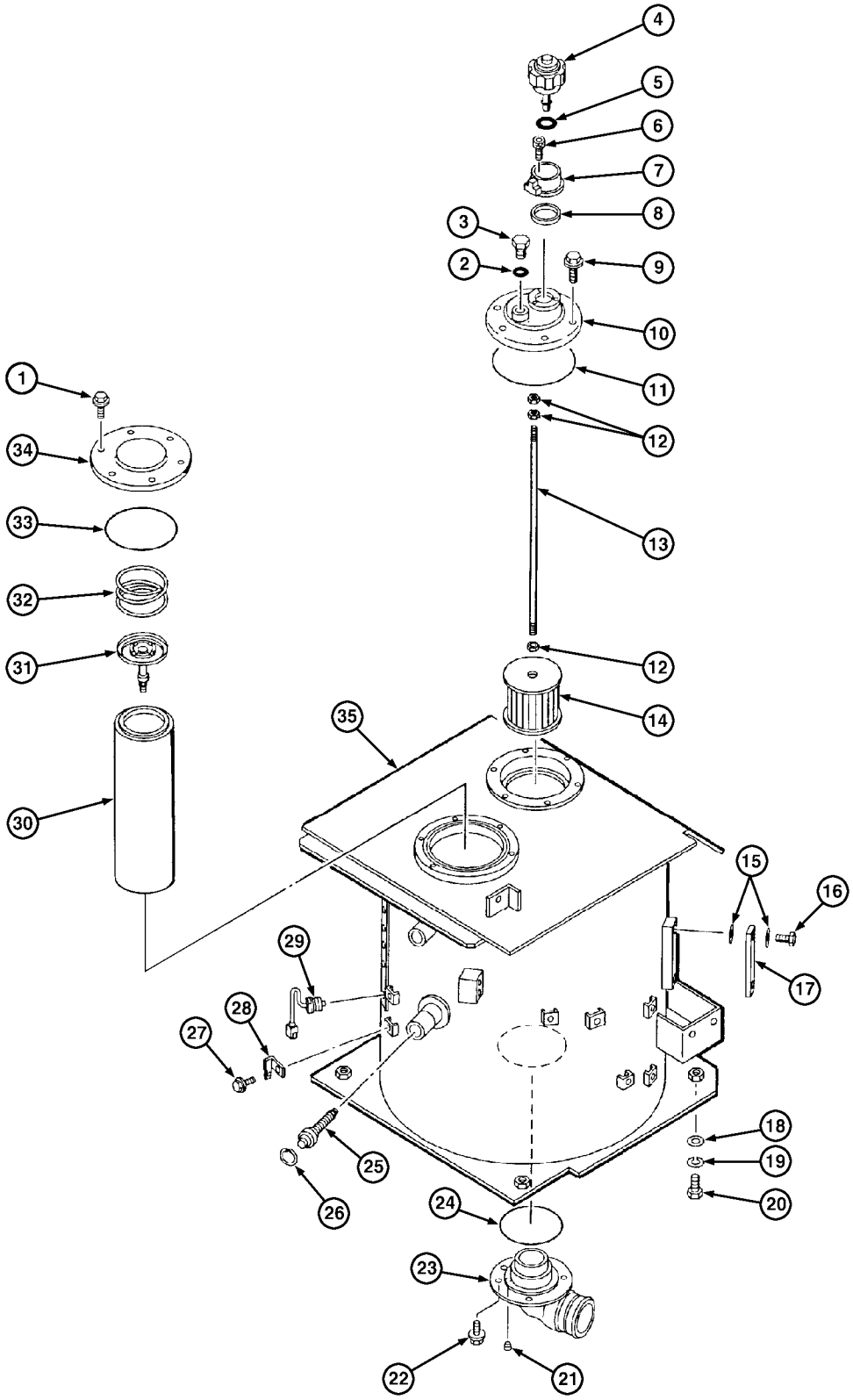
130




T115467

T115467 –UN–01JUL98

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CED,OUOE026,8 –19–18JUN98–1/2

**1—Cap Screw (6 used)**
**2—O-Ring**
**3—Plug**
**4—Filter**
**5—O-Ring**
**6—Allen Screw (4 used)**
**7—Housing**
**8—Packing**
**9—Cap Screw (6 used)**
**10—Cover**
**11—O-Ring**
**12—Nut (3 used)**
**13—Rod**
**14—Suction Strainer**
**15—Washer Seal**
**16—Cap Screw (2 used)**
**17—Gauge**
**18—Washer (4 used)**
**19—Lock Washer (4 used)**
**20—Cap Screw (4 used)**
**21—Plug**
**22—Cap Screw and Lock Washer (6 used)**
**23—Suction Pipe**
**24—O-Ring**
**25—Oil Cooler Bypass Valve**
**26—Snap Ring**
**27—Cap Screw**
**28—Bracket**
**29—Level Switch**
**30—Filter**
**31—Valve**
**32—Spring**
**33—O-Ring**
**34—Cover**

*NOTE: It is not necessary to drain and remove the hydraulic oil tank if only the return filter element (30) is being removed. (See procedures in this group.)*

1. Tighten cap screws (1, 9 and 22).

**Cover-to-Oil Tank Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

2. Adjust rod (13) so length from end of rod to bottom of filter (screen) (14) is to specification. Tighten nuts (12) at top end of rod so top nut is the specified distance from end of rod.

**Rod and Suction Strainer—Specification**

Length ..... 702 mm (27.6 in.) from end of rod to bottom of suction strainer
Distance ..... 20 mm (0.79 in.) from end of rod to top nut

Tighten nut (12).

**Rod-to-Suction Strainer Nut—Specification**

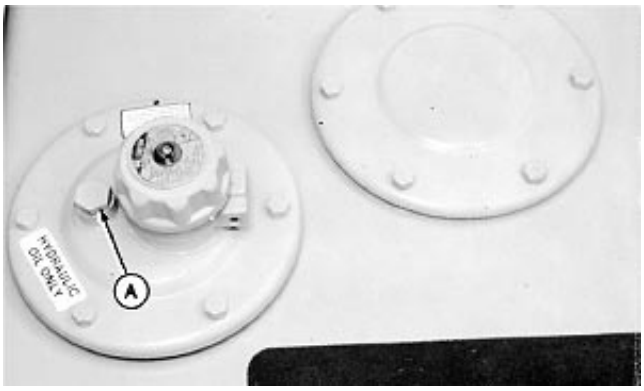
Torque ..... 17 N•m (153 lb-in.)

CED,OUOE026,8 –19–18JUN98–2/2

## REMOVE AND INSTALL RETURN FILTER AND BYPASS VALVE

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE026,7 –19–18JUN98–1/3

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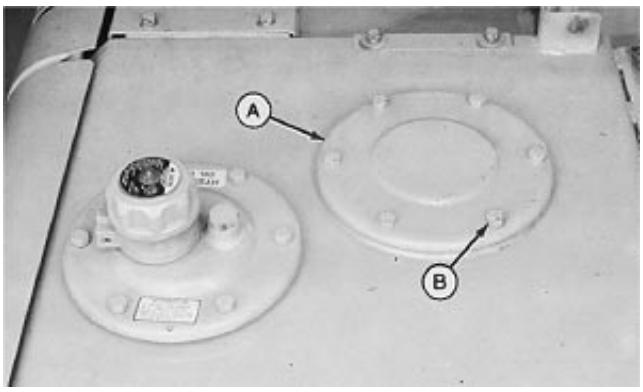
2. Hold down cover (A) against light spring (D) force when removing last two cap screws (B).

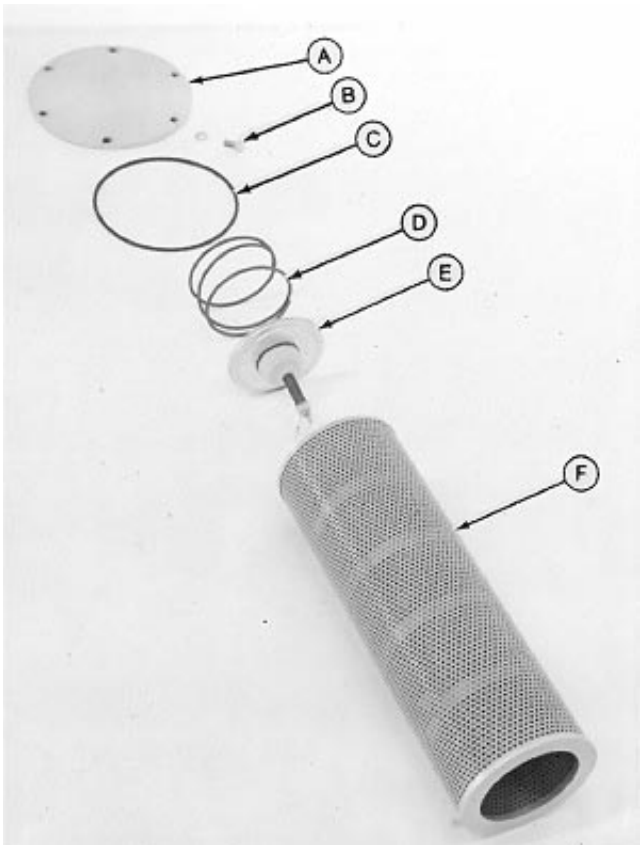
3. Remove spring (D), filter bypass valve (E) and return filter element (F).

4. Inspect element for metal particles and debris. Check for metal particles and debris at bottom of filter case. Excessive amounts of brass and steel particles can indicate a hydraulic pump, motor or valve malfunction, or a malfunction in process. A rubber type of material can indicate a cylinder packing problem.

   As necessary, drain hydraulic oil tank and clean filter case and tank. Approximate oil capacity is 159 L (42 gal).




T7995AL –UN–04MAY93




T6557GN –UN–20OCT88

**A—Cover**
**B—Cap Screw and Lock Washer (6 used)**
**C—O-Ring**
**D—Spring**
**E—Filter Bypass Valve**
**F—Return Filter Element**

**Continued on next page**

CED,OUOE026,7 –19–18JUN98–2/3

5. Install element (D) making sure it is pushed down on its seat at bottom of case.

6. Install filter bypass valve (E), spring (C), O-ring (F), cover (A) and cap screws (B).

   Tighten cap screws.

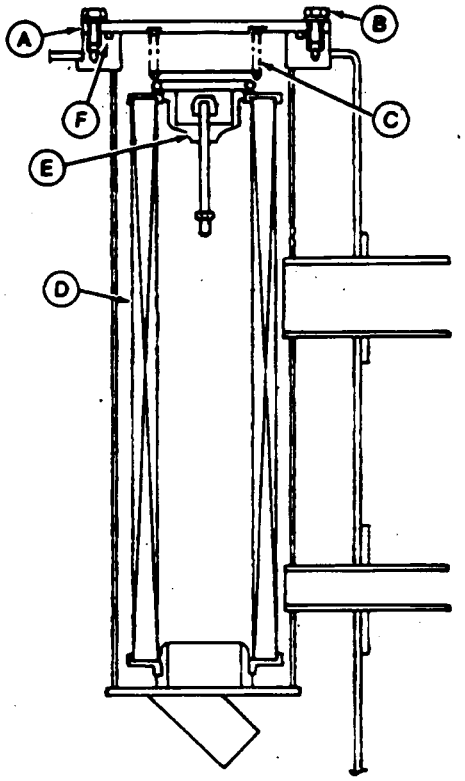
**Return Filter Cover-to-Hydraulic Oil Tank Cap Screw—Specification**

Torque ..... 49 N•m (36 lb-ft)

7. Add hydraulic oil as necessary. (See Hydraulic Oil in Group 0004.)

**IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting. Procedure must be performed to fill pump housing whenever oil has been drained from the pump or hydraulic oil tank.**

8. If hydraulic oil tank was drained, do Hydraulic Pump Start-Up Procedure. (See procedure in this group.)




T6457ED –UN–18OCT88

**A—Cover**
**B—Cap Screw**
**C—Spring**
**D—Element**
**E—Filter Bypass Valve**
**F—O-Ring**

CED,OUOE026,7 –19–18JUN98–3/3

## REMOVE AND INSTALL SUCTION STRAINER

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3360
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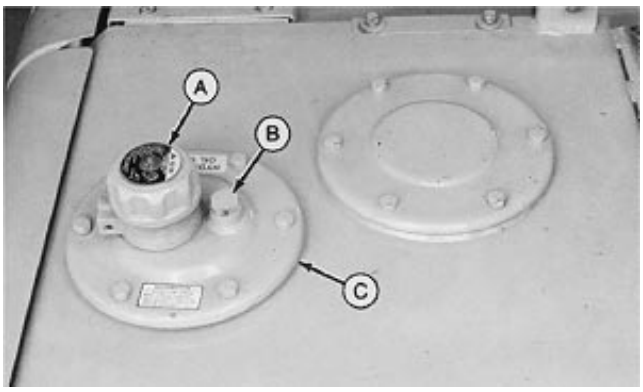
**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (B) to release air pressure in hydraulic oil tank.
2. Drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).
3. Remove filler cap (A) and cover (C).




T7995AM –UN–04MAY93

**A—Filler Cap**
**B—Vent Plug**
**C—Cover**

**Continued on next page**

CED,OUOE026,6 –19–18JUN98–1/3

4. Remove parts (D—H).

   Replace parts as necessary.

**IMPORTANT: To ensure suction strainer is held in position on suction tube, the rod and suction strainer must be adjusted to the correct length.**

5. Tighten nuts at top end of rod so top nut is 20 mm (0.79 in.) from end of rod.

   Adjust rod so the length from end of rod to the bottom of suction strainer is to specification.

   Tighten nut (I).

**Rod-to-Suction Strainer Nut—Specification**

Torque ..... 17 N•m (153 lb-in.)

**Rod and Suction Strainer—Specification**

Distance..... 20 mm (0.79 in.) from end of rod to top nut
Length..... 702 mm (27.6 in.) from end of rod to bottom of suction strainer

6. Install suction strainer and rod (D and E) making sure it is pushed down on suction tube at bottom of oil tank.

7. Install cover (C). Make sure rod is through hole in cover.

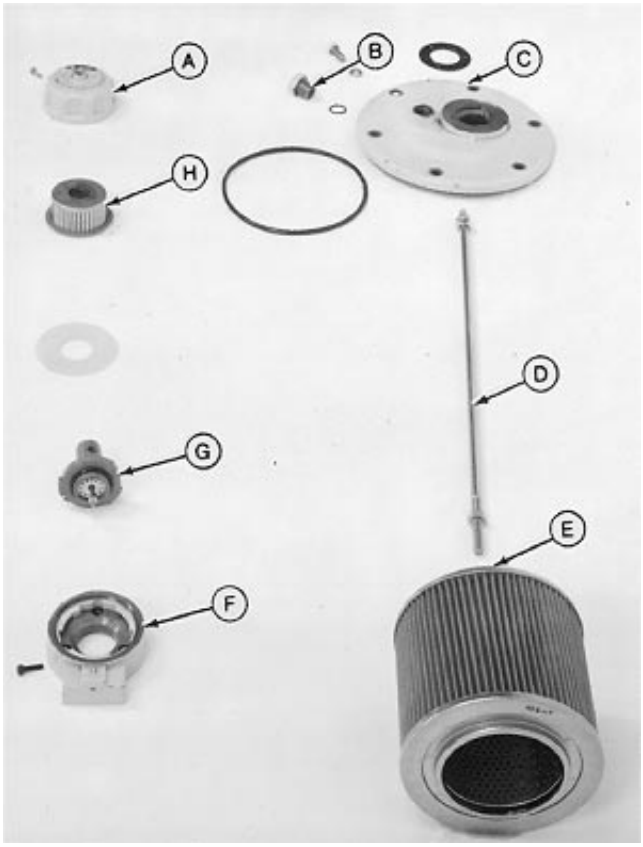
   Tighten cap screws.

**Cover-to-Hydraulic Oil Tank Cap Screw—Specification**

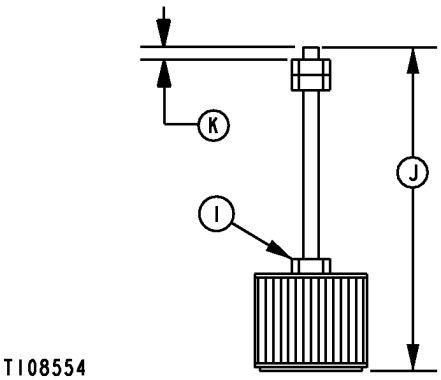
Torque ..... 49 N•m (36 lb-ft)

Install parts (A, B, and F—H).

8. Add hydraulic oil to tank until it is between marks on sight glass. (See Hydraulic Oil in Group 0004.)




T6557GL –UN–20OCT88




T108554

T108554 –UN–25MAR97

**A—Filler Cap**
**B—Vent Plug**
**C—Cover**
**D—Rod and Nuts**
**E—Suction Strainer**
**F—Housing**
**G—Relief Valve**
**H—Filter**
**I—Nut**
**J—702 mm (27.6 in.)**
**K—20 mm (0.79 in.)**

**Continued on next page**

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3360
136

**IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting. Procedure must be performed to fill pump housing whenever oil has been drained from the pump or hydraulic oil tank.**

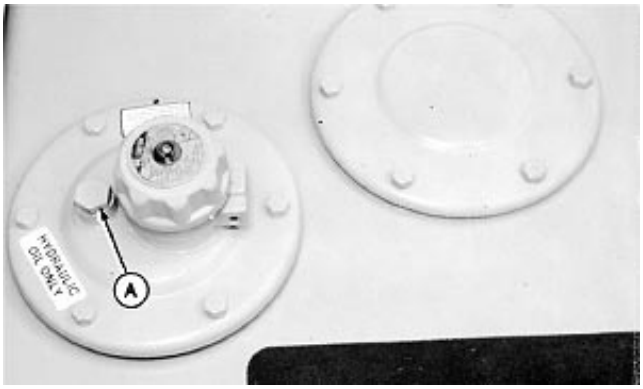
9. Do Hydraulic Pump Start-Up Procedure. (See procedure in this group.)

CED,OUOE026,6 –19–18JUN98–3/3

## DISASSEMBLE AND ASSEMBLE HYDRAULIC OIL TANK RELIEF VALVE AND BREATHER FILTER CAP

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure in hydraulic tank.




T7869AT –UN–12NOV92

**A—Vent Plug**

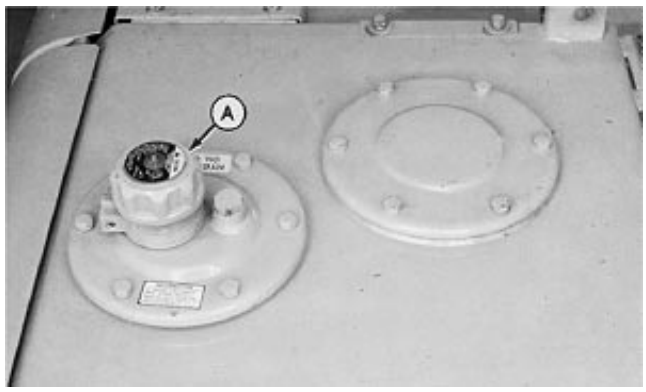
**Continued on next page**

TX,33,GG2571 –19–18MAR97–1/2

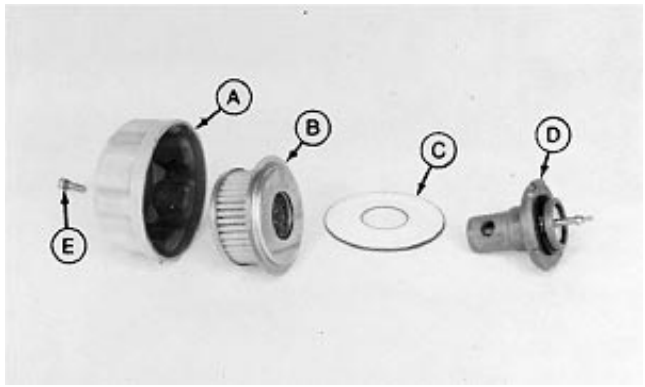
2. Insert a 4 mm hex key wrench in base and turn to release locking pin. Remove cap (A).

3. Remove cap screws (E). Remove parts (B—D).

   Replace parts as necessary.




T7995AN –UN–04MAY93




T7995AX –UN–04MAY93

**A—Cap**
**B—Breather Filter**
**C—Seal**
**D—Relief Valve**
**E—Cap Screw (3 used)**

TX,33,GG2571 –19–18MAR97–2/2

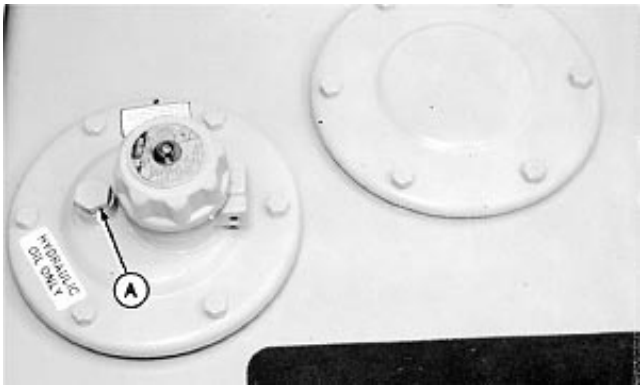
## REMOVE AND INSTALL RESTRICTION VALVE

33
3360
138

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.

2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE026,5 –19–18JUN98–1/2

3. Loosen T-bolt type hose clamps on coupling (C). Slide hose onto oil cooler-to-hydraulic oil tank line (A).
4. Repair or replace restriction valve (E) and snap ring (D).
5. Tighten T-bolt type hose clamps on coupling (C).

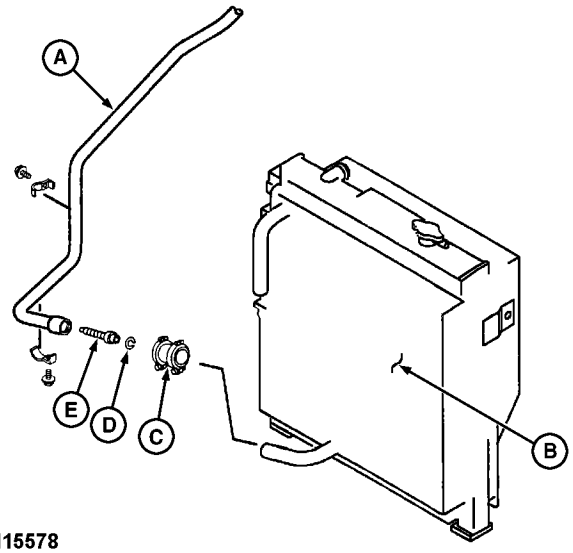
**Coupling T-Bolt Type Hose Clamp—Specification**

Torque ..... 4.4 N•m (40 lb-in.)

6. Check oil level in hydraulic oil tank. Add oil as necessary. (See Hydraulic Oil in Group 0004.)

**IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting. Procedure must be performed to fill pump housing whenever oil has been drained from the pump or hydraulic oil tank.**

7. Do Hydraulic Pump Start-Up Procedure. (See procedure in this group.)




T115578 —UN—01JUL98

T115578

**A—Oil Cooler-to-Hydraulic Oil Tank Line**
**B—Oil Cooler**
**C—Coupling**
**D—Snap Ring**
**E—Restriction Valve**

CED,OUOE026,5 –19–18JUN98–2/2

## REMOVE AND INSTALL OIL COOLER BYPASS VALVE

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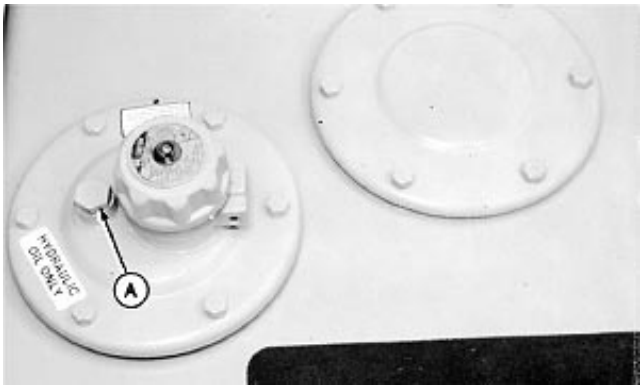
3360
140

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.

2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).




T7869AT –UN–12NOV92

**A—Vent Plug**

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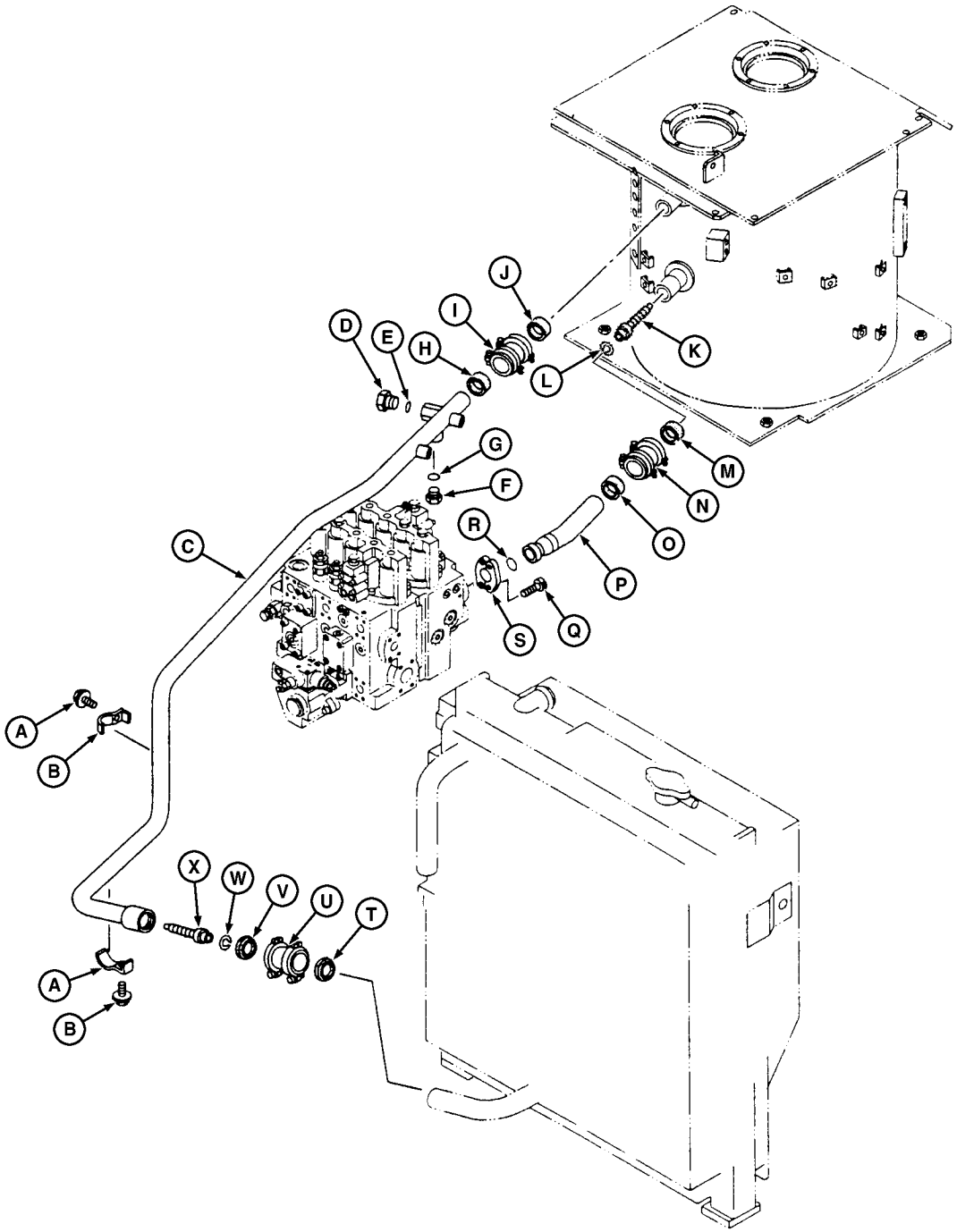
CED,OUOE027,268 –19–27MAY98–1/3




T115625

T115625 –UN–01JUL98

**A—Cap Screw (2 used)**
**B—Clamp (2 used)**
**C—Oil Cooler-to-Hydraulic Oil Tank Line**
**D—Plug**
**E—O-Ring**
**F—Plug**
**G—O-Ring**
**H—Seal**
**I—Coupling**
**J—Seal**
**K—Oil Cooler Valve**
**L—Snap Ring**
**M—Seal**
**N—Coupling**
**O—Seal**
**P—Control Valve-to-Hydraulic Oil Tank Line**
**Q—Cap Screw (4 used)**
**R—O-Ring**
**S—Split Flange (2 used)**
**T—Seal**
**U—Coupling**
**V—Seal**
**W—Snap Ring**
**X—Restriction Valve**

3. Loosen nuts on coupling (N). Slide coupling onto control valve-to-hydraulic oil tank line (P). Remove cap screws (Q) and split flanges (S) and remove line.

**Continued on next page**

CED,OUOE027,268 –19–27MAY98–2/3

4. Repair or replace oil cooler bypass valve (K).

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5. Tighten cap screws and nuts on coupling.

**Control Valve-to-Hydraulic Oil Tank Coupling Cap Screw and Nut—Specification**

Torque..... 11.4 N•m (100 lb-in.)

6. Check oil level in hydraulic oil tank. Add oil as necessary. (See Hydraulic Oil in Group 0004.)

**IMPORTANT: Hydraulic pump will be damaged if not filled with oil before starting. Procedure must be performed to fill pump housing whenever oil has been drained from the pump or hydraulic oil tank.**

7. Do Hydraulic Pump Start-Up Procedure. (See procedure in this group.)

CED,OUOE027,268 –19–27MAY98–3/3

## REMOVE AND INSTALL RADIATOR AND OIL COOLER

**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 completely.**

TS281 –UN–23AUG88

1. Drain coolant from radiator. Approximate capacity is 30 L (8 gal).

2. Drain hydraulic tank. Approximate capacity is 159 L (42 gal).

**Continued on next page**

CED,OUOE024,216 –19–18MAY98–1/3

3. Remove plug to drain hydraulic oil from oil cooler.
4. Remove radiator expansion tank. (See procedure in this group.)
5. Remove charge air cooler. (See procedure in Group 0520.)

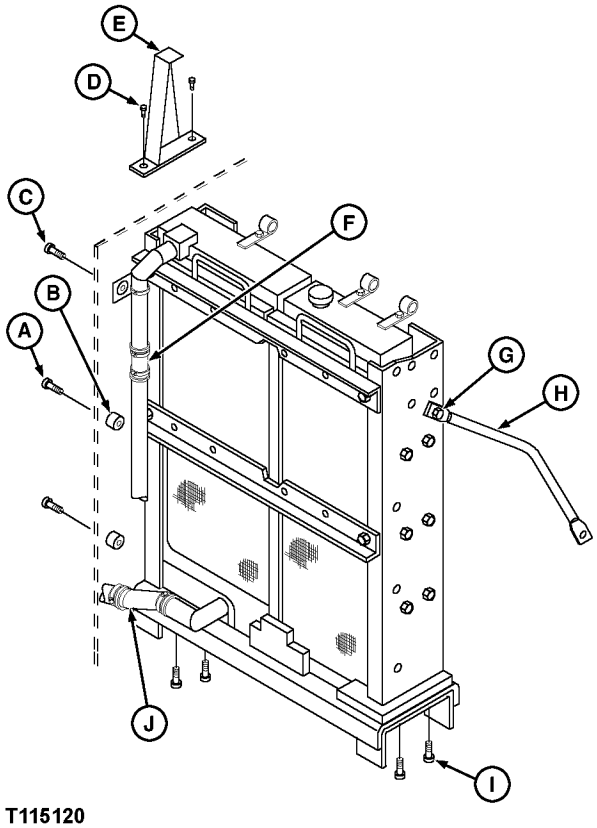
*NOTE: It is not necessary to evacuate the air conditioning system.*

6. Remove cap screws from air conditioning condenser. (See procedure in Group 1830).
7. Remove fan, shroud, and guards. (See procedure in this group.)
8. Loosen clamp and remove lower radiator hose.
9. Loosen clamps. Remove hoses (F and J).
10. Remove cap screws (D). Remove cover (E).
11. Remove cap screws (A, C, G, and I). Remove spacers (B).

**CAUTION: Use appropriate lifting device for heavy components.**

*NOTE: The radiator and oil cooler are removed as an assembly.*

12. Remove radiator and oil cooler assembly.
13. Disassemble oil cooler and radiator. (See procedure in this group.)
14. Repair or replace as necessary.
15. Assemble oil cooler and radiator. (See procedure in this group.)
16. Install radiator and oil cooler assembly.
17. Install spacers (B) and tighten cap screws (A, C, G, and I).




T115120

T115120 –UN–17JUN98

**A—Cap Screw (2 used)**
**B—Spacer (2 used)**
**C—Cap Screw**
**D—Cap Screw (2 used)**
**E—Cover**
**F—Upper Hose**
**G—Cap Screw**
**H—Support**
**I—Cap Screw (4 used)**
**J—Lower Hose**

**Continued on next page**

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18. Install cover (E). Tighten cap screws (D).
19. Install hoses (F and J). Tighten clamps.
20. Install lower radiator hose. Tighten clamp.
21. Install fan, shroud, and guards. (See procedure in this group).
22. Install air conditioning condenser. (See procedure in Group 1830.)
23. Install charge air cooler. (See procedure in Group 0520.)
24. Install radiator expansion tank. (See procedure in this group.)
25. Fill hydraulic tank. Approximate capacity is 159 L (42 gal).
26. Fill radiator and expansion tank with coolant. Approximate capacity is 30 L (8 gal).

CED,OUOE024,216 –19–18MAY98–3/3

## DISASSEMBLE AND ASSEMBLE RADIATOR AND OIL COOLER ASSEMBLY

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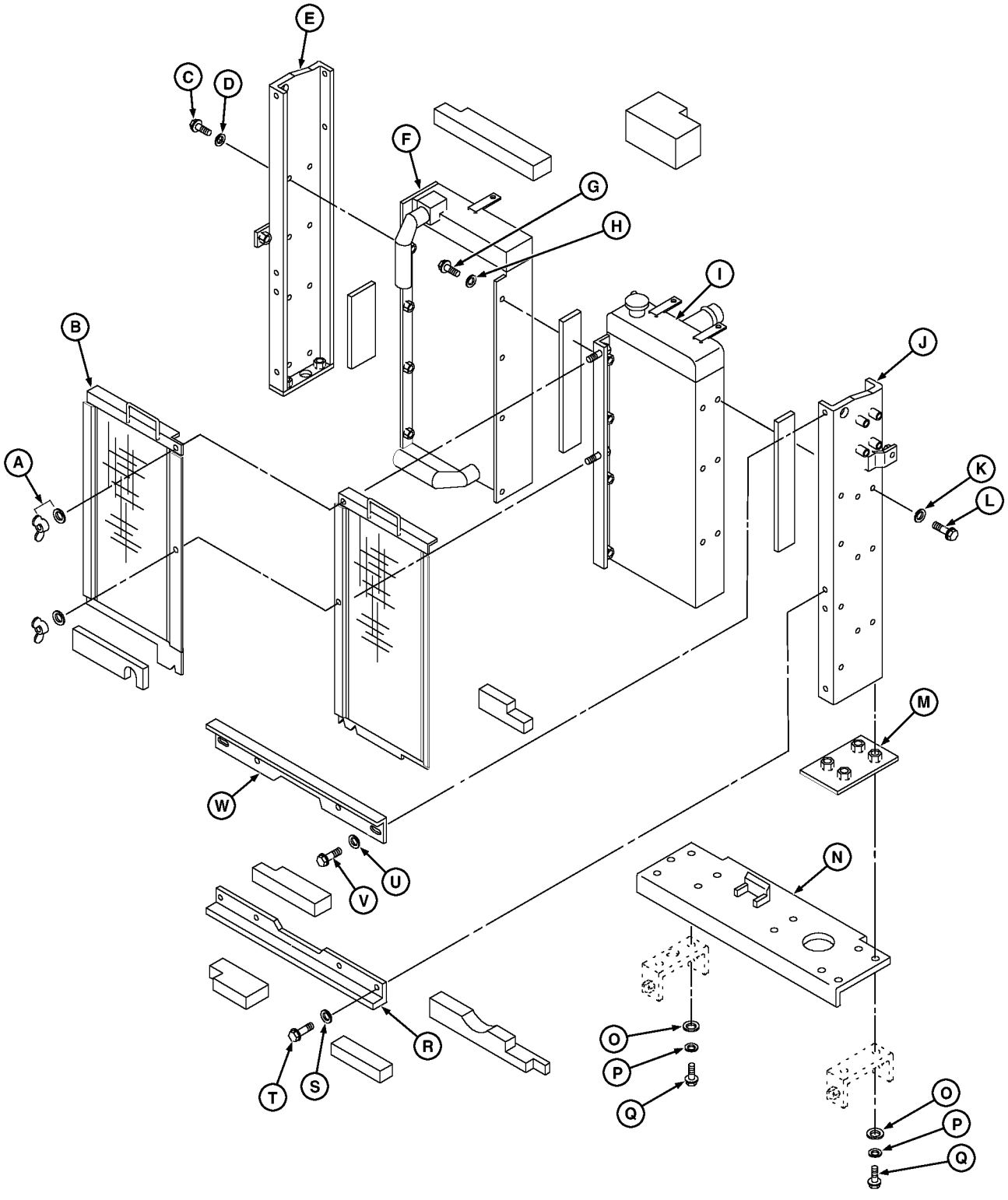


T115839

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CED,OUOE024,217 –19–19MAY98–1/2

**A—Wing Nut and Washer (2 used)**
**B—Radiator Screen (2 used)**
**C—Cap Screw (3 used)**
**D—Washer (3 used)**
**E—Forward Support**
**F—Oil Cooler**
**G—Cap Screw (4 used)**
**H—Washer (4 used)**
**I—Radiator**
**J—Rear Support**
**K—Washer (3 used)**
**L—Cap Screw (3 used)**
**M—Spacer**
**N—Lower Support**
**O—Lock Washer (4 used)**
**P—Washer (4 used)**
**Q—Cap Screw (4 used)**
**R—Bottom Bracket**
**S—Washer (2 used)**
**T—Cap Screw (2 used)**
**U—Washer (2 used)**
**V—Cap Screw (2 used)**
**W—Upper Bracket**



CED,OUOE024,217 –19–19MAY98–2/2

## REMOVE AND INSTALL BOOM CYLINDER CONTROLLED LOAD LOWERING VALVE

*NOTE: Procedure is similar for both left and right boom cylinder controlled load lowering valves; left boom cylinder controlled load lowering valve is shown.*

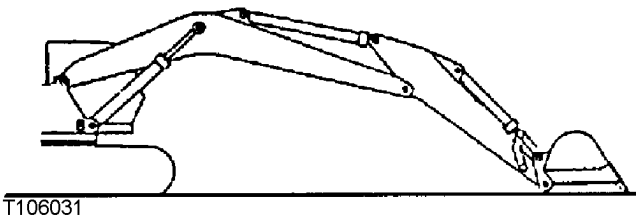
1. Park machine on a firm , level surface.

CED,OUOE020,33 –19–14MAR99–1/3

2. Retract arm and bucket cylinders. Lower boom so bucket is on ground.
3. Stop engine.

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

4. Loosen vent plug to release air pressure from hydraulic oil tank.




T106031 –UN–10JAN97

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CED,OUOE020,33 –19–14MAR99–2/3

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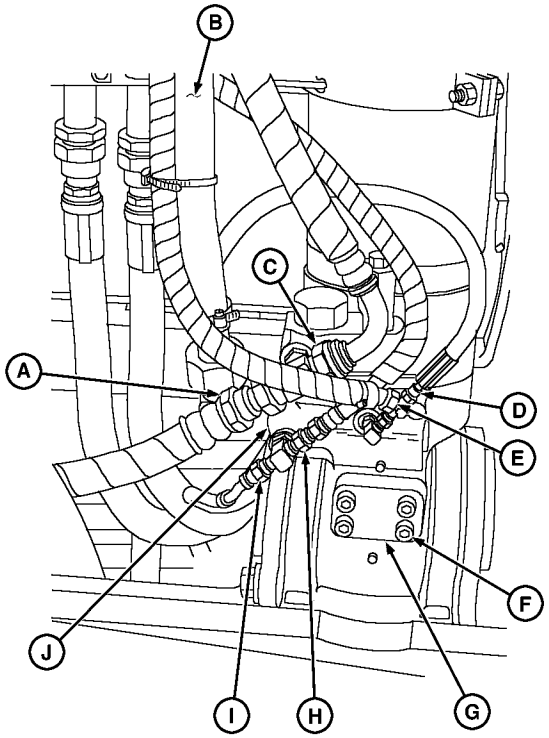
*NOTE: Hoses (E) and (G) are for left boom cylinder controlled load lowering valve only.*

5. Disconnect hoses (A, C, D, E, H and I)
6. Disconnect pipe (B).
7. Remove four cap screws (F), flange (G) and valve (J). Replace parts as necessary.




T120516 –UN–25MAR99

**T120516**

*Left Side Valve*

**A—Hose**
**B—Pipe**
**C—Hose**
**D—Hose**
**E—Hose (Left Side Only)**
**F—Cap Screw (4 used)**
**G—Flange**
**H—Hose**
**I—Hose (Left Side Only)**
**J—Valve**

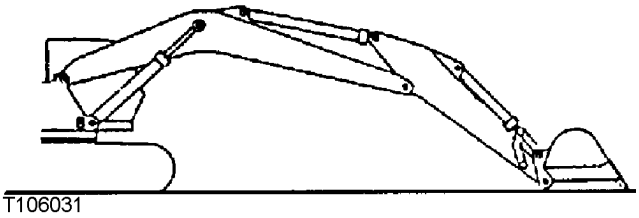
CED,OUOE020,33 –19–14MAR99–3/3

## REMOVE AND INSTALL BOOM CYLINDER



*NOTE: Procedure is the same for both left and right boom cylinders; right boom cylinder is shown.*

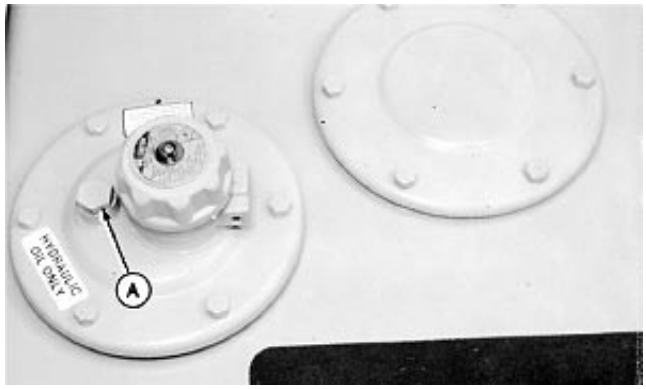
1. Park machine on a firm, level surface.
2. Retract arm and bucket cylinders. Lower boom so bucket is on ground.
3. Stop engine.




CED,OUOE026,9 –19–18JUN98–1/5

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

4. Loosen vent plug (A) to release air pressure from hydraulic oil tank.




**A—Vent Plug**

**Continued on next page**

CED,OUOE026,9 –19–18JUN98–2/5

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5. Disconnect lubricant line at rod end of cylinder.

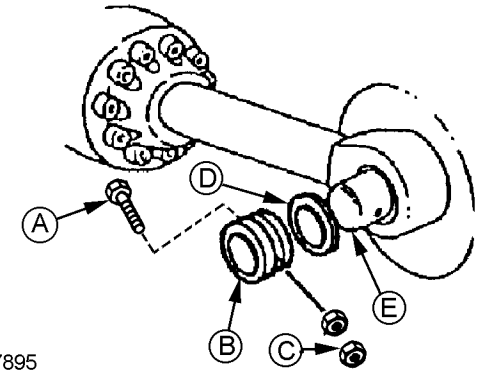
**CAUTION: The approximate weight of boom cylinder is 324 kg (714 lb).**

**Boom Cylinder—Specification**

Weight..... 324 kg (714 lb) approximate

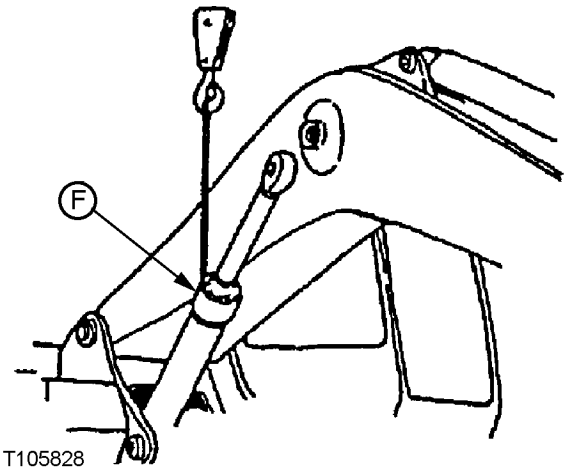
6. Connect boom cylinder (F) to hoist using a lifting strap.
7. Remove nuts (C), cap screw (A), retainer (B) and shims (D). Take notice of location of shim for assembly.
8. Push boom cylinder-to-boom pin (E) into boom.

   Lower boom cylinder (F) onto a floor stand.




T107895

T107895 –UN–10MAR97




T105828

T105828 –UN–30DEC96

**A—M20 Cap Screw**
**B—Retainer**
**C—M20 Nut (2 used)**
**D—Shim (Washer) (As Required)**
**E—Boom Cylinder-to-Boom Pin**
**F—Boom Cylinder**

**Continued on next page**

CED,OUOE026,9 –19–18JUN98–3/5

**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

9. Disconnect lines (G) from cylinder.
10. Take notice of washer (J) locations for assembly.

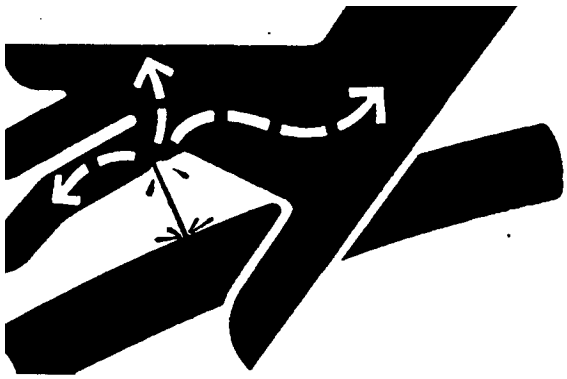
    Remove parts (H—K) to remove cylinder.
11. Repair or replace cylinder.
12. Install washers (J) equally on each side of cylinder head end to get minimum amount of clearance in joint.
13. Align pin bores so dust seals are not damaged as boom cylinder-to-frame pin (K) is installed.

    Tighten nuts (I) against each other, not the retainer. Cap screw (H) must be free to turn in hole.

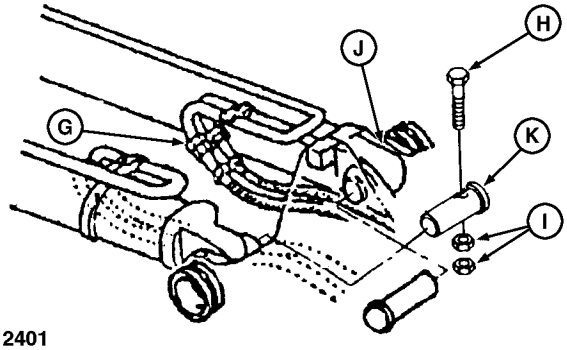
**Boom Cylinder-to-Frame Pin M20 Cap Screw Nut—Specification**

| | |
|---|---|
| Torque ..... | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |

14. Connect lines (G).



X9811 –UN–23AUG88




T112401

T112401 –UN–03DEC97

**G—Rod End-to-Boom Section Bottom Port Line —Head End-to-Boom Section Top Port Line**
**H—M20 Cap Screw**
**I—M20 Nut (2 used)**
**J—Washer (As Required)**
**K—Boom Cylinder-to-Frame Pin**

**Continued on next page**

CED,OUOE026,9 –19–18JUN98–4/5

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**IMPORTANT: Trapped air suddenly compressed in a cylinder is heated and ignites the oil used for assembly causing cap seal and ring damage. Start with cylinder rod retracted and the rod end filled with clean oil. Connect the cylinder head end and lines. Operate function to slowly extend rod. Procedure will eliminate most of the air and reduce the possibility of damage.**

15. Start the engine.

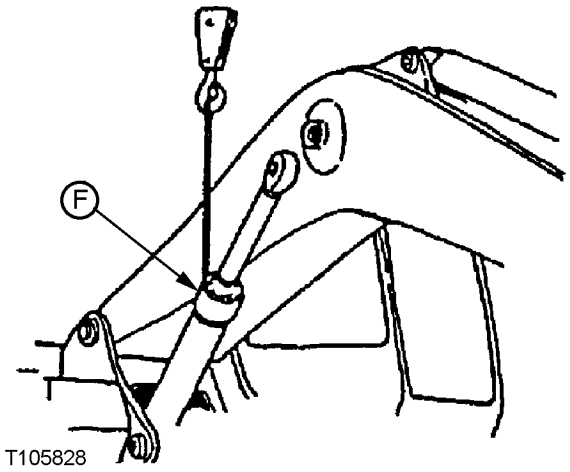
16. Slowly extend boom cylinder (F) to align pin bores so dust seals are not damaged as cylinder-to-boom pin (E) is installed.

17. Install shims (D) to get minimum amount of clearance between boom and cylinder rod end.

    Install retainer (B), cap screw (A) and nuts (C). Tighten nuts against each other, not the retainer. Cap screw must be free to turn in hole.

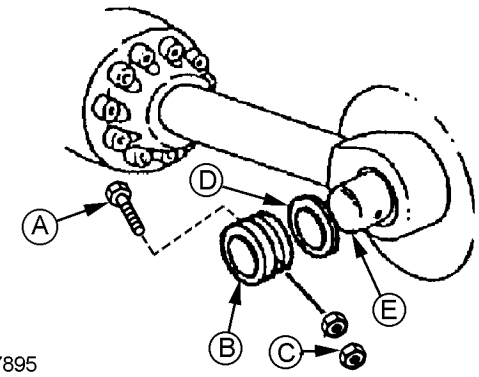
**Boom Cylinder-to-Boom Pin M20 Cap Screw Nut—Specification**

| | |
|---|---|
| Torque ..... | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |




T105828

T105828 –UN–30DEC96




T107895

T107895 –UN–10MAR97

**A—M20 Cap Screw**
**B—Retainer**
**C—M20 Nut (2 used)**
**D—Shim (As Required)**
**E—Boom Cylinder-to-Boom Pin**
**F—Boom Cylinder**

18. Connect lubricant line.

19. Lubricate all pivot joints. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in Group 0004.)

20. Bleed air from cylinder. (See procedure in this group.)

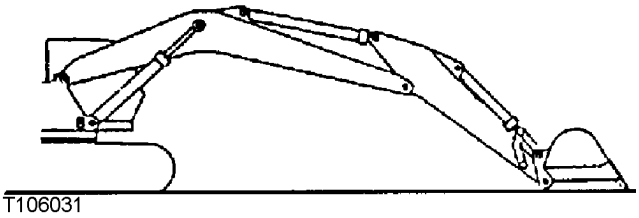
21. Check oil level in hydraulic oil tank. Add oil as necessary. (See Hydraulic Oil in Group 0004.)

CED,OUOE026,9 –19–18JUN98–5/5

## REMOVE AND INSTALL ARM CYLINDER



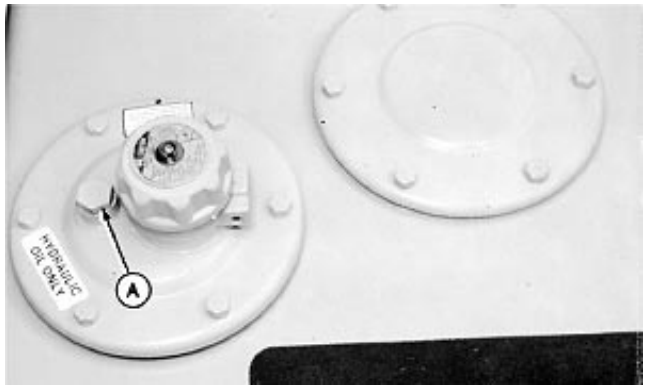
1. Park machine on a firm, level surface.
2. Retract arm and bucket cylinders. Lower boom so bucket is on ground.
3. Stop engine.




CED,OUOE026,10 –19–18JUN98–1/5

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

4. Loosen vent plug (A) to release air pressure from hydraulic oil tank.




**A—Vent Plug**

**Continued on next page**

CED,OUOE026,10 –19–18JUN98–2/5

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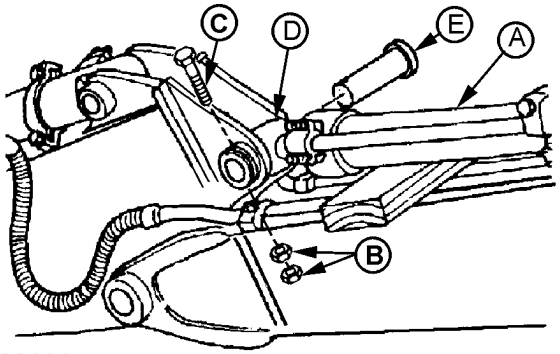
**CAUTION: The approximate weight of arm cylinder is 493 kg (1087 lb).**

**Arm Cylinder—Specification**

Weight..... 493 kg (1087 lb) approximate

5. Connect arm cylinder (A) to a hoist using lifting straps.
6. Remove nuts (B) and cap screw (C). Take notice of washer (D) locations for assembly.
7. Remove arm cylinder-to-arm pin (E).




T108491 –UN–24MAR97

**T108491**

**A—Arm Cylinder**
**B—M20 Nut (2 used)**
**C—M20 Cap Screw**
**D—Washer (As Required)**
**E—Arm Cylinder-to-Arm Pin**

**Continued on next page**

CED,OUOE026,10 –19–18JUN98–3/5

**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

8. Disconnect hydraulic lines (F) and lubricant line (G).

9. Remove parts (H—K) to remove arm cylinder (A). Take notice of location of washers (I) for assembly.

10. Repair or replace cylinder.

11. Install washers (I) equally on each side of cylinder head and rod ends to get minimum amount of clearance in joints.

12. Align pin bores so dust seals are not damaged as arm cylinder-to-boom pin (J) is installed.

    Install cap screw (H) and nuts (K). Tighten nuts against each other, not the retainer. Cap screw must be free to turn in hole.

**Arm Cylinder-to-Boom Pin M20 Cap Screw Nut—Specification**

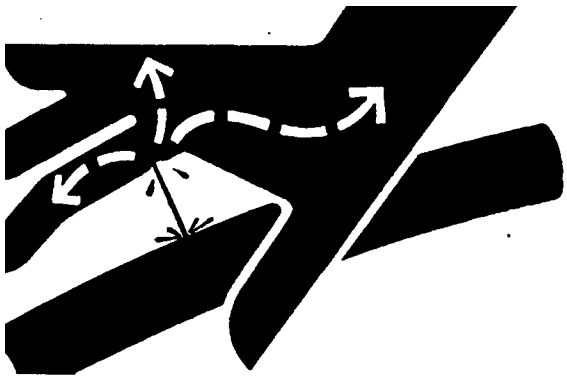
| | |
|---|---|
| Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |

13. Connect lubricant line (G) and hydraulic lines (F).

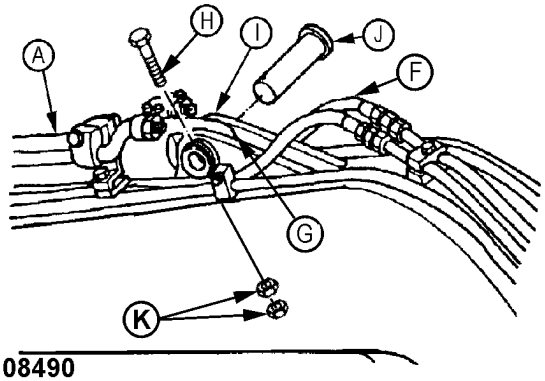
**IMPORTANT: Trapped air suddenly compressed in a cylinder is heated and ignites the oil used for assembly causing cap seal and ring damage. Start with cylinder rod retracted and the rod end filled with clean oil. Connect the cylinder head end and lines. Operate function to slowly extend rod. Procedure will eliminate most of the air and reduce the possibility of damage.**

14. Start engine.

    Slowly extend cylinder to align pin bores so dust seals are not damaged as arm cylinder-to-arm pin is installed.



X9811 –UN–23AUG88




T108490 –UN–24MAR97

T108490

**A—Arm Cylinder**
**F—Arm Cylinder Head End-to-Arm Section Bottom Port Line**
**—Arm Cylinder Rod End-to-Arm Section Top Port Line**
**G—Lubricant Line**
**H—M20 Cap Screw**
**I—Washer (As Required)**
**J—Arm Cylinder-to-Boom Pin**
**K—M20 Nut (2 used)**

**Continued on next page**

CED,OUOE026,10 –19–18JUN98–4/5

15. Install cap screw and nuts.

    Tighten the nuts against each other, not the retainer. Cap screw must be free to turn in hole.

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**Arm Cylinder-to-Arm Pin M20 Cap Screw Nut—Specification**

| | |
|---|---|
| Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |

16. Lubricate all pivot joints. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Grease in Group 0004.)

17. Bleed air from cylinder. (See procedure in this group.)

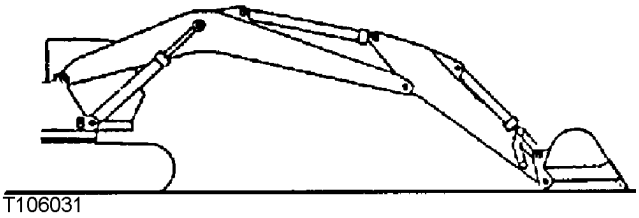
18. Check oil level in hydraulic oil tank. Add oil as necessary. (See Hydraulic Oil in Group 0004.)

CED,OUOE026,10 –19–18JUN98–5/5

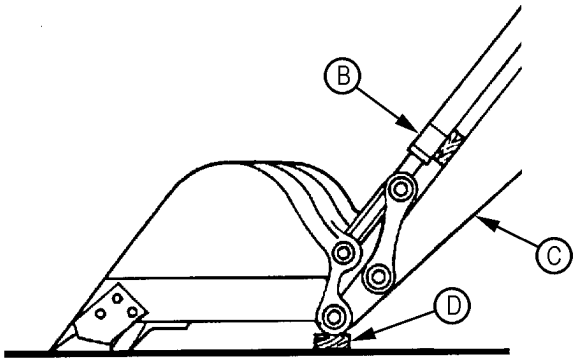
## REMOVE AND INSTALL BUCKET CYLINDER



1. Park machine on a firm, level surface.
2. Retract arm cylinder and bucket cylinder (B). Lower boom so bucket is on ground and end of arm (C) is on a wooden block (D).
3. Stop engine.




T106031 –UN–10JAN97



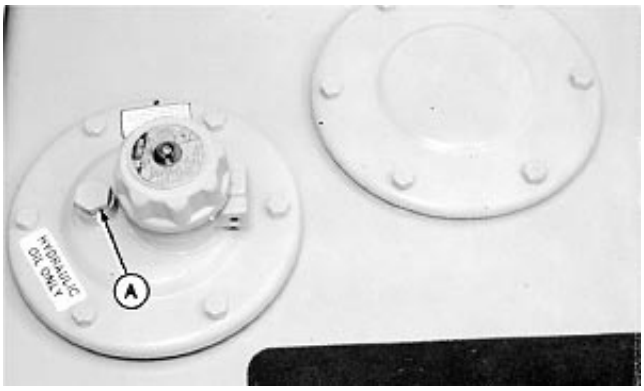

T106135 –UN–09JAN97

**B—Bucket Cylinder**
**C—Arm**
**D—Wooden Block**

CED,OUOE026,11 –19–18JUN98–1/5

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

4. Loosen vent plug (A) to release hydraulic pressure in reservoir.




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE026,11 –19–18JUN98–2/5

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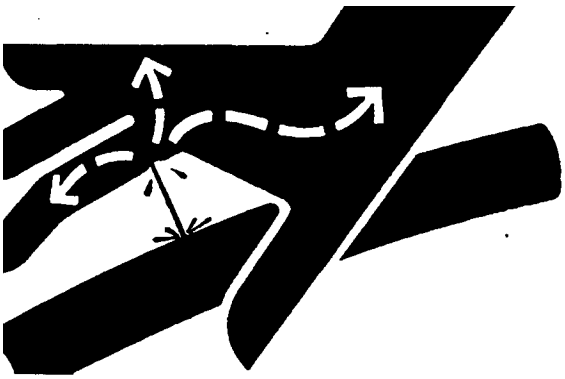
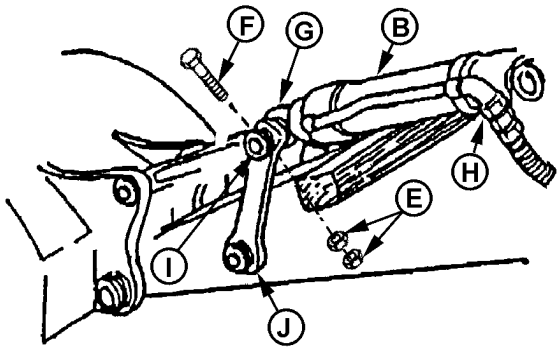
**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

5. Disconnect hydraulic lines (H).
6. Connect center link to a hoist using a lifting strap.
7. Put a wooden block between bucket cylinder and arm to hold cylinder up when side and center links-to-bucket cylinder pin (I) is removed.
8. Remove nuts (E) and cap screw (F).
9. As side and center links-to-bucket cylinder pin is removed, lower links to ground.

   Take notice of washer (G) locations for assembly.

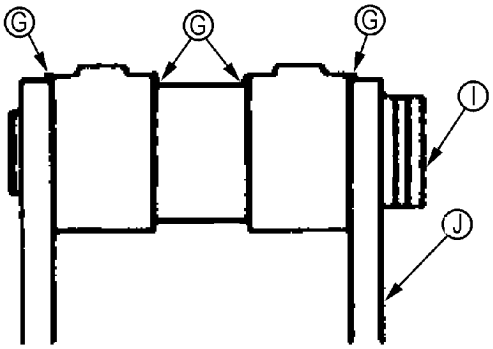


X9811 –UN–23AUG88




T108498

T108498 –UN–24MAR97




T106137

T106137 –UN–09JAN97

**B—Bucket Cylinder**
**E—M20 Nut (2 used)**
**F—M20 Cap Screw**
**G—Washer (As Required)**
**H—Bucket Cylinder Rod End-to-Bucket Section Top Port Line**
**—Bucket Cylinder Head End-to-Bucket Section Bottom Port Line**
**I—Side and Center Links-to-Bucket Cylinder Pin**
**J—Side Link**

**Continued on next page**

CED,OUOE026,11 –19–18JUN98–3/5

**CAUTION: The approximate weight of bucket cylinder is 261 kg (575 lb).**

**Bucket Cylinder—Specification**

Weight..... 261 kg (575 lb) approximate

10. Connect bucket cylinder (B) to hoist using a lifting strap.
11. Remove nuts (K) and cap screw (L).
12. Take notice of washer (M) locations for assembly.

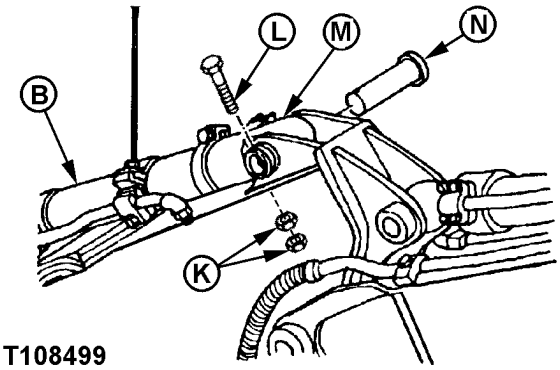
    Remove bucket cylinder-to-arm pin (N). Remove cylinder.
13. Repair or replace cylinder.
14. Install washers equally on each side of bucket cylinder head end to get minimum amount of clearance in joint.
15. Align pin bores so dust seals are not damaged as bucket cylinder-to-arm pin is installed.

    Install cap screw and nuts. Tighten nuts against each other, not the retainer. Cap screw must be free to turn in hole.

**Bucket Cylinder-to-Arm Pin M20 Cap Screw—Specification**

Torque ..... 540 N•m (400 lb-ft) tighten nut against nut, not the retainer

16. Connect hydraulic lines.




T108499

T108499 –UN–24MAR97

**B—Bucket Cylinder**
**K—M20 Nut (2 used)**
**L—M20 Cap Screw**
**M—Washer (As Required)**
**N—Bucket Cylinder-to-Arm Pin**

**Continued on next page**

33
3360
160

**IMPORTANT: Trapped air suddenly compressed in a cylinder is heated and ignites the oil used for assembly causing cap seal and ring damage. Start with cylinder rod retracted and the rod end filled with clean oil. Connect the cylinder head end and lines. Operate function to slowly extend rod. Procedure will eliminate most of the air and reduce the possibility of damage.**

17. Start engine.

    Slowly extend bucket cylinder (B) to align pin bores so dust seals are not damaged as bucket cylinder-to-side and center links pin (I) is installed.

18. Install washers (G) equally on each side of cylinder rod end and side links to get minimum amount of clearance in joint.

    Install cap screw (F) and nuts (E). Tighten the nuts against each other, not the retainer. Cap screw must be free to turn in hole.

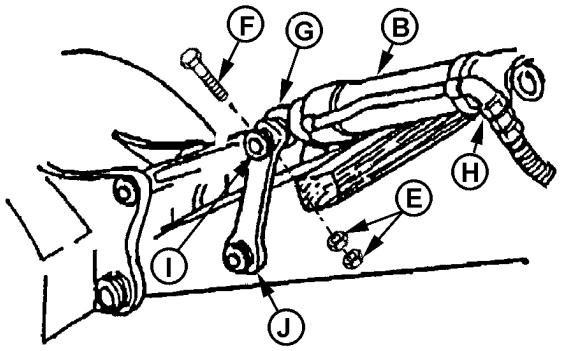
**Bucket Cylinder-to-Link Pin M20 Cap Screw Nut—Specification**

| | |
|---|---|
| Torque | 540 N•m (400 lb-ft) tighten nut against nut, not the retainer |

19. Lubricate all pivot joints. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in Group 0004.)

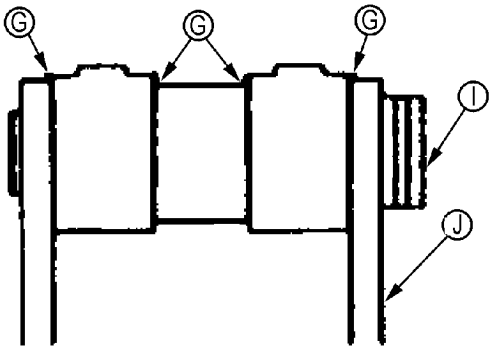
20. Bleed air from cylinder. (See procedure in this group.)

21. Check oil level in hydraulic oil tank. Add oil as necessary. (See Hydraulic Oil in Group 0004.)




T108498

T108498 –UN–24MAR97




T106137

T106137 –UN–09JAN97

**B—Bucket Cylinder**
**E—M20 Nut (2 used)**
**F—M20 Cap Screw**
**G—Washer (As Required)**
**H—Bucket Cylinder Rod End-to-Bucket Section Top Port Line**
**—Bucket Cylinder Head End-to-Bucket Section Bottom Port Line**
**I—Side and Center Links-to-Bucket Cylinder Pin**
**J—Side Link**

CED,OUOE026,11 –19–18JUN98–5/5

## HYDRAULIC CYLINDER BLEED PROCEDURE



**IMPORTANT: Trapped air suddenly compressed in a cylinder is heated and ignites the oil used for assembly causing cap seal and ring damage. Start with cylinder rod retracted and the rod end filled with clean oil. Connect the cylinder head end and lines. Operate function to slowly extend rod. Procedure will eliminate most of the air and reduce the possibility of damage.**

*NOTE: Bleed air at initial start-up, whenever major repairs or maintenance (oil change) is done on hydraulic system, or when machine has been in storage for a period of time.*

1. Run engine at slow idle.
2. Slowly operate function to move cylinder to the most horizontal position possible.
3. Slowly extend and retract cylinder several times to approximately 100 mm (4 in.) from end of stroke.
4. Operate cylinder several times to full stroke.

TX,33,GG2374 –19–23JUL98–1/1

## DISASSEMBLE BOOM, ARM OR BUCKET CYLINDER

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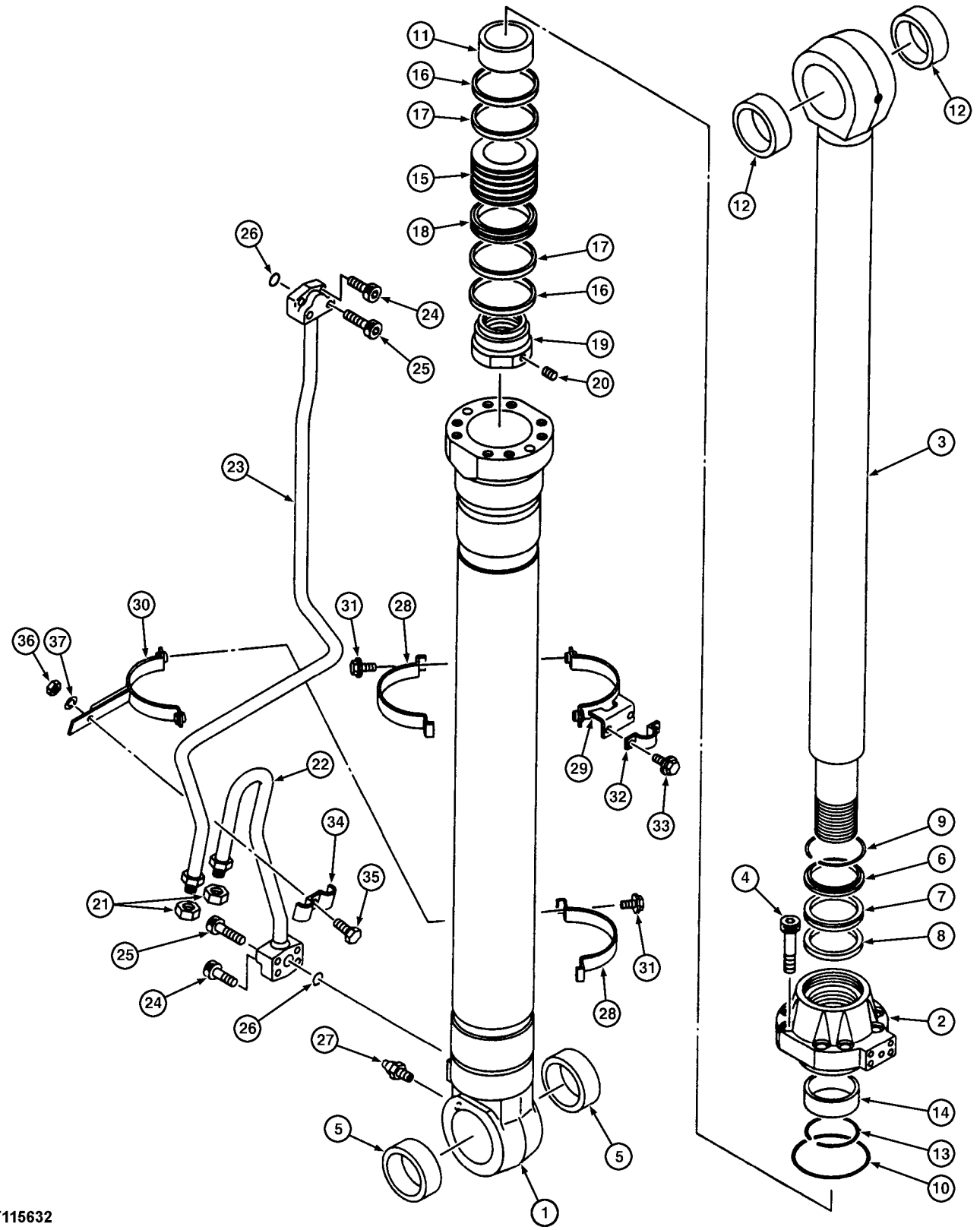


*Right Boom Cylinder*

T115632 –UN–01JUL98

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–1/18

*Hydraulic System*

**1—Barrel**
**2—Rod Guide**
**3—Rod**
**4—Cap Screw (9 used)**
**5—Bushing**
**6—Wiper Seal**
**7—Backup Ring and U-Cup Seal**
**8—Step Ring**
**9—Snap Ring**
**10—O-Ring**
**11—Cushion Ring**
**12—Bushing**
**13—Snap Ring**
**14—Wear Ring**
**15—Piston**
**16—Ring**
**17—Wear Ring**
**18—Seal (O-Ring, Cap Seal and Backup Rings)**
**19—Nut**
**20—Set Screw**
**21—Cap (2 used)**
**22—Line**
**23—Line**
**24—Cap Screw**
**25—Cap Screw**
**26—O-Ring**
**27—Grease Fitting**
**28—Clamp**
**29—Clamp**
**30—Clamp**
**31—Cap Screw**
**32—Pipe, Clamp**
**33—Cap Screw**
**34—Pipe, Clamp**
**35—Cap Screw**
**36—Nut**
**37—Lock Washer**

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**Continued on next page**

CED,OUOE026,4 –19–18JUN98–2/18

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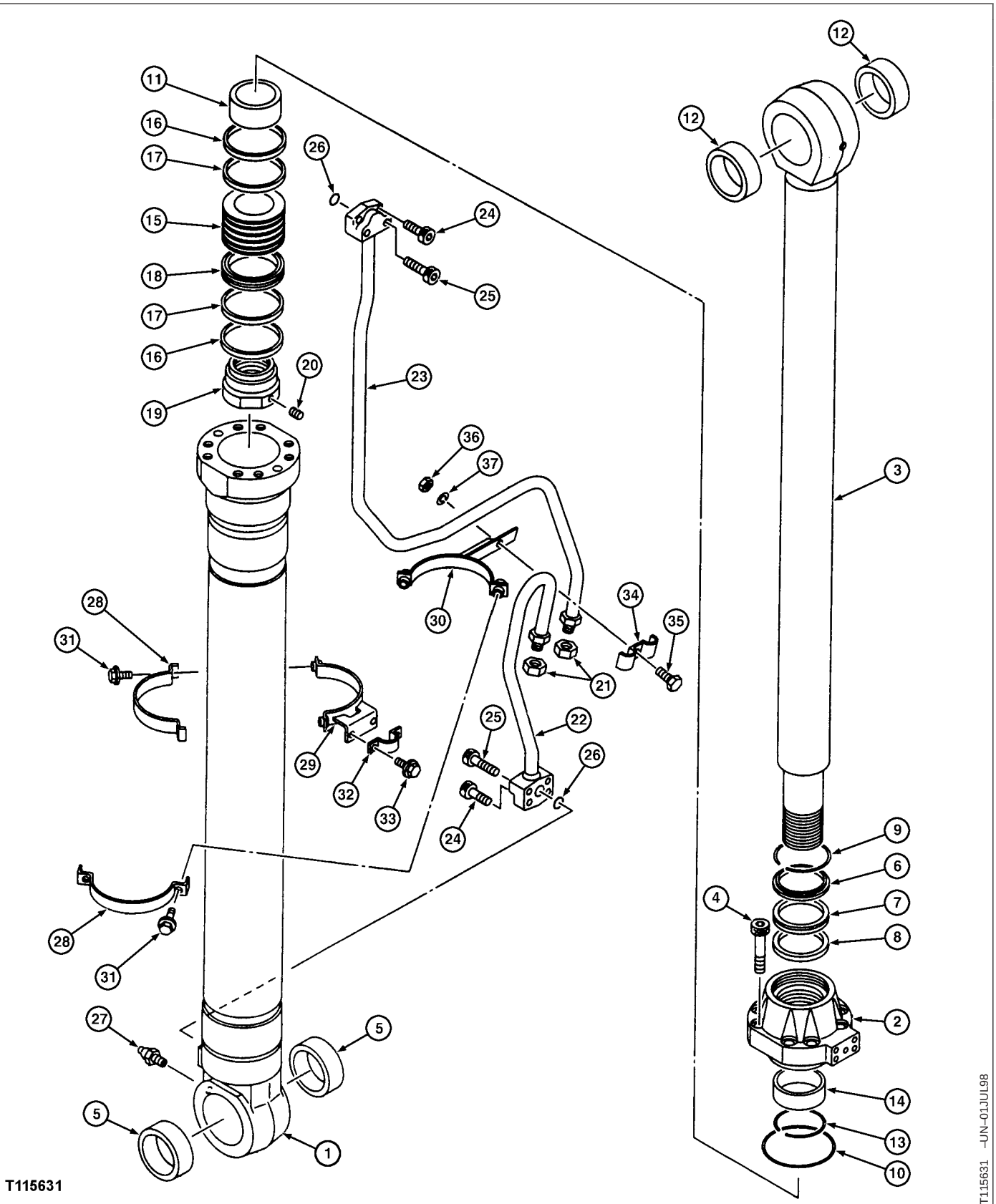


*Left Boom Cylinder*

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CED,OUOE026,4 –19–18JUN98–3/18

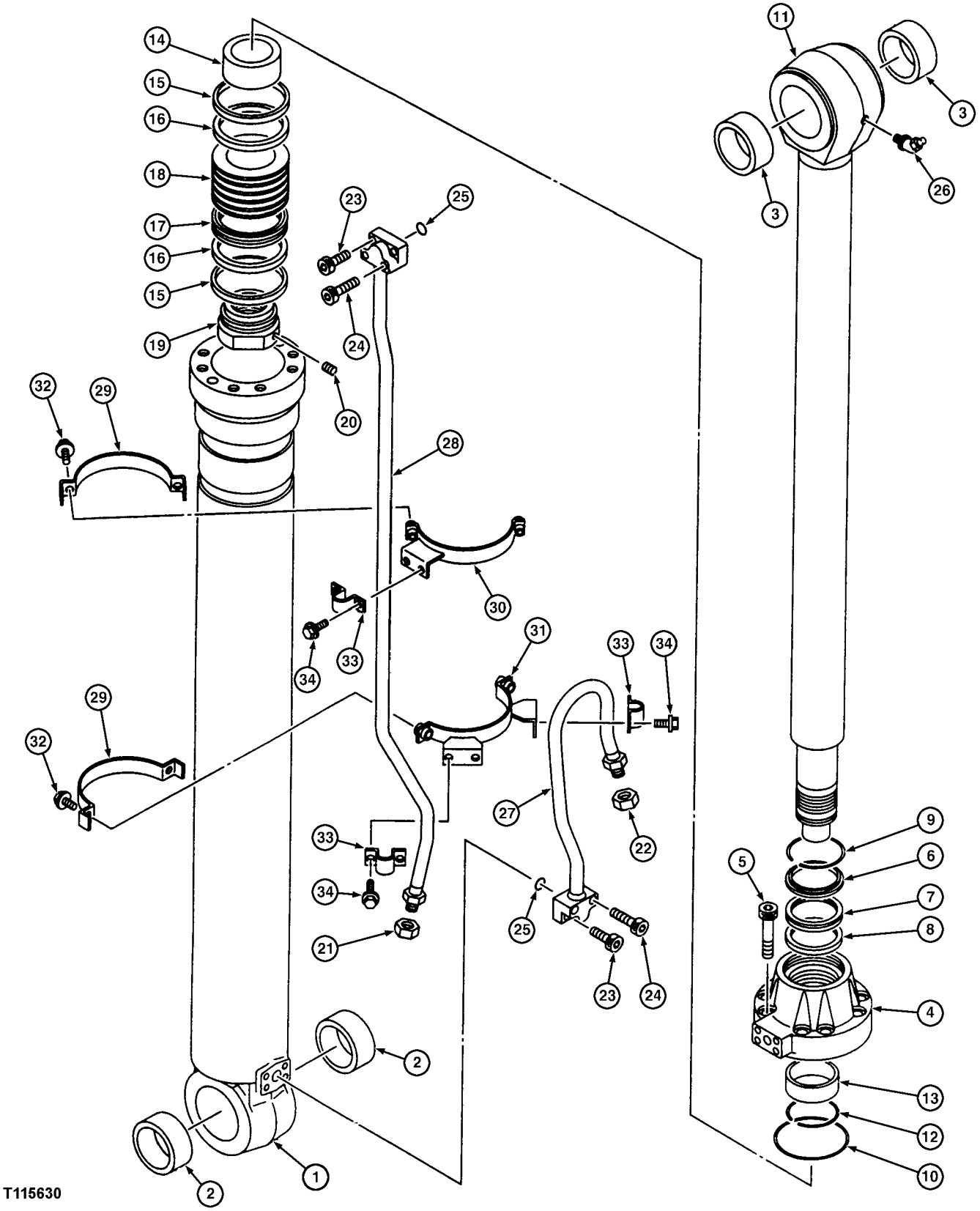
*Hydraulic System*



**1—Barrel**
**2—Rod Guide**
**3—Rod**
**4—Cap Screw (9 used)**
**5—Bushing**
**6—Wiper Seal**
**7—Backup Ring and U-Cup Seal**
**8—Step Ring**
**9—Snap Ring**
**10—O-Ring**
**11—Cushion Ring**
**12—Bushing**
**13—Snap Ring**
**14—Wear Ring**
**15—Piston**
**16—Ring**
**17—Wear Ring**
**18—Seal (Expander Ring, Cap Seal and Backup Rings)**
**19—Nut**
**20—Set Screw**
**21—Cap (2 used)**
**22—Line**
**23—Line**
**24—Cap Screw**
**25—Cap Screw**
**26—O-Ring**
**27—Grease Fitting**
**28—Clamp**
**29—Clamp**
**30—Clamp**
**31—Cap Screw**
**32—Pipe, Clamp**
**33—Cap Screw**
**34—Pipe, Clamp**
**35—Cap Screw**
**36—Nut**
**37—Lock Washer**

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–4/18




*Arm Cylinder*

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–5/18

*Hydraulic System*

**1—Barrel**
**2—Bushing**
**3—Bushing**
**4—Rod Guide**
**5—Cap Screw (8 used)**
**6—Wiper Seal**
**7—Backup Ring and U-Cup Seal**
**8—Step Ring**
**9—Snap Ring**
**10—O-Ring**
**11—Rod**
**12—Snap Ring**
**13—Wear Ring**
**14—Cushion Ring**
**15—Ring**
**16—Wear Ring**
**17—Seal (Expander Ring, Cap Seal and Backup Rings)**
**18—Piston**
**19—Nut**
**20—Set Screw**
**21—Cap**
**22—Cap**
**23—Cap Screw**
**24—Cap Screw**
**25—O-Ring**
**26—Grease Fitting**
**27—Line**
**28—Line**
**29—Clamp**
**30—Clamp**
**31—Clamp**
**32—Cap Screw**
**33—Pipe, Clamp**
**34—Cap Screw**

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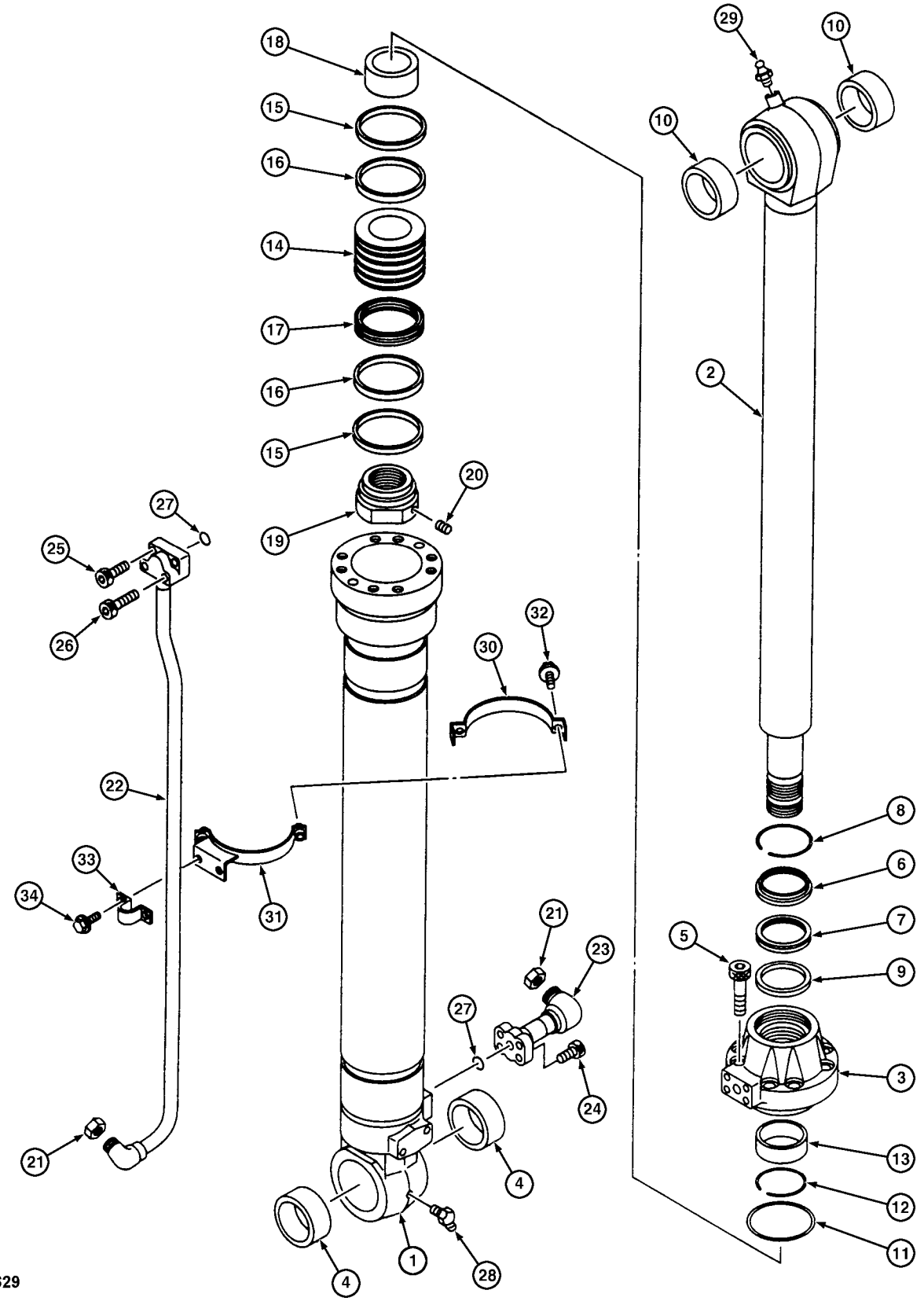
**Continued on next page**

CED,OUOE026,4 –19–18JUN98–6/18




*Bucket Cylinder*

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–7/18

*Hydraulic System*

**1—Barrel**
**2—Rod**
**3—Rod Guide**
**4—Bushing**
**5—Cap Screw (8 used)**
**6—Wiper Seal**
**7—Seal**
**8—Snap Ring**
**9—Ring**
**10—Bushing**
**11—O-Ring**
**12—Snap Ring**
**13—Wear Ring**
**14—Piston**
**15—Ring**
**16—Ring Wear**
**17—Seal Ring (Expander Ring, Cap Seal and Backup Rings)**
**18—Cushion Seal**
**19—Nut**
**20—Set Screw**
**21—Cap**
**22—Line**
**23—Line**
**24—Cap Screw**
**25—Cap Screw**
**26—Cap Screw**
**27—O-Ring**
**28—Grease Fitting**
**29—Grease Fitting**
**30—Clamp**
**31—Clamp**
**32—Cap Screw**
**33—Pipe, Clamp**
**34—Cap Screw**

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**Continued on next page**

CED,OUOE026,4 –19–18JUN98–8/18

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**CAUTION: The approximate weight of boom cylinder is 324 kg (714 lb).**

**The approximate weight of arm cylinder is 493 kg (1087 lb).**

**The approximate weight of bucket cylinder is 261 kg (575 lb).**

**Boom Cylinder—Specification**

Weight..... 324 kg (714 lb) approximate

**Arm Cylinder:—Specification**

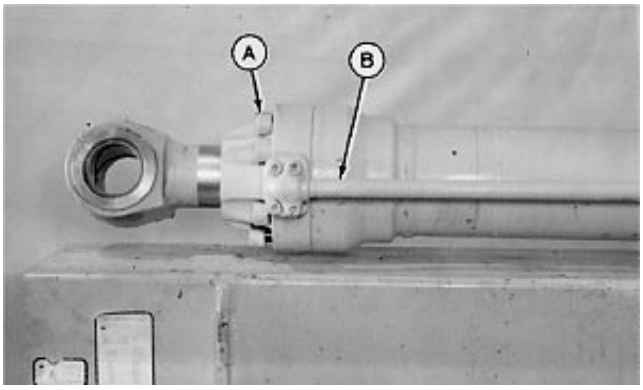
Weight..... 493 kg (1087 lb) approximate

**Bucket Cylinder—Specification**

Weight..... 261 kg (575 lb) approximate

*NOTE: Disassemble procedure is the same for all cylinders except as noted. Disassemble of cylinder is shown using the JT30043 Cylinder Service Stand.*

1. Fasten head end of cylinder to cylinder service stand.
2. Remove line (B).
3. Pull rod out so piston is against rod guide.
4. Connect rod to a hoist using a lifting strap.
5. Remove cap screws (A).
6. Pull rod, rod guide, and piston from barrel.



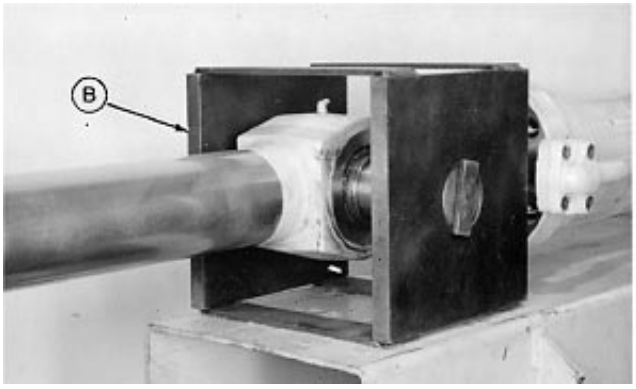

T6557HI –UN–27OCT88

**A—Cap Screw**
**B—Hydraulic Line**

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–9/18

7. Install rod eye in sliding housing (B). Install housing in cylinder service stand.

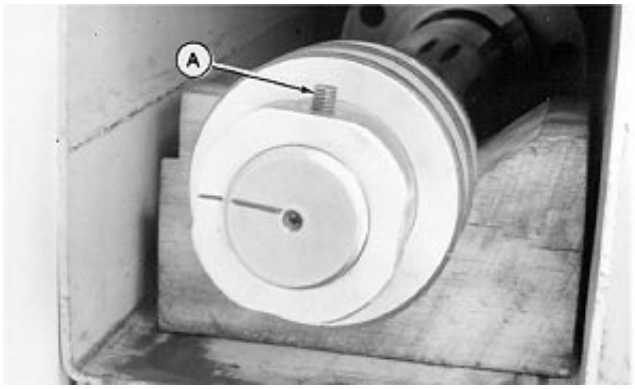



T6557HK –UN–27OCT88

**B—Sliding Housing and Stand Assembly**

CED,OUOE026,4 –19–18JUN98–10/18

8. Remove set screw (A).




T6557HL –UN–27OCT88

**A—Set Screw**

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–11/18

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172

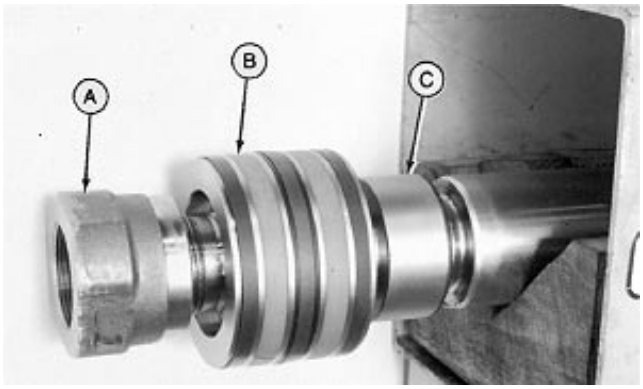
9. Loosen nut (A) using JT05794 Wrench and Adapter Plate.


T6557HM –UN–27OCT88

CED,OUOE026,4 –19–18JUN98–12/18

10. Take notice that radius on cushion ring is toward the shoulder on the rod.

    Remove nut (A), piston (B), and cushion ring (C) from rod.




T6557HN –UN–27OCT88

**A—Nut**
**B—Piston**
**C—Cushion Ring**

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–13/18

11. Remove parts (A—C).

    Measure width of ring (A).

**Boom Ring—Specification**

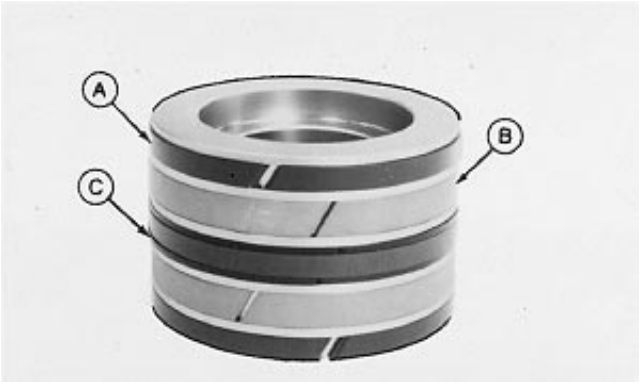
Width..... 9.60—9.80 mm (0.377—0.386 in.) nominal
Width..... 9.55 mm (0.376 in.) limit of use

**Bucket Ring—Specification**

Width..... 9.60—9.80 mm (0.377—0.386 in.) nominal
Width..... 9.55 mm (0.376 in.) limit of use

**Arm Ring—Specification**

Width..... 9.60—9.80 mm (0.377—0.386 in.) nominal
Width..... 9.55 mm (0.376 in.) limit of use




T6557HV –UN–27OCT88

**A—Ring (2 used)**
**B—Wear Ring (2 used)**
**C—Seal (O-Ring, Cap Seal and Backup Rings)**

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–14/18

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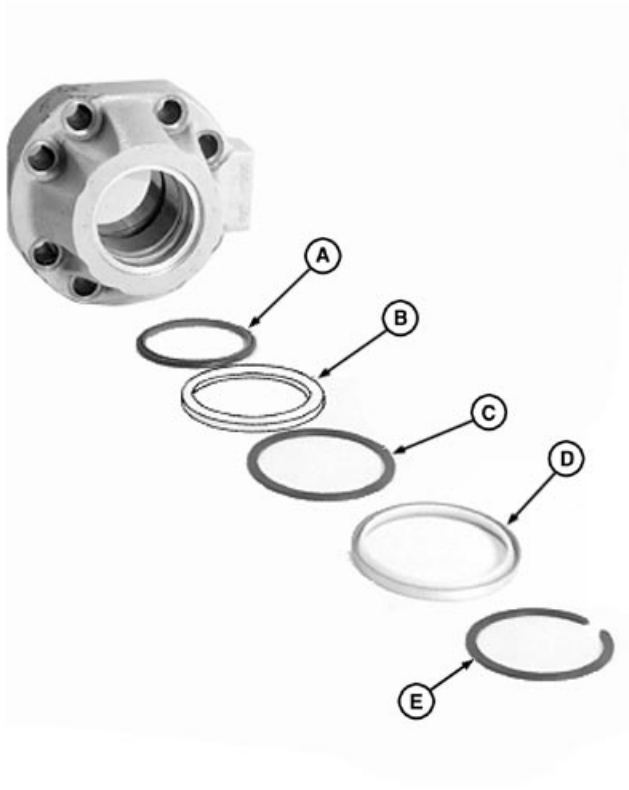
12. Remove rod guide from rod.
13. Remove parts (A—E).



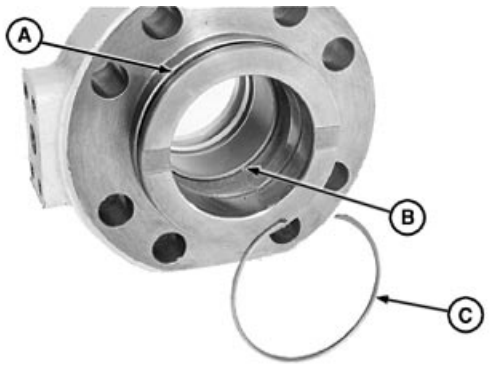

T117041 –UN–09SEP98

**A—Step Ring**
**B—U-Cup Seal**
**C—Backup Ring**
**D—Wiper Seal**
**E—Snap Ring**

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–15/18

14. Remove O-ring (A).
15. Remove snap ring (C).
16. Remove bushing (B).




T117042 –UN–09SEP98

*Wear Ring, O-Ring and Snap Ring*

**A—O-Ring**
**B—Bushing**
**C—Snap Ring**

CED,OUOE026,4 –19–18JUN98–16/18

17. Inspect dust seals (A) and bushing (B) for wear or damage, replace as necessary. (See Remove and Install Bushing and Seals in Group 3340.)

**Boom Cylinder Rod End Bushing—Specification**

ID ..... 110 mm (4.33 in.) nominal
ID ..... 111.5 mm (4.40 in.) limit of use

**Boom Cylinder Head End Bushing—Specification**

ID ..... 110 mm (4.33 in.) nominal
ID ..... 111.5 mm (4.40 in.) limit of use

**Bucket Cylinder Head End Bushing—Specification**

ID ..... 90 mm (3.54 in.) nominal
ID ..... 91.5 mm (3.60 in.) limit of use

**Bucket Cylinder Rod End Bushing—Specification**

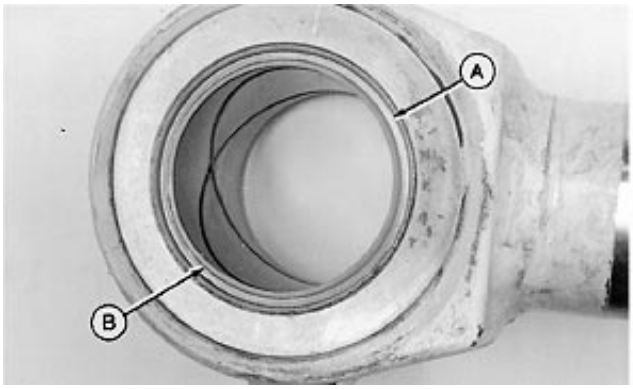
ID ..... 100 mm (3.94 in.) nominal
ID ..... 101.5 mm (4.00 in.) limit of use

**Arm Cylinder Rod End Bushing—Specification**

ID ..... 110 mm (4.33 in.) nominal
ID ..... 111.5 mm (4.40 in.) limit of use

**Arm Cylinder Head End Bushing—Specification**

ID ..... 110 mm (4.33 in.) nominal
ID ..... 111.5 mm (4.40 in.) limit of use




T6557HR –UN–27OCT88

**A—Dust Seals**
**B—Bushing**

**Continued on next page**

CED,OUOE026,4 –19–18JUN98–17/18

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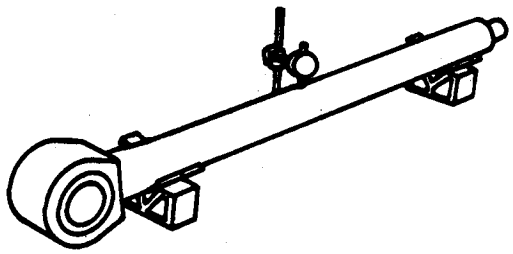
18. Check for rod curvature.

    Put rod on V-blocks. Measure for rod curvature using a dial indicator.

19. Inspect rod surface for scratches or wear.



T6585XG –UN–27OCT88

**Boom Rod—Specification**

Curvature ..... 0.5 mm per 1 m (0.020 in. per 3.25 ft)

**Boom Rod Allowable Scratch—Specification**

Depth ..... 0.1 mm (0.004 in.) (enough to detect by a fingernail)

**Boom Rod—Specification**

OD ..... 105.0 + 0.036 - 0.090 mm (4.1339 + 0.0014 - 0.0035 in.)

**Arm Rod—Specification**

Curvature ..... 0.5 mm per 1 m (0.020 in. per 3.25 ft)

**Arm Rod Allowable Scratch—Specification**

Depth ..... 0.1 mm (0.004 in.) (enough to detect by a fingernail)

**Arm Rod—Specification**

OD ..... 115.0 + 0.036 - 0.090 mm (4.5276 + 0.0014 - 0.0035 in.)

**Bucket Rod—Specification**

Curvature ..... 0.5 mm per 1 m (0.020 in. per 3.25 ft)

**Bucket Rod Allowable Scratch—Specification**

Depth ..... 0.1 mm (0.004 in.) (enough to detect by a fingernail)

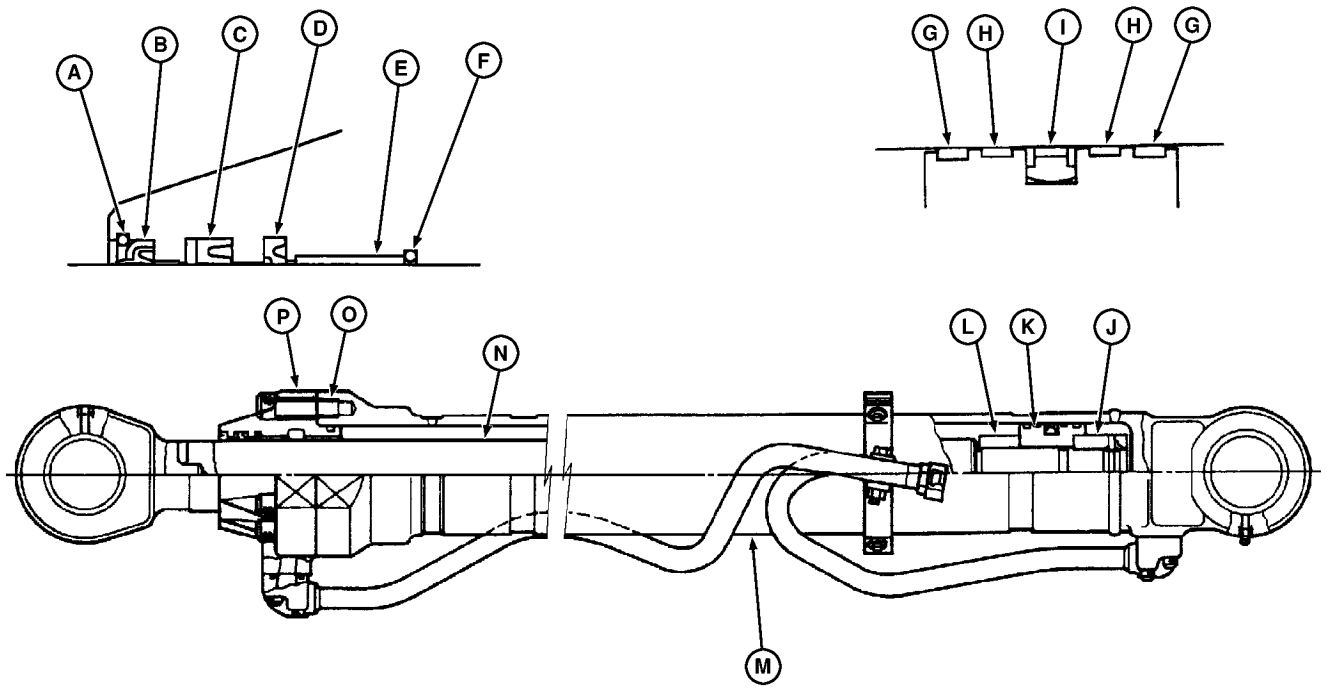
**Bucket Rod—Specification**

OD ..... 95.0 + 0.036 - 0.090 mm (3.7402 + 0.0014 - 0.0035 in.)

CED,OUOE026,4 –19–18JUN98–18/18

## ASSEMBLE BOOM, ARM OR BUCKET CYLINDER






T117057

T117057 –UN–09SEP98

*Bucket Cylinder*

**A—Snap Ring**
**B—Wiper Seal**
**C—Backup Ring and U-Cup Seal**
**D—Step Ring**
**E—Wear Ring**
**F—Snap Ring**
**G—Ring (2 used)**
**H—Wear Ring (2 used)**
**I—Seal (O-Ring, Cap Seal, and Backup Rings)**
**J—Nut**
**K—Piston**
**L—Cushion Ring**
**M—Barrel**
**N—Rod**
**O—Cap Screw (8 used)**
**P—Rod Guide**

*NOTE: Use a cylinder repair kit when assembling a rebuildable cylinder.*

1. Install bushings and dust seals in rod and head ends of cylinders. (See Remove and Install Bushings and Seals in Group 3340.)

**Continued on next page**

CED,OUOE026,12 –19–19JUN98–1/10

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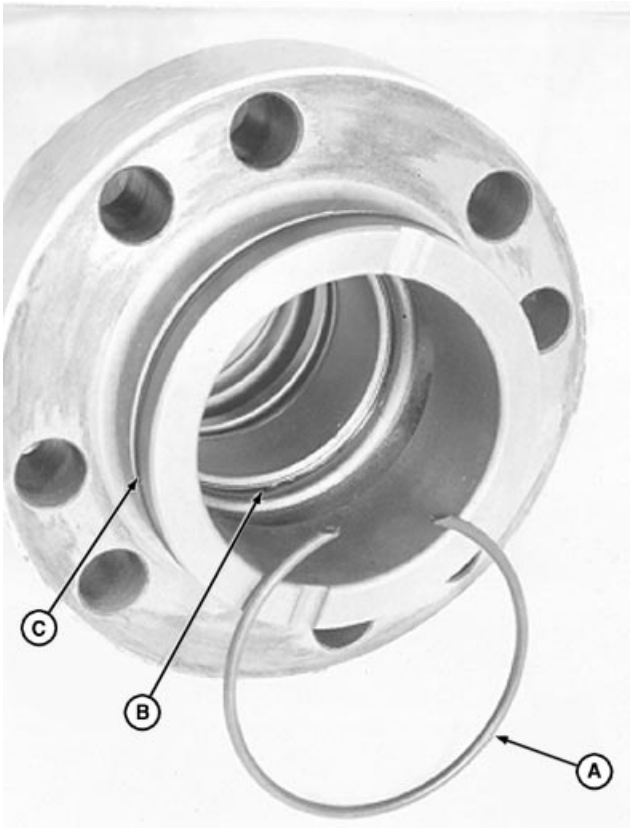
2. Push bushing (B) to bottom of bore using a driver disk and a press.
3. Install snap ring (A).
4. Install O-ring (C).

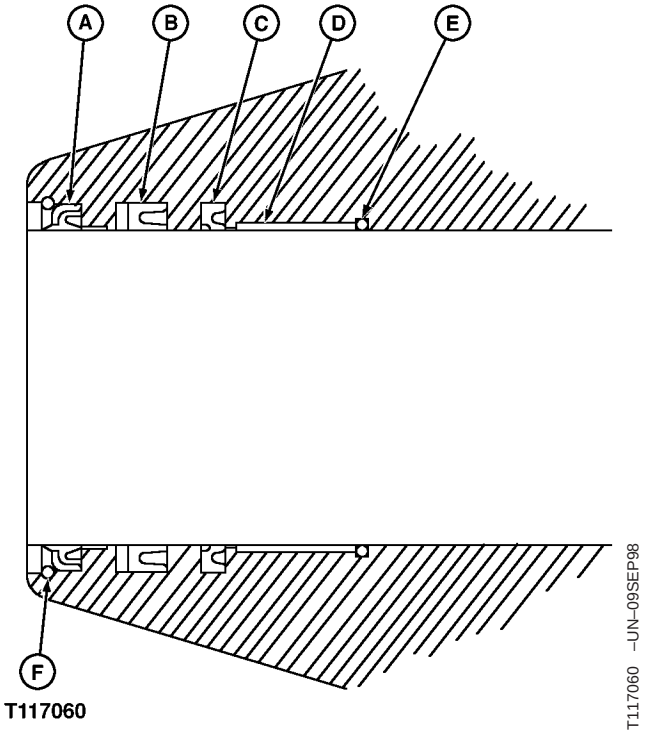



**A—Snap Ring**
**B—Bushing**
**C—O-Ring**

**Continued on next page**

CED,OUOE026,12 –19–19JUN98–2/10

5. Install wiper seal (A) and backup ring and U-cup seal (B).
6. Install step ring (C) and wear ring (D) with lip toward inside of cylinder.
7. Install snap rings (E and F).




**T117060**

**A—Wiper Seal**
**B—Backup Ring and U-Cup Seal**
**C—Step Ring**
**D—Wear Ring**
**E—Snap Ring**
**F—Snap Ring**

**Continued on next page**

CED,OUOE026,12 –19–19JUN98–3/10

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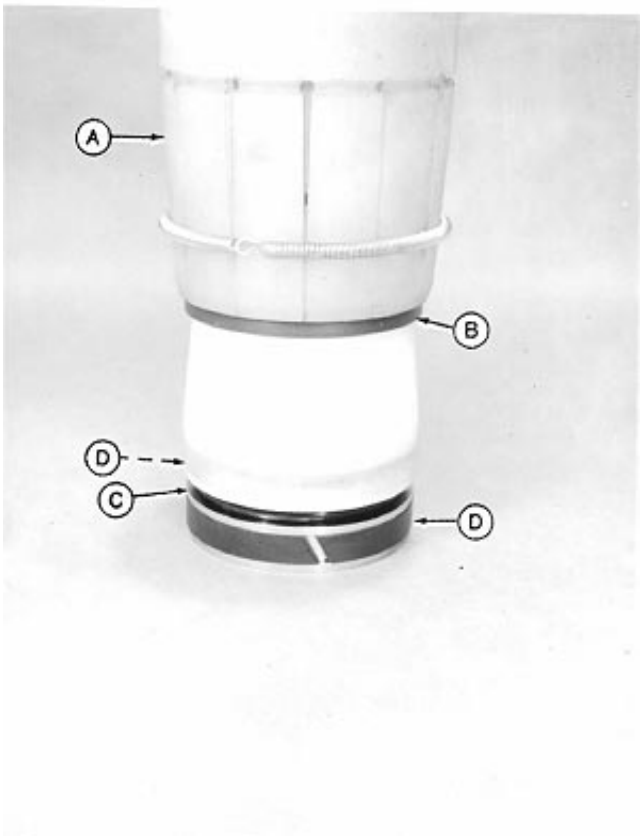
180

8. Install expander ring (C) into middle groove of piston.

9. Install the wear rings (D). The wear ring in groove above helps support the thin section of installer. The wear ring below keeps the cap seal from going into that groove if pushed too far.

10. Install correct installer on boom, arm or bucket piston. Apply clean oil to installer.

11. Push cap seal (B) down installer and into middle groove over expander ring (C) on piston, using correct size pusher (A).




T7964AQ –UN–18MAR93

**A—JDG901-3 Pusher**
**—JDG945 Installer for Boom**
**—JDG843-1 Installer for Bucket**
**—JDG901-1 Installer for Arm**
**B—Cap Seal**
**C—Expander Ring**
**D—Wear Ring**

**Continued on next page**

CED,OUOE026,12 –19–19JUN98–4/10

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181

12. Check cap seal. Seal must fit tight against O-ring and not turn. If seal can be turned, it has been stretched too much and can be damaged during assembly into cylinder barrel.

13. For a cap seal that has been stretched too much, shrink it to its original size using a ring compressor or a plastic tie band and hose clamp.

    When using a ring compressor, put a piece of shim stock between cap seal and compressor at joint so it does not damage seal.

    When using a plastic tie band and hose clamp, grind a taper on one end of tie band. Install tie band with taper against cap seal. Before tightening the hose clamp, check to be sure tie band is under hose clamp all around piston.

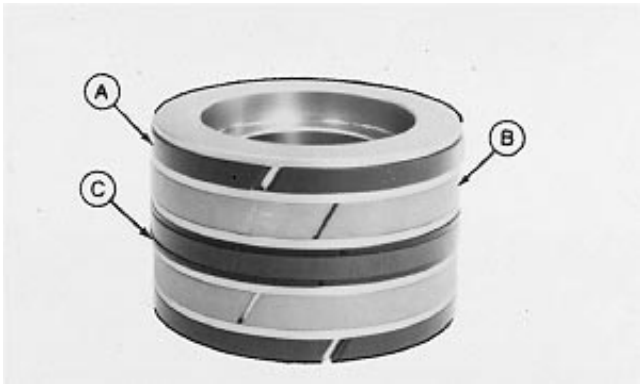
T6396AC –UN–27OCT88

CED,OUOE026,12 –19–19JUN98–5/10

14. Install a backup ring (C) on each side of cap seal.

15. Install wear rings (B) and rings (A).

    Turn the rings so slits are 180° from each other.



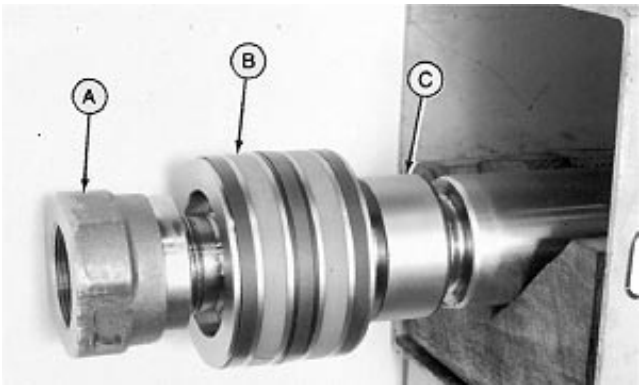

T6557HV –UN–27OCT88

**A—Ring (2 used)**
**B—Wear Ring (2 used)**
**C—Backup Ring (2 used)**

**Continued on next page**

CED,OUOE026,12 –19–19JUN98–6/10

16. Install rod in JT30043 Hydraulic Cylinder Repair Stand.
17. Carefully install rod guide on rod. Do not damage seals.
18. Install cushion ring (C) with radius end towards shoulder on rod.
19. Install piston (B) with counterbore towards nut (A).




*Rod Guide and Piston Installation*

**A—Nut**
**B—Piston**
**C—Cushion Ring**

CED,OUOE026,12 –19–19JUN98–7/10

20. Install nut (A) and tighten as specified using JT05794 Wrench and JT05797 Adapter Plate for bucket cylinder, JT07332 Adapter Plate for boom cylinder or JT05798 Adapter Plate for arm cylinder.

**Boom Cylinder Piston-to-Rod Nut—Specification**

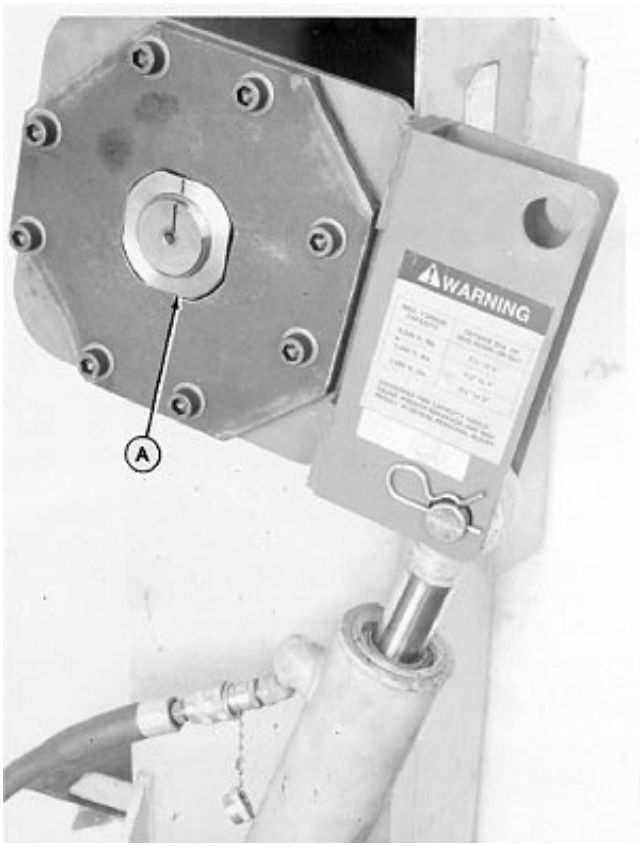
Torque ..... 9810 N•m (7230 lb-ft)

**Arm Cylinder Piston-to-Rod Nut—Specification**

Torque ..... 22 050 N•m (16,270 lb-ft)

**Bucket Cylinder Piston-to-Rod Nut—Specification**

Torque ..... 10 000 N•m (7380 lb-ft)




**A—Nut**

**Continued on next page**

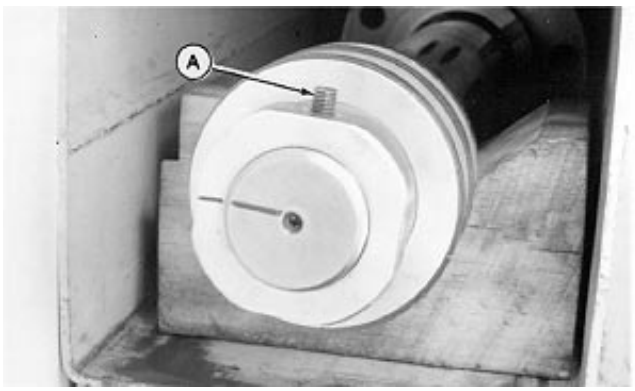
CED,OUOE026,12 –19–19JUN98–8/10

21. Install set screw (A) and tighten.

**Nut-to-Rod Set Screw—Specification**

Torque ..... 64 N•m (47 lb-ft)

22. Stake set screw in two places 90° from previous stake marks.




**A—Set Screw**

CED,OUOE026,12 –19–19JUN98–9/10

23. Apply clean oil to piston and seals. Attach a hoist to rod. Carefully install rod in cylinder housing. Do not damage piston seals and rings.

24. Install and tighten cap screws (A).

**Boom Cylinder Rod Guide-to-Barrel Cap Screw—Specification**

Torque ..... 830 N•m (615 lb-ft)

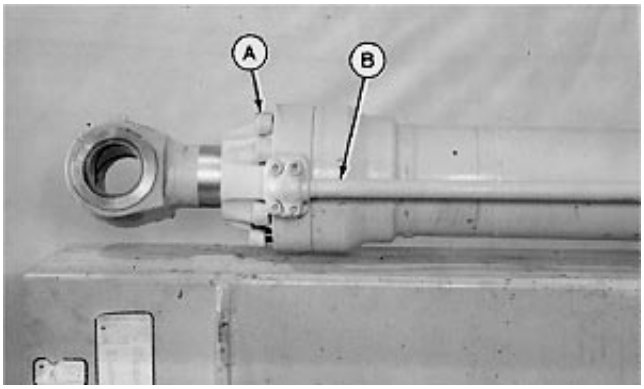
**Arm Cylinder Rod Guide-to-Barrel Cap Screw—Specification**

Torque ..... 1230 N•m (905 lb-ft)

**Bucket Cylinder Rod Guide-to-Barrel Cap Screw—Specification**

Torque ..... 830 N•m (615 lb-ft)

25. Connect line (B).




**A—Cap Screw**
**B—Hydraulic Lines**

CED,OUOE026,12 –19–19JUN98–10/10

## REMOVE AND INSTALL AUXILIARY HYDRAULICS PRESSURE REDUCING VALVE

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3360
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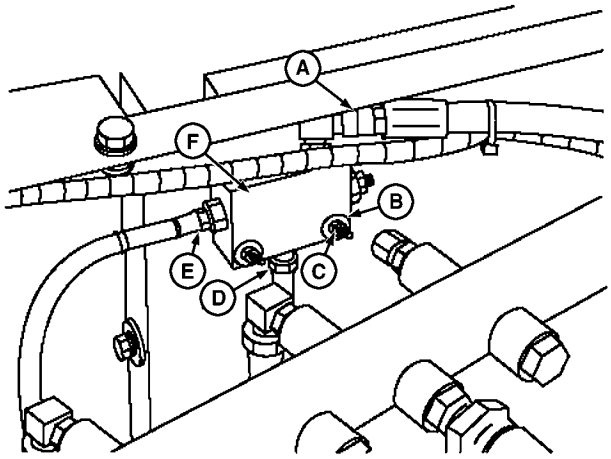
**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug to release hydraulic pressure in reservoir.

CED,OUOE020,39 –19–19MAR99–1/2

2. Disconnect hoses (A, D and E).
3. Remove nuts (C) and washers (B).
4. Remove valve (F). Replace parts as necessary.




T120701 –UN–25MAR99

T120701

**A—Pilot Control Valve Hose**
**B—Washer (2 used)**
**C—Nut (2 used)**
**D—Inlet Hose**
**E—Solenoid Control Valve Hose**
**F—Valve**

CED,OUOE020,39 –19–19MAR99–2/2

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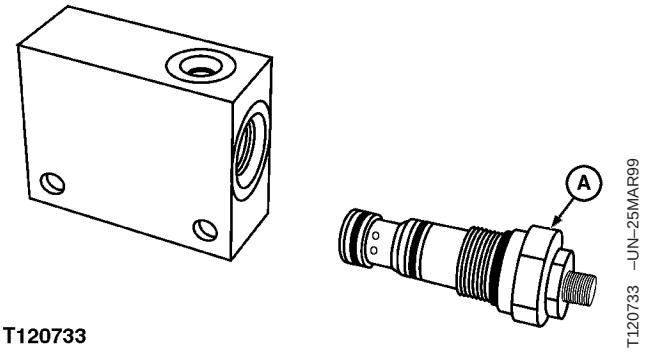
## DISASSEMBLE AND ASSEMBLE AUXILIARY HYDRAULICS PRESSURE REDUCING VALVE

Remove valve. Replace parts as necessary.

**Pressure Reducing Valve—Specification**

Torque ..... 62 N•m (46 lb-ft)




**T120733**

**A—Valve**

CED,OUOE020,40 –19–19MAR99–1/1

## REMOVE AND INSTALL AUXILIARY HYDRAULICS SOLENOID CONTROL VALVE

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

1. Loosen vent plug to release hydraulic pressure in reservoir.

**Continued on next page**

CED,OUOE020,41 –19–19MAR99–1/2

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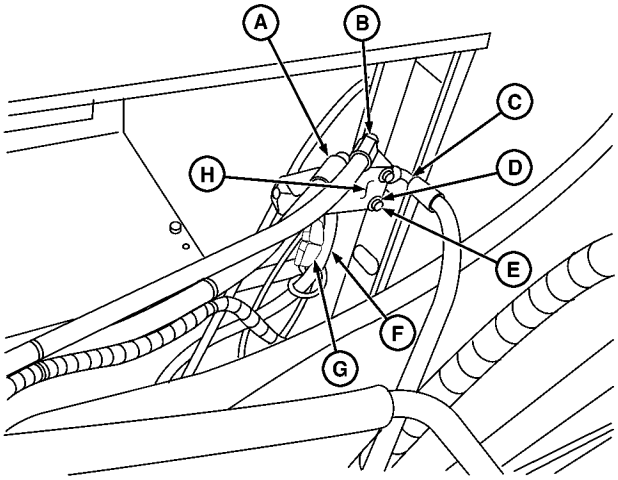
186

2. Disconnect connector (G).
3. Disconnect hoses (A—C and F).
4. Remove cap screws (E) and washers (D).
5. Remove valve (H). Replace parts as necessary.




T120734 –UN–25MAR99

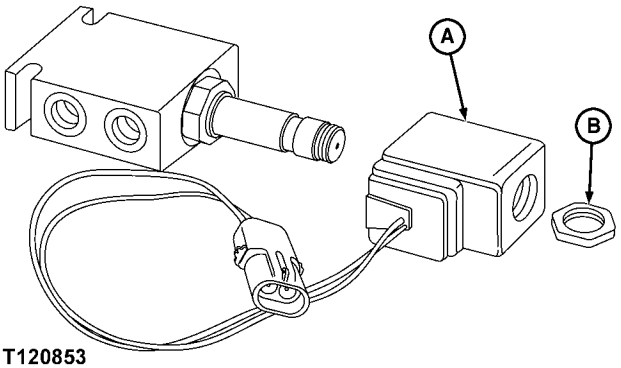
**T120734**

**A—Auxiliary Valve Hose**
**B—Pressure Reducing Valve Hose**
**C—Drain Hose**
**D—Washer (2 used)**
**E—Cap Screw (2 used)**
**F—Pressure Supply Hose**
**G—Connector**
**H—Valve**

CED,OUOE020,41 –19–19MAR99–2/2

## DISASSEMBLE AND ASSEMBLE AUXILIARY HYDRAULICS SOLENOID CONTROL VALVE

1. Remove nut (B) and solenoid (A).




T120853 –UN–29MAR99

**T120853**

**A—Nut**
**B—Solenoid**

**Continued on next page**

CED,OUOE020,42 –19–22MAR99–1/2

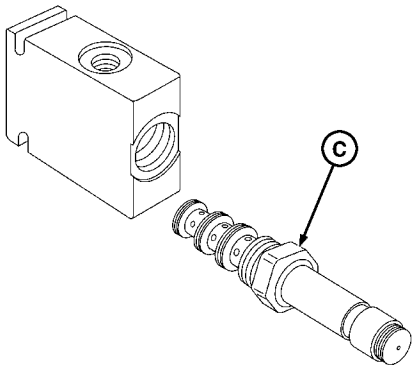
2. Remove valve (C). Replace parts as necessary.

**Solenoid Nut—Specification**

Torque ..... 20 N•m (15 lb-ft)

**Solenoid Control Valve—Specification**

Torque ..... 62 N•m (46 lb-ft)




T120854 –UN–29MAR99

**T120854**

**C—Valve**

CED,OUOE020,42 –19–22MAR99–2/2

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187

# CHAPTER 20

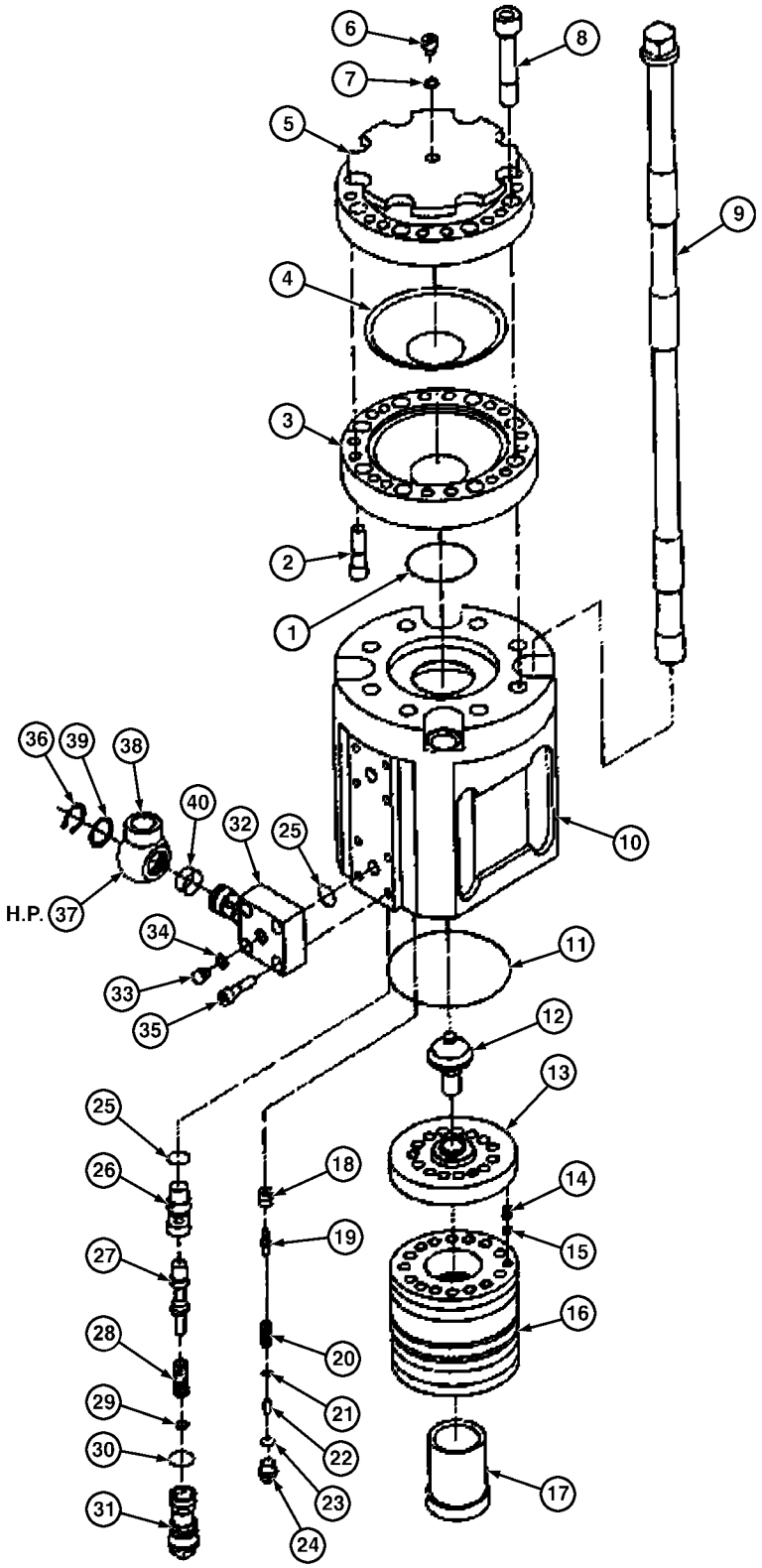
# SECTION 33

# HYDRAULIC IMPACT BREAKER REPAIR

**BLANK**

33
2

## HYDRAULIC IMPACT BREAKER DISASSEMBLY




T120469

T120469 –UN–22MAR99

**Continued on next page**

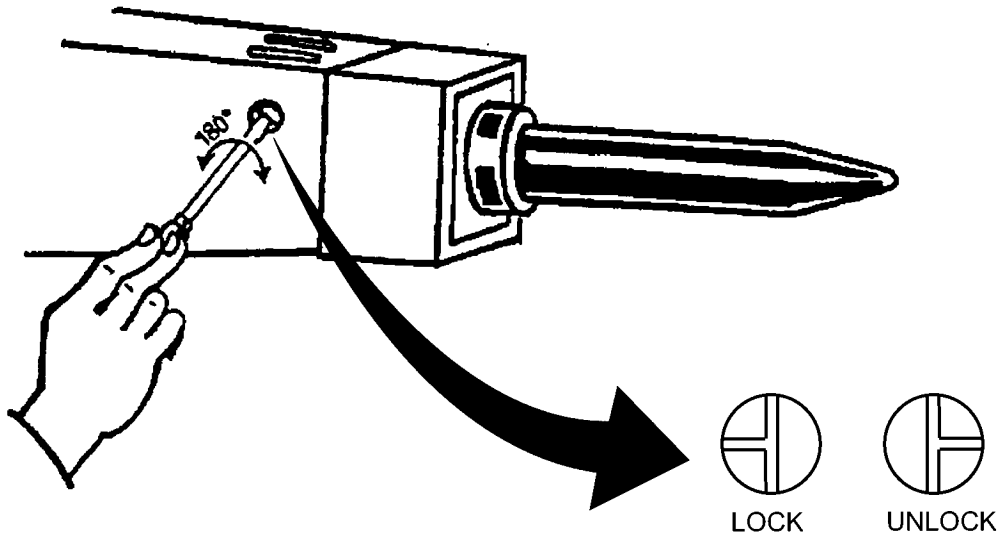
CED,OUOE039,1 –19–20MAR99–1/42

*Hydraulic Impact Breaker*



1—O-Ring
2—Shell Fixing Screw
3—Half Lower Shell - Spy Hole
4—Diaphragm
5—Half Upper Shell
6—Inflating Screw
7—Sealing Ring
8—Accumulator Screw
9—Side Bolt-Rubber Type
10—Head
11—O-Ring
12—Mushroom Valve
13—Box Body Cover
14—Dowel
15—O-Ring
16—Distributor Box Body
17—Distributor
18—Valve Body
19—Needle
20—Spring
21—Adjustment Shim
22—Spacer Barrel
23—O-Ring
24—Plug
25—O-Ring
26—Barrel
27—Slide
28—Spring
29—Adjustment Shim
30—O-Ring
31—Guiding Plug
32—Link
33—Plug 1/4” Gas
34—Sealing Washer
35—Screw
36—Seeger (Snap Ring)
37—H.P. Connection 1 in.
38—L.P. Connection 1-1/4 in.
39—Washer
40—O-Ring

CED,OUOE039,1 –19–20MAR99–2/42




T120556

T120556 –UN–15APR99

**DISASSEMBLE TOOL, CAP, CONNECTORS AND SHOCK ABSORBERS**

1. Position breaker horizontally on a flat surface, using a suitable lifting device.
2. In order to remove tool, insure that retaining axles are not in locked position.
3. With large screwdriver, push in on locking bolt and rotate to unlocked position.

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–3/42

*Hydraulic Impact Breaker*

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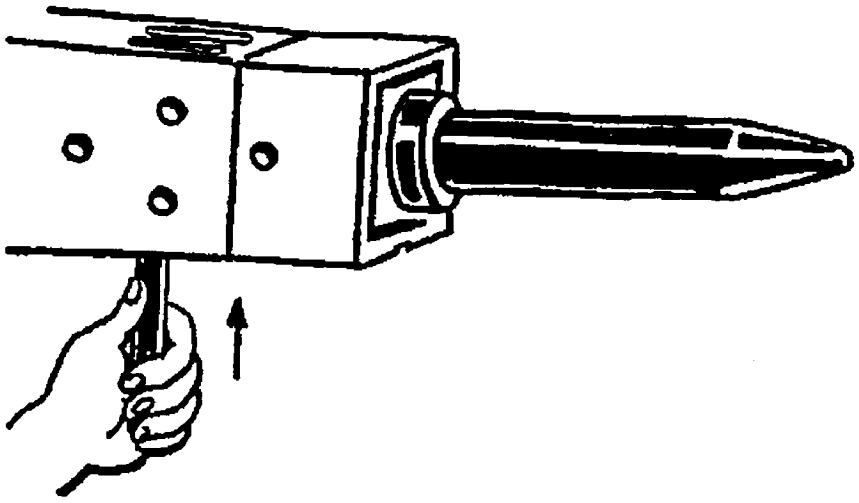
4

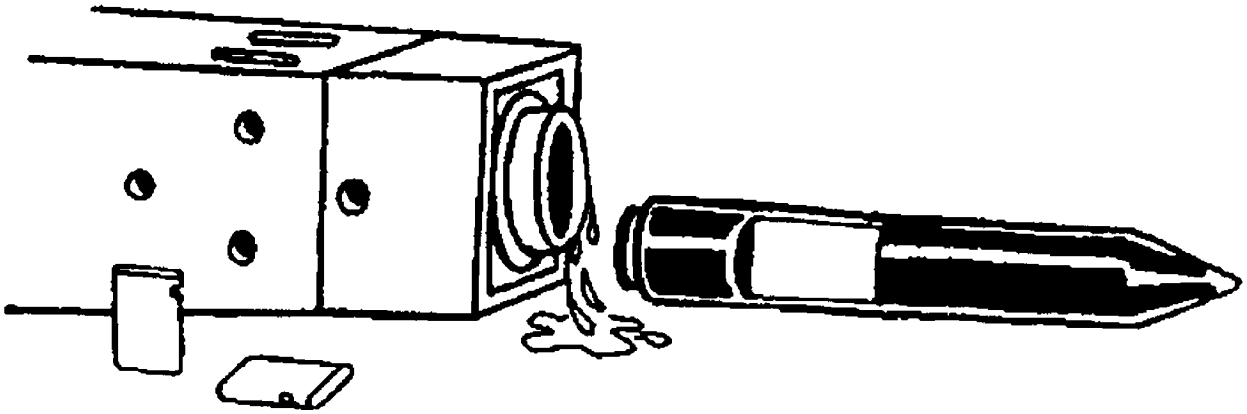


T120557

T120557 –UN–22MAR99

4. Push retaining axles out from opposite side.

CED,OUOE039,1 –19–20MAR99–4/42



T120558

T120558 –UN–22MAR99

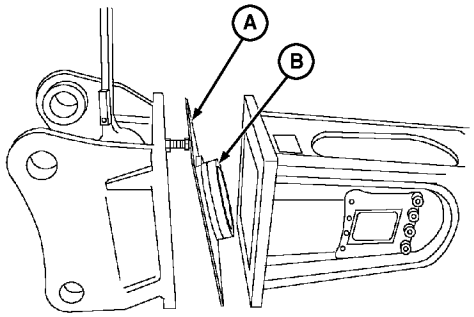
**CAUTION: The tool may be hot if the breaker was just being used. The approximate weight of the tool is 105 kg (232 lb).**

5. Remove tool.

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–5/42

6. With two wrenches, remove 12 nuts, bolts and lockwashers.
7. Remove top shock absorber holder (A) and the upper shock absorber (B).



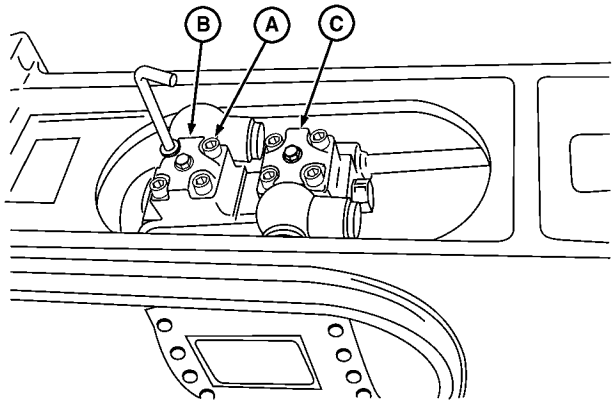

T120476 –UN–22MAR99

**T120476**

**A—Shock Absorber Holder**
**B—Upper Shock Absorber**

CED,OUOE039,1 –19–20MAR99–6/42

8. With an Allen wrench, remove screws (A) holding high pressure link group (B) and check condition of O-ring.
9. Repeat preceding step for the Low Pressure Link group (C), located directly below High Pressure group.




T120477 –UN–22MAR99

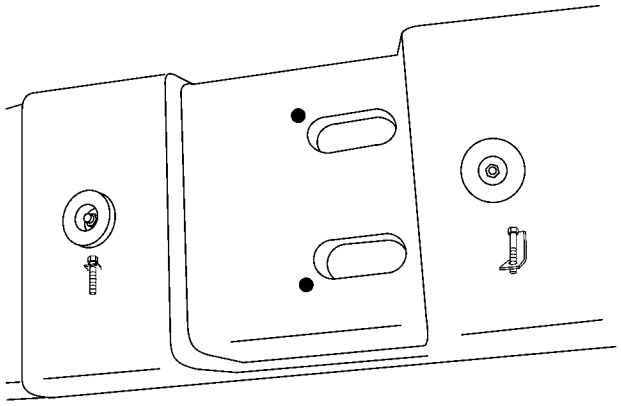
**T120477**

**A—Screw (8 used)**
**B—High Pressure Link**
**C—Low Pressure Link**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–7/42

10. Remove grease fittings and install 3/8 -16 bolts to hold wear pads and shims in place.

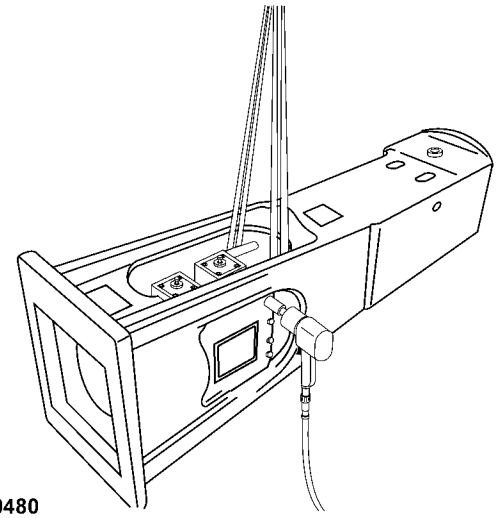


T120479

T120479 –UN–22MAR99

CED,OUOE039,1 –19–20MAR99–8/42

11. Support breaker in the case.



T120480

T120480 –UN–22MAR99

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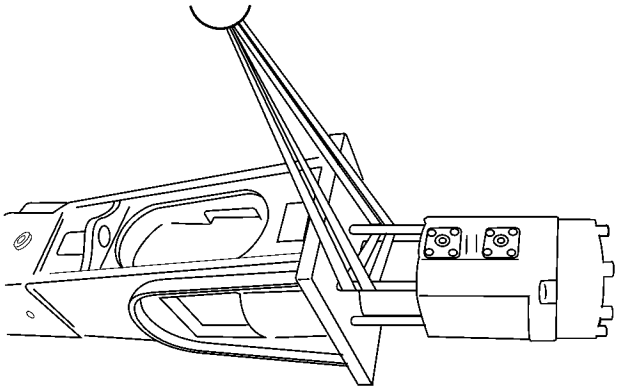
CED,OUOE039,1 –19–20MAR99–9/42

**CAUTION: The approximate weight of the breaker is 905 kg (1994 lb).**

*NOTE: Before removing side shock absorbers, mark support plate and frame, to identify correct position.*

12. Remove both side shock absorbers by removing 8 bolts and washers from each.

13. Slide breaker out of case, as shown. Use appropriate hook.



T120481 –UN–22MAR99

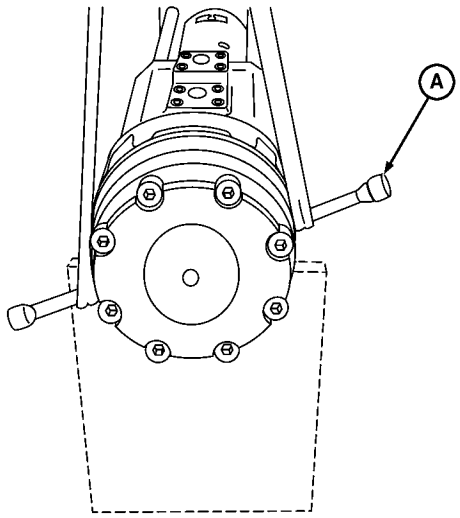
**T120481**

CED,OUOE039,1 –19–20MAR99–10/42

14. Once the breaker is out of the case, install two bolts (A) into the head assembly. If necessary, these bolts can be removed from the accumulator.

*NOTE: Be certain to check the condition of the accumulator bolts by holding the bolt by the thread end and tapping the head with a hammer. The bolt should ring.*

15. Install breaker in suitable holding bracket to keep in upright position.




T120482 –UN–22MAR99

**T120482**

**A—Bolt**

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CED,OUOE039,1 –19–20MAR99–11/42

*Hydraulic Impact Breaker*

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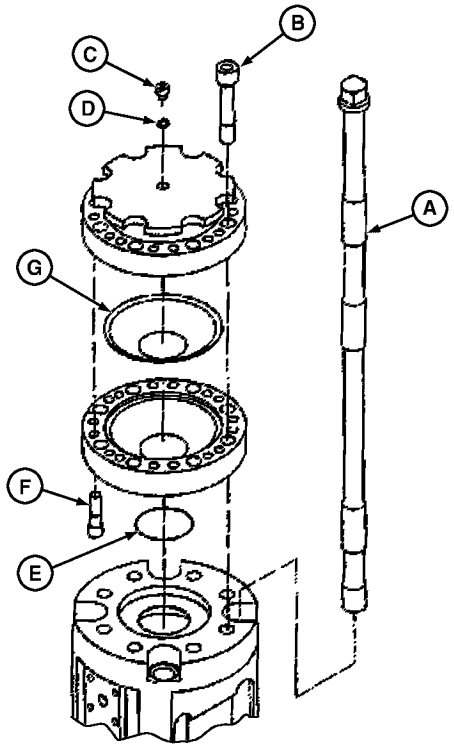


T120586

T120586 –UN–22MAR99

**A—Side Bolt—Rubber Type**
**B—Accumulator Screw**
**C—Inflating Screw**
**D—Sealing Ring**
**E—O-Ring**
**F—Shell Fixing Screw**
**G—Diaphragm**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–12/42

**DISASSEMBLE ACCUMULATOR**

**CAUTION: Compressed gases, by their nature, are hazardous. They are capable of creating environments that are oxygen deficient, flammable or explosive. Death has occurred during a routine repair on a carrier when a nitrogen-charged canister on the carrier exploded as it was being disassembled.**

**CAUTION: Nitrogen, which is present in our atmosphere, can still displace the oxygen in a room or enclosure and cause suffocation.**

**CAUTION: Never deliberately breathe, or allow others to breathe, any compressed gas of any type. It is possible to deplete the oxygen in the bloodstream and cause rapid suffocation and DEATH.**

**CAUTION: Always wear proper clothing for the job. Protective clothing, safety shoes and leather gloves should be worn, in addition to the required helmet or other protective gear. Any time compressed gases are handled, safety glasses should be worn.**

**CAUTION: Keep a fire extinguisher close at hand. Situate flammable gas cylinders in a location so that if a fire does occur, it may be easily extinguished. In some cases, it may be better to evacuate the area and let the cylinder burn, especially if escaping gas could collect and explode.**

**CAUTION: Never attempt to adapt fittings from one device or cylinder to another. Fittings or hoses may not be compatible with the gas products and may fail violently. Gases should never be transferred from one cylinder to another. The rate of flow of the gas itself may be sufficient to cause an explosion.**

**CAUTION: Check valves are an important safety feature, but don't rely on them 100% to prevent a "back-flow" condition. Always open the cylinder slowly. Purge the regulator and hoses by allowing a small amount of gas to pass through the system.**

**CAUTION: Nitrogen may burn, but will not ignite readily. The cylinder may explode in the heat of a fire.**

**CAUTION: Vapors may cause dizziness or suffocation. Contact with liquid may cause frostbite. Fire may produce irritating or poisonous gases.**

*NOTE: It is recommended that the accumulator be disassembled every 500 working hours. At this time, the diaphragm should be replaced, even if it appears to be in good condition. WHEN THE ACCUMULATOR GOES FLAT, THE RUBBER DIAPHRAGM MUST BE REPLACED, EVEN IF ITS CONDITION APPEARS SATISFACTORY.*

1. Unscrew eight accumulator screws (B) with an Allen wrench. (Once screws have been loosened, they maybe removed with an air wrench.)
2. Remove inflating screw (C) and sealing ring (D).
3. Remove accumulator from head. Check condition of O-ring (E).
4. Remove 16 shell fixing screws (F) and open accumulator.
5. Replace diaphragm (G).

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–13/42

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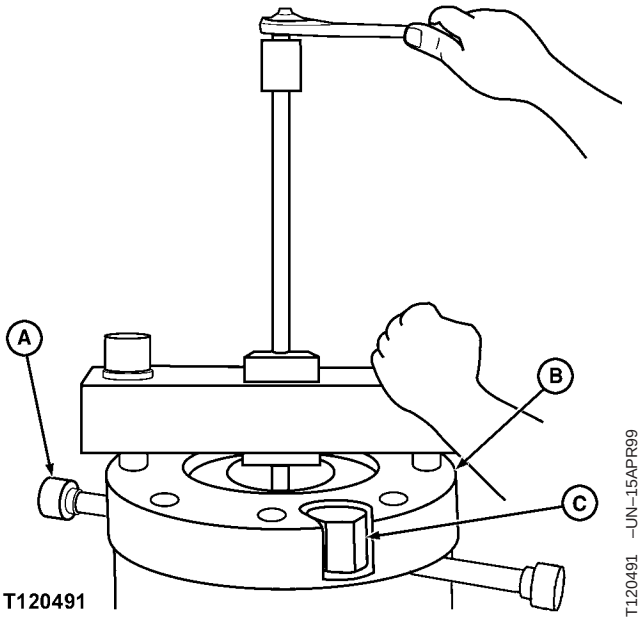
## DISASSEMBLE HEAD

1. Loosen and unscrew 4 rubber side bolts (C).
2. Install accumulator bolts (A) into head assembly (B). Use puller as shown, to remove head assembly.

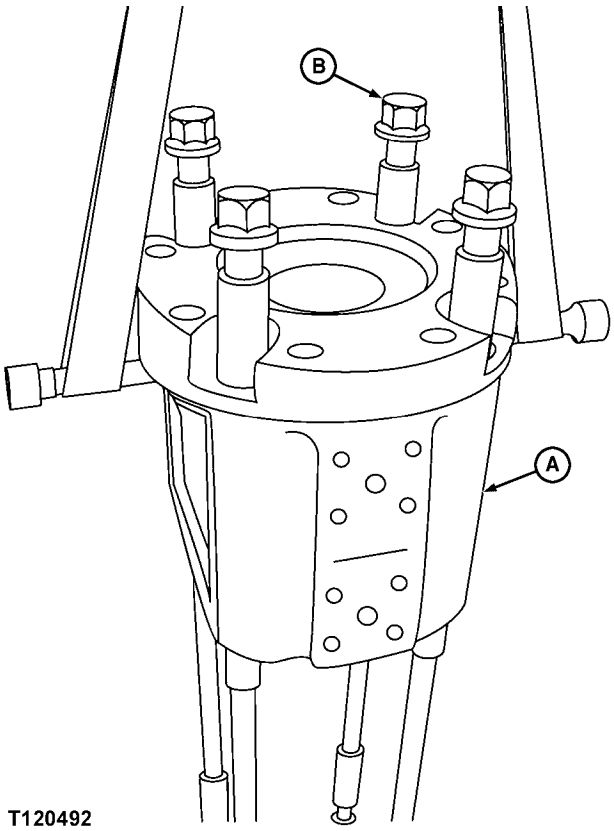



**A—Accumulator Bolt**
**B—Head Assembly**
**C—Rubber Side Bolt (4 used)**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–14/42

3. Using proper lifting tool, remove head assembly (A) and side bolts (B) from breaker and set aside. Slide side bolts out one by one. Check nut threads. Check support condition of side bolts and replace if necessary.




**A—Head Assembly**
**B—Side Bolt**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–15/42

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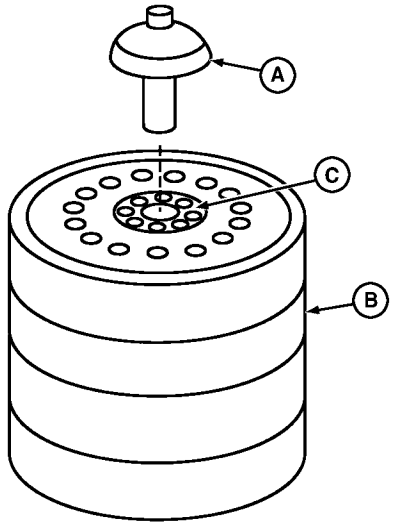
12

4. Remove mushroom valve (A) from distributor box body (B). Inspect condition of sealing surface.

5. Clean valve, cover and set aside in clean area.

*NOTE: If mushroom valve shows signs of wear, use valve lapping compound to smooth the mating surface between the valve and the box body cover (C).*




T120587

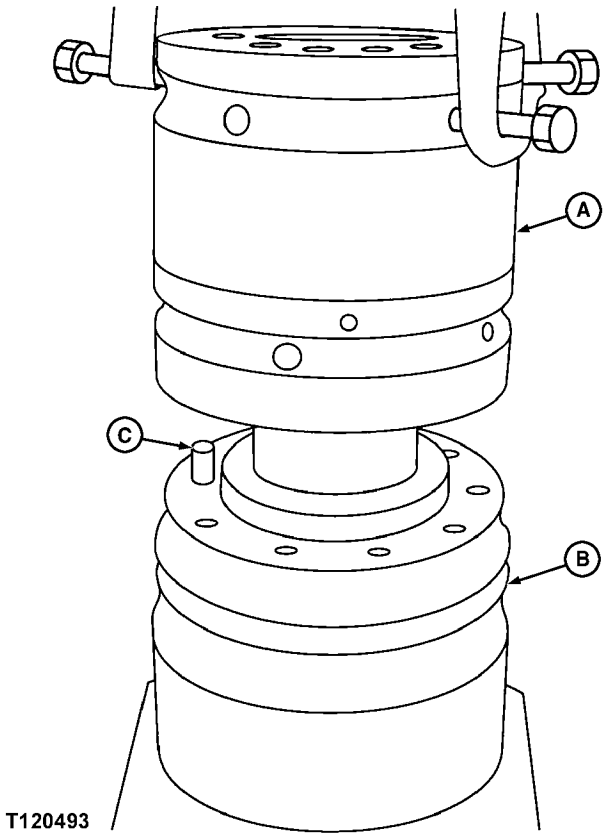
T120587 –UN–22MAR99

**A—Mushroom Valve**
**B—Distributor Box Body**
**C—Box Body Cover**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–16/42

6. Using proper lifting tool, lift distributor box body (A) from cylinder (B) enough to see locator pin (C). Not location of pin.




**A—Distributor Box Body**
**B—Cylinder**
**C—Locator Pin**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–17/42

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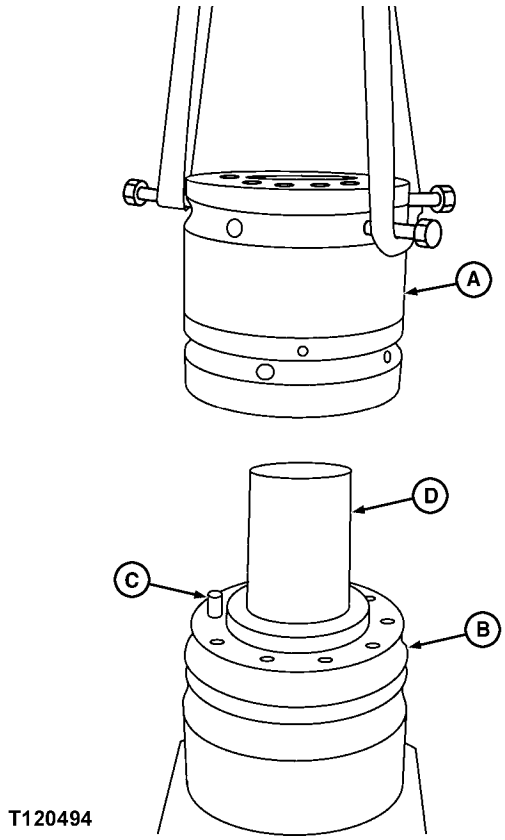
**CAUTION: The distributor (D) may stick to box body (A) and fall out during this process.**

7. Lift distributor box body (A) off cylinder assembly (B) and distributor (D), as shown. Retain locator pin (C).

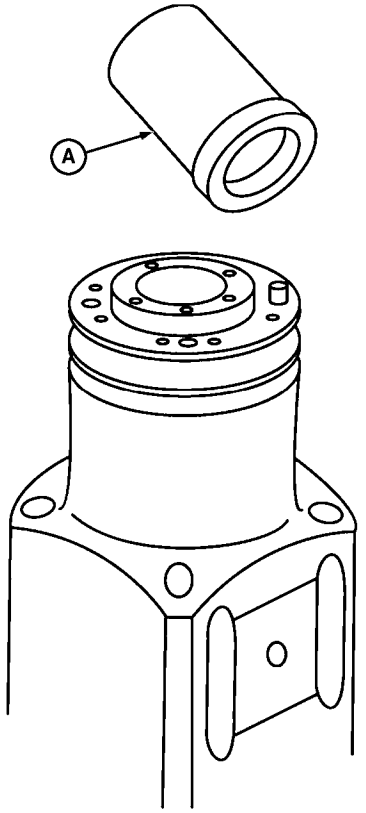



**A—Distributor Box Body**
**B—Cylinder**
**C—Dowel**
**D—Distributor**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–18/42

8. Check that distributor face (A) and inside are smooth and clean.




T120495

T120495 –UN–22MAR99

**A—Distributor Face**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–19/42

*Hydraulic Impact Breaker*

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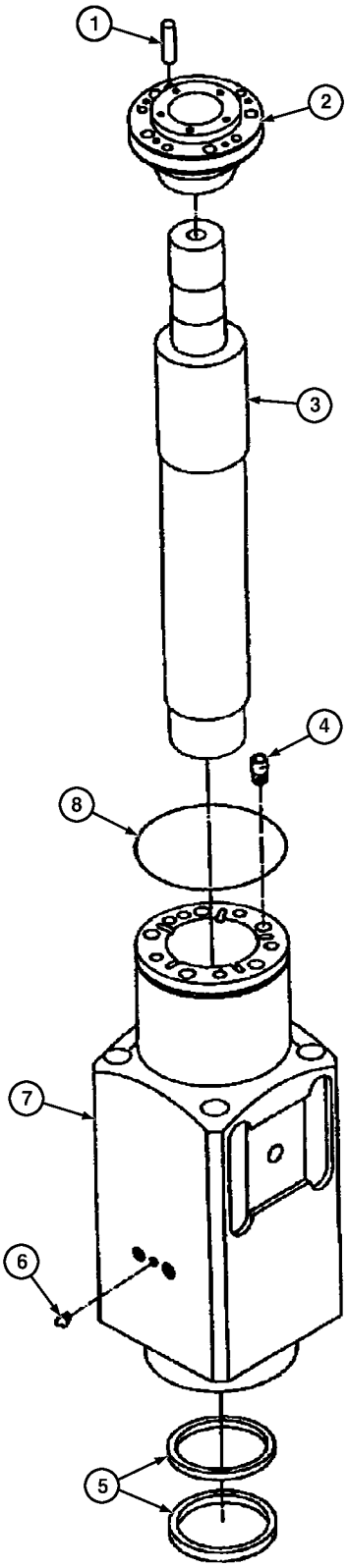
16




T120470 –UN–22MAR99

**T120470**

**1—Centering Pin**
**2—Guide Adapter**
**3—Piston**
**4—Valve**
**5—U-Joint**
**6—Grease Nipple**
**7—Cylinder**
**8—O-Ring**

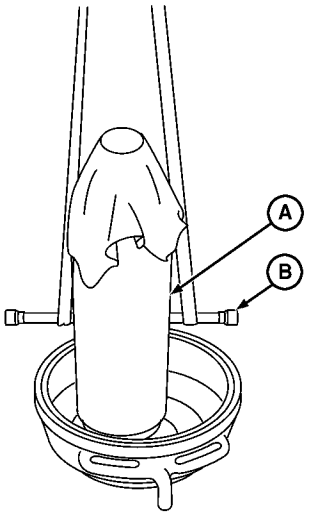
**Continued on next page**

CED,OUOE039,1 –19–20MAR99–20/42

## DISASSEMBLE CYLINDER

**CAUTION: The cylinder assembly may be top heavy. Cover the assembly with a rag to prevent oil from spraying out of the guide adapter.**

1. Lift piston and cylinder assembly (A) out off chuck housing using accumulator bolts (B), as shown. Remove oil still inside cylinder. Ensure that centering pin remains in place inside guide adapter.



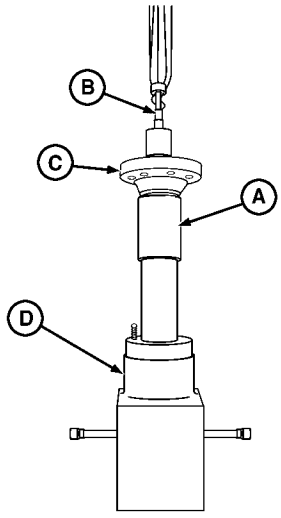

T120496

T120496 –UN–22MAR99

**A—Cylinder Assembly**
**B—Accumulator Bolt**

CED,OUOE039,1 –19–20MAR99–21/42

2. Attach lift to accumulator screw (B) threaded into end of piston (A) and lift piston and guide adapter (C) out of cylinder (D). Check that the two parts are not worn, especially at support surfaces.




T120497

T120497 –UN–15APR99

**A—Piston**
**B—Accumulator Screw**
**C—Guide Adapter**
**D—Cylinder**

**Continued on next page**

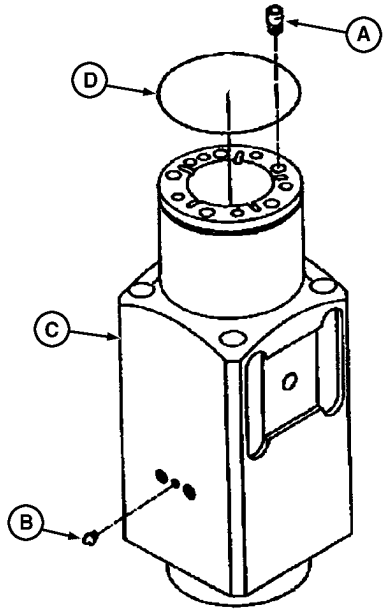
CED,OUOE039,1 –19–20MAR99–22/42

33
18

3. Remove valves (A and B) from cylinder (C) and check seating surface. Surface should be perfectly circular, of equal thickness all around, and without indentation. Clean valves and replace if necessary.

4. Check O-ring (D) and sealing area of cylinder, and replace if necessary.

5. Check guiding areas of cylinder, by head.




T120498

T120498 –UN–15APR99

**A—Valve**
**B—Valve**
**C—Cylinder**
**D—O-Ring**

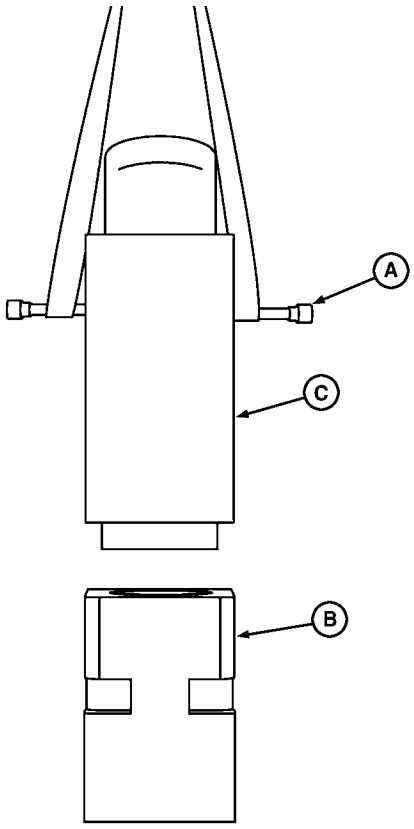
**Continued on next page**

CED,OUOE039,1 –19–20MAR99–23/42

33
19

6. Place accumulator screws (A) in holes on sides of the cylinder (C). Extract cylinder (C) from chuck housing (B).

7. Check inside of cylinder for scoring and defects. Hone out defects in cylinder walls with appropriate, lubricated tool [recommended: BRM Flex-Hone]. If cylinder is honed, clean with warm, soapy water then re-oil. Replace cylinder if necessary.




T120499 –UN–22MAR99

T120499

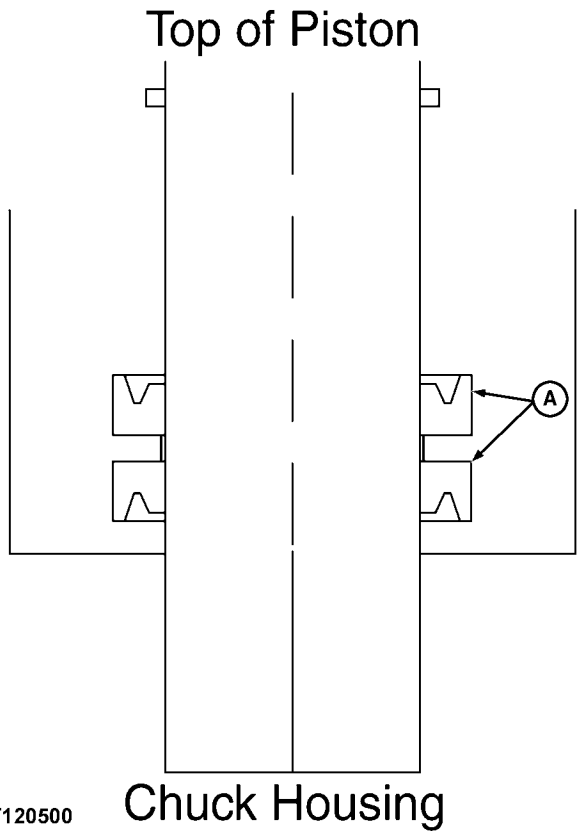
**A—Accumulator Screw**
**B—Chuck Housing**
**C—Cylinder**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–24/42

33
20

8. Remove U-joint seals (B) from inside cylinder and replace if necessary. Carefully clean U-joint seal internal grooves.



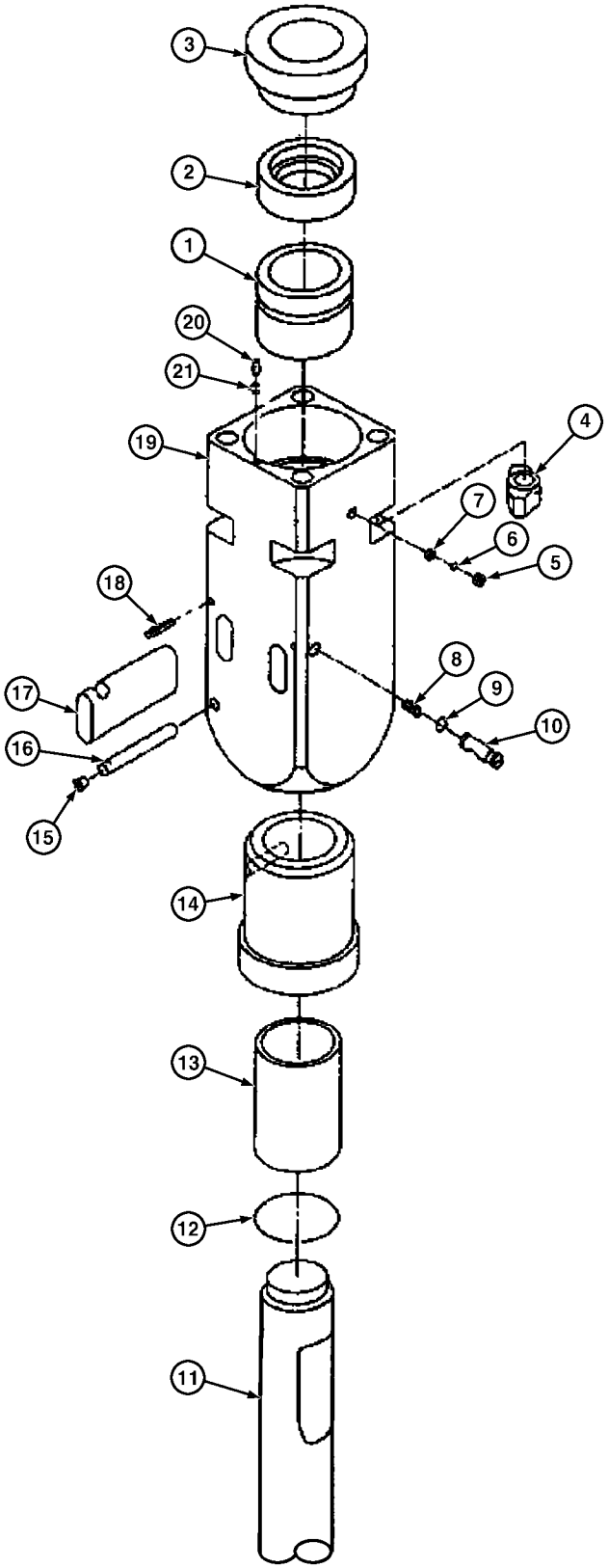

**A—U-Joint Seal**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–25/42

*Hydraulic Impact Breaker*

33
22




T120468

T120468 –UN–22MAR99

Continued on next page

CED,OUOE039,1 –19–20MAR99–26/42

*Hydraulic Impact Breaker*

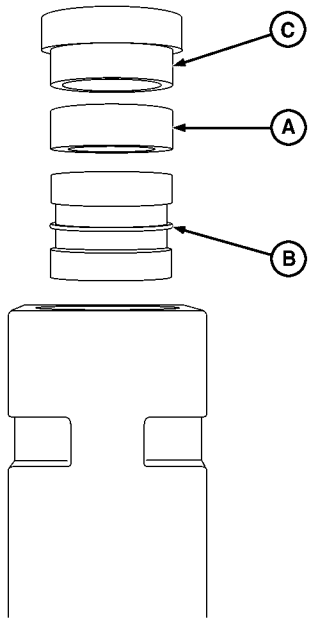


**1—Upper Bushing**
**2—Spacer**
**3—Grease Nipple/Spacer Ring**
**4—Side Rod Nut**
**5—Flange**
**6—Plate**
**7—Seat**
**8—Spring**
**9—O-Ring**
**10—Lock Bolt**
**11—Piston**
**12—Insert Circlip**
**13—Insert Bushing**
**14—Insert Holder**
**15—Nylon Plug**
**16—Bush Pin**
**17—Retaining Axle**
**18—Elastic Pin**
**19—Chuck Housing - Bare**
**20—Greasing Pin**
**21—O-Ring**

CED,OUOE039,1 –19–20MAR99–27/42

## DISASSEMBLE CHUCK HOUSING

1. Slide spacers (A and C) out by hand. If resistant, gently tap with small hammer.
2. Slide out upper bush (B) by hand. If necessary, weld small disc on inside and press to extract upper bush.




T120507 –UN–22MAR99

**T120507**

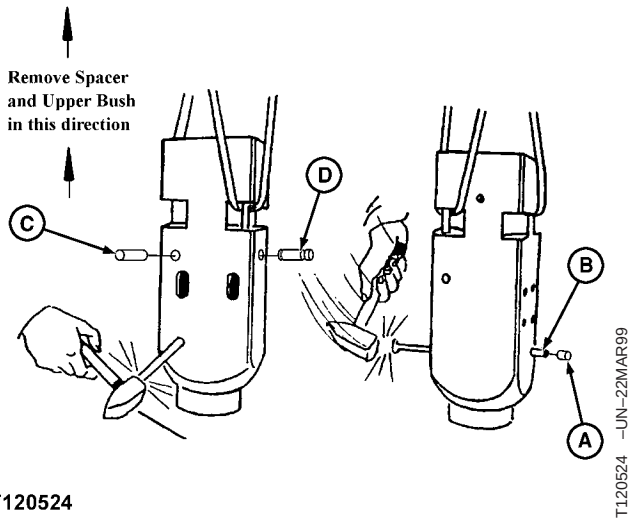
**A—Spacer**
**B—Upper Bush**
**C—Spacer Ring**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–28/42

3. Remove nylon plugs (A) with a pin and slide bushing pin (B) out.

4. Drive elastic pin (C) in until it falls into chuck housing. This will cause lock bolt (D) to be released.

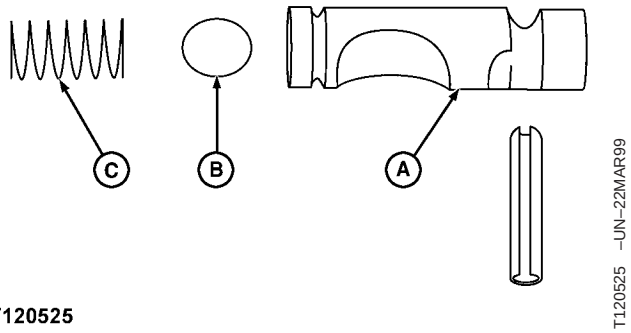



**T120524**

**A—Nylon Plugs**
**B—Bushing Pin**
**C—Elastic Pin**
**D—Lock Bolt**

CED,OUOE039,1 –19–20MAR99–29/42

5. Check wear on lock bolt (A), O-ring (B), and spring (C). Replace as necessary.

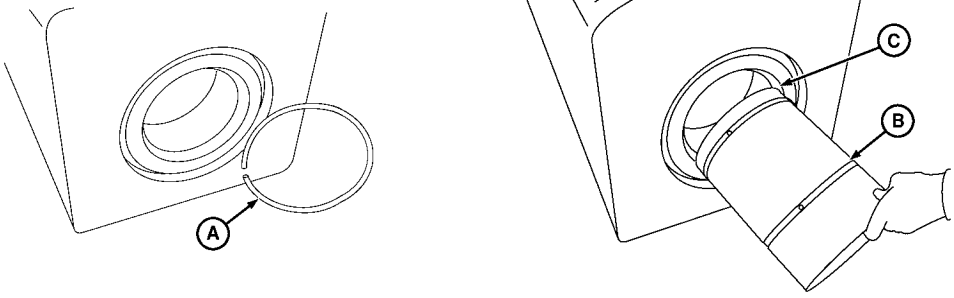



**T120525**

**A—Lock Bolt**
**B—O-Ring**
**C—Spring**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–30/42




T120526

T120526 –UN–29MAR99

**A—Circlip** **B—Insert Bushing** **C—Insert Holder**

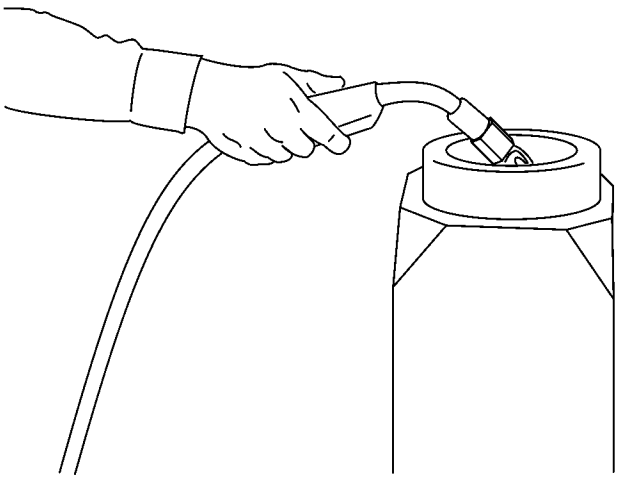
6. Remove circlip (A) and insert bushing (B). Clean insert holder (C).

*NOTE: If the insert bushing is steel and it does not slide out of the holder, the bushing will need to be cut. Protect the upper portion of housing, upper bushing, spacer and piston with a fire proof material. Using a 82.2°C (180°F) cutting torch, equipped with a gouging nozzle and exercise caution when cutting to prevent damaging the insert holder.*

CED,OUOE039,1 –19–20MAR99–31/42

7. To remove lower bushing, weld steel disc inside chuck housing.

*NOTE: If the lower bushing is an insert holder, and does not need to be replaced, skip the next two steps.*



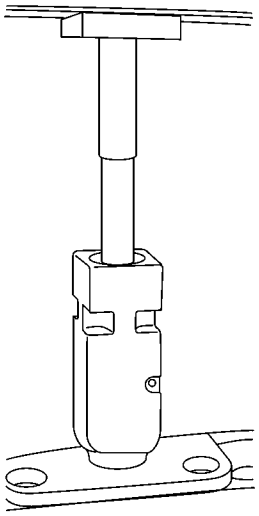
T120527

T120527 –UN–22MAR99

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–32/42

8. Using a press, extract chuck bush by pressing on welded disc.



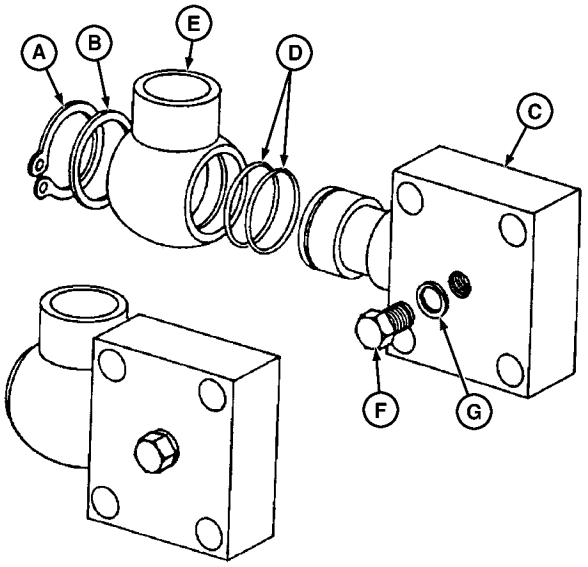
T120528

T120528 –UN–22MAR99

CED,OUOE039,1 –19–20MAR99–33/42

## DISASSEMBLE HIGH AND LOW PRESSURE LINKS

1. Disassemble seeger/snap ring (A) with pliers and remove washer (B).
2. Slide H.P. connection (E) off link (C). Check condition of O-ring (D) and mortising areas. Clean O-rings and replace as needed.
3. Remove plug (F) and sealing washer (G).




T120529

T120529 –UN–22MAR99

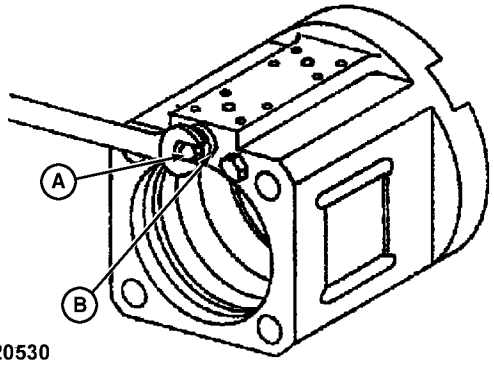
**A—Seeger/Snap Ring**
**B—Washer**
**C—Link**
**D—O-Ring**
**E—H.P. Connection 1 in.**
**F—Plug 1/4 in. Gas**
**G—Sealing Washer**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–34/42

**DISASSEMBLE (POWER) PRESSURE-REGULATING VALVE.**

1. Remove guiding plug (A) and adjustment shims (B).



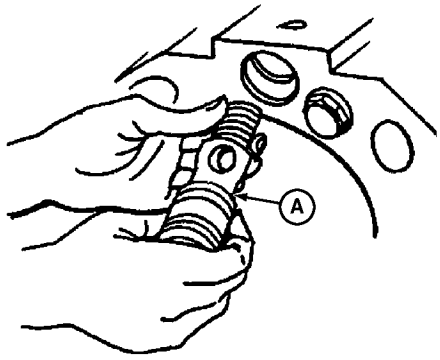

T120530

T120530 –UN–22MAR99

**A—Guiding Plug**
**B—Adjustment Shim**

CED,OUOE039,1 –19–20MAR99–35/42

2. Extract spring (A).




T120532

T120532 –UN–22MAR99

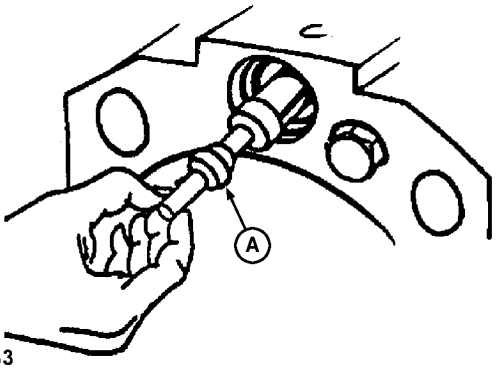
**A—Spring**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–36/42

33
28

3. Extract slide piston (A).




T120533

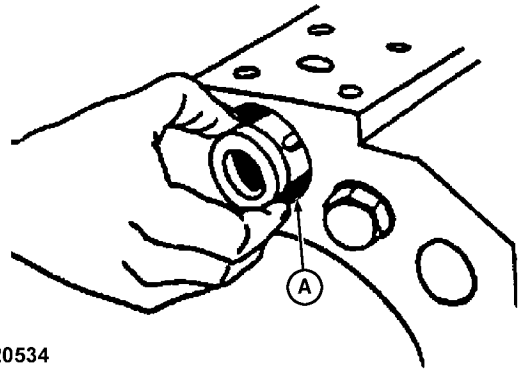
T120533 –UN–22MAR99

**A—Slide Piston**

CED,OUOE039,1 –19–20MAR99–37/42

4. Extract barrel (A) using a hook-shaped tool to pull barrel from breaker head.

5. Check sliding areas of all parts for wear. Clean the parts carefully, and replace O-ring if necessary.




T120534

T120534 –UN–22MAR99

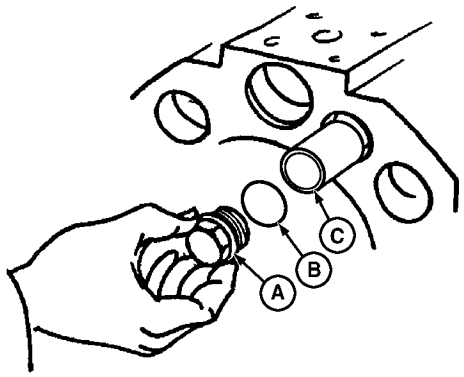
**A—Barrel**

**Continued on next page**

CED,OUOE039,1 –19–20MAR99–38/42

**DISASSEMBLE FREQUENCY REGULATING (SPEED) VALVE**

1. Remove plug (A) and O-ring (B). Replace O-ring. Remove spacer barrel (C).




T120535

T120535 –UN–22MAR99

**A—Plug**
**B—O-Ring**
**C—Spacer Barrel**

CED,OUOE039,1 –19–20MAR99–39/42

2. Remove adjustment shims (A). Do not change number of shims at this time. Extract spring (B).


T120536

T120536 –UN–22MAR99

**A—Adjustment Shim**
**B—Spring**

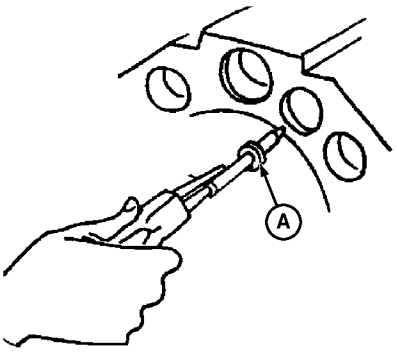
**Continued on next page**

CED,OUOE039,1 –19–20MAR99–40/42

*Hydraulic Impact Breaker*

33
30

3. Remove needle (A) using needle-nosed pliers.



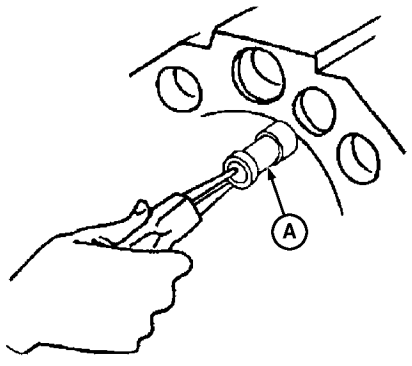

T120537

T120537 –UN–22MAR99

**A—Needle**

CED,OUOE039,1 –19–20MAR99–41/42

4. Remove valve body (A).
5. Clean needle and valve body and set assembly aside.



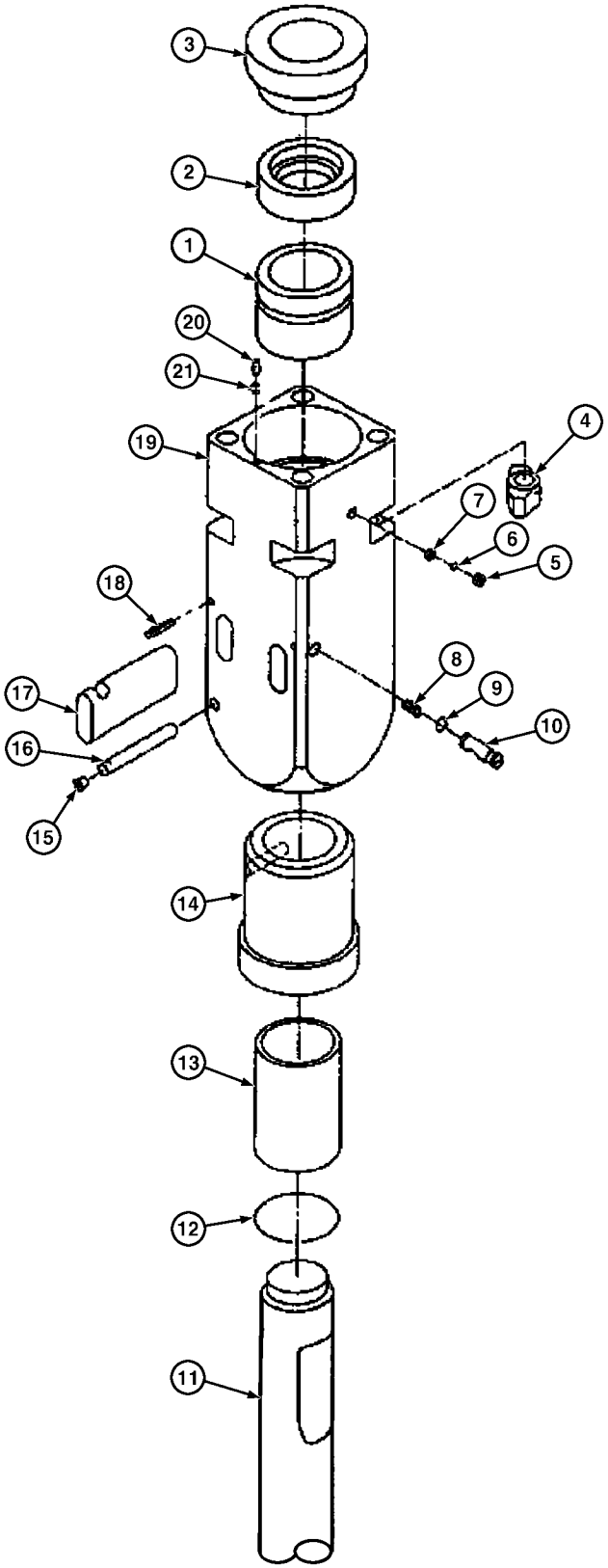

T120538

T120538 –UN–22MAR99

CED,OUOE039,1 –19–20MAR99–42/42

33
32

## HYDRAULIC IMPACT BREAKER ASSEMBLY




T120468

T120468 –UN–22MAR99

Continued on next page

CED,OUOE039,6 –19–20MAR99–1/37

**1—Upper Bush**
**2—Spacer**
**3—Spacer Ring**
**4—Side Rod Nut**
**5—Flange**
**6—Plate**
**7—Seat**
**8—Spring**
**9—O-Ring**
**10—Lock Bolt**
**11—Piston**
**12—Insert Circlip**
**13—Insert Bushing**
**14—Insert Holder**
**15—Nylon Plug**
**16—Bush Pin**
**17—Retaining Axle**
**18—Elastic Pin**
**19—Chuck Housing - Bare**
**20—Greasing Pin**
**21—O-Ring**

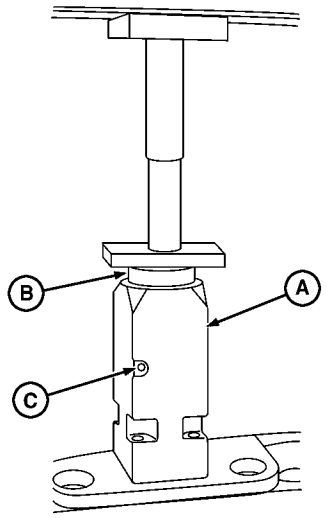
**ASSEMBLE CHUCK HOUSING**

1. Assemble chuck housing (19), lining up bush pin slot with bush pin hole in chuck housing.
2. Place bushing pin (16) in bush pin slot and measure distances at each end to ensure pin is lined up straight.

CED,OUOE039,6 –19–20MAR99–2/37

3. *NOTE: Dry ice should be used to shrink the lower bushing prior to installation.*

Place insert holder (B) and chuck housing (A) under a press and press insert holder into chuck housing until bush pin slot and hole (C) line up.




T120648

T120648 –UN–15APR99

**A—Chuck Bushing**
**B—Insert Holder**
**C—Bush Pin Hole**

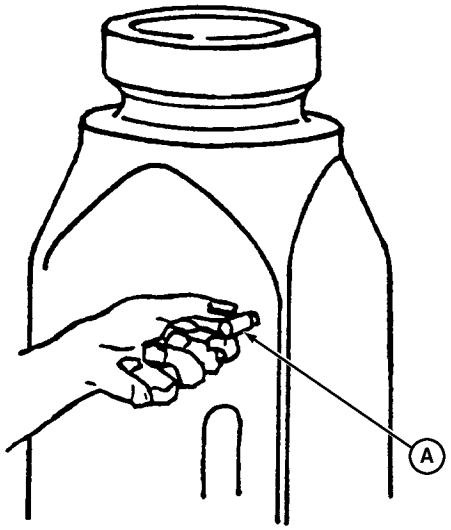
**Continued on next page**

CED,OUOE039,6 –19–20MAR99–3/37

33

34

4. Insert bush pin (A), using hammer if necessary.



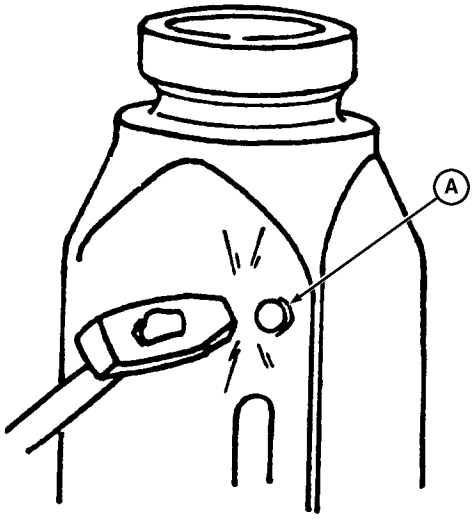

T120649 –UN–23MAR99

**T120649**

**A—Bushing Pin**

CED,OUOE039,6 –19–20MAR99–4/37

5. Insert nylon plugs (A) in both ends of bush pin hole, using a hammer.




T120650 –UN–22MAR99

**T120650**

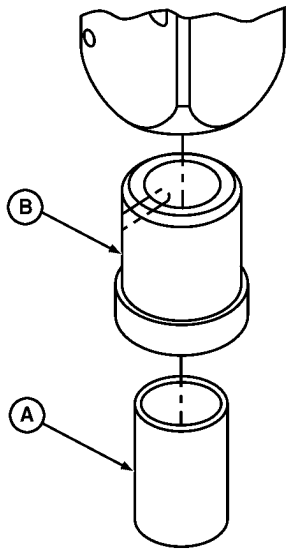
**A—Nylon Plug**

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–5/37

6. Install insert bushing (A) into insert holder (B).

*NOTE: Beveled end of the insert bushing (A) goes in first. Grease grooves on the insert (A) and the holder (B) must line up when the bushing bottoms in the holder.*



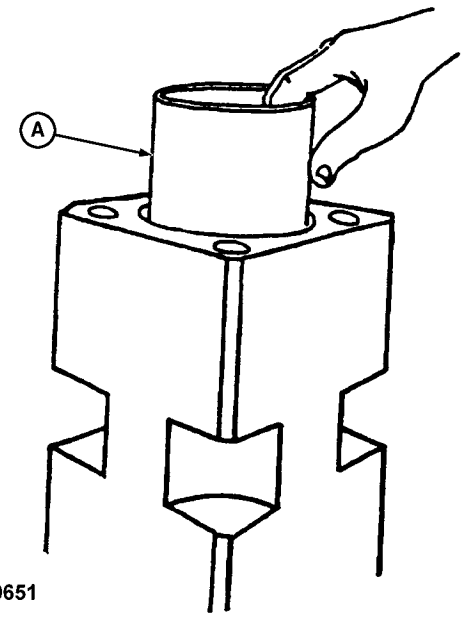

T120658

T120658 –UN–22MAR99

**A—Insert Bushing**
**B—Insert Holder**

CED,OUOE039,6 –19–20MAR99–6/37

7. Turn housing over and insert upper bush (A).




T120651

T120651 –UN–22MAR99

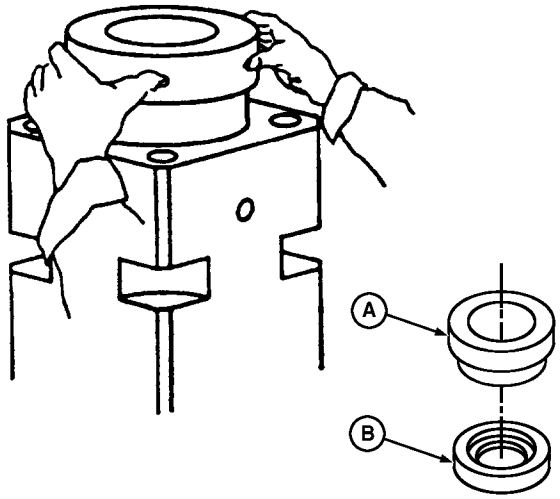
**A—Upper Bushing**

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–7/37

33
36

8. Insert spacer (A) and spacer ring (B) into chuck housing.



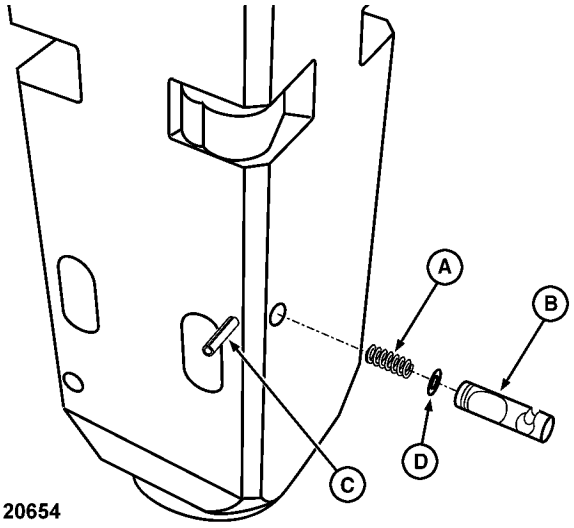

T120652 –UN–22MAR99

T120652

**A—Spacer**
**B—Spacer Ring**

CED,OUOE039,6 –19–20MAR99–8/37

9. Insert spring (A) in appropriate slot in housing.




T120654 –UN–15APR99

T120654

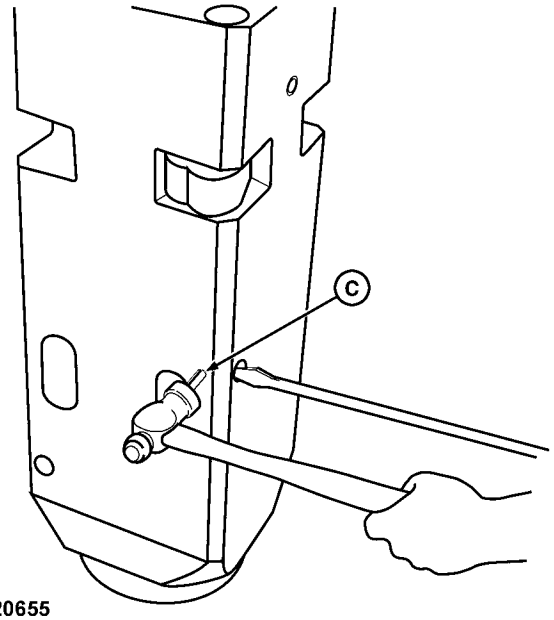
**A—Spring**
**B—Lock Bolt**
**C—Elastic Pin**
**D—O-Ring**

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–9/37

33
37

Assemble O-ring on lock bolt (B) and screw assembly into chuck housing with a screwdriver, making sure that groove is in line with pin hole. Hold lock bolt in position, and hammer elastic pin (C) in.




T120655

T120655 –UN–23MAR99

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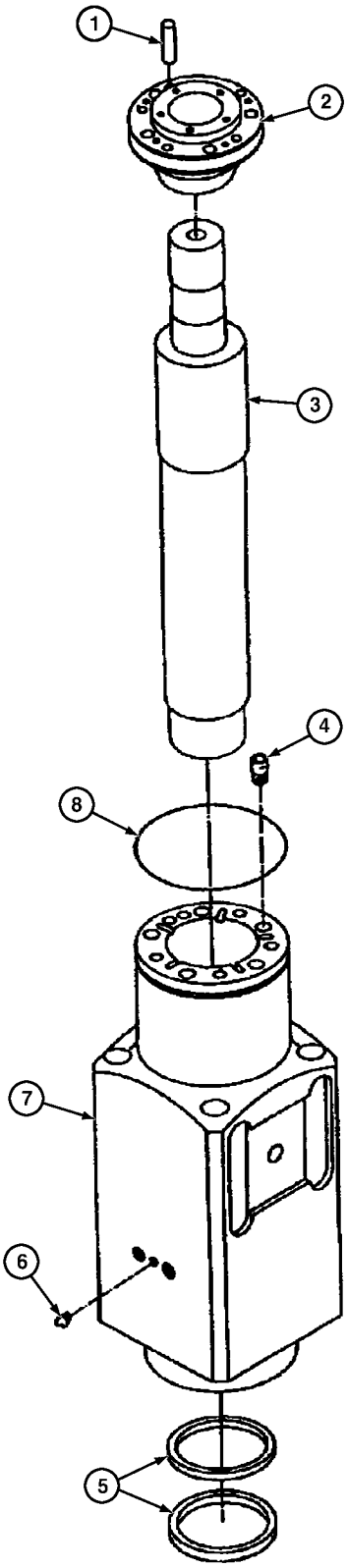
CED,OUOE039,6 –19–20MAR99–10/37

*Hydraulic Impact Breaker*

33
38




T120470 –UN–22MAR99

**T120470**

**1—Centering Pin**
**2—Guide Adapter**
**3—Piston**
**4—Valve**
**5—U-Joint Seals**
**6—Grease Nipple**
**7—Cylinder**
**8—O-Ring**

**Continued on next page**

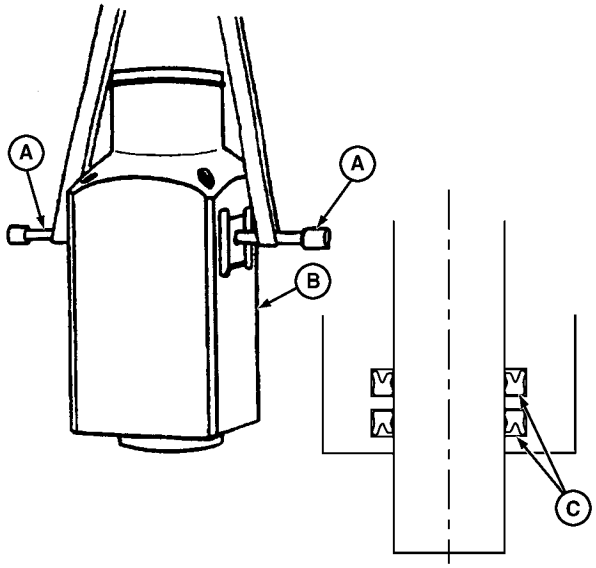
CED,OUOE039,6 –19–20MAR99–11/37

**ASSEMBLE CYLINDER**

1. Insert two accumulator screws (A) in sides of cylinder (B), as shown. Use suitable lifting device to suspend cylinder.

*NOTE: Be sure that the seals are assembled back-to back, with the lips on the outer sides.*

2. Assemble U-joint seals (C) into internal grooves of cylinder (B).



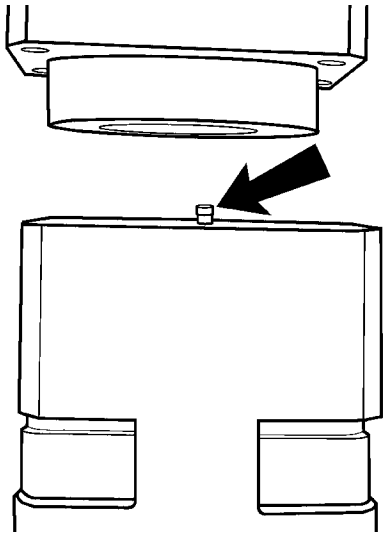

T120660

T120660 –UN–22MAR99

**A—Accumulator Screw**
**B—Cylinder**
**C—U-Joint Seal**

CED,OUOE039,6 –19–20MAR99–12/37

3. Insert locator pin into lower chuck housing.



T120661

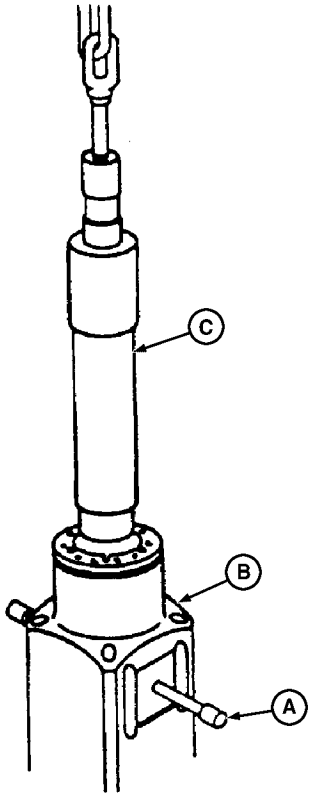
T120661 –UN–22MAR99

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–13/37

33
40

4. Using accumulator screw (A) threaded into end of piston (C), cover piston into cylinder (B).



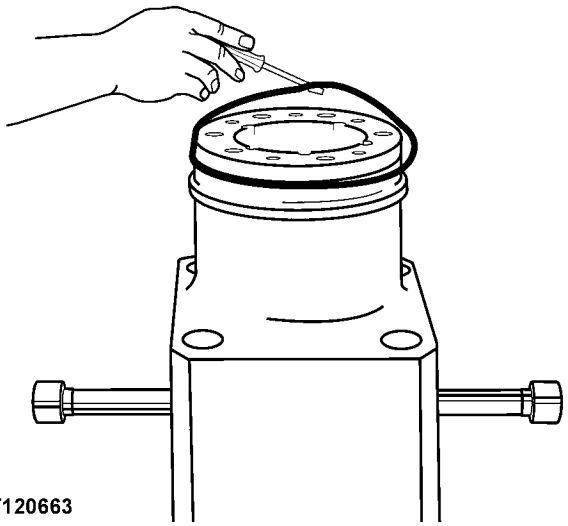

T120662

T120662 –UN–22MAR99

**A—Accumulator Screw**
**B—Cylinder**
**C—Piston**

CED,OUOE039,6 –19–20MAR99–14/37

5. Install O-ring onto cylinder.



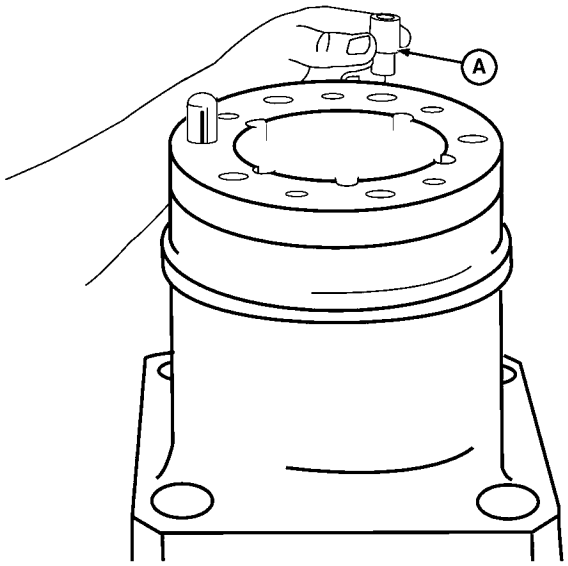
T120663

T120663 –UN–22MAR99

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–15/37

6. Insert five check valves (A) into cylinder.

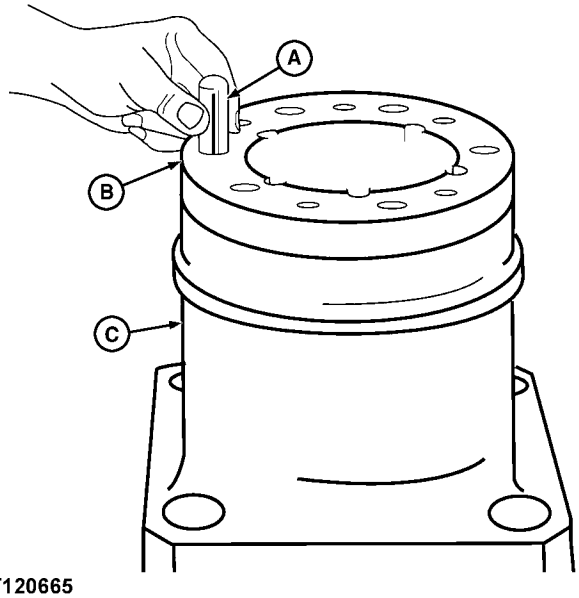



T120664

T120664 –UN–15APR99

CED,OUOE039,6 –19–20MAR99–16/37

7. Insert centering pin (A) into guide adapter (B). Place guide adapter onto cylinder (C).




T120665

T120665 –UN–15APR99

**A—Centering Pin**
**B—Guide Adapter**
**C—Cylinder**

**Continued on next page**

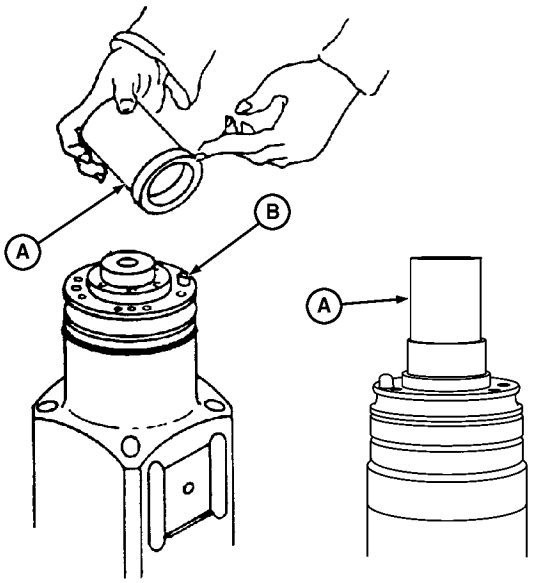
CED,OUOE039,6 –19–20MAR99–17/37

33
42

8. Place distributor (A) onto guide adapter.

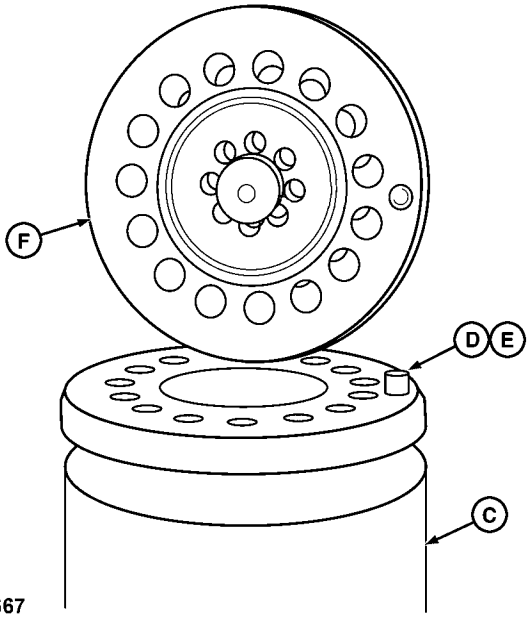
9. Brush centering pin (B) with lithium grease. Lower distributor box body (C) by accumulator screws onto distributor, guiding with centering pin.

10. Assemble dowel (D) and O-ring (E), and plate into distributor box body (C). Place box body cover (F) onto distributor box body.




T120666

T120666 –UN–15APR99




T120667

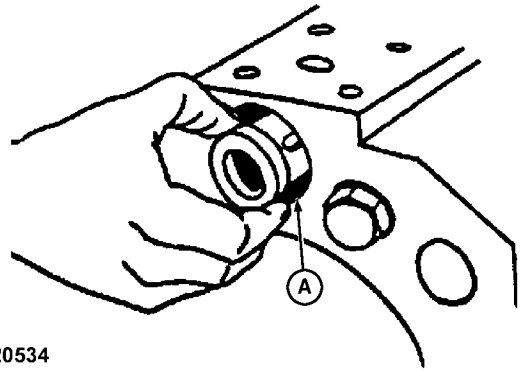
T120667 –UN–15APR99

**A—Distributor**
**B—Centering Pin**
**C—Distributor Box Body**
**D—Dowel**
**E—O-Ring**
**F—Box Body Cover**

**Continued on next page**

**ASSEMBLE PRESSURE REGULATING AND FREQUENCY VALVES**

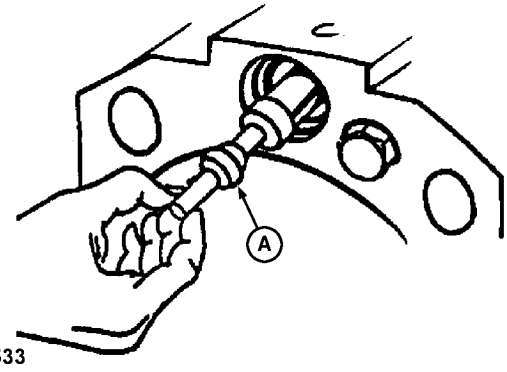
1. Place barrel with O-ring (A), into central hole in head, as shown.




**A—Barrel and O-Ring**

CED,OUOE039,6 –19–20MAR99–19/37

2. Insert slide piston (A) into central hole in head.




**Continued on next page**

CED,OUOE039,6 –19–20MAR99–20/37

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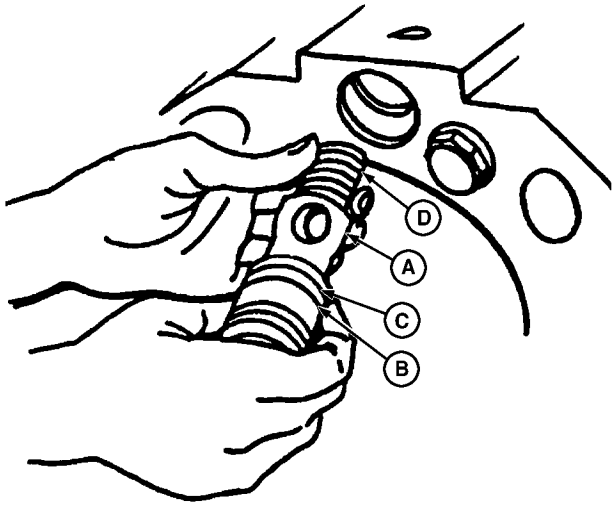
44

*NOTE: DO NOT alter the number of adjustment shims at this time.*

3. Assemble guiding plug (A), O-ring (B), adjustment shims (C), and spring (D). Insert assembly into central hole in head. Tighten with Allen wrench to proper torque specification.




T120672 –UN–22MAR99

**T120672**

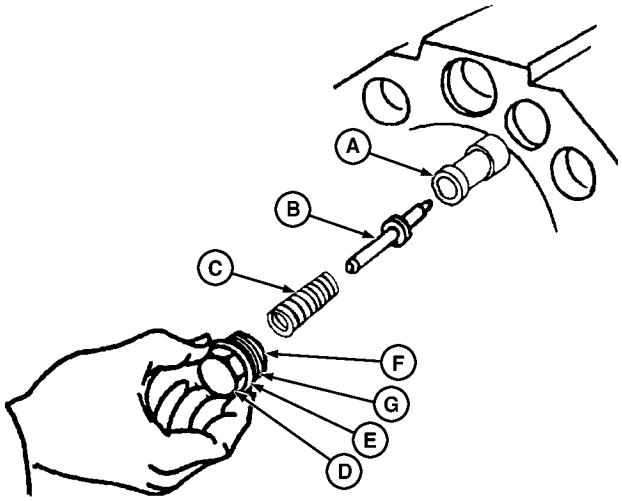
**A—Guiding Plug**
**B—O-Ring**
**C—Adjustment Shim**
**D—Spring**

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–21/37

33
45

4. Assemble valve body (A), needle (B), and spring (C) into hole in head to right of central hole.
5. Assemble plug (D), O-ring (E), spacer barrel (F) and adjustment shims (G).
6. Close the right hole with the assembled plug, using Allen wrench. to torque to specification.




T120673 –UN–22MAR99

**T120673**

**A—Valve Body**
**B—Needle**
**C—Spring**
**D—Plug**
**E—O-Ring**
**F—Spacer Barrel**
**G—Adjustment Shim**

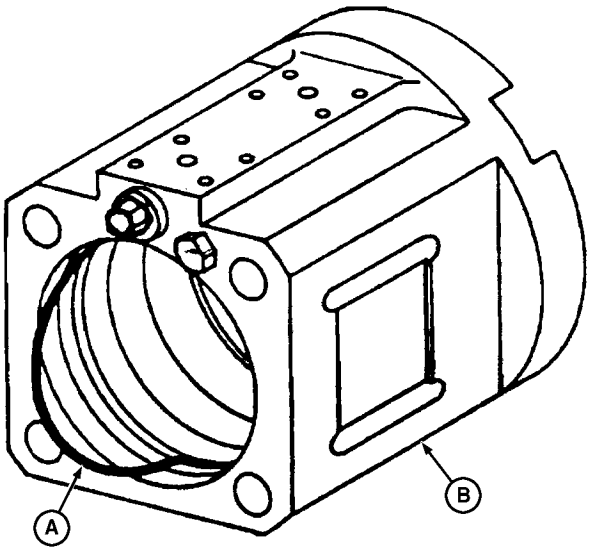
**Continued on next page**

CED,OUOE039,6 –19–20MAR99–22/37

33
46

## ASSEMBLE HEAD

1. Insert O-ring (A) into O-ring groove located at lower portion of head assembly (B).



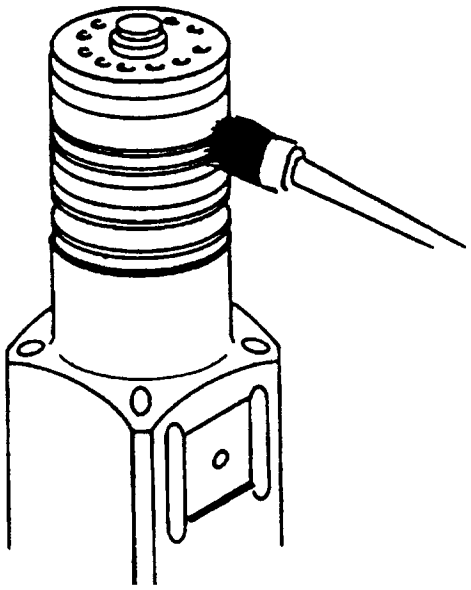

T120674 –UN–22MAR99

**T120674**

**A—O-Ring**
**B—Head Assembly**

CED,OUOE039,6 –19–20MAR99–23/37

2. Lubricate all sliding areas between box body and head.



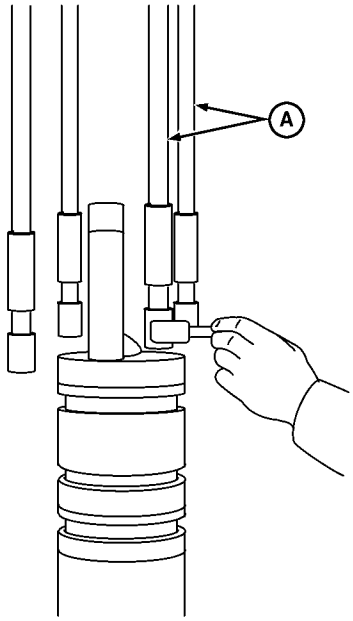
T120675 –UN–22MAR99

**T120675**

**Continued on next page**

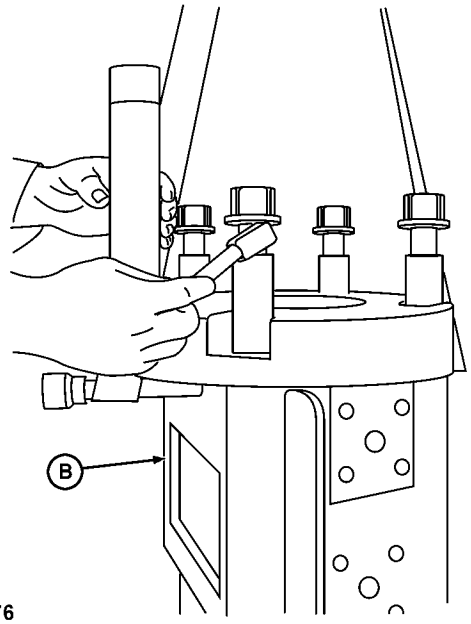
CED,OUOE039,6 –19–20MAR99–24/37

3. Lubricate both upper heads and lower threads of side rods (A), using INDIGO Supreme 1000 grease. Install side rods (A) into head (B).




T120677

T120677 –UN–22MAR99




T120676

T120676 –UN–22MAR99

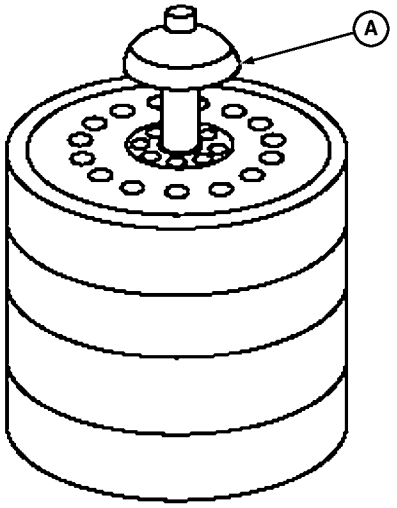
**A—Side Rod**
**B—Head**

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–25/37

33
48

4. Insert mushroom valve (A).




T120686

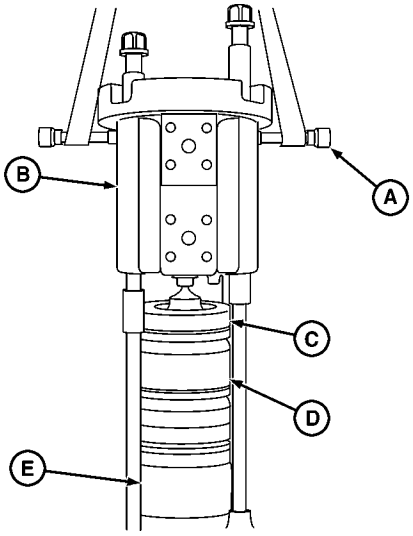
T120686 –UN–23MAR99

**A—Mushroom Valve**

CED,OUOE039,6 –19–20MAR99–26/37

5. Insert two accumulator screws (A) in either side of head in appropriate holes. Lift head (B) and position it perpendicular to box body cover (C) and distributor box body (D).

6. Lower head (B) onto cylinder (E).




T120678

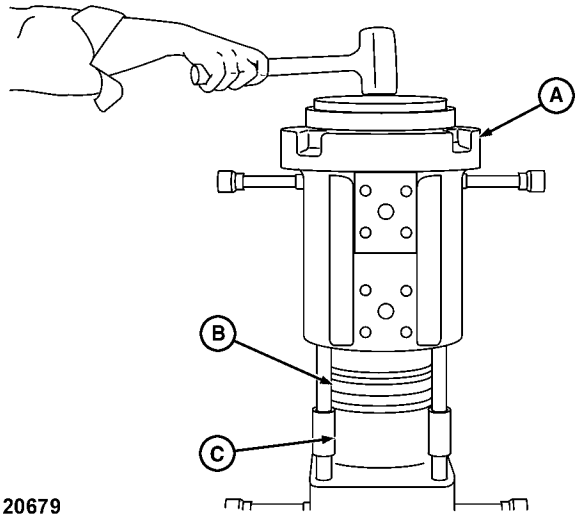
T120678 –UN–23MAR99

**A—Accumulator Screw**
**B—Head**
**C—Box Body Cover**
**D—Distributor Box Body**
**E—Cylinder**

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–27/37

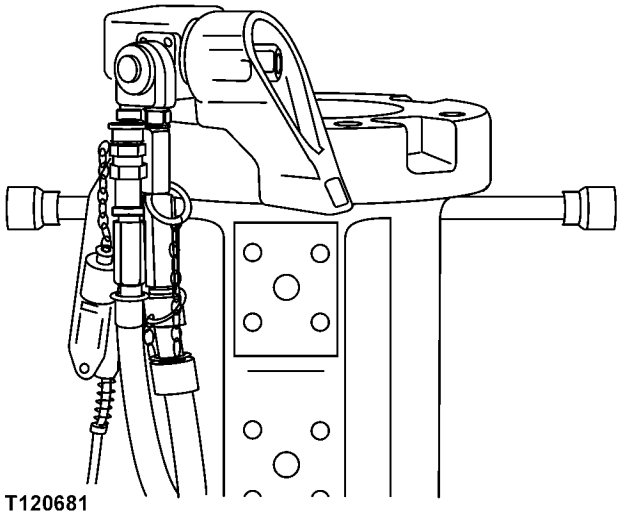
7. Using side shock, hammer head (A) with plastic/dead-blow sledge hammer until head meets box body cover (B), and cylinder (C).




**A—Head**
**B—Box Body Cover**
**C—Cylinder**

CED,OUOE039,6 –19–20MAR99–28/37

8. Cross-tighten side bolts to proper torque specification using hydraulic wrench.

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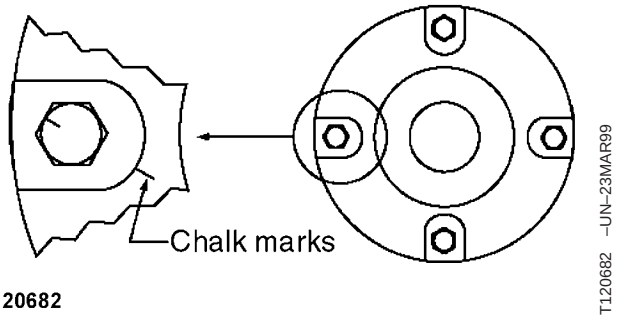
CED,OUOE039,6 –19–20MAR99–29/37

33
50

*NOTE: The side bolts are tightened to final torque in stages to reduce twisting of the bolts. The final torque is the torque specified in the torque chart plus 180 degrees.*

9. Mark side bolt heads with chalk and tighten additional 180 degrees, then tighten an additional 15 degrees.

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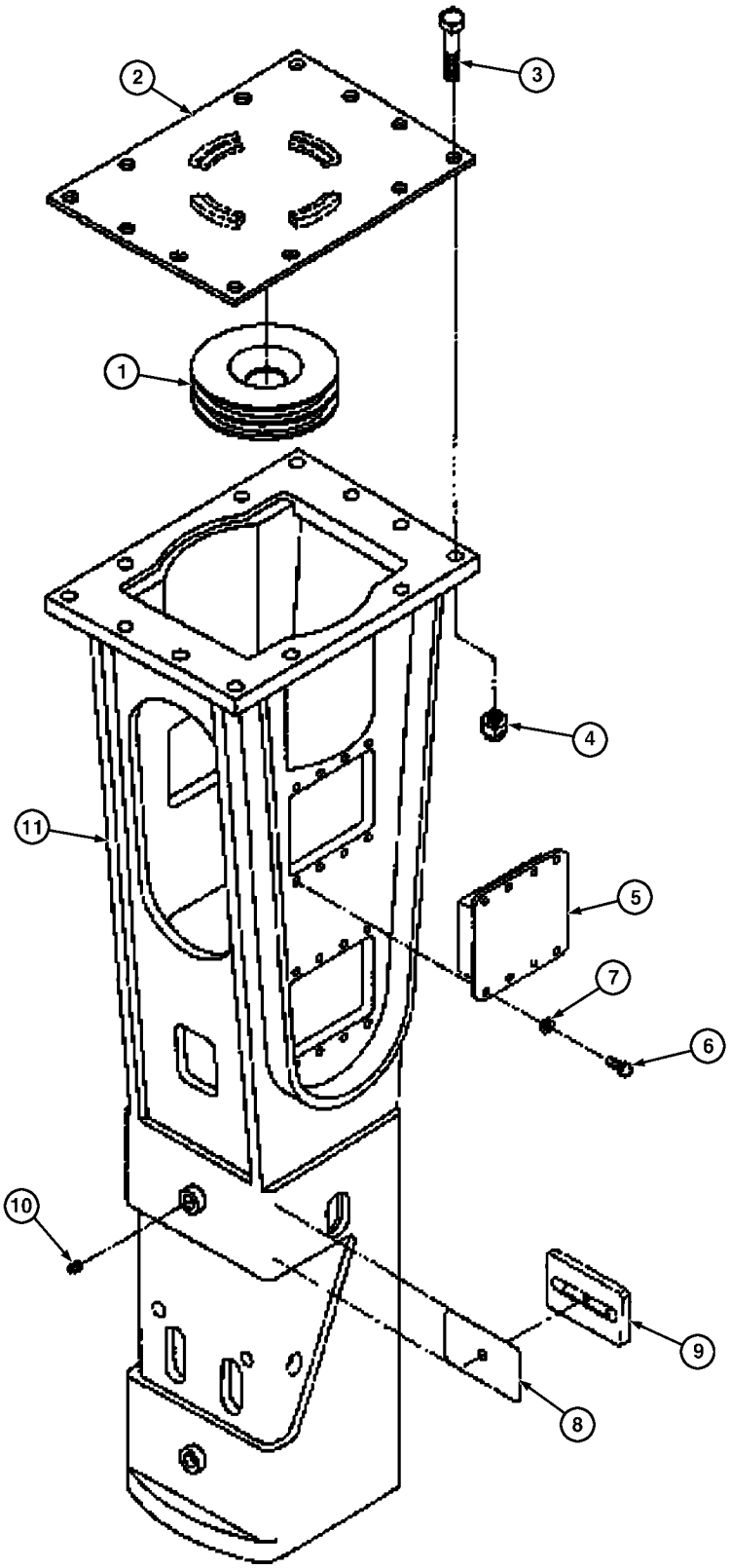
CED,OUOE039,6 –19–20MAR99–30/37

*Hydraulic Impact Breaker*

33
52




T120467

T120467 –UN–22MAR99

Continued on next page

CED,OUOE039,6 –19–20MAR99–31/37

**1—Upper Shock Absorber**
**2—Shock Absorber Holder**
**3—Top Cap Bolt and Washer**
**4—Top Cap Lock Nut**
**5—Side Shock Absorber**
**6—Shock Absorber Bolt**
**7—Disk Lock Washer**
**8—Wear Plate Shim .036 in. or .048 in.**
**9—Wear Plate**
**10—Grease Nipple**
**11—Casing**

## ASSEMBLE BREAKER CASE AND MOUNTING BRACKET

1. Install wear plate (9) and shims (8).
2. Slide breaker into casing (11).
3. Push breaker deep inside casing. Check breaker for proper clearance per specification and shim as required.
4. Assemble side shock absorbers (5) with Allen wrench and tighten to proper torque specification.
5. Measure clearance between breaker and case.
6. Assemble shock absorber holder (2) and upper shock absorber (1).
7. Install grease fitting (10) into case (11).
8. Install top shock absorber (1), holder (2) and the mounting bracket onto casing with screws (3) and self-locking nuts (4). Tighten to proper torque specification.

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–32/37

33
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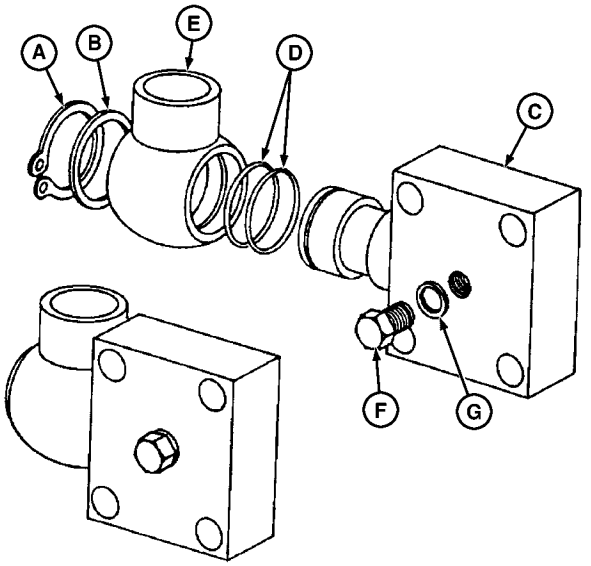
## ASSEMBLE HIGH AND LOW PRESSURE LINKS

1. Install plug (F) and sealing washer (G) onto link (C).
2. Insert two O-ring seals (D) inside H.P. and L.P. connections (E). Then install connections on neck of links.
3. Assemble washer (B) and seeger/snap ring (A) onto connections.




T120529 –UN–22MAR99

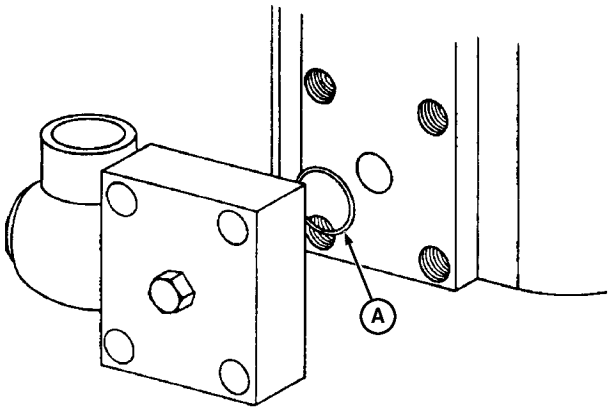
**T120529**

**A—Seeger/Snap Ring**
**B—Washer**
**C—Link**
**D—O-Ring**
**E—H.P. Connection 1 in.**
**F—Plug 1/4 in. Gas**
**G—Sealing Washer**

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–33/37

4. Insert two O-rings (A) in sockets on back sides of links.



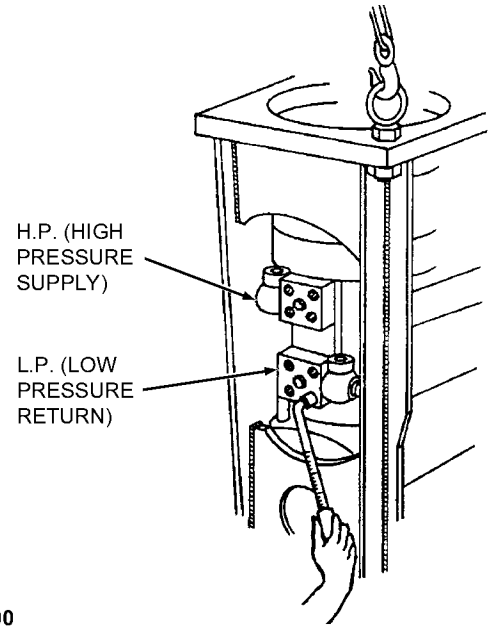

T120702 –UN–23MAR99

**T120702**

**A—O-Ring**

CED,OUOE039,6 –19–20MAR99–34/37

5. Install H.P. connection (high pressure supply) onto upper part of breaker, and L.P. connection (low pressure supply) onto lower part of breaker. Use Allen wrench to tighten to proper torque specification.




T120700 –UN–23MAR99

**T120700**

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CED,OUOE039,6 –19–20MAR99–35/37

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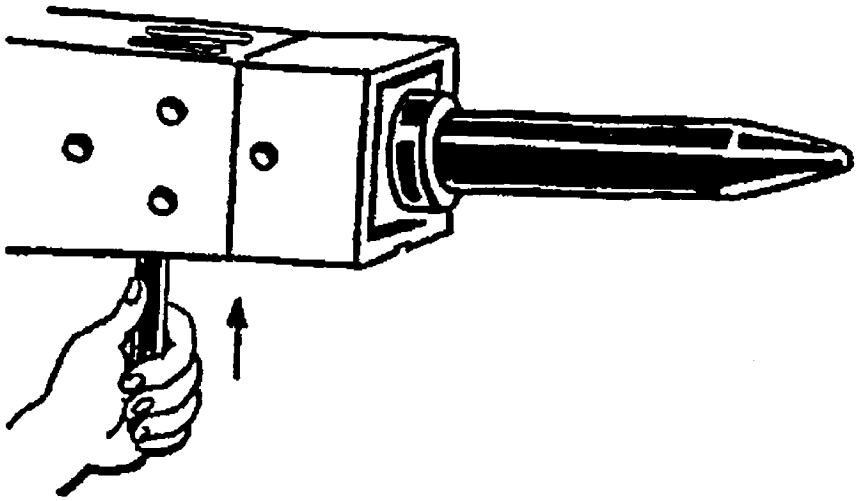


T120557

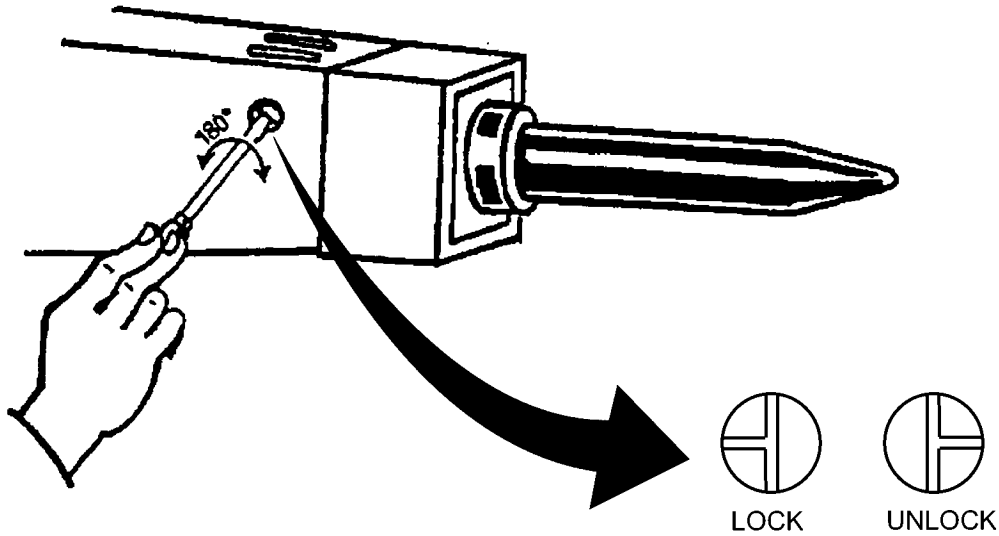
T120557 –UN–22MAR99

**ASSEMBLE TOOL**

1. Grease tool well . Ensure cavity is clean and bush is lubricated. Using suitable lifting device, insert tool in cavity so that side notches are aligned with axle slots and push in snugly.
2. Insert retaining axles with the indents facing front breaker.

**Continued on next page**

CED,OUOE039,6 –19–20MAR99–36/37




T120556

T120556 –UN–15APR99

3. With large screwdriver, push in on lock bolts located on sides of breaker and rotate 180° to secure axles.

CED,OUOE039,6 –19–20MAR99–37/37

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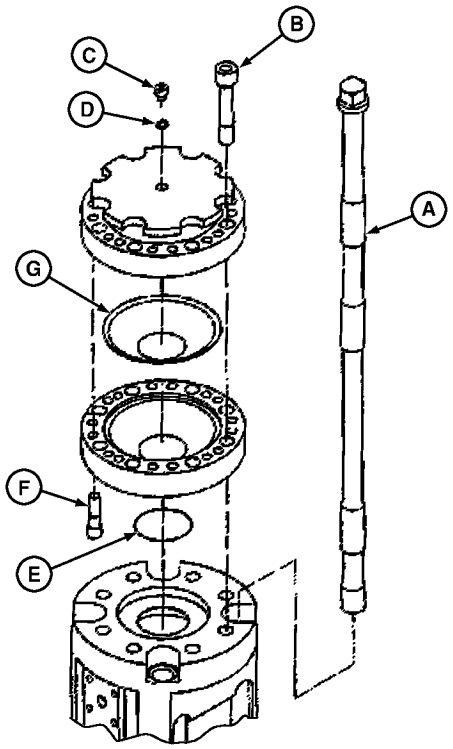
## ACCUMULATOR ASSEMBLY AND NITROGEN RECHARGE




T120586 –UN–22MAR99

**T120586**

**A—Side Bolt—Rubber Type**
**B—Accumulator Screw**
**C—Inflating Screw**
**D—Sealing Ring**
**E—O-Ring**
**F—Shell Fixing Screw**
**G—Diaphragm**

**Continued on next page**

CED,OUOE039,4 –19–20MAR99–1/7

**ASSEMBLE ACCUMULATOR**

**CAUTION: Compressed gases, by their nature, are hazardous. They are capable of creating environments that are oxygen deficient, flammable or explosive. Death has occurred during a routine repair on a carrier when a nitrogen-charged canister on the carrier exploded as it was being disassembled.**

**CAUTION: Nitrogen, which is present in our atmosphere, can still displace the oxygen in a room or enclosure and cause suffocation.**

**CAUTION: Never deliberately breathe, or allow others to breathe, any compressed gas of any type. It is possible to deplete the oxygen in the bloodstream and cause rapid suffocation and DEATH.**

**CAUTION: Always wear proper clothing for the job. Protective clothing, safety shoes and leather gloves should be worn, in addition to the required helmet or other protective gear. Any time compressed gases are handled, safety glasses should be worn.**

**CAUTION: Keep a fire extinguisher close at hand. Situate flammable gas cylinders in a location so that if a fire does occur, it may be easily extinguished. In some cases, it may be better to evacuate the area and let the cylinder burn, especially if escaping gas could collect and explode.**

**CAUTION: Never attempt to adapt fittings from one device or cylinder to another. Fittings or hoses may not be compatible with the gas products and may fail violently. Gases should never be transferred from one cylinder to another. The rate of flow of the gas itself may be sufficient to cause an explosion.**

**CAUTION: Check valves are an important safety feature, but don't rely on them 100% to prevent a "back-flow" condition. Always open the cylinder slowly. Purge the regulator and hoses by allowing a small amount of gas to pass through the system.**

**CAUTION: Nitrogen may burn, but will not ignite readily. The cylinder may explode in the heat of a fire.**

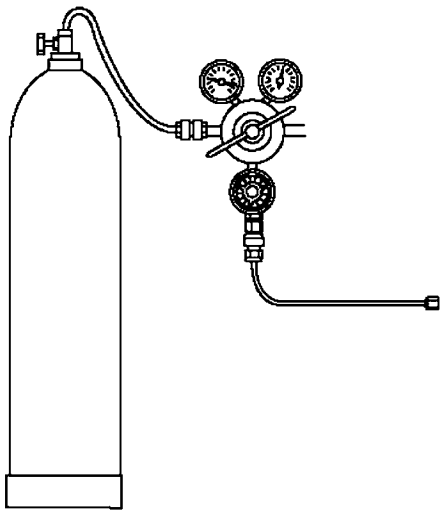
**CAUTION: Vapors may cause dizziness or suffocation. Contact with liquid may cause frostbite. Fire may produce irritating or poisonous gases.**

1. Insert new diaphragm (G) and assemble upper and lower halves of accumulator.
2. Install sixteen shell fixing screws (F) with an Allen wrench, and Torque per Specification.
3. Check condition of O-ring (E) and insert on lower side in appropriate seat. Place accumulator on head.
4. Replace sealing ring (D) and check sealing zone. Insert inflating screw (C) with Teflon tape and "finger tighten".
5. Assemble accumulator onto breaker.
6. Insert eight accumulator screws (B) with an Allen wrench. (Once screws have been started, they maybe installed with an air wrench.)
7. Insert four rubber side bolts (A).

**Continued on next page**

## NITROGEN RECHARGE

1. Carefully insert pressure reducer/regulator assembly into nitrogen tank, following safety instructions. Nitrogen bottle must not have a level below 45 bars (652.5 psi).



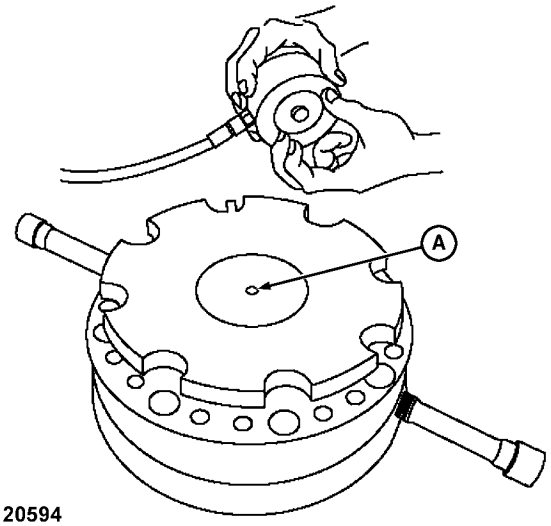
T120593 –UN–22MAR99

**T120593**

CED,OUOE039,4 –19–20MAR99–3/7

2. Attach rubber hose to pressure reducer/regulator and nitrogen tank valve.

3. Attach inflating body so hexagonal pin fits inside inflating screw (A). Check O-ring on sealing face.




T120594 –UN–22MAR99

**T120594**

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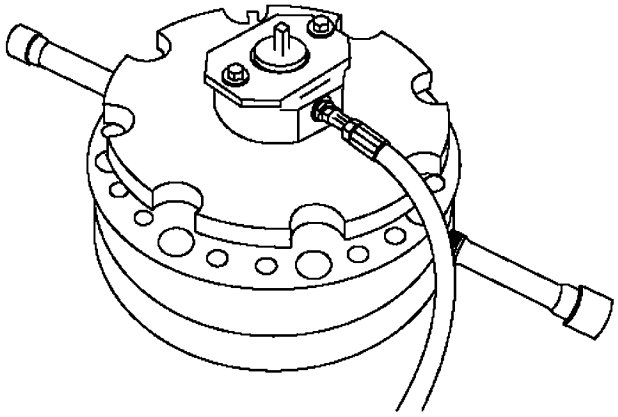
CED,OUOE039,4 –19–20MAR99–4/7

4. Install inflating body to accumulator.



T120595

T120595 –UN–22MAR99

CED,OUOE039,4 –19–20MAR99–5/7

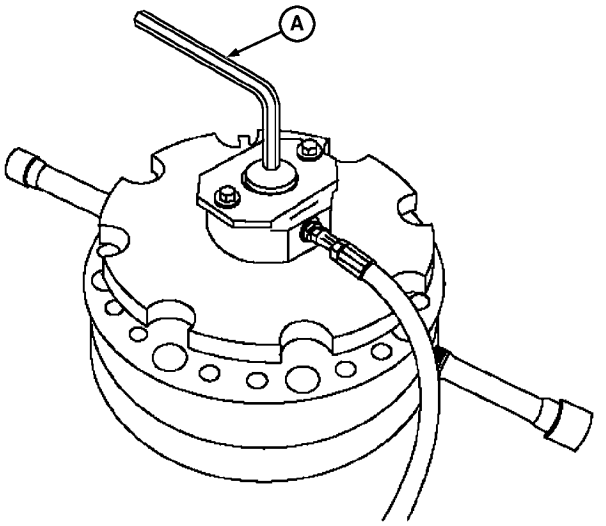
5. Using an Allen wrench (A), slowly unscrew square pin on inflating body to open nitrogen.

6. To clean accumulator, set pressure regulator on tank at its preset pressure value. Start nitrogen by opening charging valve on tank, then close charging valve on the tank and discharge nitrogen in accumulator shell.

7. Set pressure regulator on tank to value indicated in Torque Specifications. Start nitrogen by opening charging valve on tank. After about five minutes, when pressure in accumulator has reached appropriate level, close off square pin on inflating body with wrench.

8. Close nitrogen tank and discharge emissions pipe.

9. Attach pressure reducer/regulator once again to inflating screw and check that pressure has reached appropriate level (see Torque Specifications). Remove regulator and tighten inflating screw with 14 mm Allen wrench to final torque of 5 kg/m maximum.




T120597

T120597 –UN–22MAR99

Continued on next page

CED,OUOE039,4 –19–20MAR99–6/7

33
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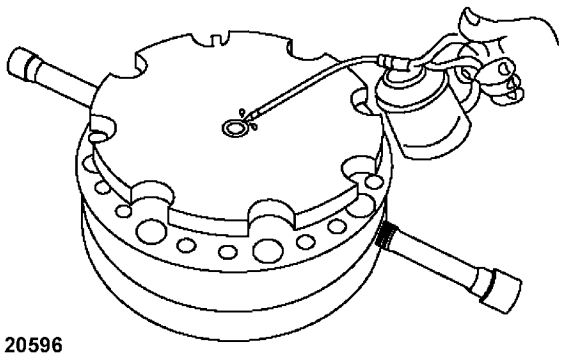
10. Using some oil, verify that there are no nitrogen leaks from inflating screw or on sides.

11. Turn accumulator upside down and fill holes with oil to check that diaphragm has no defects. If no bubbles appear, accumulator is correctly charged and ready to be fitted to breaker.



T120596

T120596 –UN–22MAR99

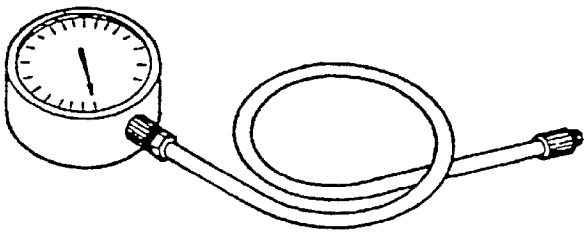
CED,OUOE039,4 –19–20MAR99–7/7

## HYDRAULIC IMPACT BREAKER SET-UP AND OIL PRESSURE REGULATION

*NOTE: All of the following calibration operations must be carried out when the oil is warm, and the carrier is at operating temperature.*

**MATERIALS NEEDED**

Tools to properly set up the carrier/breaker combination:



T120621

T120621 –UN–22MAR99

1. Flow meter with adequate range for anticipated flows and pressures.

2. Pressure Gauges:

   - 0-3500 or 05000 psi Glycerine-filled Manometer, with snubber and 1/4 in. NPT male end
   - 0-5000 psi Glycerine-filled Manometer, with snubber and 1/4 in. NPT male end
   - Two 1/4 in. BPT to 1/4 in. NPT female adapters
   - Optional: Two 15 in. hoses to allow gauges to be held off to the side for confirmation of readings while breaker is running.

**Continued on next page**

CED,OUOE039,5 –19–20MAR99–1/9

## BREAKER INLET PRESSURE CALIBRATION

1. Remove 1/4 in. gas plug (A) from high-pressure connection (A), using 19 mm (.7480") Allen wrench. Install flow meter in place of breaker. Connect H.P. breaker line to INLET of flow meter, and L.P. hammer line to outlet of flow meter. Set restrictor valve to full open position.

2. Start carrier at low idle and check for line leaks. Engage breaker control at low idle to bleed air from flow meter as follows:

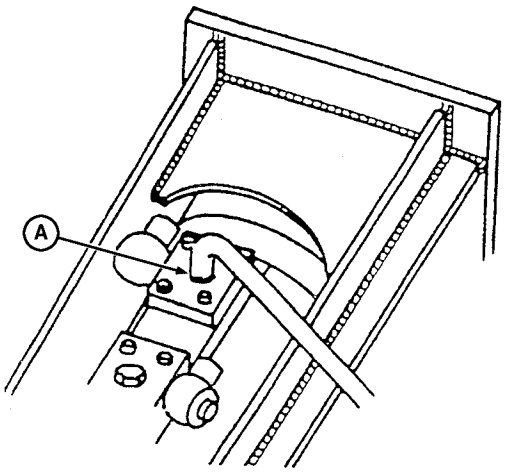
   a. Operate hydraulic circuit by starting and stopping circuit a few times.

   b. Press electrical control switch and verify that control valve is working by observing hydraulic flow, which is shown as a slight movement in hydraulic popes.

   c. Let oil run in system for 5-10 minutes, then switch engine off.

   d. Breaker will self-bleed out any trapped air. Run at half-throttle for 1-2 minutes after hook-up.

3. Have an assistant in the carrier cab. Engage and hold hammer control. SLOWLY bring carrier RPM up to high idle and ensure there are no leaks in flow meter connections. Close flow meter restrictor valve until flow and pressure on flow meter are in range of the hammer specifications. Run carrier with circuit engaged until temperature of hydraulic oil is stabilized.




T120622

T120622 –UN–23MAR99

## OIL FLOW CALIBRATION/REGULATION

With oil temperature stabilized and within breaker specifications, set-up can be started. Adjust flow meter restrictor to operating pressure of breaker. Observe and record flow reading on Breaker Delivery Report. If pressure reading obtained is WITHIN specified range, proceed to High Back Pressure Level section.

**Continued on next page**

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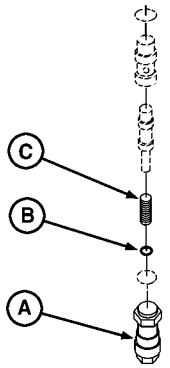
If flow meter reading indicates that pressure is ABOVE recommended average in Owner's Manual, engine rpm may be reduced until recommended pressure level is achieved. To work on flow from breaker, SLOWLY adjust flow meter restrictor to fully closed position. Observe where circuit relief starts to "crack" (flow drops off). Also observe point at which circuit relief is "fully open" (flow is Zero). This figure must be a minimum of 600 psi over the maximum operating pressure of the breaker. Adjust or correct before proceeding!

CED,OUOE039,5 –19–20MAR99–3/9

**BREAKER INSUFFICIENT OIL FLOW ADJUSTMENTS**

If pressure reading obtained is BELOW average recommended value in Owner's Manual, make necessary corrections to meet specification (e.g. check carrier diverter valve, filters, piping, check OEM specifications for breaker size capacity). If flow is still not adequate, as a last resort, adjustment shims (B) must be inserted underneath spring (C) into guiding plug (A) in the following procedures:

1. Stop engine.
2. Discharge pressure in pipes by operating breaker circuit while engine is stopped.
3. Bleed oil tank air to reduce pressure.
4. Move ball check valves to OFF position.
5. Move breaker to horizontal position, curving it under boom.
6. Cap off hammer return line to avoid oil leakage.




T120626

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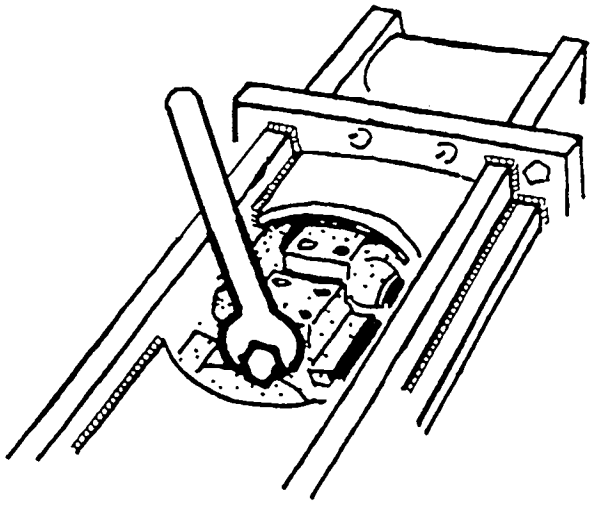
**Continued on next page**

CED,OUOE039,5 –19–20MAR99–4/9

*Hydraulic Impact Breaker*



7. Remove guiding plug (“Power Valve”) with wrench, as per the Torque Specifications.



T120623

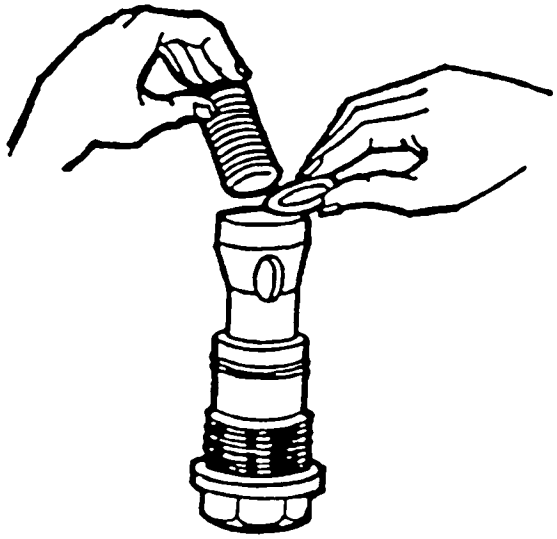
T120623 –UN–22MAR99

CED,OUOE039,5 –19–20MAR99–5/9

8. Insert necessary number of adjustment shims inside guiding plug, underneath spring, to obtain pressure required. Each 1 mm shim inserted increases pressure level approximately 5 bars (73 psi). The maximum allowed number of shims is eight.

9. Replace spring in guiding plug and reassemble, tightening firmly.

10. To REDUCE hammer pressure level, perform procedure, REMOVING adjustment shims.



T120624

T120624 –UN–22MAR99

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CED,OUOE039,5 –19–20MAR99–6/9

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## HIGH BACK-PRESSURE LEVELS

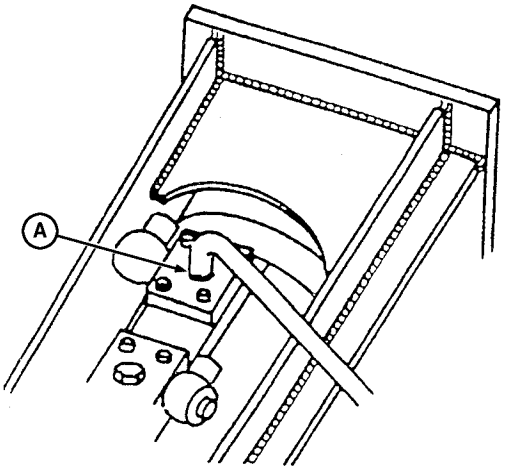
Check back pressure reading by removing 1/4 in. gas plug (A), and attach pressure gauge, with scale setting of 20 bars (290 psi). Run breaker and note pressure level (gauge will fluctuate; read average). If level is above recommended level in Technical Specifications, return line must be modified by one of three following procedures:

1. Re-route return line directly to tank to eliminate any possible restrictions.

2. Replace oil filter with larger capacity filter (minimum 400 lt/min; 60u filtration mesh) or ensure that the existing filter has been serviced.

3. Increase diameter of return circuit hose or using return “T” fitting, “T”-off return to a second additional entry back to tank. (This will increase the effective area of return circuit and drop back pressure.)

4. If back pressure is still high, call your authorized dealer.




T120622

T120622 –UN–23MAR99

## BREAKER WORKING FREQUENCY CALIBRATION/REGULATION

*NOTE: Prior to undertaking this section, ensure that the back pressure in the return circuit is at the breaker specified values.*

This section will compare the speed of the breaker versus its impact power. Speed frequency is controlled by the spool and spring under the plug (A), also known as the “Speed Valve”. Power is regulated by the spool and spring under the guiding plug (B), also known as the “Guiding Valve”.

1. Verify the breaker working frequency (speed) by operating the excavator.

2. Load the breaker perpendicular, choose a compact block, and set the breaker to a maximum flow (excavator operating mode and throttle set to maximum.

**Continued on next page**

CED,OUOE039,5 –19–20MAR99–7/9

*Hydraulic Impact Breaker*

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3. Observe gauge readings while breaker is operating in material. (Working pressure tends to increase up to maximum value, depending on hardness of material to be broken.)

4. Move excavator to softer material and operate in same manner. Frequency (speed) should increased to specification maximum. (Correspondingly, working pressure tends to decrease to specification minimum.)

5. If breaker is too much, some adjustment shims may be added under spring to increase speed and reduce impact power. See the below list. If hammer shows difficulty in breaking/penetrating, some adjustment shims may be removed from under spring to increase power and reduce speed. Alternatively, shims can be added under spring to power valve, to increase developed power of breaker.

**Continued on next page**

CED,OUOE039,5 –19–20MAR99–8/9

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If frequency (speed) is too low, adjust as follows:

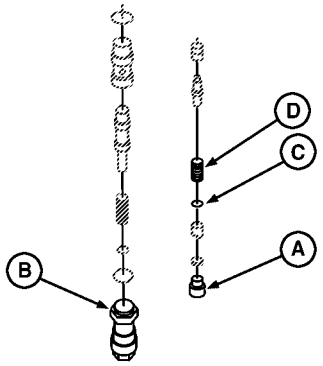
1. Check that oil flow is correct.

2. Using a hexagonal wrench (see Torque Specifications), disassemble “Speed Valve” (Plug). The purpose of this is to regulate hammer blow rate according to working conditions.

3. To increase working frequency, add adjustment shims under spring. Each shim added will increase frequency by about 2%. Maximum allowed number of shims is eight (usually adding 1—5 will do). Before adding any shims, check with your authorized dealer that there is not an easier solution. Adding adjustment shims causes the breaker to decrease its power but increase its speed. By varying the opening pressure of the “Speed Valve” according to the number of shims. However, most breakers with maximum specification flow will not need shim adjustments.

4. Replace plug “Speed Valve” onto head and tighten firmly.

If the frequency is too high, follow the above steps, in removing the adjustment shims instead of adding them. Removing adjustment shims causes the breaker to increase its power and reduce its speed. Alternatively, if the frequency is too high, verify that the flow from the carrier is not too high (in excess of hammer specifications).




T120640

T120640 –UN–23MAR99

**EXCESSIVE WORKING FREQUENCY - FURTHER ADJUSTMENTS**

If, after the shim adjustment, the working frequency is still too high, check that the needle/piston (2) is sliding easily inside the valve body (1). If the problem persists, increase the working pressure (add 2 shims to the power valve) by approximately 10 bars (145 psi). The spring rigidity is directly proportional to the hardness of the material, and so will affect the blow frequency. If operating on soft material, and the breaker speed is still too high, the “Power Valve” may have to be adjusted, as well as the “Speed Valve” (8). Refer to the following procedures.

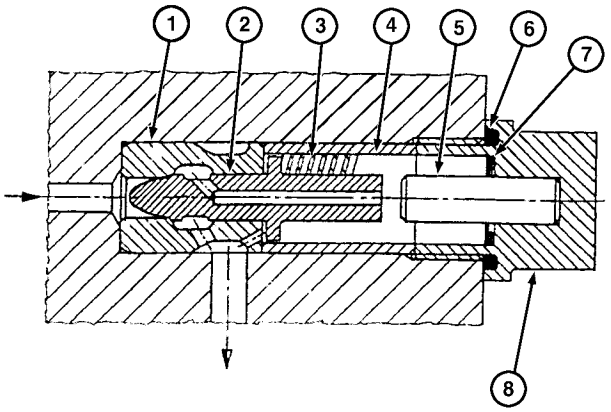
CED,OUOE039,5 –19–20MAR99–9/9

## SPECIAL WORKING FREQUENCY CALIBRATIONS

### WHEN BLOW RATES NEED TO BE CHANGED

In certain cases, such as block breaking (i.e. quarry) or piling work, variable frequencies are unnecessary/counterproductive. In these cases, the speed valve (4) may be removed from the hammer and replaced with a pin valve. The breaker is then operated at maximum power, and can be calibrated at a fixed pressure and constant rhythm.

Alternatively, the variability valves can be completely eliminated and the head hole can be sealed with a gas plug. It is also possible to operate the hammer as semi-automatic, by removing the spring (3), needle (2), and barrel (5) from the needle/piston (2).




T120641

T120641 –UN–22MAR99

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CED,OUOE012,168 –19–20MAR99–1/2

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## REGULATING A PIN VALVE

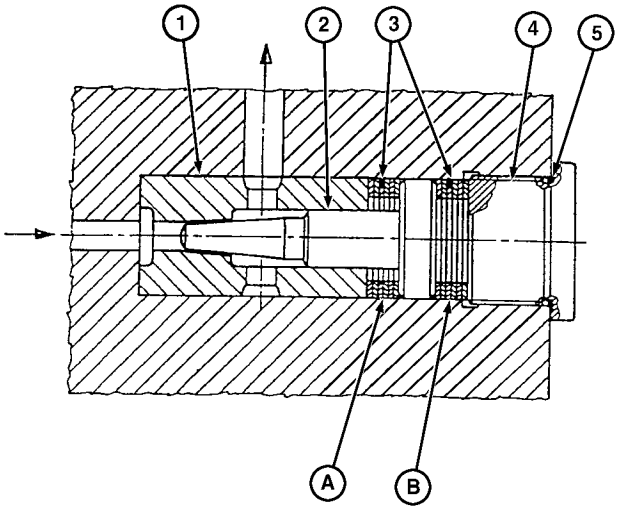
For these adjustments, be sure that the hammer pressure is regulated as listed. Rapid Stage (psi) should be 1885 and Slow Stage (psi) should be 2175.

Widening the opening of the valve (removing shims) makes the breaker more powerful but reduces its speed.

Narrowing the opening of the valve (oil passage) increases the breaker speed, but makes the blows less forceful.

Add or remove adjustment shims in the same ways for the cylindrical valve to adjust speed/power.

In a pin valve, the pressure varies with the movement of the shims. There are 12 shims. The total number in the breaker must NEVER be less than this number. To speed up the breaker (decrease power), remove shims from the “B” side and put them in the “A” side, leaving the total number of shims at 12. To slow down the breaker (increase power), move shims from the “A” side to the “B” side.

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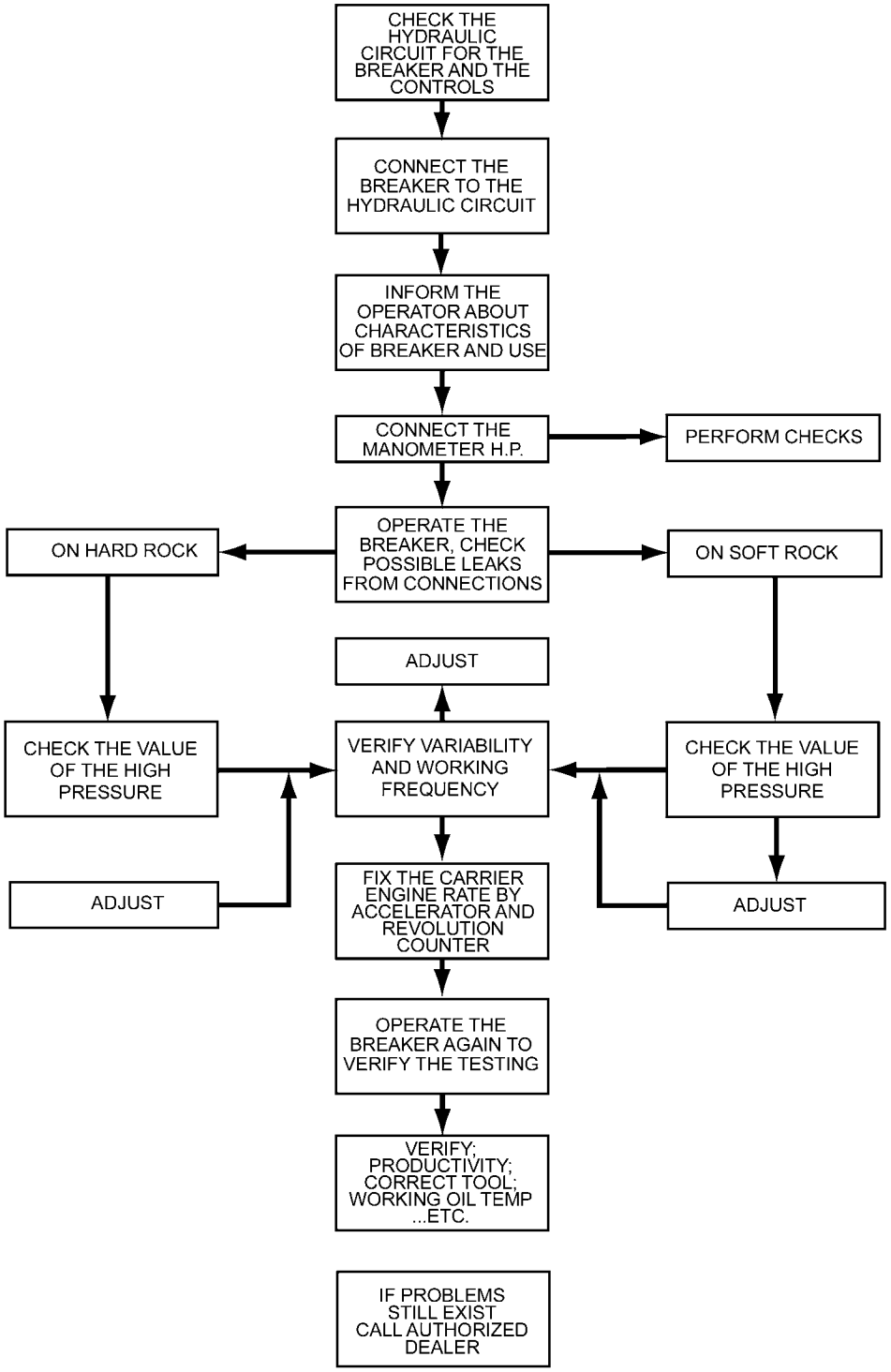
## HYDRAULIC CIRCUIT ADJUSTMENT

### HOW TO ADJUST A HYDRAULIC BREAKER




T120632

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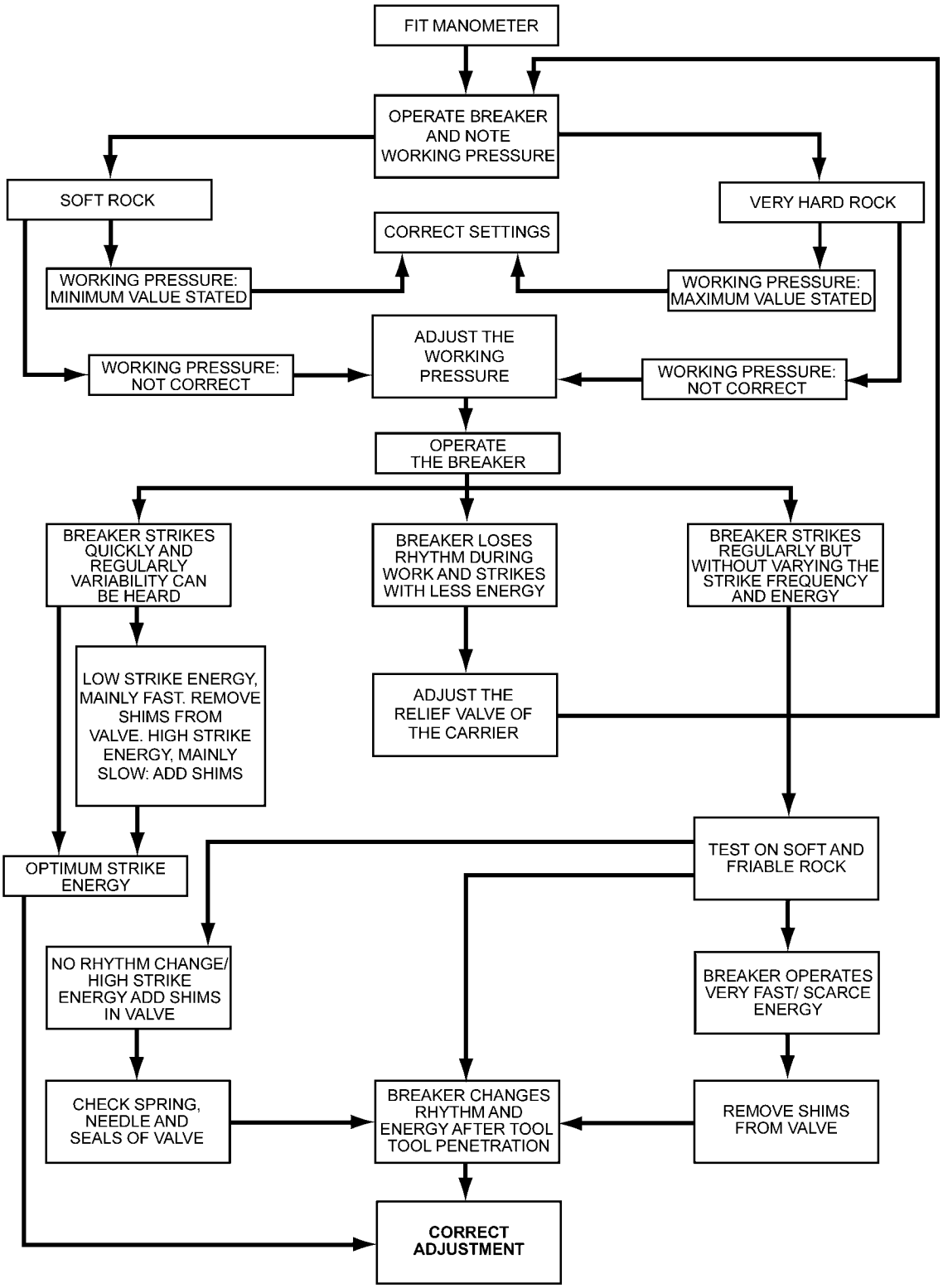
## VALVES CALIBRATION

### VALVE SETTING GUIDELINE




T120631 –UN–22MAR99

CED,OUOE012,170 –19–20MAR99–1/1

# TECHNICAL SPECIFICATIONS

**INDECO MES 3500 HD**

| | |
|---|---|
| **Impact Class:** | **5,500 ft/lb** |
| **Blows per Minute:** | **350 – 600** |
| **Carrier Weight:** | **42,000 – 72,000 lbs** |
| **Total Height:** | **96.5 in** |
| **Working Weight:** | **3,850 lbs** |
| **Length of Tool:** | **43.3 in** |
| **Diameter of Tool:** | **5.75 in** |
| **Tool Weight:** | **275 lbs** |
| **H.P. Fitting:** | **1.00 in BPP** |
| **L.P. Fitting:** | **1.25 in BPP** |
| **Maximum Oil Supply:** | **42 – 50 gpm** |
| **Pressure at Excavator:** | **2,400 psi** |
| **Pressure at Breaker:** | **2,000 – 2,150 psi** |
| **Maximum Backpressure:** | **75 psi** |
| **Accumulator Charge (Nitrogen):** | **520 psi (36 Bar)** |
| **Oil Temperature:** | **68 – 167 F** |
| **Maximum Lower Bushing ID:** | **6.22 in.** |

**Torque Specifications:**

| Item | Wrench | Ft/Lbs |
|---|---|---|
| **Under Water Plug** | **12 mm Allen** | **130** |
| **Side Bolt (See note below)** | **41 mm** | **434** |
| **Test Plugs** | **19 mm** | **4** |
| **Link Screws** | **14 mm Allen** | **130** |
| **Guide Plug** | **41 mm** | **542** |
| **Variable Speed Plug** | **24 mm** | **130** |
| **Inflating Screw** | **14 mm Allen** | **36** |
| **Shell Fixing Screw** | **17 mm Allen** | **325** |
| **Accumulator Screw** | **22 mm Allen** | **651** |
| **Shock Absorber Screw** | **22 mm** | **108** |

**Note: The sidebolt must be tightened in the head at a pre-torque of 1/2 the ending torque. Gradually cross tighten each side bolt to the torque listed in this table. Index the bolt head and turn the sidebolt an additional 180 degrees plus 15 degrees clockwise, then turn each sidebolt 15 degrees counter-clockwise.**

BLANK

# CHAPTER 21

# SECTION 43

# SWING OR PIVOTING SYSTEM REPAIR

**BLANK**

# Group 4350
# Mechanical Drive Elements

## 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.*

CED,OUOE020,52 –19–19APR99–1/7

Lifting Bracket . . . . . .JT01748

Use with a hoist to lift components.

CED,OUOE020,52 –19–19APR99–2/7

Barrel Support . . . . . DFT1089[1]

Use with bridge planks, hardwood blocks, and a wide flange beam to support the upperstructure.

[1]*Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

CED,OUOE020,52 –19–19APR99–3/7

Bridge Planks

Use with barrel supports to support upperstructure.

CED,OUOE020,52 –19–19APR99–4/7

Wide Flange Beam . . . 3.7 m (12 ft) Length of W8 x 28 lb

Use with barrel supports to support upperstructure.

**Continued on next page**

CED,OUOE020,52 –19–19APR99–5/7

*Mechanical Drive Elements*

Service Jack . . . . . 18-t (20-Ton)

Placed under each end of undercarriage to support upperstructure.

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2

CED,OUOE020,52 –19–19APR99–6/7

Guide Pin . . . . . .M27 x 2 x 150 mm[1]

To align cap screw holes in swing bearing with holes in main frame.

[1]*Fabricated tool, dealer made. (See Section 99 for instructions to make tool.)*

CED,OUOE020,52 –19–19APR99–7/7

## OTHER MATERIAL

| Number | Name | Use |
|---|---|---|
| T43514 (U.S.)<br>TY9475 (Canadian)<br>277 (LOCTITE®) | Plastic Gasket | Apply to oil seal bore in swing gearbox cover.<br>Apply to swing gearbox cover gasket.<br>Apply to swing motor mating surface.<br>Apply to swing bearing, upperstructure, and undercarriage. |
| TY16285 (U.S.)<br>TY9485 (Canadian)<br>7649 (LOCTITE®) | Cure Primer | To clean and cure surface prior to application of adhesives or sealants. |
| | Multi-Purpose Grease | To apply to lips of seals.<br>Apply to swing bearing teeth and pinion shaft.<br>Apply to swing gear balls and spacers.<br>Apply to swing bearing teeth and pinion shaft. |
| TY21517 (U.S.)<br>454 (LOCTITE®) | Instant Gel Adhesive | To bond upper and lower seal to swing bearing. |

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*LOCTITE is a trademark of Loctite Corp.*

CED,OUOE003,1119 –19–11SEP98–1/1

## SPECIFICATIONS

| Item | Measurement | Specification |
|---|---|---|
| Swing Gearbox: | | |
| Swing Motor, Brake, and Gearbox | Weight | 410 kg (905 lb) approximate |
| Gearbox-to-Frame Cap Screw | Torque | 735 N•m (540 lb-ft) |
| Swing Motor | Weight | 77 kg (169 lb) approximate |
| Cover-to-Housing Cap Screw | Torque | 88 N•m (65 lb-ft) |
| Ring Gear-to-Housing Cap Screw | Torque | 390 N•m (290 lb-ft) |
| Swing Motor and Brake-to-Ring Gear Cap Screw | Torque | 88 N•m (65 lb-ft) |
| Upperstructure: | | |
| Barrel Support | Weight | 545 kg (1200 lb) approximate |
| Machine Without Tracks | Weight | 29 245 kg (64,475 lb) approximate |
| Boom of Main Frame-to-Floor Clearance | Height<br>Height | 1500 mm (59 in.) minimum<br>1550 mm (61 in.) maximum |
| Bottom of Main Frame-to-Floor Clearance | Height<br>Height | 1500 mm (59 in.) minimum<br>1550 mm (61 in.) maximum |
| Undercarriage | Weight | 6570 kg (14,410 lb) approximate |
| Swing Bearing-to-Upperstructure Cap Screw | Torque | 1230 N•m (900 lb-ft) |
| Swing Bearing: | | |
| Swing Bearing | Weight | 500 kg (1102 lb) approximate |
| Undercarriage-to-Swing Bearing Cap Screw | Torque | 1230 N•m (900 lb-ft) |

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CED,OUOE020,53 –19–19APR99–1/1

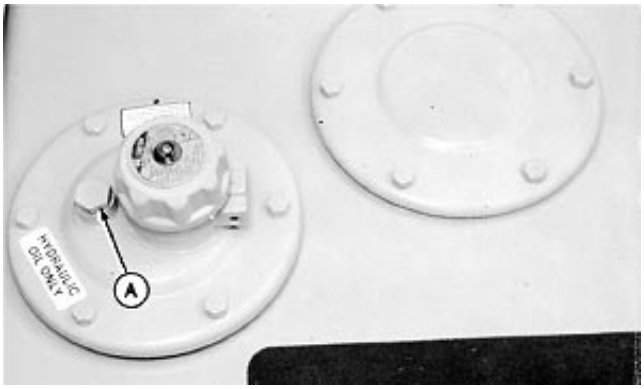
## REMOVE AND INSTALL SWING GEARBOX

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

*NOTE: Swing motor, brake, and gearbox are removed as one unit, but motor and brake may be removed separately.*

1. Loosen vent plug (A) to release air pressure from hydraulic oil tank.

2. Pull a vacuum in hydraulic oil tank using a vacuum pump or drain hydraulic oil tank. Approximate capacity is 159 L (42 gal).




T7869AT –UN–12NOV92

**A—Vent Plug**

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5

**Continued on next page**

CED,OUOE027,257 –19–19MAY98–1/3

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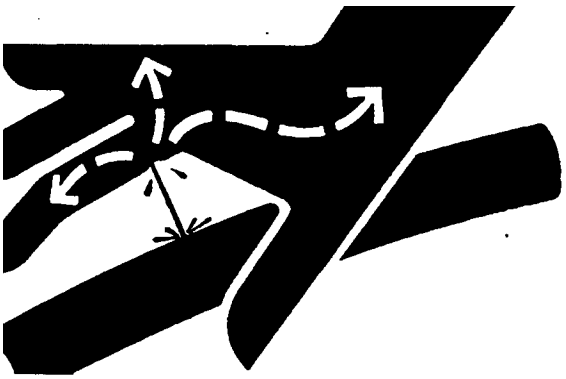
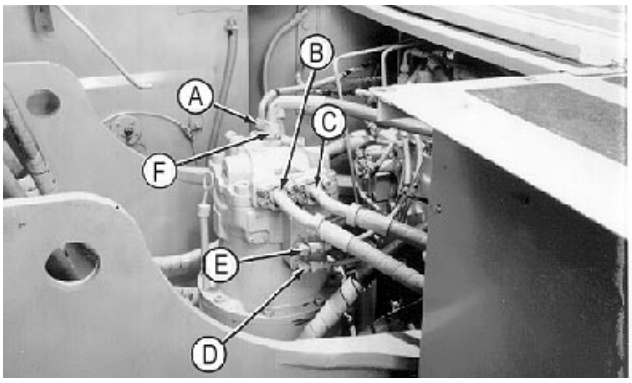
6

**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

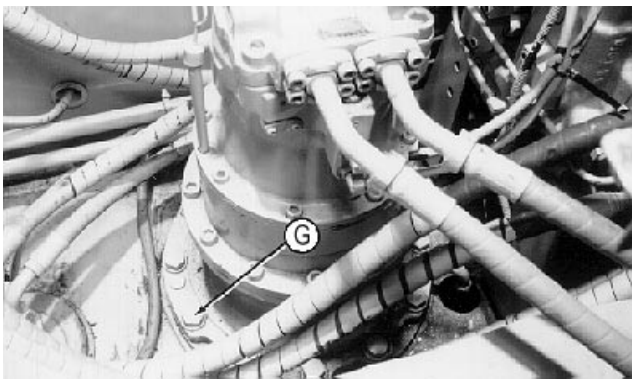
3. Disconnect lines (A—F).
4. Remove cap screws (G).



X9811 –UN–23AUG88




T105899 –UN–19DEC96




T105900 –UN–19DEC96

**A—Swing Motor Top Right Port-to-Reservoir Return Line**
**B—Swing Motor Left Front "B" Port-to-Main Control Valve Left Rear Lower Port Line**
**C—Swing Motor Left Rear "A" Port-to-Main Control Valve Left Rear Upper Port Line**
**D—Swing Brake Relief Valve "PG"Port-to-Solenoid Valve Manifold Bottom Port Line**
**E—Swing Brake Relief Valve "SH" Port-to-System Relief Manifold Block Front Port Line**
**F— Swing Motor Top Left Port-to-Main Control Valve Left Front Top Port Line**
**G—Cap Screw (12 used)**

**Continued on next page**

CED,OUOE027,257 –19–19MAY98–2/3

**CAUTION: The approximate weight of swing motor, brake, and gearbox is 410 kg (905 lb).**

**Swing Motor, Brake, and Gearbox—Specification**

Weight..... 410 kg (905 lb) approximate

5. Remove swing motor and gearbox using lifting brackets, such as JT01748 Lifting Brackets, and a hoist.

6. Repair or replace parts as necessary.

7. Install swing motor and gearbox. Tighten cap screws.

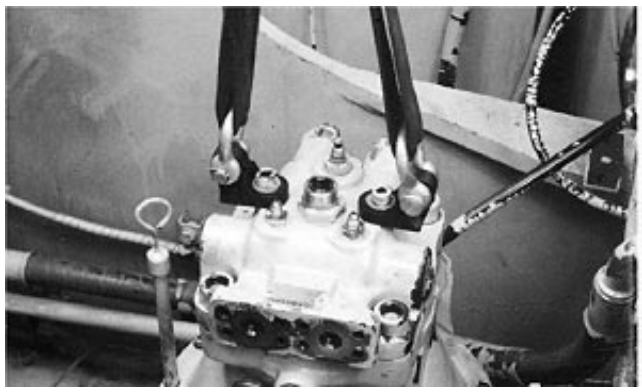
**Gearbox-to-Frame Cap Screw—Specification**

Torque ..... 735 N•m (540 lb-ft)

8. Connect lines.

**IMPORTANT: Hydraulic pump, swing motor and park brake, and swing gearbox will be damaged if not filled with oil before operating swing function. Procedure must be performed whenever a swing gearbox is installed or oil has been drained from the gearbox and hydraulic oil tank.**

9. Do swing gearbox, and swing motor and park brake start-up procedures. (See procedures in this group and Group 4360.)



T7685NL –UN–07MAY92

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CED,OUOE027,257 –19–19MAY98–3/3

## SWING GEARBOX START-UP PROCEDURE

**IMPORTANT: Swing gearbox will be damaged if not filled with oil before operating swing function. Procedure must be performed whenever a new swing gearbox is installed or oil has been drained from the gearbox.**

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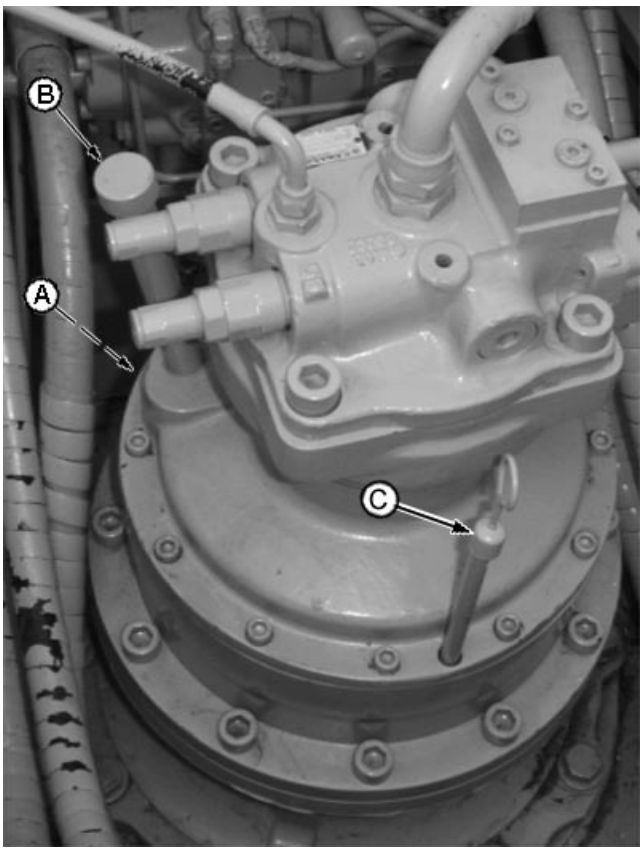
1. Check that drain line (A) plug is installed.
2. Remove fill cap (B). Add oil. (See Swing Gearbox and Propel Gearbox Oils in Group 0004.)
3. Install fill cap. Check oil level on dipstick (C).




T109982D –UN–26MAY98

**A—Drain Line**
**B—Fill Cap**
**C—Dipstick**

CED,OUOE027,258 –19–19MAY98–1/1

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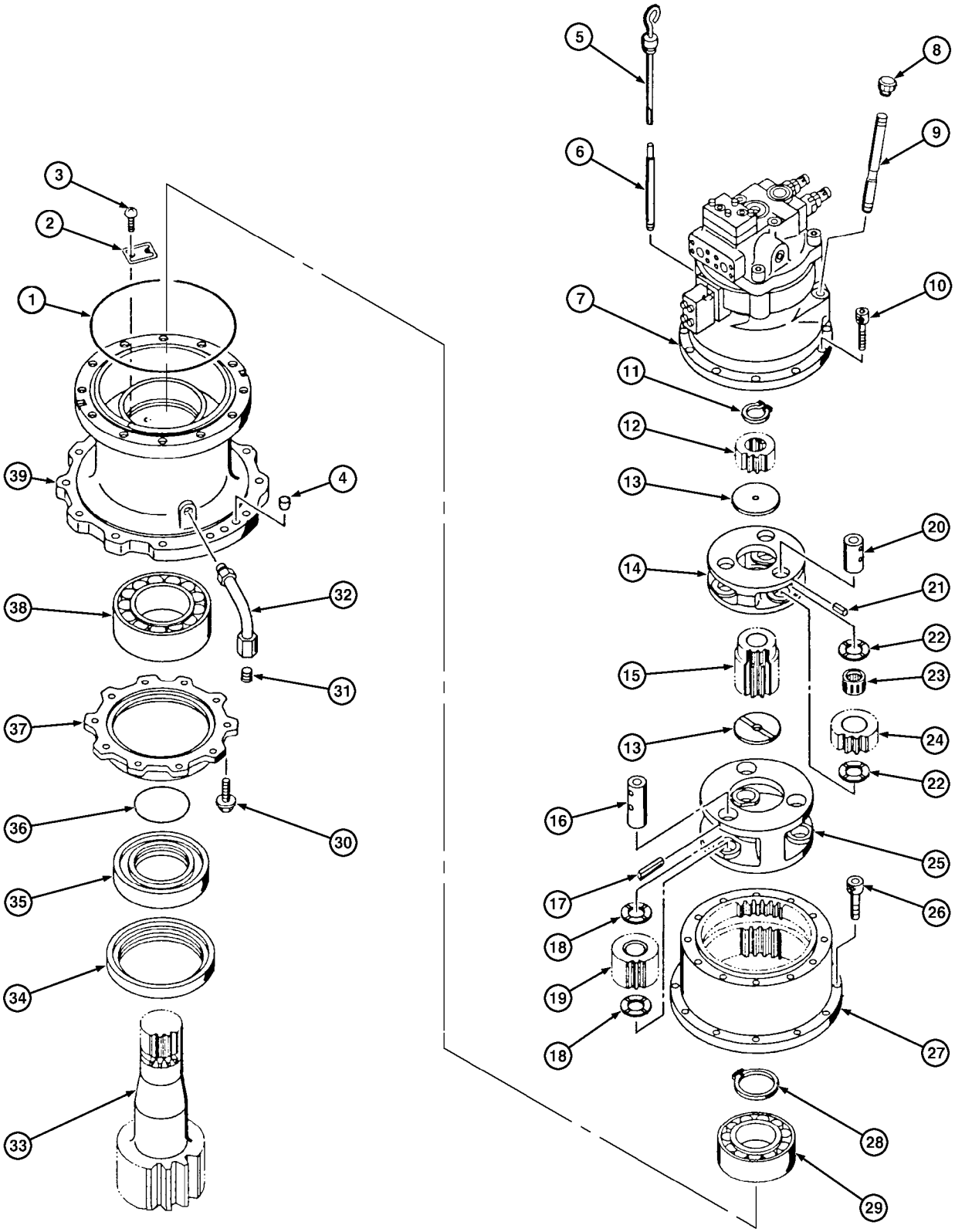
## DISASSEMBLE AND ASSEMBLE SWING GEARBOX




T115329

T115329 –UN–01JUL98

Continued on next page

CED,OUOE027,259 –19–19MAY98–1/19

**1—O-Ring**
**2—Identification Plate**
**3—Cap Screw (2 used)**
**4—Cork (2 used)**
**5—Dipstick**
**6—Pipe**
**7—Swing Motor**
**8—Cap**
**9—Pipe**
**10—Cap Screw (12 used)**
**11—Snap Ring**
**12—First Planet Sun Gear**
**13—Plate (2 used)**
**14—First Planet Pinion Carrier**
**15—Second Planet Sun Gear**
**16—Pin (Shaft) (3 used)**
**17—Spring Pin (3 used)**
**18—Thrust Plate (6 used)**
**19—Second Planet Pinion (3 used)**
**20—Pin (Shaft) (3 used)**
**21—Spring Pin (3 used)**
**22—Plate (6 used)**
**23—Needle Bearing (3 used)**
**24—First Planet Pinion (3 used)**
**25—Second Planet Pinion Carrier**
**26—Cap Screw (12 used)**
**27—Ring Gear**
**28—Snap Ring**
**29—Roller Bearing**
**30—Cap Screw and Washer (10 used)**
**31—Plug**
**32—Pipe**
**33—Pinion Shaft**
**34—Oil Seal**
**35—Wear Sleeve**
**36—O-Ring**
**37—Cover**
**38—Roller Bearing**
**39—Housing**



CED,OUOE027,259 –19–19MAY98–2/19

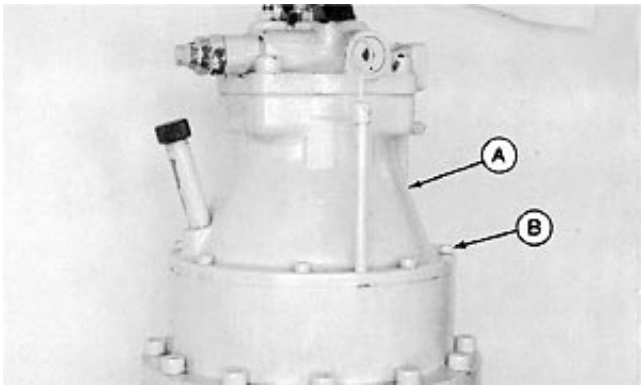
1. Drain swing gearbox oil. Approximate capacity 14 L (15 qt).

**CAUTION: The approximate weight of swing motor is 77 kg (169 lb).**

**Swing Motor—Specification**

Weight..... 77 kg (169 lb) approximate

2. Remove cap screws (B). Remove swing motor and brake (A).




T76685JX –UN–07MAY92

**A—Swing Motor and Brake**
**B—Cap Screw (12 used)**

**Continued on next page**

CED,OUOE027,259 –19–19MAY98–3/19

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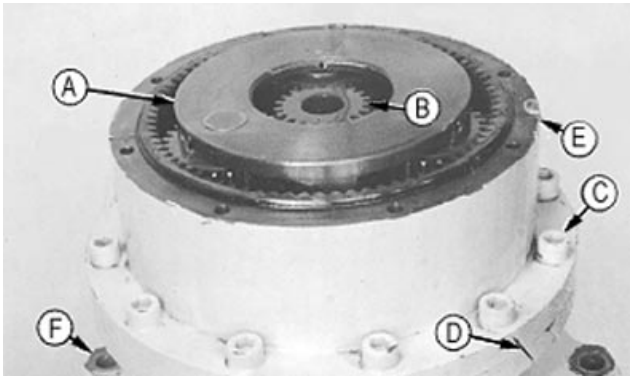
3. Make alignment mark (D) on ring gear (E) and housing (F) to aid in assembly.

4. Remove parts (A—C). Remove ring gear.

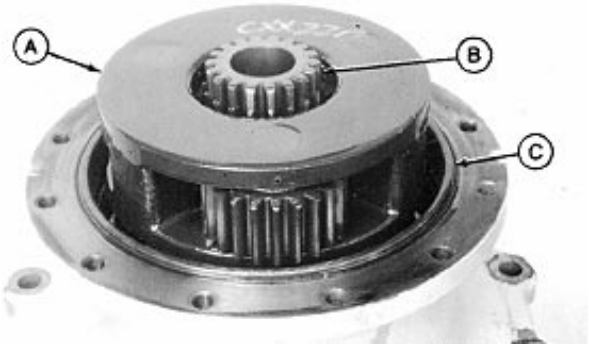



T105911 –UN–19DEC96

**A—First Planet Pinion Carrier**
**B—First Planet Sun Gear**
**C—Cap Screw (12 used)**
**D—Alignment Mark**
**E—Ring Gear**
**F—Housing**

CED,OUOE027,259 –19–19MAY98–4/19

5. Remove parts (A—C).



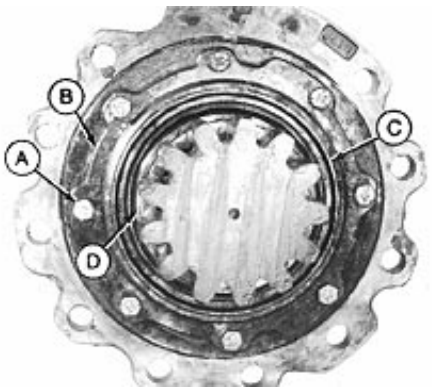

T7685JZ –UN–07MAY92

**A—Second Planet Pinion Carrier**
**B—Second Planet Sun Gear**
**C—O-Ring**

**Continued on next page**

CED,OUOE027,259 –19–19MAY98–5/19

6. Remove parts (A—D).




T7685DB –UN–22JUN92

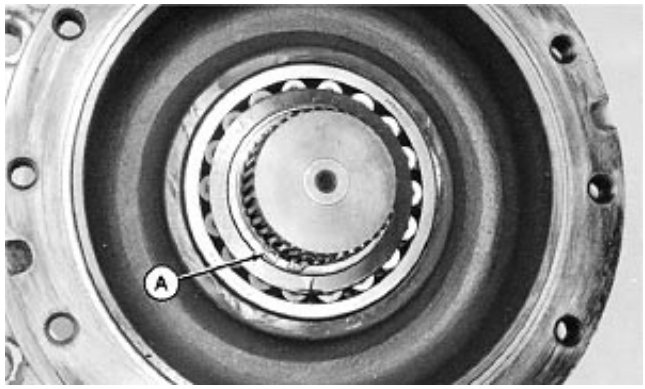


**A—Cap Screw and Washer (10 used)**
**B—Cover and O-Ring**
**C—Oil Seal**
**D—Wear Sleeve and O-Ring**

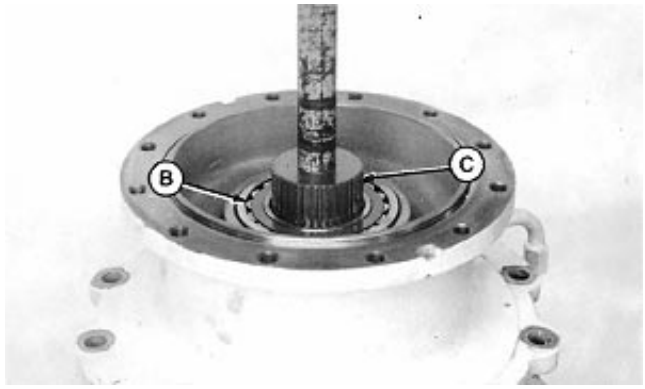
CED,OUOE027,259 –19–19MAY98–6/19

7. Remove snap ring (A).

8. Remove pinion shaft (C) using a press. Remove roller bearing (B).




T7685KB –UN–07MAY92




T7685KC –UN–07MAY92

**A—Snap Ring**
**B—Roller Bearing**
**C—Pinion Shaft**

**Continued on next page**

CED,OUOE027,259 –19–19MAY98–7/19

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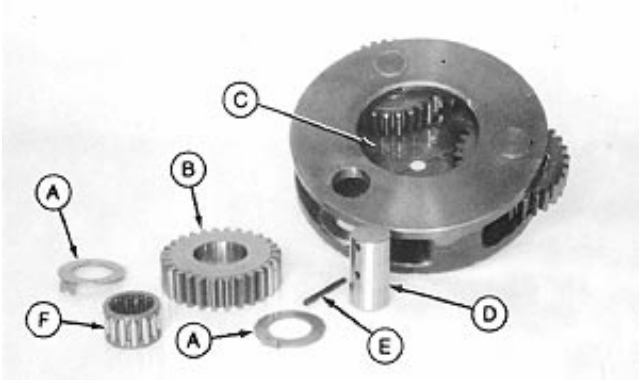
9. Remove spring pin (E).
10. Remove parts (A—D, and F).

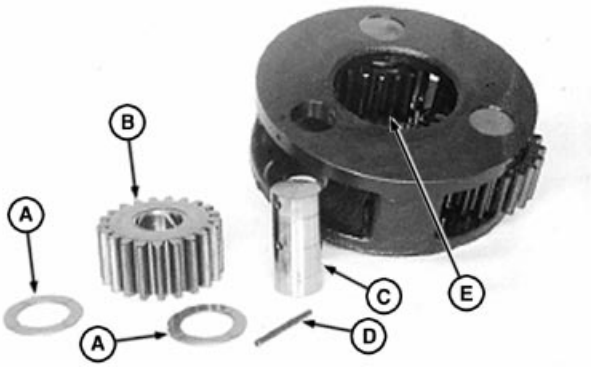



T7685KD –UN–07MAY92

**A—Plate (6 used)**
**B—First Planet Pinion (3 used)**
**C—Plate**
**D—Pin (3 used)**
**E—Spring Pin (3 used)**
**F—Needle Bearing (3 used)**

CED,OUOE027,259 –19–19MAY98–8/19

11. Remove spring pin (D).
12. Remove parts (A—C).
13. Replace parts as necessary.
14. Install plates (A and E), groove side up.
15. Install parts (B and C).



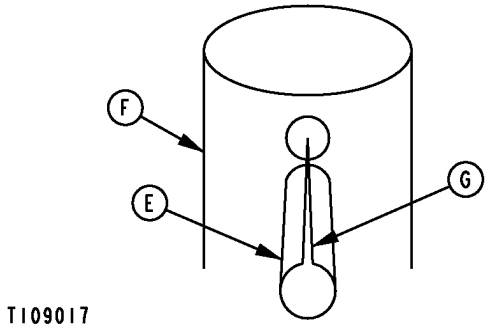

T117075 –UN–09SEP98

**A—Plate (6 used)**
**B—Second Planet Pinion (3 used)**
**C—Pin (3 used)**
**D—Spring Pin (3 used)**
**E—Plate**

**Continued on next page**

CED,OUOE027,259 –19–19MAY98–9/19

16. Install spring pin (E) with slit (G) towards end of pin (F).




T109017 –UN–17APR97

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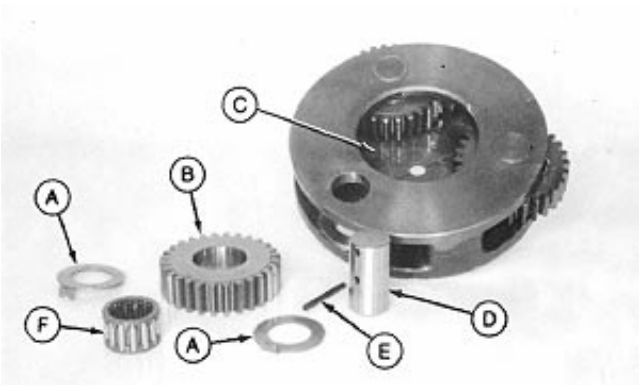
**E—Spring Pin**
**F—Pin**
**G—Slit**

CED,OUOE027,259 –19–19MAY98–10/19

17. Install parts (A—D, and F).




T7685KD –UN–07MAY92

**A—Plate (6 used)**
**B—First Planet Pinion (3 used)**
**C—Plate**
**D—Pin (3 used)**
**E—Spring Pin (3 used)**
**F—Needle Bearing (3 used)**

**Continued on next page**

CED,OUOE027,259 –19–19MAY98–11/19

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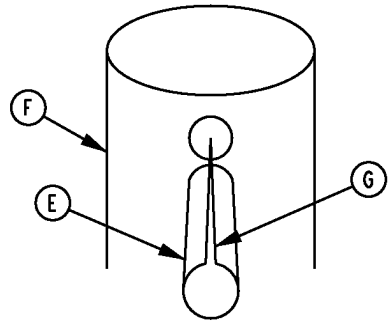
18. Install spring pin (E) with slit (G) towards end of pin (F).




T109017

T109017 –UN–17APR97

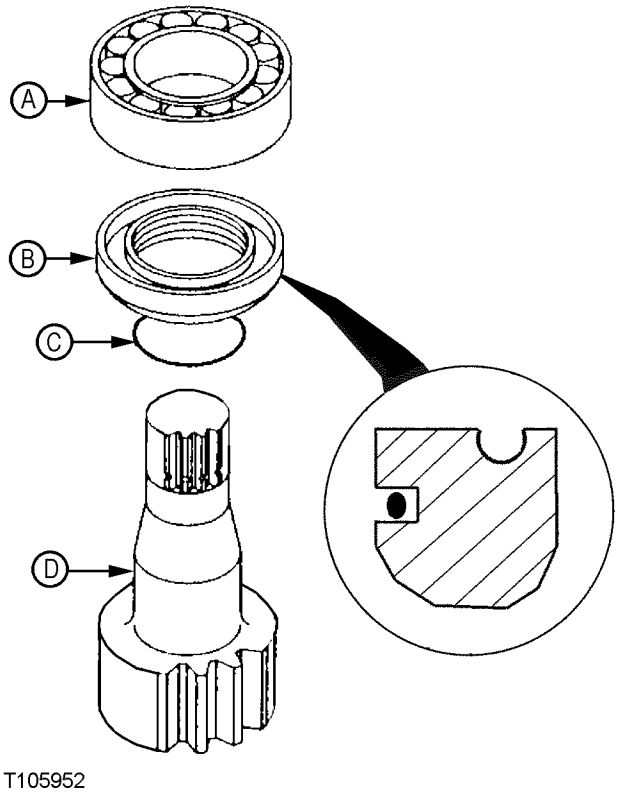
**E—Spring Pin**
**F—Pin**
**G—Slit**

CED,OUOE027,259 –19–19MAY98–12/19

19. Install wear sleeve (B) tight against shaft (D) as shown.

20. Install O-ring (C) on sleeve.

21. Install bearing (A) on pinion shaft (D).




T105952

T105952 –UN–20DEC96

**A—Roller Bearing**
**B—Wear Sleeve**
**C—O-Ring**
**D—Pinion Shaft**

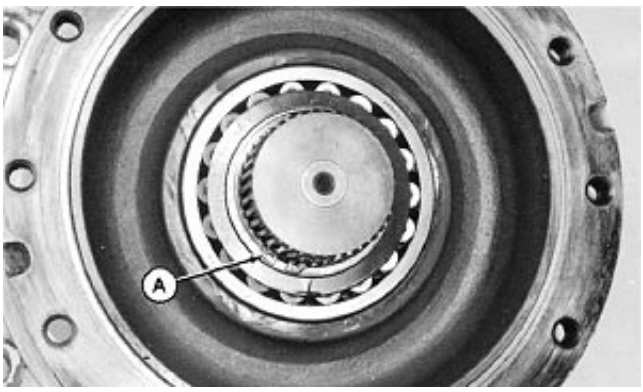
**Continued on next page**

CED,OUOE027,259 –19–19MAY98–13/19

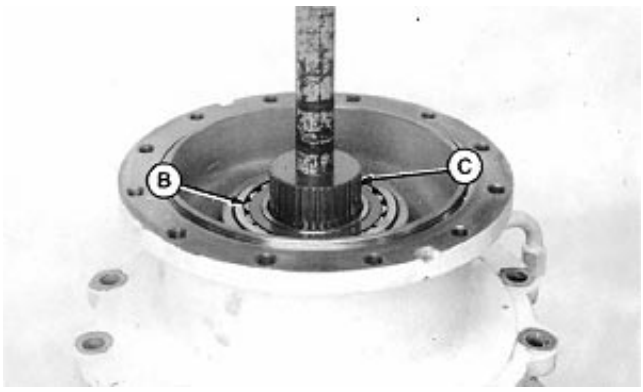
22. Install roller bearing (B) and pinion shaft (C).

23. Install snap ring (A).

24. Place swing gearbox in a vertical position with output shaft facing up. Apply plastic gasket to the seal bore.




T7685KB –UN–07MAY92




T7685KC –UN–07MAY92

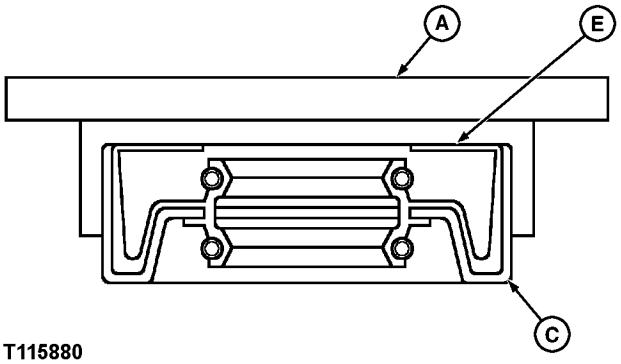
**A—Snap Ring**
**B—Roller Bearing**
**C—Pinion Shaft**

CED,OUOE027,259 –19–19MAY98–14/19

25. Apply plastic gasket to oil seal (C) bore in cover (A).

**IMPORTANT: Seal must be installed as shown or oil will leak from swing gearbox and gearbox will fail.**

26. Install oil seal (C) into cover (A) so flat metal face (E) is towards bottom of bore.




T115880 –UN–01JUL98

**T115880**

**A—Cover**
**C—Oil Seal**
**E—Flat Metal Face**

**Continued on next page**

CED,OUOE027,259 –19–19MAY98–15/19

27. Clean mating surface of cover (A) using cure primer. Apply plastic gasket to cover. Apply multi-purpose grease to lips of seal (C).

    Install cover (A) by turning cover back and forth while pushing down. Make sure seal lips are not rolled over. Use a blunt flat tip screwdriver to lift lips. Make sure screwdriver tip has no burrs or sharp edges. Tighten cap screws (B).

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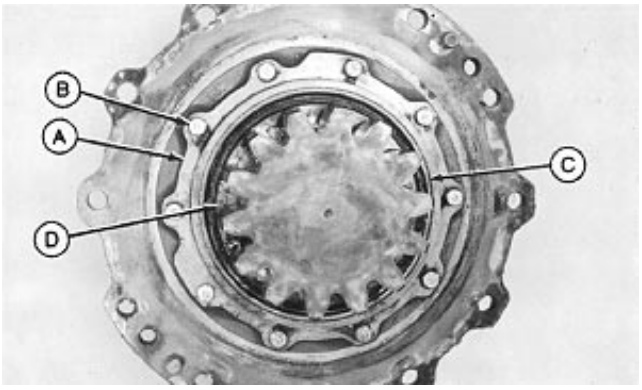
**Cover-to-Housing Cap Screw—Specification**

Torque ..... 88 N•m (65 lb-ft)

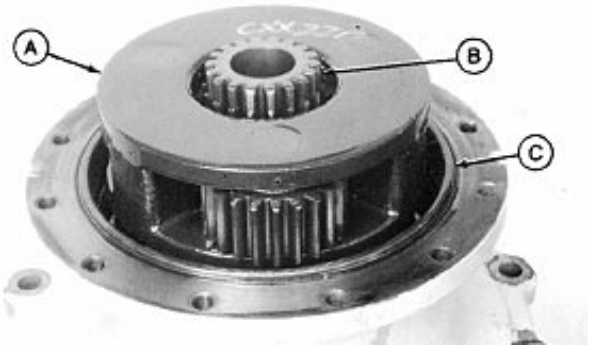



T7685KA –UN–07MAY92

**A—Cover**
**B—Cap Screw (10 used)**
**C—Oil Seal**
**D—Pinion Shaft**

CED,OUOE027,259 –19–19MAY98–16/19

28. Turn gearbox onto output shaft. Install parts (A—C).




T7685JZ –UN–07MAY92

**A—Second Planet Pinion Carrier**
**B—Second Planet Sun Gear**
**C—O-Ring**

**Continued on next page**

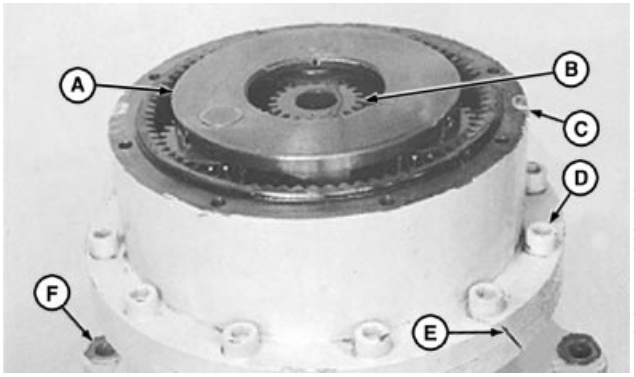
CED,OUOE027,259 –19–19MAY98–17/19

29. Install ring gear (C) aligning marks on housing (F). Tighten cap screws (D).

**Ring Gear-to-Housing Cap Screw—Specification**

Torque ..... 390 N•m (290 lb-ft)

30. Install parts (A and B). Install first planet sun gear (B), stepped side down.




T117076 –UN–09SEP98

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**A—First Planet Pinion Carrier**
**B—First Planet Sun Gear**
**C—Ring Gear**
**D—Cap Screw (12 used)**
**E—Alignment Mark**
**F—Housing**

CED,OUOE027,259 –19–19MAY98–18/19

31. Apply plastic gasket to swing motor mating surface on ring gear.

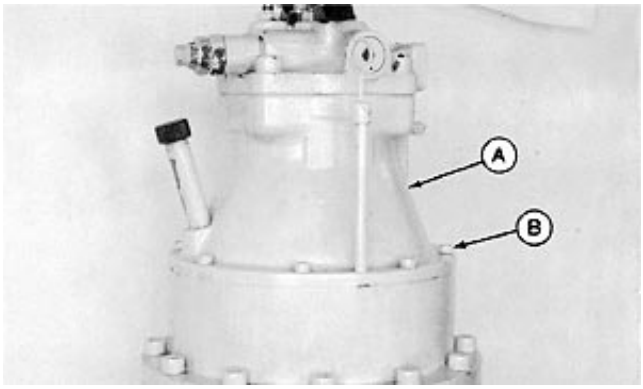
32. Install swing motor and brake (A). Tighten cap screws (B).

**Swing Motor and Brake-to-Gearbox Cap Screw—Specification**

Torque ..... 88 N•m (65 lb-ft)

33. Install drain pipe.

34. Do Swing Gearbox Start-Up Procedure in this group.




T76853JX –UN–07MAY92

**A—Swing Motor and Brake**
**B—Cap Screw**

CED,OUOE027,259 –19–19MAY98–19/19

## REMOVE UPPERSTRUCTURE

**CAUTION: Keep the angle between boom and arm at 90—100° to prevent machine from sliding backwards.**

*NOTE: Procedure requires two technicians. The cement floor must be a minimum of 102 mm (4 in.) thick. Area must be large enough so the upperstructure can be turned 180° with the angle between boom and arm at 90—100° and the tracks laid out flat on the floor.*

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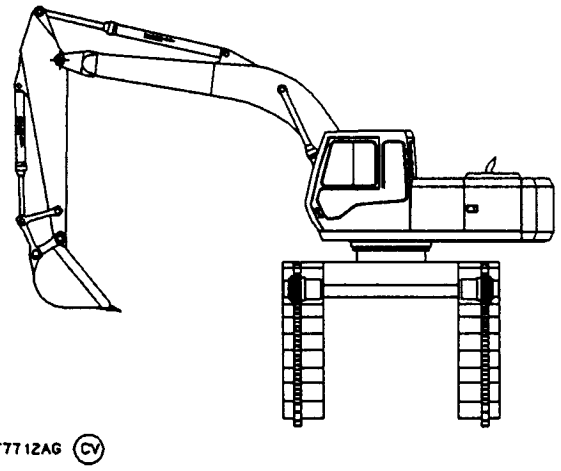
1. Park machine with boom to left side (cab side toward sprocket) of undercarriage. Move arm so angle between boom and arm is 90—100°.

2. Disconnect tracks and lay out flat on floor to sprocket end of undercarriage. (See procedure in Group 0130.)

*NOTE: To make removal of main frame-to-swing bearing cap screws easier after machine is raised into position, loosen the cap screws one turn at this time.*

3. Turn upperstructure to right side. Raise right side of undercarriage using boom down function.




T7712AG –UN–24FEB92

**Continued on next page**

CED,OUOE027,235 –19–15MAY98–1/7

4. Put hardwood blocks (B), approximately 355 mm (14 in.), between track rollers (A) and track chain (C).

5. Turn upperstructure back to left side so it is 90° to track.

**CAUTION: The approximate weight of DFT1089 Barrel Support is 545 kg (1200 lb).**

**The approximate weight of the 330LCR machine without tracks is 29 245 kg (64,475 lb).**

**DFT1089 Barrel Support—Specification**

Weight..... 545 kg (1200 lb) approximate

**Machine Without Tracks—Specification**

Weight..... 29 245 (64,475 lb) approximate

6. Put DFT1089 Barrel Supports (G) under the counterweight (D). (See Section 99 for instructions to make barrel supports.)

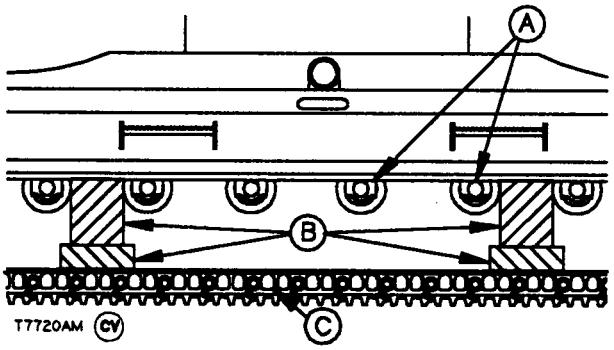
   To provide enough clearance, use bridge planks (E) and hardwood blocks (F) to raise the height of supports and planks to 1500 mm (59 in.). Do not put blocks under cap screw heads. Keep height to a maximum of 51 mm (2 in.) more than specified.

**Boom of Main Frame-to-Floor Clearance—Specification**

Height ..... 1500 mm (59 in.) minimum
Height ..... 1550 mm (61 in.) maximum

**CAUTION: Keep the angle between boom and arm at 90—100° to prevent machine from sliding backwards.**

7. Slowly raise left side, using boom down function, until machine is level.




T7720AM –UN–07MAY92

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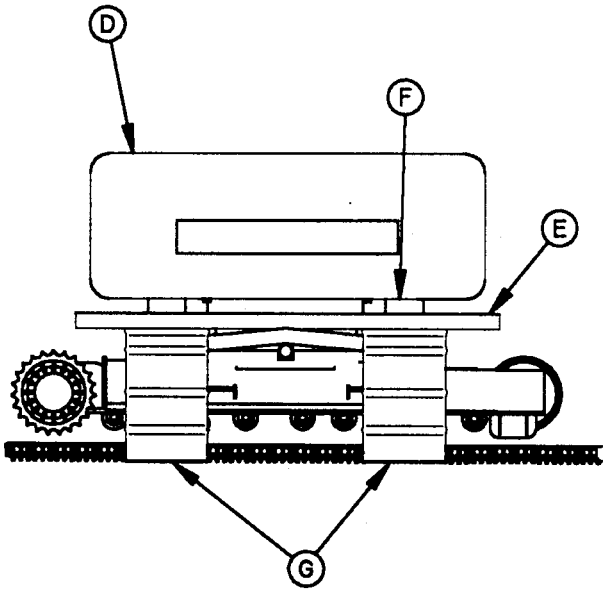


T7720AN –UN–07MAY92

**A—Track Roller**
**B—Hardwood Block (As Required)**
**C—Track Chain**
**D—Counterweight**
**E—Bridge Plank (As Required)**
**F—Hardwood Block (As Required)**
**G—DFT1089 Barrel Support (2 used)**

**Continued on next page**

CED,OUOE027,235 –19–15MAY98–2/7

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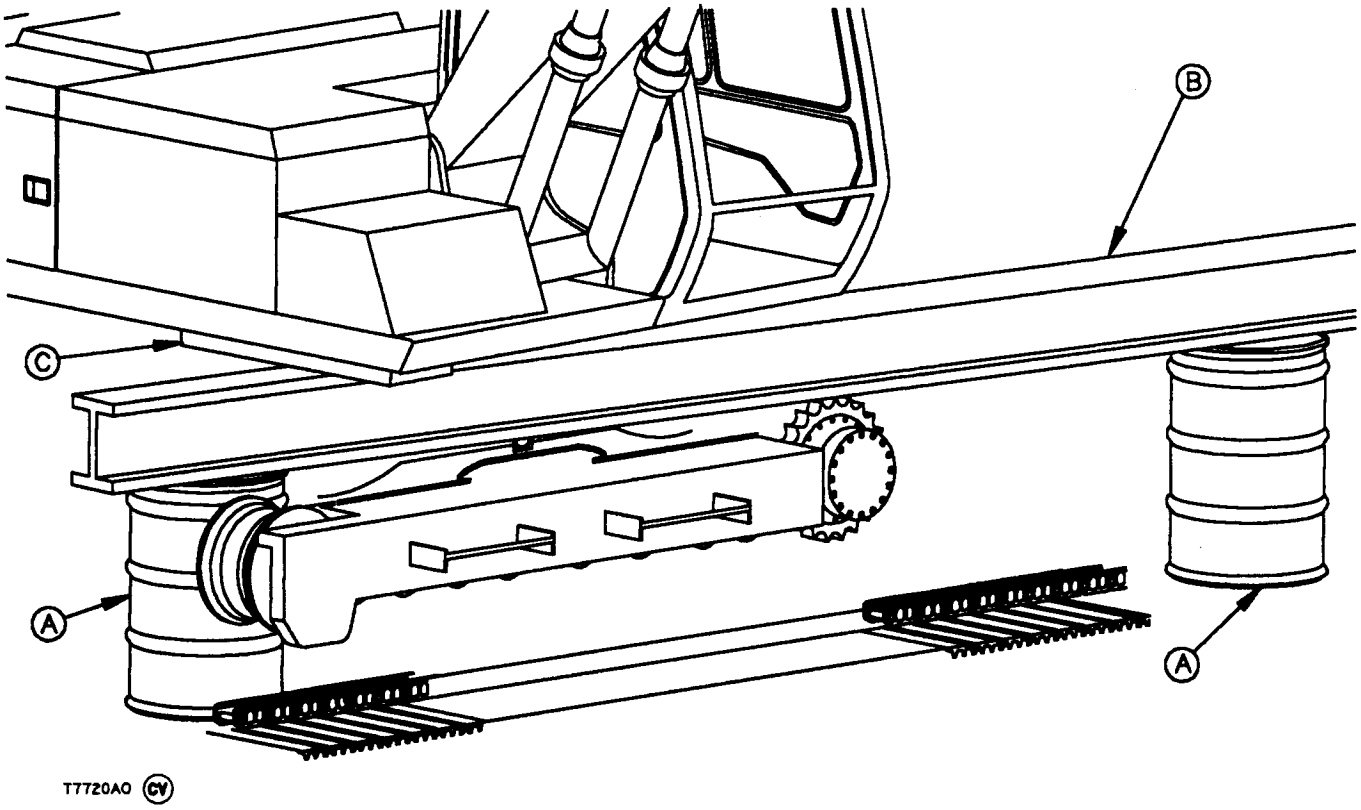



T7720AO –UN–07MAY92

**A—DFT1089 Barrel Support (2 used)**
**B—3.7 m (12 ft) Length of W8 x 35 lb Wide Flange Beam**
**C—Hardwood Block (As Required)**

*NOTE: For maximum support, the barrel supports must be positioned so the beam is under the main frame and corner of cab as far as possible.*

*Install hardwood blocks (C) as needed to make up for any unevenness.*

8. Put DFT1089 Barrel Supports (A) and a 3.7 m (12 ft) length of W8 x 35 lb Wide Flange Beam (B) under main frame at right boom cylinder and right corner of cab.

9. Lower machine so main frame and corner of cab is on the beam.

   Check that bottom of main frame is 1500 mm (59 in.) off the floor and level. Keep height to a maximum of 51 mm (2 in.) more than specified.

**Bottom of Main Frame-to-Floor Clearance—Specification**

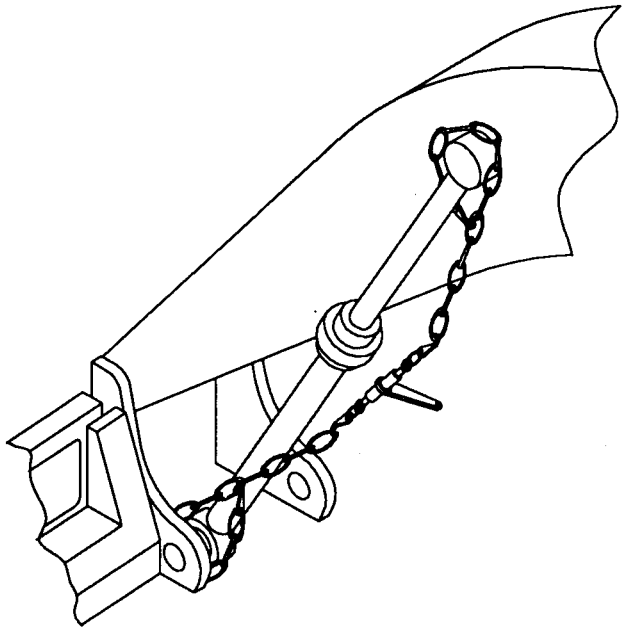
Height..... 1500 mm (59 in.) minimum
Height..... 1550 mm (61 in.) maximum

**Continued on next page**

CED,OUOE027,235 –19–15MAY98–3/7

10. Install a 13 mm (1/2 in.) chain around boom cylinder head end boss on frame and rod end boss on boom. Tighten chain just enough to remove slack using a chain binder.

11. Disconnect negative battery cables.



T7149AJ (CV)

T7149AJ –UN–05OCT89

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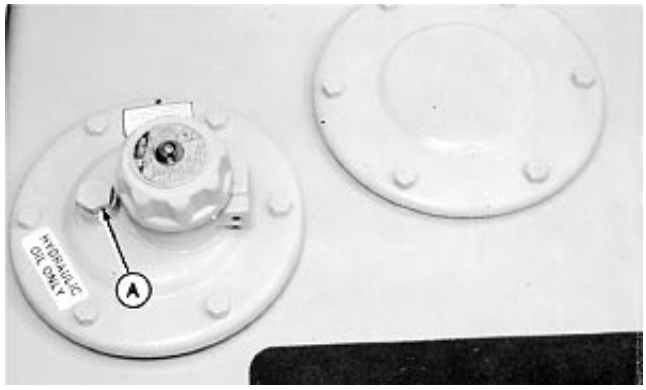
CED,OUOE027,235 –19–15MAY98–4/7

**CAUTION: The hydraulic oil tank is pressurized. High pressure release of oil from pressurized system can cause serious burns or penetrating injury. Release pressure from tank by loosening vent plug. It is not necessary to remove vent plug.**

12. Loosen vent plug (A) to relieve hydraulic oil tank pressure.



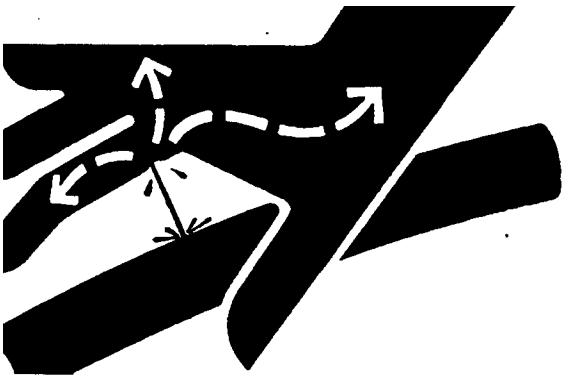

T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE027,235 –19–15MAY98–5/7

**CAUTION: To avoid injury from escaping fluid under pressure, stop engine and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**



X9811 –UN–23AUG88

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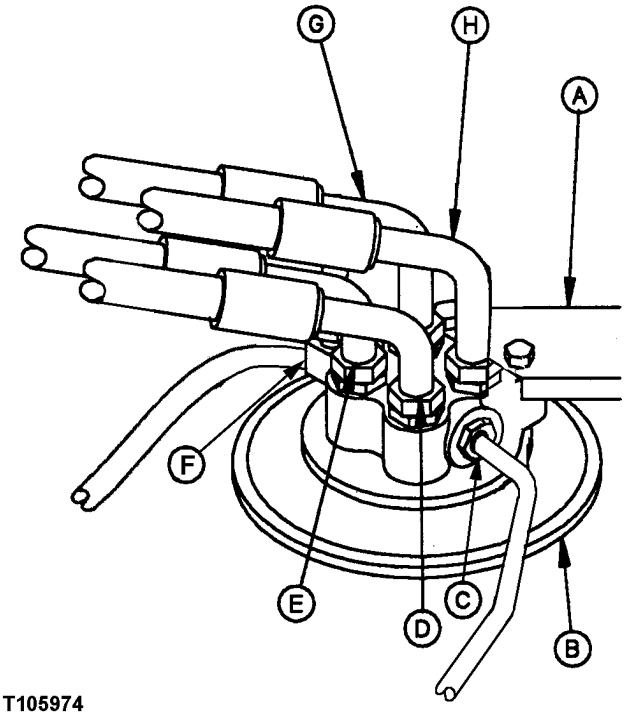
13. Disconnect lines (C—H). Remove fittings for more clearance between rotary manifold and upperstructure.
14. Remove stop (A).
15. Remove cover (B).

**CAUTION: The approximate weight of the 330LCR undercarriage is 6570 kg (14,410 lb).**

**Undercarriage—Specification**

Weight..... 6570 kg (14,410 lb) approximate

16. Put an 18-t (20-ton) service jack under each end of undercarriage. Use hardwood blocks if necessary.




T105974 –UN–09JAN97

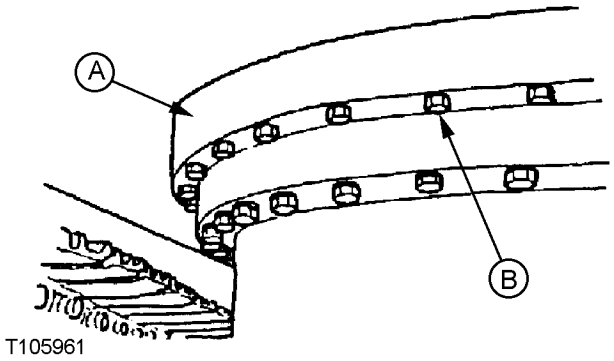
**T105974**

**A—Stop**
**B—Cover**
**C—P1-to-Proportional Solenoid Valve “SH” Port Line**
**D—Port 2-to-Right Propel Section Bottom Port (Reverse) Line**
**E—Port 4-to-Left Propel Section Bottom Port (Reverse) Line**
**F—Port D-to-Return Manifold**
**G—Port 3-to-Left Propel Section Top Port (Forward) Line**
**H—Port 1-to-Right Propel Section Top Port (Forward) Line**

**Continued on next page**

CED,OUOE027,235 –19–15MAY98–6/7

17. Remove cap screws (B) from swing bearing (A).
18. Replace parts as necessary.
19. Slowly lower undercarriage onto track chain.
20. Lift sprocket end of undercarriage so sprocket clears track chain.
21. Pull undercarriage out from under upperstructure.
22. Remove swing bearing. (See procedure in this group.)




**A—Swing Bearing**
**B—Cap Screw (36 used)**

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CED,OUOE027,235 –19–15MAY98–7/7

## INSTALL UPPERSTRUCTURE

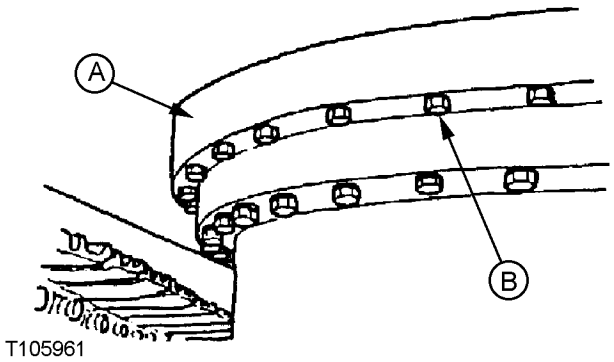
1. Push undercarriage under upperstructure.
2. Install guide pins to help align holes in swing bearing (A) with holes in main frame. (See Section 99 for instructions to make tool.)
3. Raise undercarriage into position using two 18-t (20-ton) service jacks. It may be necessary to turn swing bearing inner race to align teeth with teeth on swing motor pinion shaft.

*NOTE: If all cap screws are not accessible, tighten them after the machine has been lowered and supports have been removed.*

4. Install cap screws (B) in swing bearing (A) and tighten cap screws.

**Swing Bearing-to-Upperstructure Cap Screw—Specification**

Torque ..... 1230 N•m (900 lb-ft)




**A—Swing Bearing**
**B—Cap Screw (36 used)**

**Continued on next page**

CED,OUOE027,237 –19–15MAY98–1/4

5. Install cover (B).
6. Install stop (A).
7. Connect lines.
8. Connect negative battery cable.

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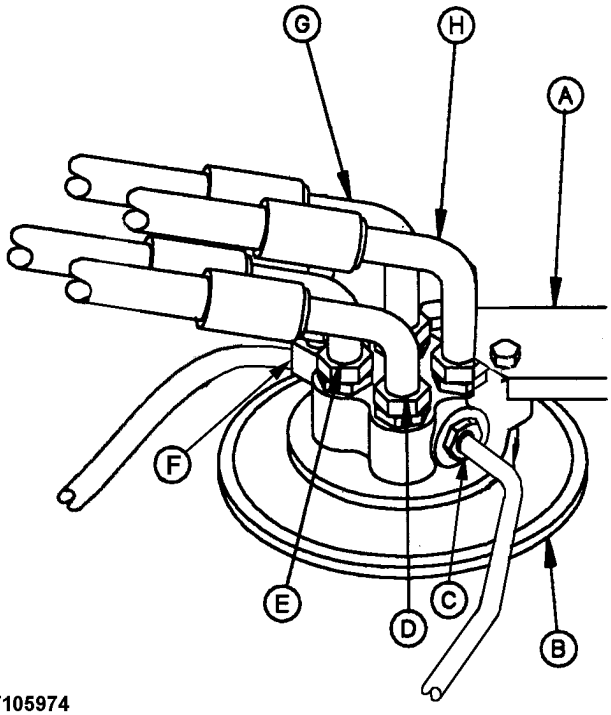
9. Remove chain from boom cylinder.



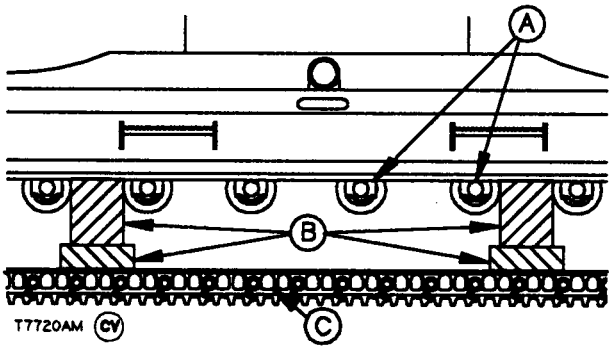

**T105974**

**A—Stop**
**B—Cover**
**C—P1-to-Proportional Solenoid Valve “SH” Port Line**
**D—Port 2-to-Right Propel Section Bottom Port (Reverse) Line**
**E—Port 4-to-Left Propel Section Bottom Port (Reverse) Line**
**F—Port D-to-Return Manifold**
**G—Port 3-to-Left Propel Section Top Port (Forward) Line**
**H—Port 1-to-Right Propel Section Top Port (Forward) Line**

**Continued on next page**

CED,OUOE027,237 –19–15MAY98–2/4

10. Put hardwood blocks (B) between track rollers (A) and track chain (C) on the counterweight side.




T7720AM –UN–07MAY92

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**A—Track Roller**
**B—Hardwood Block (As Required)**
**C—Track Chain**

**Continued on next page**

CED,OUOE027,237 –19–15MAY98–3/4

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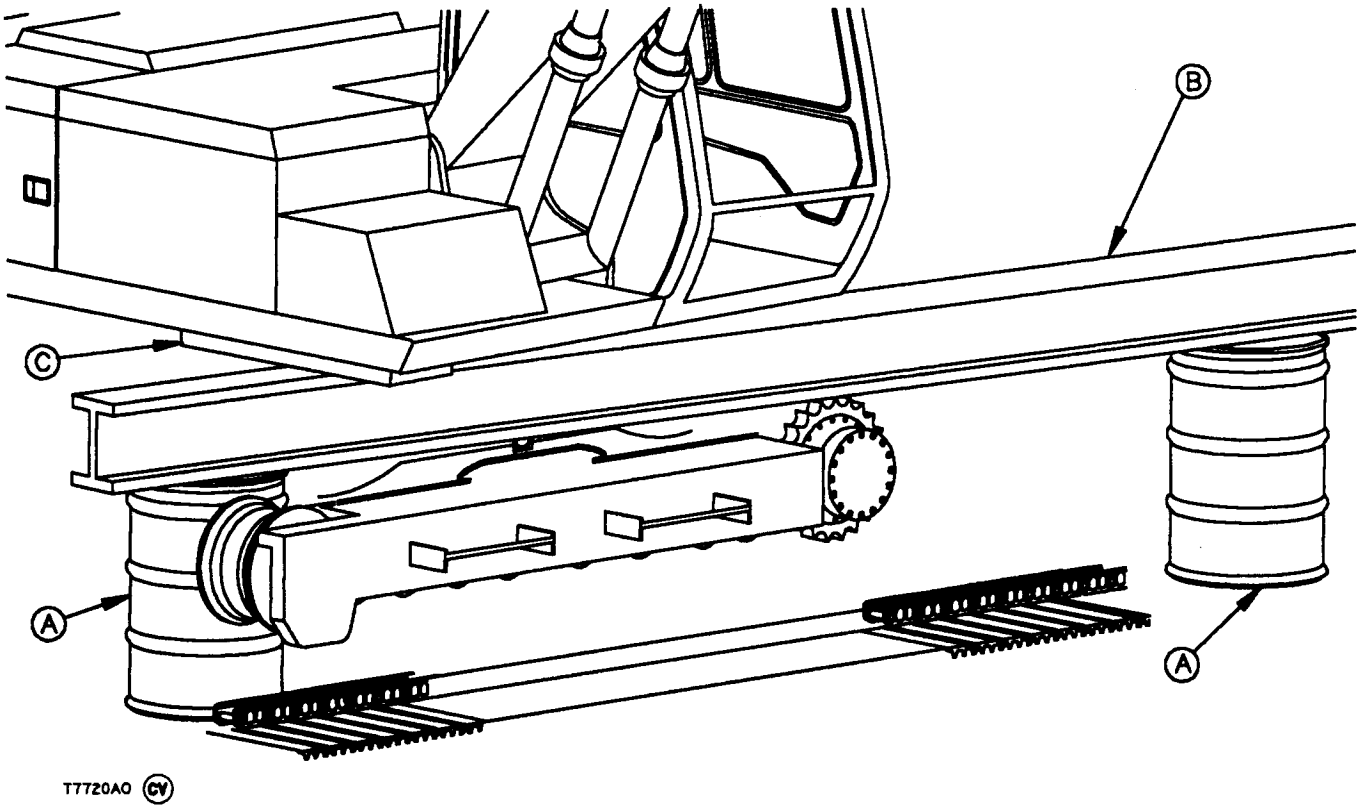



T7720AO –UN–07MAY92

**A—DFT1089 Barrel Support (2 used)**
**B—3.7 m (12 ft) Length of W8 x 35 lb Wide Flange Beam**
**C—Hardwood Block (As Required)**

11. Raise machine just enough to remove hardwood blocks (C), wide flange beam (B), and barrel supports (A).
12. Lower machine so lower track rollers and front idler are on track chain.
13. Remove bridge planks and barrel supports from other side.
14. Turn upperstructure to other side and raise machine just enough to remove hardwood blocks between roller and track chain.
15. Lower machine so lower track rollers and front idler are on track chain.
16. Tighten any of the swing bearing-to-upperstructure cap screws that could not be tightened.

**Swing Bearing-to-Upperstructure Cap Screw—Specification**

Torque..... 1230 N•m (900 lb-ft)

17. Install track chains. (See procedure in Group 0130).
18. Adjust track sag. (See procedure in Group 0130.)

CED,OUOE027,237 –19–15MAY98–4/4

## REMOVE AND INSTALL SWING BEARING

1. Remove upperstructure. (See procedure in this group.)

**CAUTION: The approximate weight of swing bearing is 500 kg (1102 lb).**

**Swing Bearing—Specification**

Weight..... 500 kg (1102 lb) approximate

2. Connect swing bearing to hoist using lifting brackets (C) such as JT01748 Lifting Brackets.
3. Remove cap screws (D). Remove bearing.
4. Replace upper and lower seals, steel balls, and spacers as necessary. (See procedures in this group.)
5. Clean mating surfaces of swing bearing, upperstructure, and undercarriage using cure primer.
6. Apply plastic gasket to mating surfaces of swing bearing, upperstructure, and undercarriage.

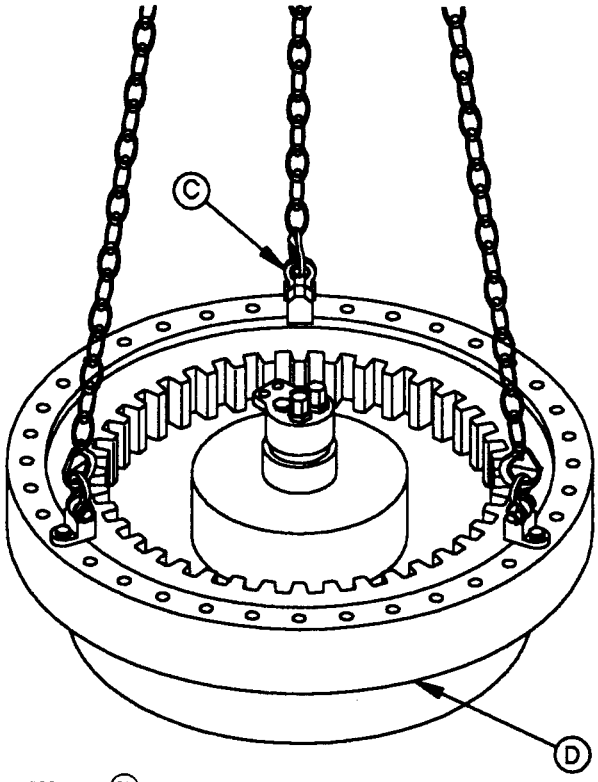
**IMPORTANT: The tooth marked with the letter “G” or “S”, or equivalent is the starting and stopping point for the hardening process. The tooth and bearing loading plug must be installed on right side of machine so use of that part of swing bearing is minimized.**

7. Install swing bearing on undercarriage so tooth (A) marked “G” or “S”, or equivalent and bearing loading plug (B) is to right side of machine.
8. Install cap screws (D) and tighten.

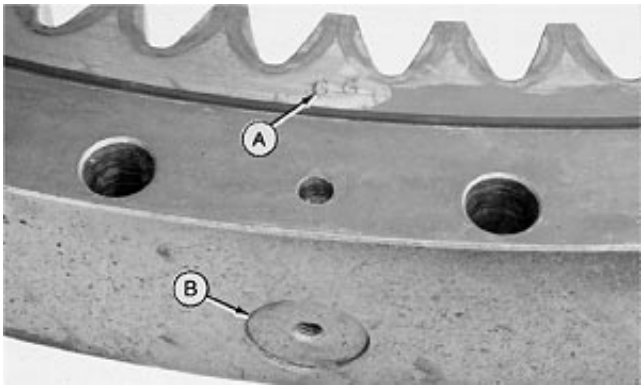
**Swing Bearing-to-Undercarriage Cap Screw—Specification**

Torque ..... 1230 N•m (900 lb-ft)

9. Apply multi-purpose grease to swing bearing teeth and pinion shaft. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in Group 0004.)




T7764AB –UN–07MAY92




T5925AA –UN–11APR90

**A—Tooth**
**B—Loading Plug**
**C—Lifting Bracket (3 used)**
**D—Cap Screw (36 used)**

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CED,OUOE027,236 –19–15MAY98–1/1

## DISASSEMBLE AND ASSEMBLE SWING BEARING

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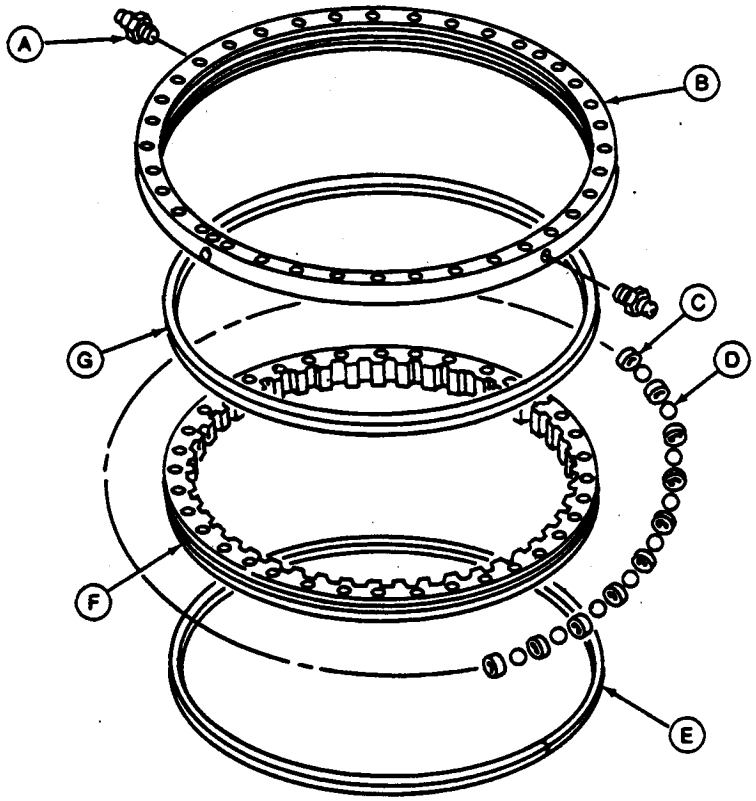



T6626JP –UN–07NOV88

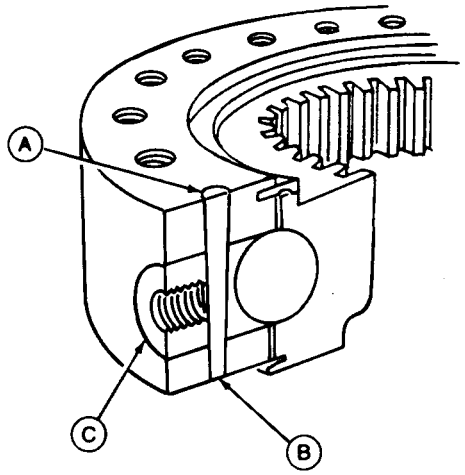
**A—Lubrication Fitting (2 used)**
**B—Outer Race**
**C—Spacer (95 used)**
**D—Steel Ball (95 used)**
**E—Lower Seal**
**F—Inner Race**
**G—Upper Seal**

1. Install new upper and lower seals (E and G) after assembly if torn or damaged. (See procedure in this group.)

**Continued on next page**

CED,OUOE027,238 –19–15MAY98–1/4

2. Grind tack weld (A) off top of taper pin (B).
3. Drive taper pin out from the bottom side of bearing.
4. Remove loading plug (C) using a M10-1.5 cap screw.




T6876FI –UN–07MAY92

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**A—Tack Weld**
**B—Taper Pin**
**C—Loading Plug**

**Continued on next page**

CED,OUOE027,238 –19–15MAY98–2/4

5. Remove steel balls (A) using a magnet.
6. Remove spacers (B) using a length of wire.
7. Turn inner race to remove remaining steel balls and spacers.
8. Lift outer race off inner race.
9. Install outer race over inner race.
10. Replace parts as necessary.
11. Apply multi-purpose grease to spacers (B) and steel balls (A) and install.

    Install the same number of spacers as were removed.

    Turn inner race as needed to install spacers and steel balls.

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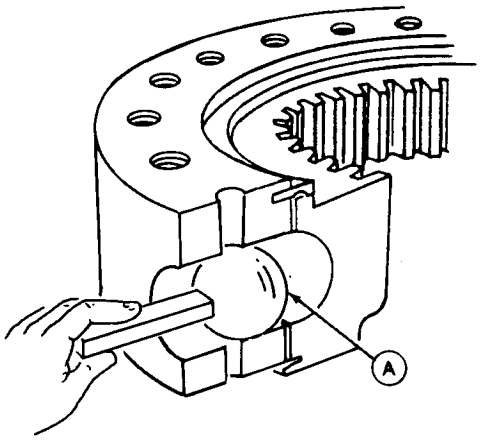
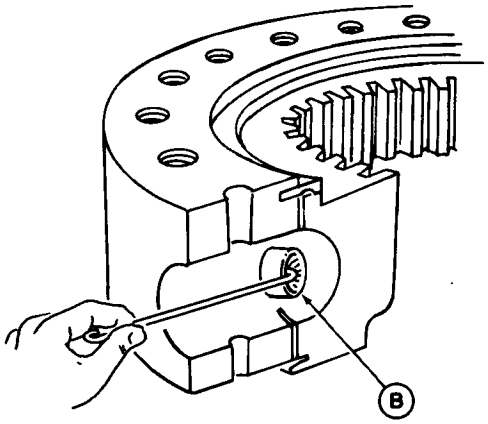



T6876FK –UN–07MAY92



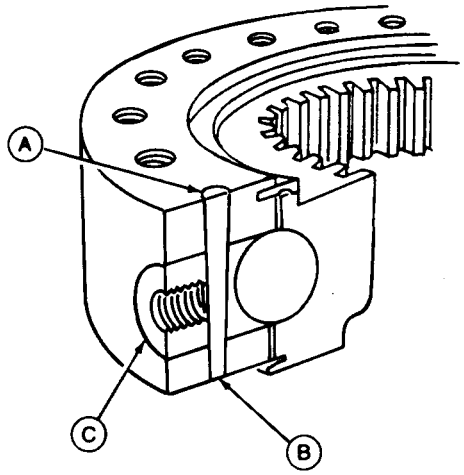

T7763AB –UN–07MAY92

**A—Steel Ball (95 used)**
**B—Spacer (95 used)**

**Continued on next page**

CED,OUOE027,238 –19–15MAY98–3/4

12. Install loading plug (C).
13. Install taper pin (B) even with top of swing bearing.
14. Tack weld (A) pin to swing bearing.
15. Add multi-purpose grease to swing bearing through lubrication fittings. (See Track Adjuster, Working Tool Pivot, Swing Bearing, and Swing Bearing Gear Grease in Group 0004.)




T6876FI –UN–07MAY92

**A—Tack Weld**
**B—Taper Pin**
**C—Loading Plug**

CED,OUOE027,238 –19–15MAY98–4/4

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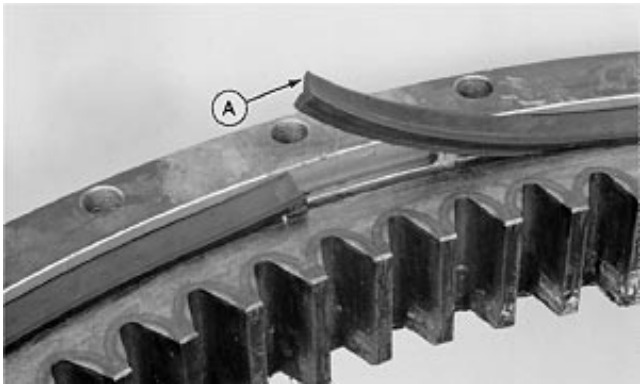
## INSTALL SWING BEARING UPPER SEAL




**A—Seal**

1. Remove upperstructure. (See procedure in this group.)
2. Remove old seal (A).
3. Scrape old adhesive from seal groove.

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4. Thoroughly clean seal groove and new seal using cure primer.
5. Apply instant gel adhesive sparingly to seal groove.
6. Install seal with lip against outer bearing race.

   Start about 76 mm (3 in.) from end of seal using a blunt instrument to force seal into groove. Push seal in direction of portion already installed to avoid stretching seal.
7. Before bringing ends of seal together, cut off excess length.
8. Apply adhesive to both ends of seal. Push ends into seal groove making sure they come together.

**IMPORTANT: To avoid pulling seal out of groove, adhesive must cure for at least 24 hours before using swing function.**

9. Let adhesive cure for at least 24 hours before using swing function.

CED,OUOE023,50 –19–19MAR98–1/1

## INSTALL SWING BEARING LOWER SEAL

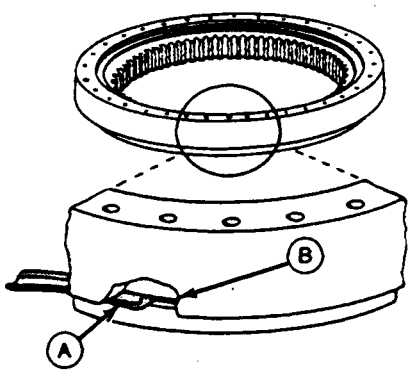
*NOTE: Part of swing bearing shown cut away to show lower seal in groove.*

1. Remove old seal (A).
2. Scrape old adhesive from seal groove (B) and thoroughly clean seal groove and new seal using cure primer.
3. Apply instant gel adhesive sparingly to seal groove.
4. Install seal with seal lip against outer race.

   Start about 76 mm (3 in.) from end of seal using a blunt instrument to force seal into groove. Push seal in direction of portion already installed to avoid stretching seal.
5. Before bringing ends of seal together, cut off excess length.
6. Apply adhesive to both ends of seal. Push ends into seal groove making sure they come together.

**IMPORTANT: To avoid pulling seal out of groove, adhesive must cure for at least 24 hours before using swing function.**

7. Let adhesive cure for at least 24 hours before using swing function.




T5936BA –UN–17MAY89

**A—Seal**
**B—Seal Groove**

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4350
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CED,OUOE027,266 –19–22MAY98–1/1

## SPECIFICATIONS

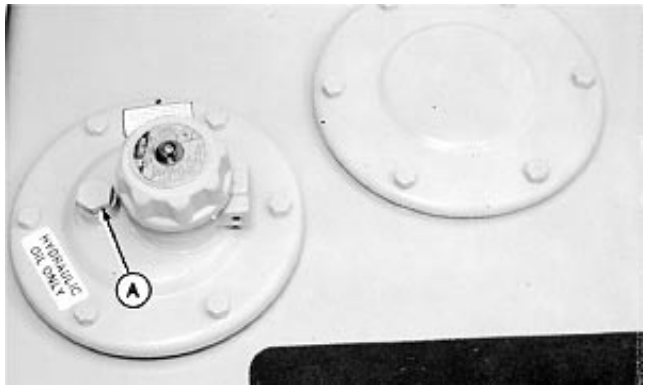
| Item | Measurement | Specification |
|---|---|---|
| Swing Motor | Weight | 77 kg (169 lb) approximate |
| Motor-to-Gearbox Cap Screw | Torque | 88 N•m (65 lb-ft) |
| Valve Housing-to-Motor Housing Cap Screw | Torque | 430 N•m (320 lb-ft) |
| Swing Motor Make-Up Valve Plug-to-Housing | Torque | 330 N•m (245 lb-ft) |
| Crossover Relief Valve Body-to-Housing | Torque | 176 N•m (130 lb-ft) |
| Park Brake Release Valve Housing-to-Motor Housing Cap Screw | Torque | 9.8 N•m (87 lb-in.) |



CED,OUOE003,1181 –19–09JUL98–1/1

## REMOVE AND INSTALL SWING MOTOR AND PARK BRAKE

1. Remove vent plug (A) to release air pressure from hydraulic oil tank.
2. Pull a vacuum in hydraulic oil tank or drain hydraulic oil tank. Approximate oil capacity is 159 L (42 gal).




T7869AT –UN–12NOV92

**A—Vent Plug**

**Continued on next page**

CED,OUOE027,260 –19–20MAY98–1/2

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2

**CAUTION: To avoid injury from escaping fluid under pressure, stop engine, and relieve the pressure in the system before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

3. Disconnect lines (A—F).

**CAUTION: The approximate weight of swing motor is 77 kg (169 lb).**

**Swing Motor—Specification**

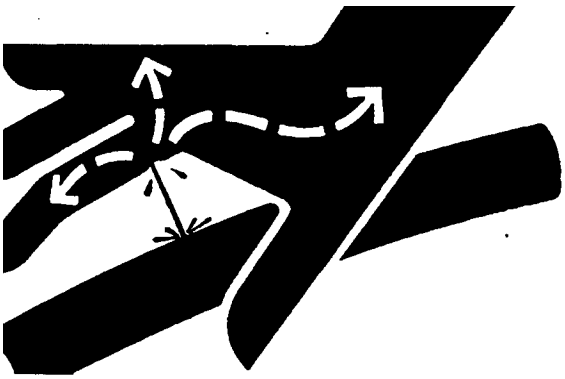
Weight..... 77 kg (169 lb) approximate

4. Remove cap screws (G). Remove swing motor and brake.
5. Replace parts as necessary.
6. Install swing motor and brake. Tighten cap screws (G).

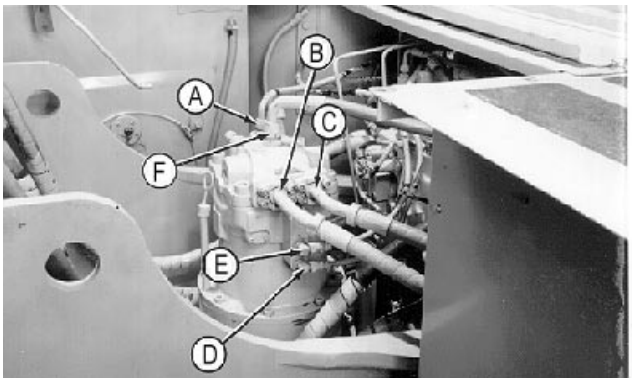
**Motor-to-Gearbox Cap Screw—Specification**

Torque ..... 88 N•m (65 lb-ft)

7. Connect lines (A—F).
8. Do Swing Motor and Park Brake Start-Up Procedure. (See procedure in this group.)



X9811 –UN–23AUG88




T105899 –UN–19DEC96


T105990 –UN–09JAN97

**A—Swing Motor Top Right Port-to-Reservoir Return Line**
**B—Swing Motor Left Front "B" Port-to-Main Control Valve Left Rear Lower Port Line**
**C—Swing Motor Left Rear "A" Port-to-Main Control Valve Left Rear Upper Port Line**
**D—Swing Brake Relief Valve "PG" Port-to-Solenoid Valve Manifold Bottom Port Line**
**E—Swing Brake Relief Valve "SH" Port-to-System Relief Valve Manifold Block Front Port Line**
**F—Swing Motor Top Left Port-to-Main Control Valve Left Front Top Port Line**
**G—Cap Screw (12 used)**

CED,OUOE027,260 –19–20MAY98–2/2

## SWING MOTOR AND PARK BRAKE START-UP PROCEDURE

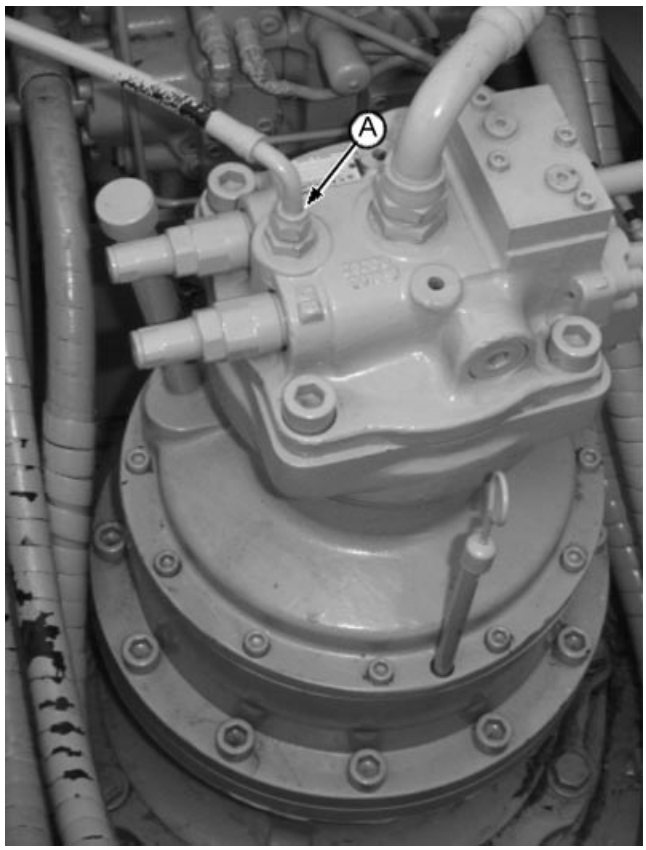
**IMPORTANT: Swing motor will be damaged if not filled with oil before operating swing function. Procedure must be performed whenever a new swing motor is installed or oil has been drained from the motor.**

**Procedure is to ensure the swing motor is filled with oil.**

1. Disconnect swing motor drain line (A).
2. Fill motor with hydraulic oil through drain port until oil reaches the level of drain port.

*NOTE: Air must be allowed to escape from the swing motor while filling.*

3. Connect drain line.




**A—Swing Motor Drain Line**

TX,43,GG2763 –19–15JUL97–1/1

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3

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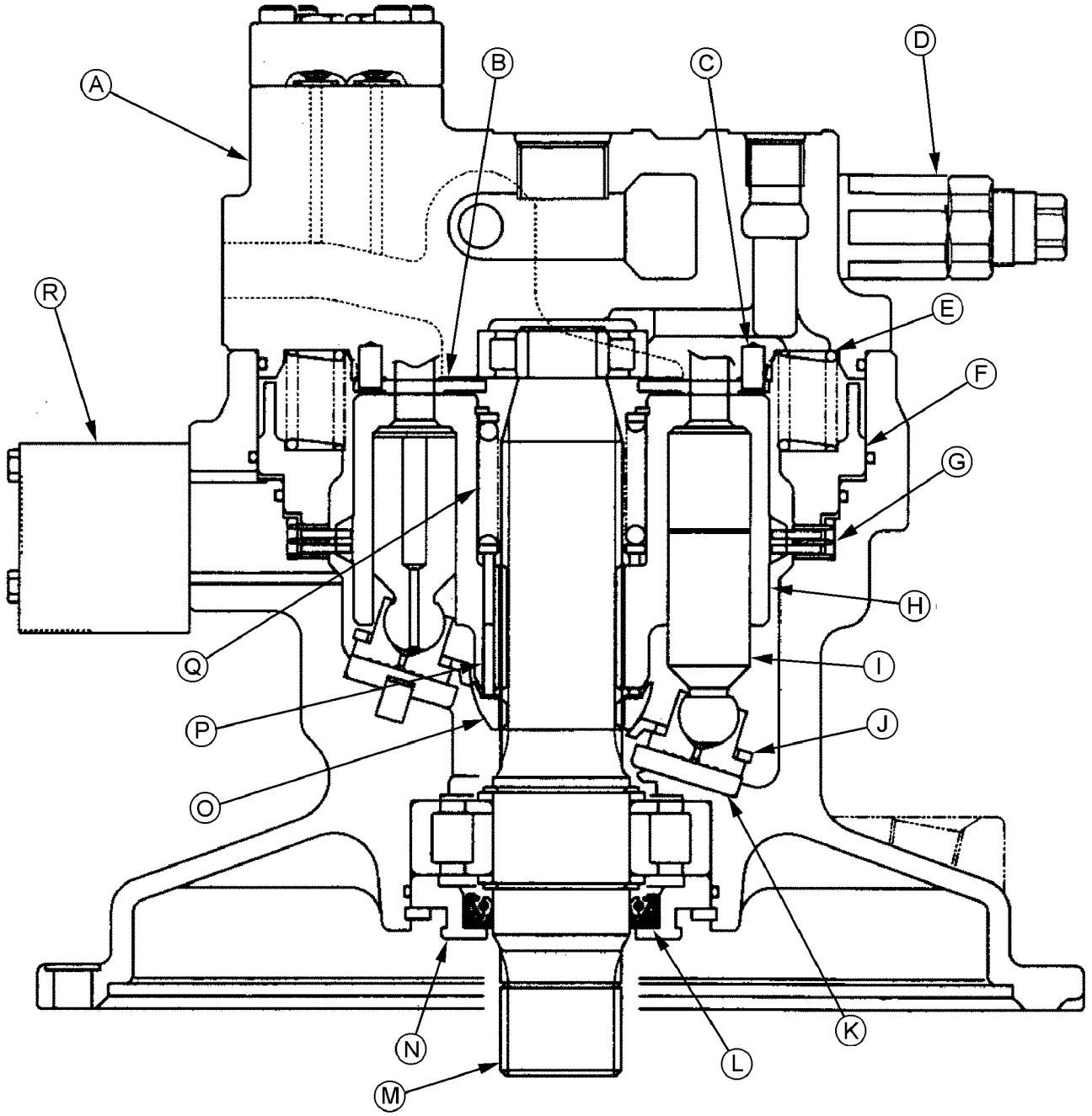
4

## DISASSEMBLE SWING MOTOR AND PARK BRAKE




T117077

T117077 –UN–09SEP98

**A—Cover**
**B—Valve Plate**
**C—Dowel Pin**
**D—Crossover Relief Valve**
**E—Spring**
**F—Piston**
**G—Disk and Plate**
**H—Cylinder Block**
**I—Piston**
**J—Retainer**
**K—Thrust Plate**
**L—Oil Seal**
**M—Output Shaft**
**N—Seal Retainer**
**O—Ball Bushing**
**P—Force Pin**
**Q—Spring**
**R—Park Brake Release Valve**

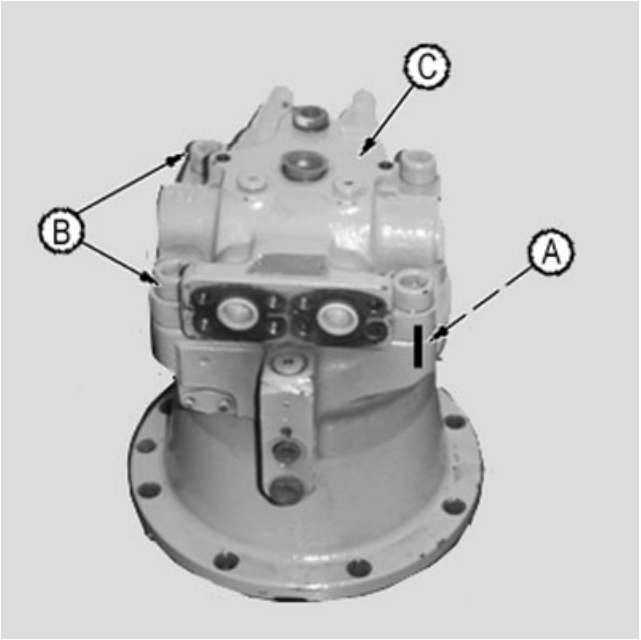
**Continued on next page**

CED,OUOE027,261 –19–20MAY98–1/8

1. Remove drain plug. Drain oil.
2. Make alignment mark (A) on swing motor valve housing and cover to motor housing for assembly.

**CAUTION: Swing motor valve housing and cover is under spring pressure. Cap screws must be loosened in even steps to release spring force.**

3. Loosen cap screws (B) in even steps to release spring force. Remove valve housing and cover (C).




T106131B –UN–09JAN97

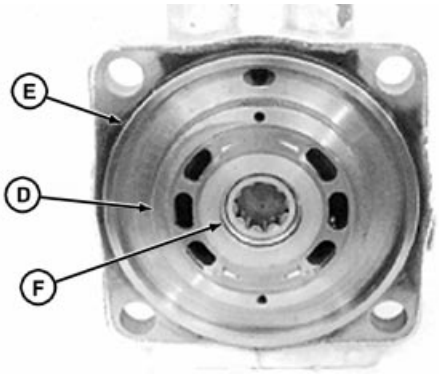
**A—Plug Alignment Mark**
**B—Cap Screw (4 used)**
**C—Valve Housing and Cover**

CED,OUOE027,261 –19–20MAY98–2/8

**IMPORTANT: Valve plate (D) may remain on valve housing and cover or stay with cylinder block. Be careful not to damage valve plate.**

4. Remove parts (D and E).

   Remove outer race of roller bearing (F) from cover and the inner race from output shaft if replacement is necessary.




T117082 –UN–09SEP98

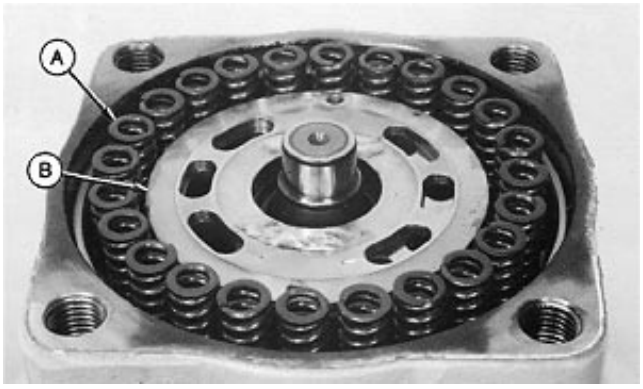
**D—Valve Plate**
**E—O-Ring**
**F—Roller Bearing**

**Continued on next page**

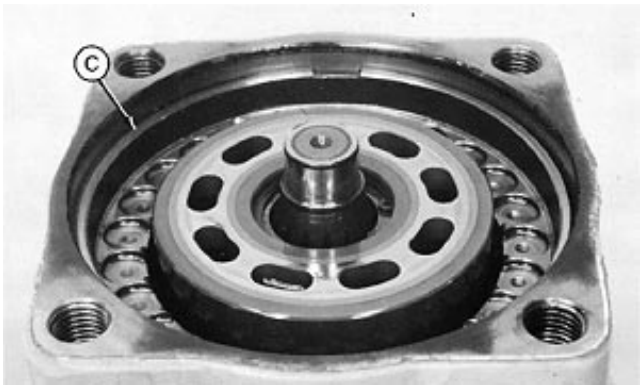
CED,OUOE027,261 –19–20MAY98–3/8

5. Remove valve plate (B) if not removed.
6. Remove brake springs (A).
7. Remove parts (C—F).

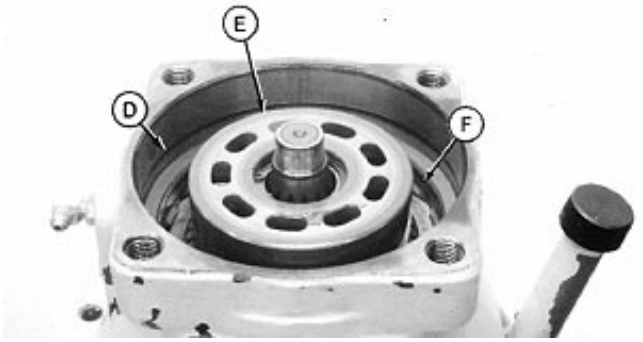





T7685KJ –UN–07MAY92




T7685KK –UN–07MAY92



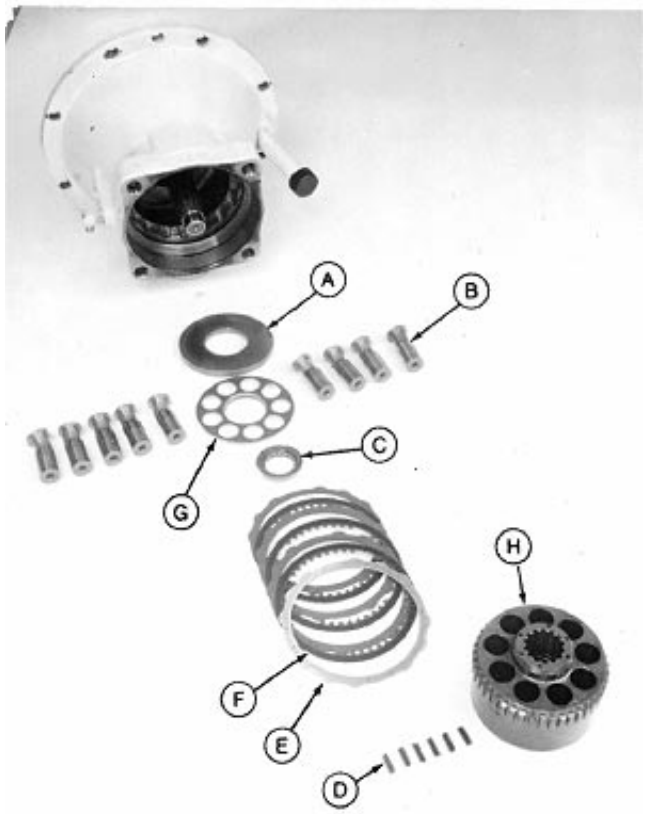

T7685KL –UN–07MAY92

**A—Brake Spring (22 used)**
**B—Valve Plate**
**C—Brake Piston**
**D—O-Ring**
**E—Cylinder Block**
**F—O-Ring**

**Continued on next page**

CED,OUOE027,261 –19–20MAY98–4/8

8. Remove parts (A—G).




T7685KM –UN–07MAY92

**A—Thrust Plate**
**B—Piston (9 used)**
**C—Ball Bushing and Washer**
**D—Force Pin (12 used)**
**E—Separator Plate (3 used)**
**F—Friction Disk (2 used)**
**G—Retainer**
**H—Cylinder Block**

**Continued on next page**

CED,OUOE027,261 –19–20MAY98–5/8

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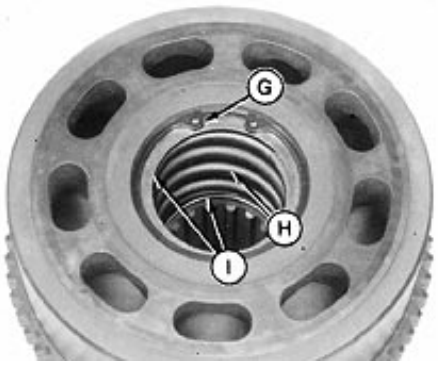
**CAUTION: Spring (H) is under pressure. Remove spring load from snap ring before removing it.**

9. Push top washers (I) and spring (H) down using a disk and a press. Remove snap ring (G).

10. Remove washers and spring. The 50 x 61 x 3 mm washers are next to the snap ring and the 47 x 61 x 3 mm washer is at the bottom.




T7966CZ –UN–14APR93

**G—Snap Ring**
**H—Spring**
**I—50 x 61 x 3 mm Top Washer (3 used)**
**—47 x 61 x 3 mm Bottom Washer**

CED,OUOE027,261 –19–20MAY98–6/8

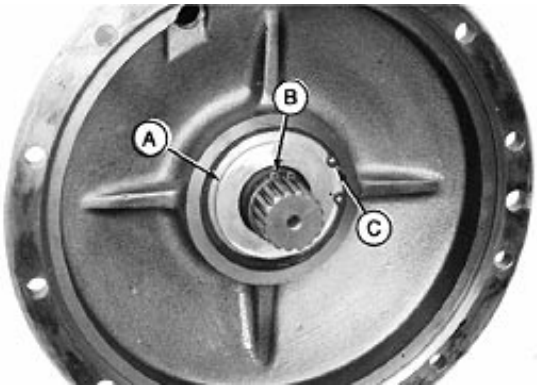
11. Remove snap ring (B) from output shaft (D).

12. Remove snap ring (C).

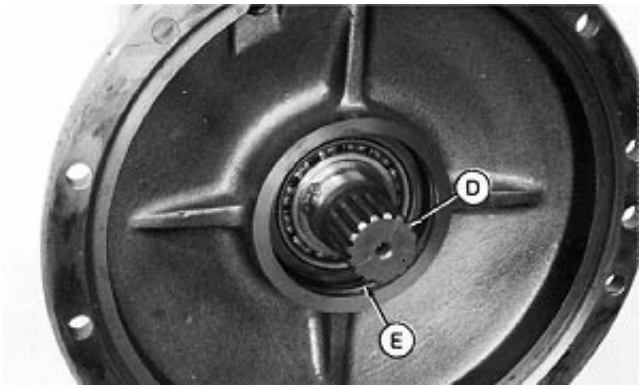
13. Remove cover (A).

14. Remove O-ring (E).

15. Push output shaft (D) from housing using a press.




T7966CV –UN–14APR93




T7966CW –UN–14APR93

**A—Cover**
**B—Snap Ring**
**C—Snap Ring**
**D—Output Shaft**
**E—O-Ring**

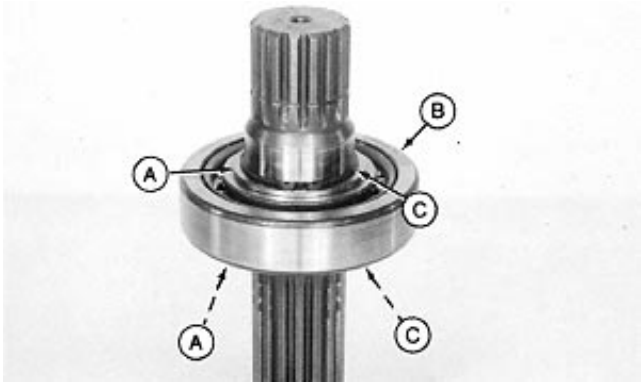
**Continued on next page**

CED,OUOE027,261 –19–20MAY98–7/8

16. Remove snap rings (C) and washers (A).

17. Remove roller bearing (B) using a press. Push bearing to the long end of shaft so oil seal surface on shaft is not damaged.

18. Repair or replace parts as necessary.




T7966CX –UN–14APR93

43
4360
9

**A—Washer (2 used)**
**B—Roller Bearing**
**C—Snap Ring (2 used)**

CED,OUOE027,261 –19–20MAY98–8/8

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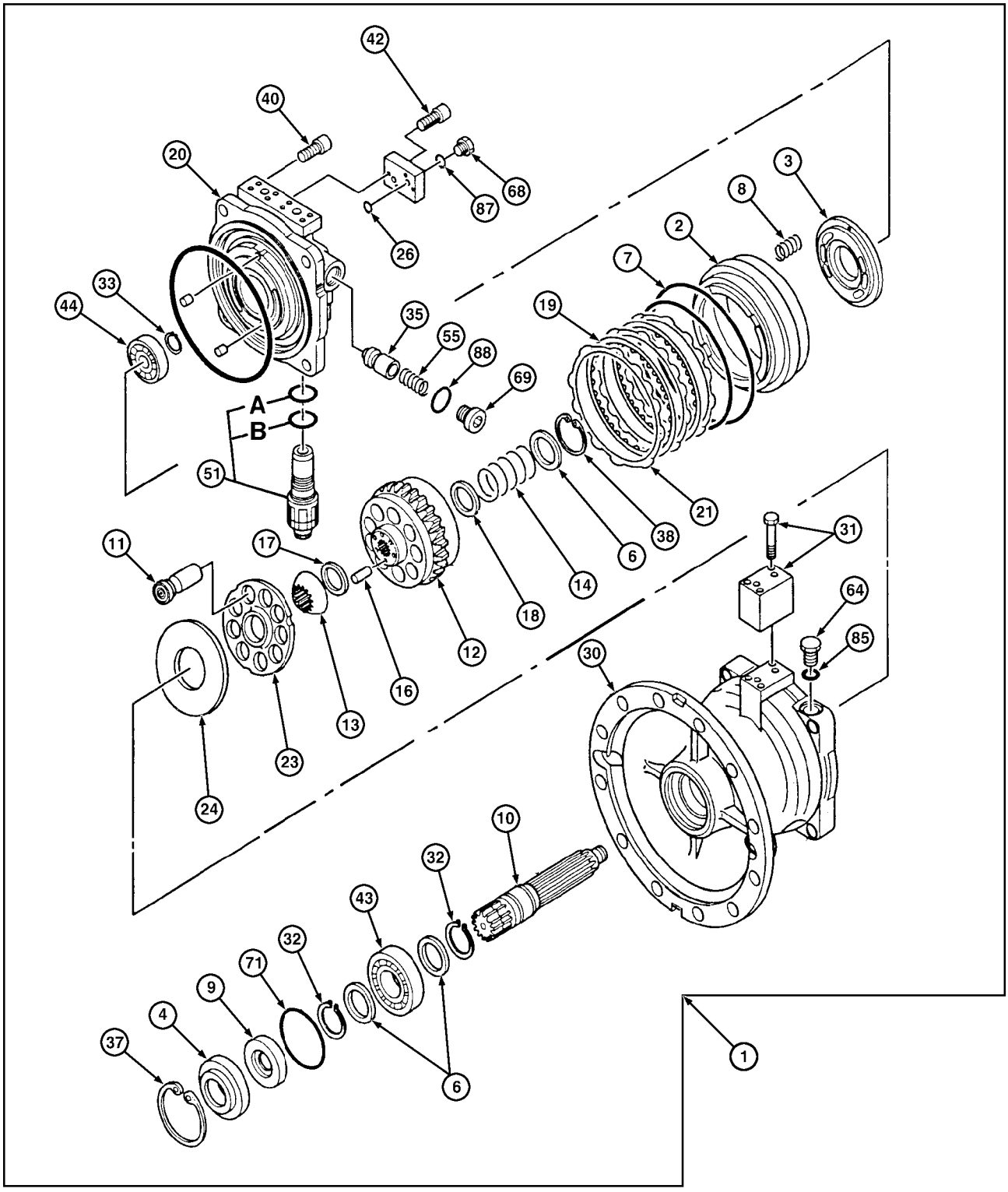
10

## ASSEMBLE SWING MOTOR AND PARK BRAKE




T117087

T117087 –UN–09SEP98

**Continued on next page**

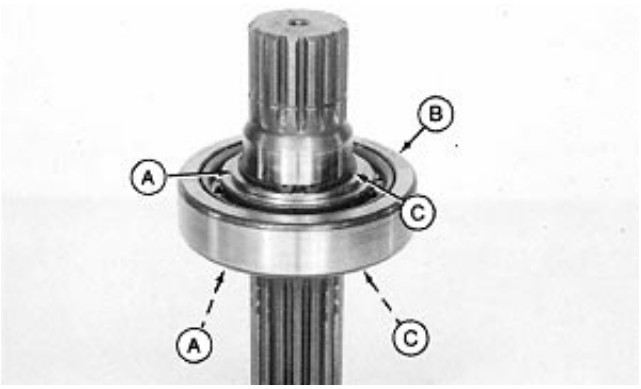
CED,OUOE027,262 –19–20MAY98–1/8

**1—Swing Motor**
**2—Brake Piston**
**3—Valve Plate**
**4—Cover**
**5—Plate**
**6—50 x 61 x 3 mm Top Washer (3 used)**
**7—O-Ring**
**8—Spring (24 used)**
**9—Oil Seal**
**10—Output Shaft**
**11—Piston (9 used)**
**12—Cylinder Block**
**13—Ball Bushing**
**14—Spring**
**16—Force Pin (12 used)**
**17—Washer**
**18—47 x 61 x 3 mm Bottom Washer**
**19—Friction Disk (2 used)**
**20—Valve Housing and Cover**
**21—Separator Plate (3 used)**
**23—Retainer**
**24—Thrust Plate**
**26—Packing (2 used)**
**30—Housing**
**31—Park Brake Release Valve and Cap Screw**
**32—Snap Ring (2 used)**
**33—Snap Ring**
**35—Make-Up Check Valve (2 used)**
**37—Snap Ring**
**38—Snap Ring**
**40—Cap Screw (4 used)**
**42—Cap Screw (4 used)**
**43—Roller Bearing**
**44—Roller Bearing**
**51—Crossover Relief Valve (2 used)**
**51A—O-Ring and Backup Ring (2 used)**
**51B—Backup Ring**
**55—Spring (2 used)**
**64—Plug**
**68—Plug (2 used)**
**69—Plug (2 used)**
**70—O-Ring**
**71—O-Ring**
**72—O-Ring**
**85—O-Ring**
**87—O-Ring (2 used)**
**88—O-Ring (2 used)**

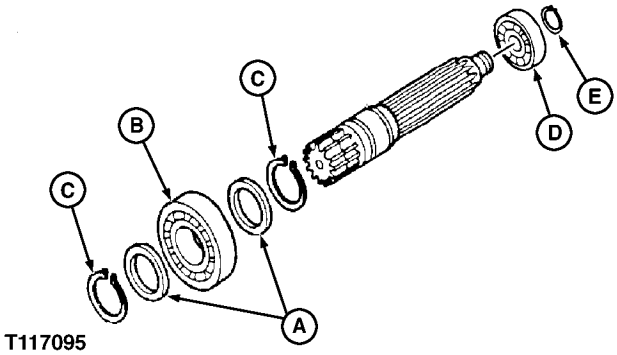
43
4360
11

CED,OUOE027,262 –19–20MAY98–2/8

1. Install snap ring (C) in groove next to oil seal surface on output shaft.
2. Install the washer (A).
3. Install roller bearing (B) using a press.
4. Install the second washer and snap ring.
5. Install inner race of roller bearing (D) on output shaft so the model number stamped on bearing is towards the valve housing and cover.
6. Install snap ring (E).




T7966CX –UN–14APR93




T117095

T117095 –UN–09SEP98

**A—Washer (2 used)**
**B—Roller Bearing**
**C—Snap Ring (2 used)**
**D—Roller Bearing**
**E—Snap Ring**

**Continued on next page**

CED,OUOE027,262 –19–20MAY98–3/8

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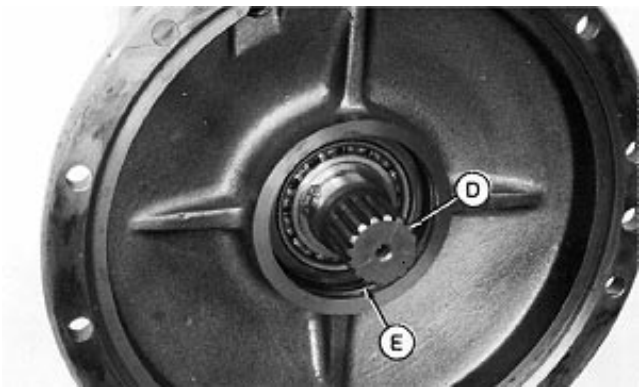
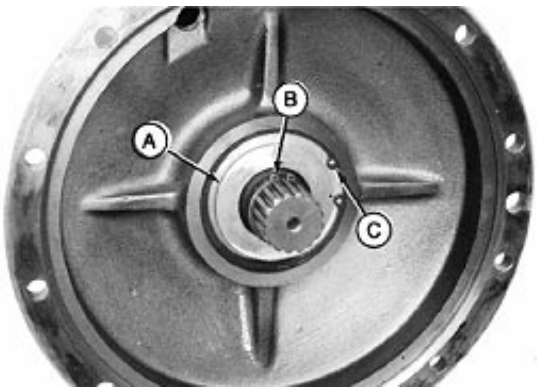
12

7. Install output shaft (D) and roller bearing into housing.
8. Install O-ring (E) into groove in housing. Apply clean oil to O-ring.
9. Install oil seal in cover (A) so seal lip (spring side) is towards the inside of housing. Apply clean oil to seal lips.
10. Install cover and oil seal into housing.
11. Install snap rings (B and C).




T7966CW –UN–14APR93



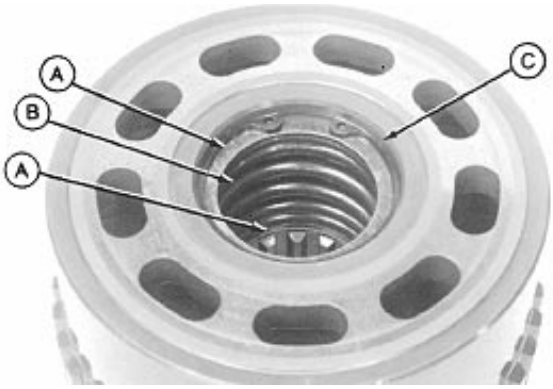

T7966CV –UN–14APR93

**A—Cover and Oil Seal**
**B—Snap Ring**
**C—Snap Ring**
**D—Output Shaft**
**E—O-Ring**

CED,OUOE027,262 –19–20MAY98–4/8

12. Install 47 x 61 x 3 mm washer (A) at the bottom of bore in cylinder block, the spring (B), and then the 50 x 61 x 3 mm washers (A).
13. Compress the spring using a disk and a press.

    Install the snap ring (C).




T7685KN –UN–07MAY92

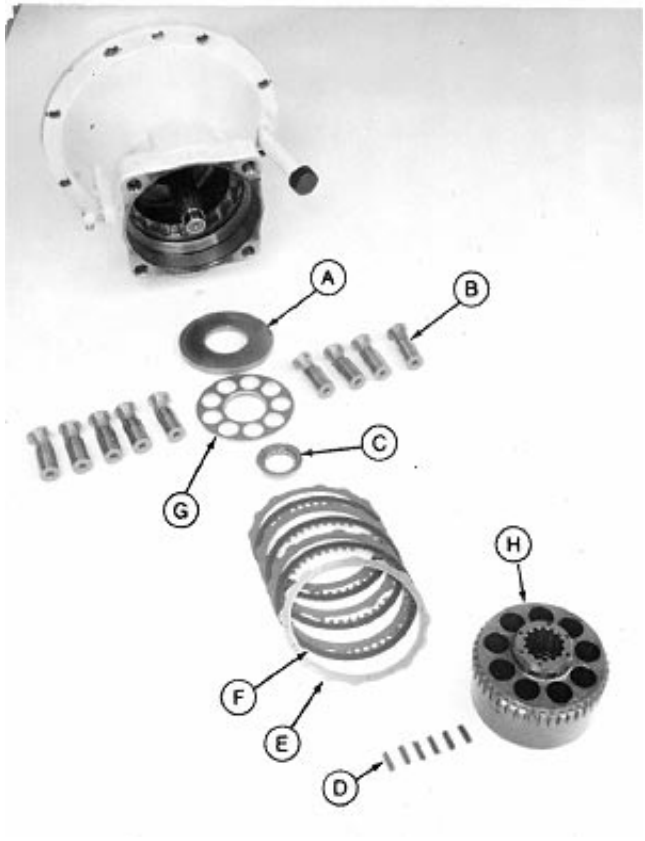
**A—50 x 61 x 3 mm Top Washer (3 used)**
**—47 x 61 x 3 mm Bottom Washer**
**B—Spring**
**C—Snap Ring**

**Continued on next page**

CED,OUOE027,262 –19–20MAY98–5/8

14. Install parts (A—H).

    Install the separator plates (F) so the missing tangs are aligned with the missing teeth on the friction disks (F).




**A—Thrust Plate**
**B—Piston (9 used)**
**C—Ball Bushing and Washer**
**D—Force Pin (12 used)**
**E—Separator Plate (3 used)**
**F—Friction Disk (2 used)**
**G—Retainer**
**H—Cylinder Block**

**Continued on next page**

CED,OUOE027,262 –19–20MAY98–6/8

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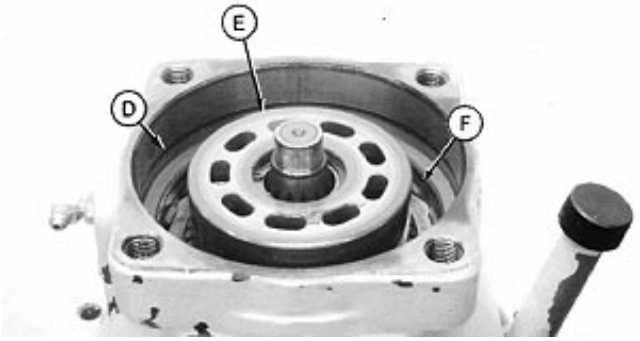
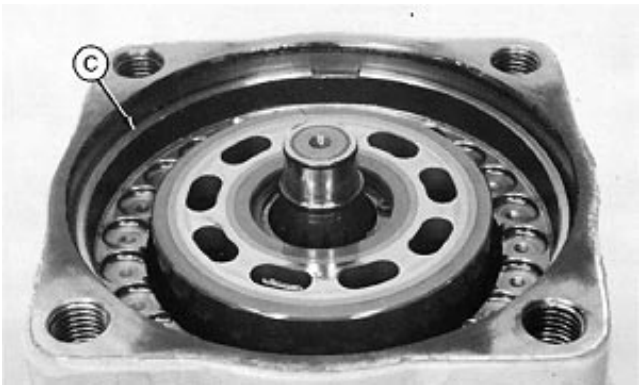
14

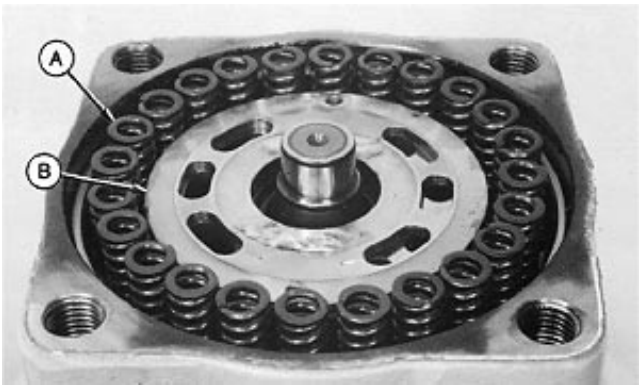
15. Install parts (A—F).




T7685KL –UN–07MAY92




T7685KK –UN–07MAY92




T7685KJ –UN–07MAY92

**A—Brake Spring (22 used)**
**B—Valve Plate**
**C—Brake Piston**
**D—O-Ring**
**E—Cylinder Block**
**F—O-Ring**

**Continued on next page**

CED,OUOE027,262 –19–20MAY98–7/8

16. Install O-ring (E) and valve plate (D).

17. Install outer race of roller bearing (F) so the model number stamped on bearing is towards the valve housing and cover (C).

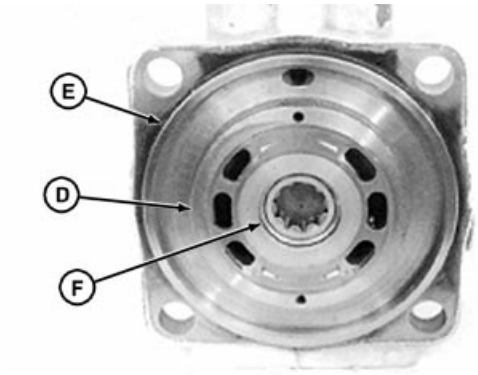
18. Install valve housing and cover (C) so work ports are towards the machined surface for park brake release valve.

    Tighten cap screws (B).

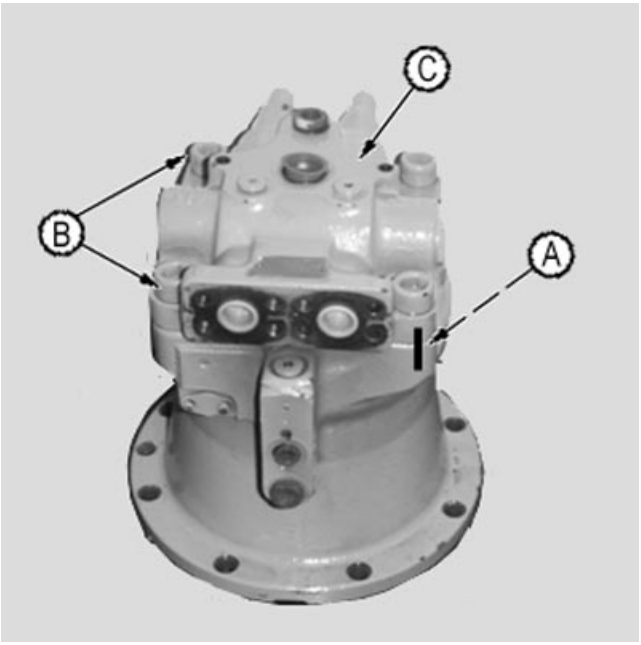
**Valve Housing-to-Motor Housing Cap Screw—Specification**

Torque ..... 430 N•m (320 lb-ft)

19. Add oil. (See Hydraulic Oil in Group 0004.)




T117082 –UN–09SEP98




T106131B –UN–09JAN97

**A—Plug**
**B—Cap Screw (4 used)**
**C—Valve Housing and Cover**
**D—Valve Plate**
**E—O-Ring**
**F—Roller Bearing**

CED,OUOE027,262 –19–20MAY98–8/8

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## DISASSEMBLE AND ASSEMBLE SWING MOTOR MAKE-UP AND CROSSOVER RELIEF VALVES

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1. Disassemble make-up valves (A) remove parts (B—E).
2. Remove crossover relief valves (F).
3. Replace parts as necessary.
4. Install parts (B—E). Tighten plug (D).

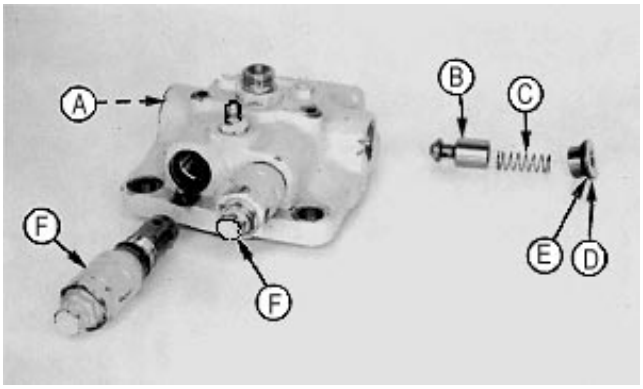
**Swing Motor Make-Up Valve Plug-to-Housing—Specification**

Torque ..... 330 N•m (245 lb-ft)

5. Install and tighten crossover relief valves (F).

**Crossover Relief Valve Body-to-Housing—Specification**

Torque ..... 176 N•m (130 lb-ft)

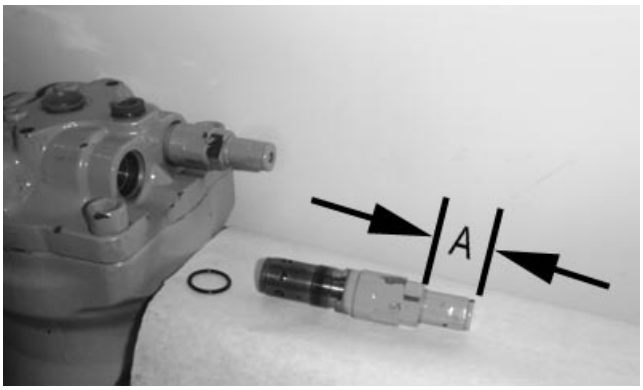



T106147 –UN–10JAN97

**A—Make-Up Valve (2 used)**
**B—Poppet**
**C—Spring**
**D—Plug**
**E—O-Ring**
**F—Crossover Relief Valve (2 used)**

CED,OUOE027,264 –19–20MAY98–1/3

6. Take dimension (A) and record for assembly.




T106132B –UN–09JAN97

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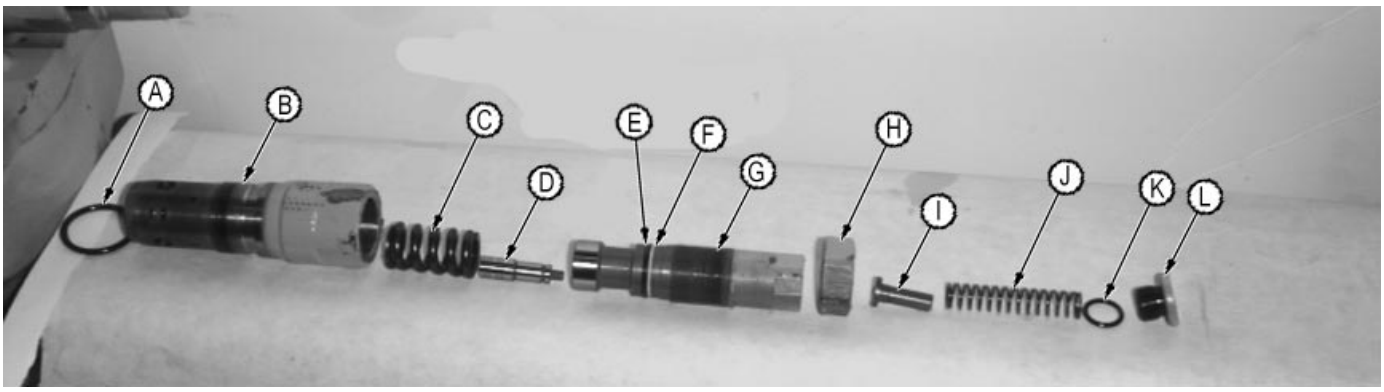
CED,OUOE027,264 –19–20MAY98–2/3




T106134B –UN–09JAN97

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**A—O-Ring**
**B—Valve Body**
**C—Spring**
**D—Piston**
**E—O-Ring**
**F—Backup Ring**
**G—Adjusting Plug**
**H—Nut**
**I—Spring Guide**
**J—Spring**
**K—O-Ring**
**L—Plug**

**IMPORTANT: Disassembly of relief valve is shown for convenience of cleaning. Service parts are not available. The relief valve must be replaced.**

7. Disassemble crossover relief valve (A—L).

8. Clean and inspect parts.

9. Replace relief valve if any part is damaged or worn.

**IMPORTANT: Make sure the poppet in body (B) slides into the bore in adjusting plug (G) while assembling. Failure to do so will force the plug out the end of body.**

10. Assemble relief valve (A—L).

11. Adjust plug (G) to original dimension.

12. Check swing crossover relief valve pressure setting. (See procedure in Group 9025-25.)

CED,OUOE027,264 –19–20MAY98–3/3

## DISASSEMBLE AND ASSEMBLE SWING MOTOR PARK BRAKE RELIEF VALVE

Tighten cap screws (43).

**Park Brake Release Valve Housing-to-Motor Housing Cap Screw—Specification**

Torque ..... 9.8 N•m (87 lb-in.)

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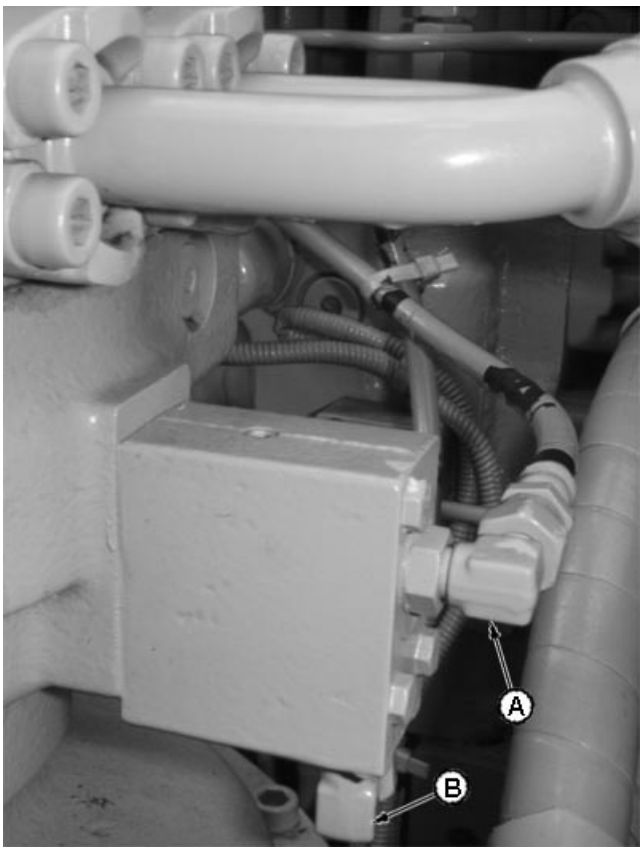
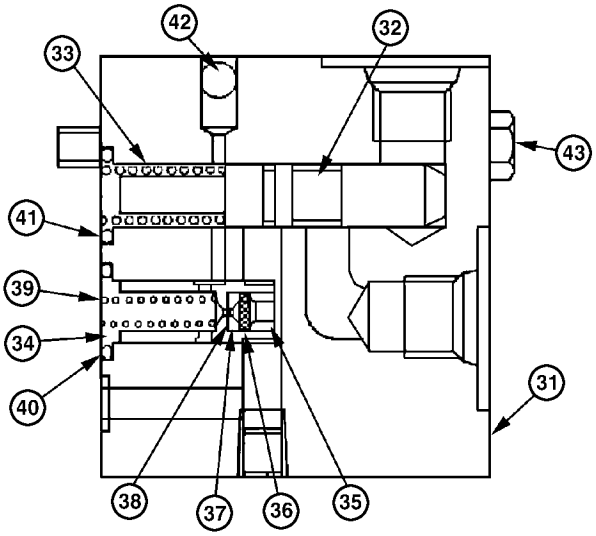



T109983B –UN–13JUN97




T109946

T109946 –UN–09SEP98

**A—Pilot Pressure From Solenoid Valve Manifold**
**B—Pilot Pressure Signal From Top Right Front Port of Control Valve**
**31—Housing**
**32—Spool**
**33—Spring**
**34—Plunger**
**35—Bushing**
**36—Filter**
**37—Spacer**
**38—Orifice**
**39—Spring**
**40—O-Ring**
**41—O-Ring (2 used)**
**42—Steel Ball**
**43—Cap Screw (3 used)**

CED,OUOE027,263 –19–20MAY98–1/1

# CHAPTER 22

# SECTION 99

# DEALER FABRICATED TOOLS

**BLANK**

## ST4920 TRACK RECOIL SPRING DISASSEMBLY AND ASSEMBLY TOOL

*NOTE: It is recommended that DFT1087 Track Recoil Spring Disassembly and Assembly Guard Tool be used with track recoil spring disassembly and assembly tool.*

*Dimensions given are metric.*

Tool is the same as used on other machines except the holder (C). For each track adjuster use the holder with the correct size hole for the nut on that track adjuster.

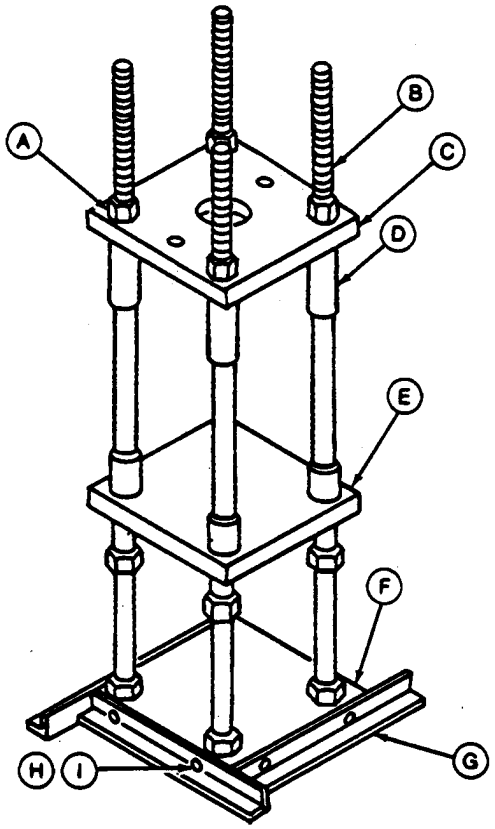
Track Recoil Spring Disassembly and Assembly Tool (compression tool) is used with hydraulic jack to compress recoil spring in track adjuster repair.

Material required:

- 1020 HR Steel for Holder (C), Supporting Plate (E), Base Plate (F), and Base (G).
- 1020 HR Steel for Holder (C), Supporting Plate (E), Base Plate (F), and Base (G).
- “D” Grade (SAE Grade 5) for Eyebolts (D), Nuts (A), and Cap Screws (H).
- “F” Grade (SAE Grade 8) for Studs (B).

Print Numbers:

- ST4050 Nut (A)
- ST4045 Bolt (B)
- ST4035 Holder (Plate) (C)
- ST4036 Holder (Plate) (C)
- ST4037 Holder (Plate) (C)
- ST4047 Eyebolt (D)
- ST4040 Supporting Base (E)
- ST4042 Base Plate (F)
- ST4041 Base (G)
- ST4046 Cap Screw (H)
- ST4049 Lock Washer (I)




T6585UY –UN–24MAR98

**A—Nut (12 used)**
**B—Stud (4 used)**
**C—Holder**
**D—Eyebolt (2 used)**
**E—Supporting Plate**
**F—Base Plate**
**G—Base (4 used)**
**H—Cap Screw (8 used)**
**I—Lock Washer (8 used)**

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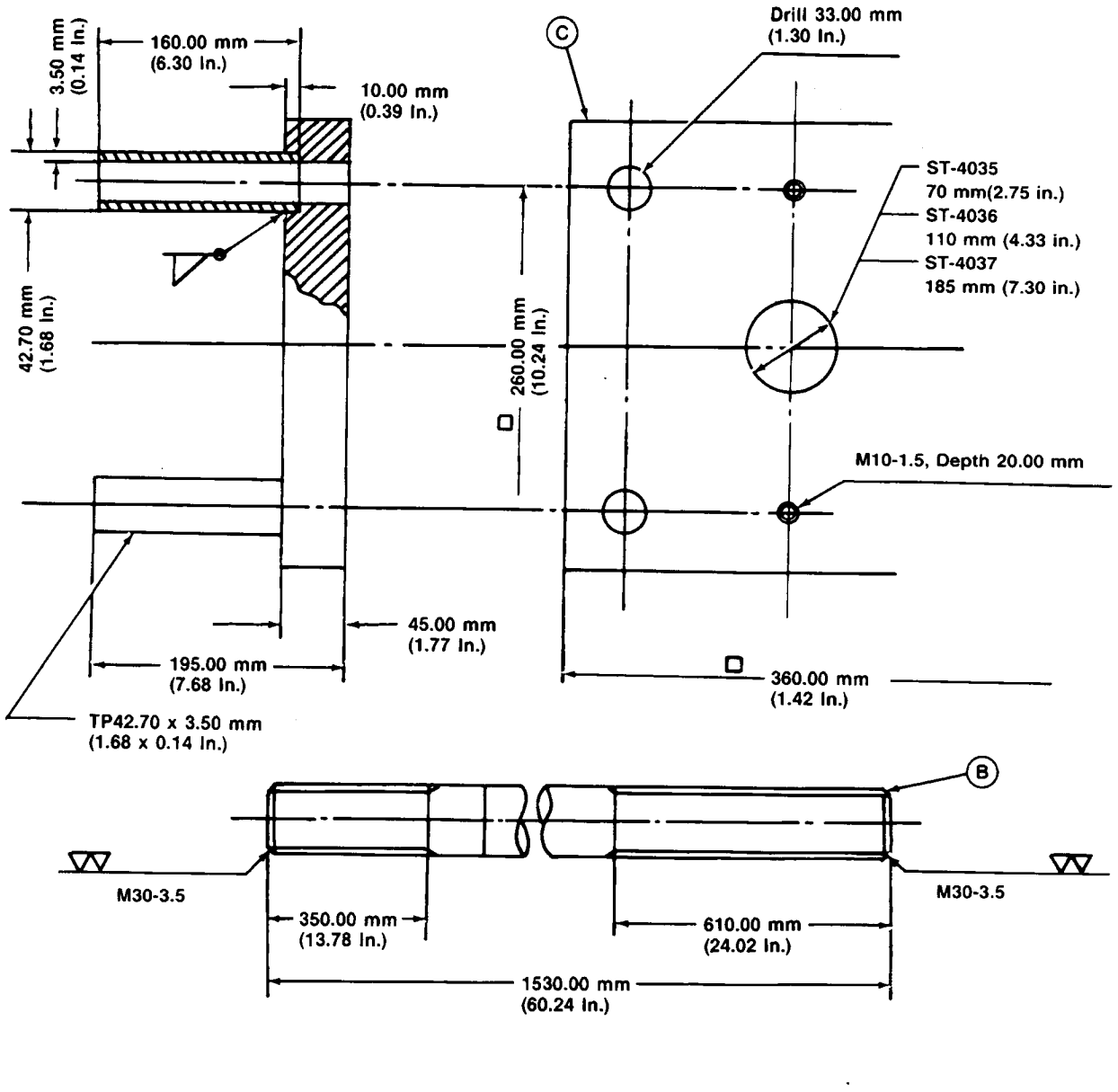
CED,OUOE023,2244 –19–29MAR97–1/4

*Dealer Fabricated Tools*



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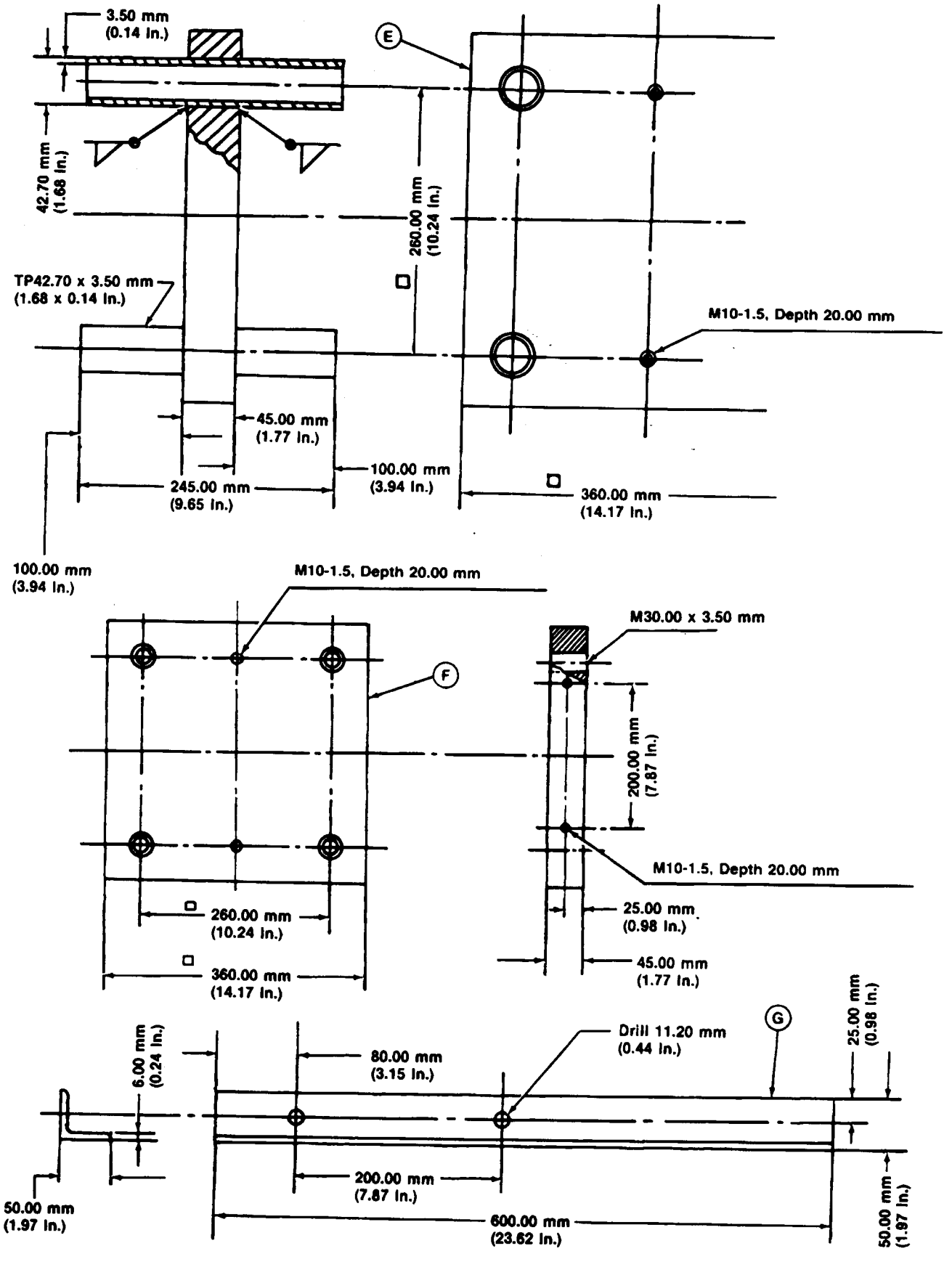
CED,OUOE023,2244 –19–29MAR97–2/4

*Dealer Fabricated Tools*



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CED,OUOE023,2244 –19–29MAR97–3/4

*Dealer Fabricated Tools*

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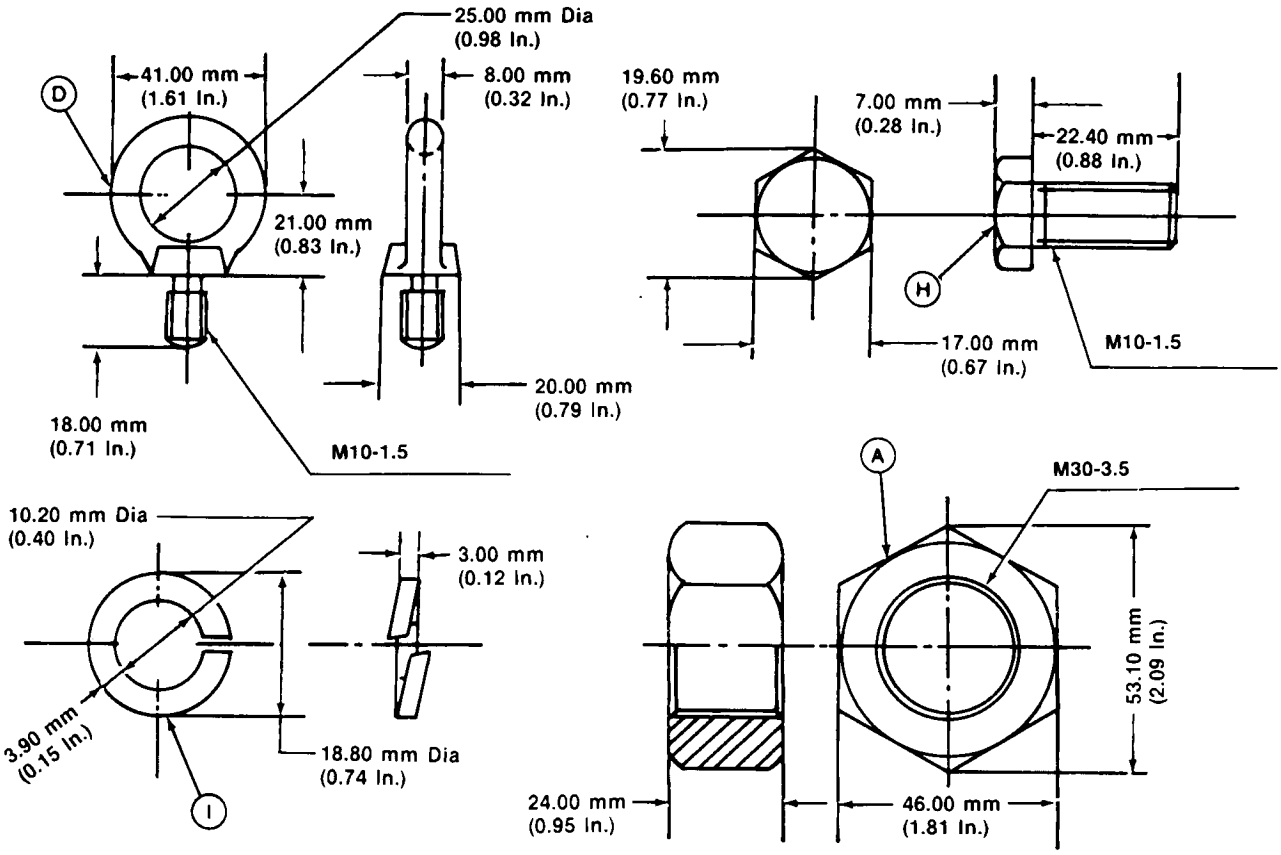
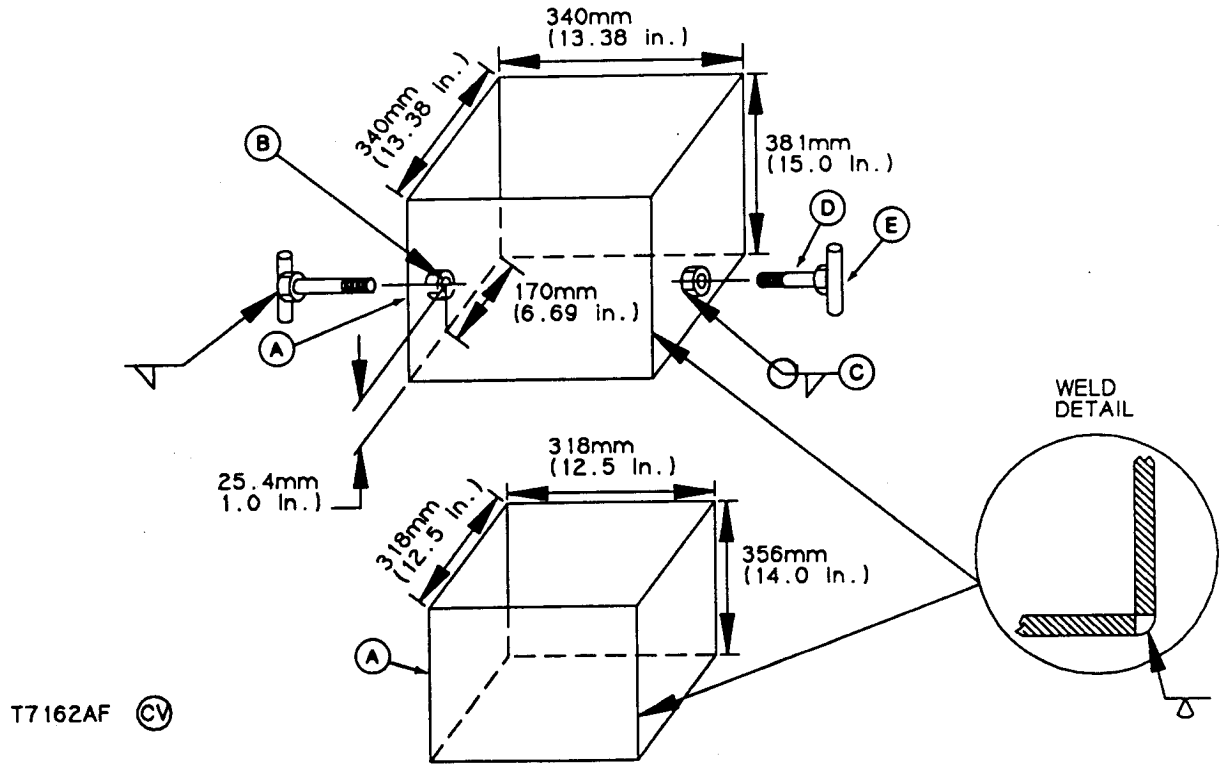



T7029CG –UN–06JUL89

CED,OUOE023,2244 –19–29MAR97–4/4

## DFT1087 TRACK RECOIL SPRING DISASSEMBLY AND ASSEMBLY GUARD TOOL




T7162AF –UN–17OCT89

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**A—3/16 in. 1020 CR Steel Plate** **B—9/16 in. Hole (2 places)** **C—1/2 in. Nut (2 used)** **D—1/2 x 2 in. Cap Screw (2 used)** **E—1/2 x 3 in. Steel Round Stock (2 used)**

Track Disassembly and Assembly Guard Tool is used with ST4920 Track Recoil Spring Disassembly and Assembly Tool.

Material required:

- 3/16 in. 1020 CR Steel Plate (A)
- 1/2 in. Nut (C) (2 used)
- 1/2 x 2 in. Cap Screw (D) (2 used)
- 1/2 x 3 in. Steel Round Stock (E) (2 used)

CED,OUOE023,2245 –19–29MAR97–1/1

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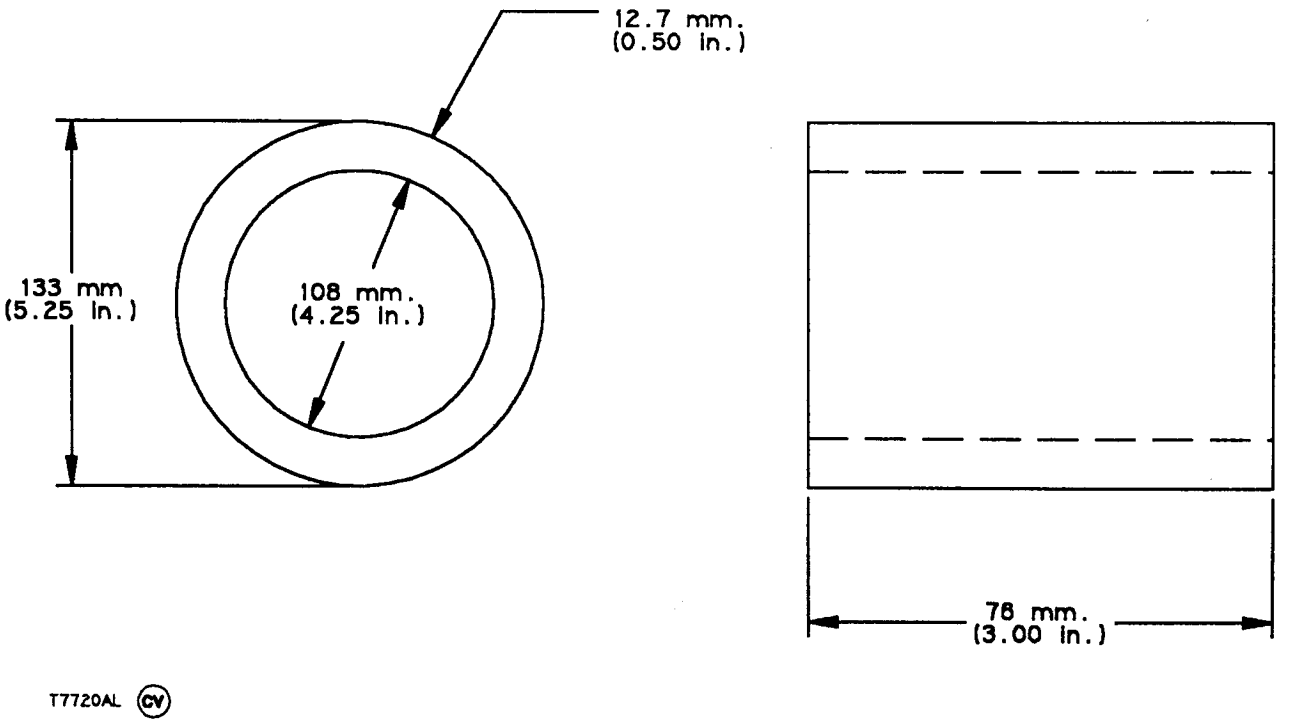
## DFT1112 SPACER




Spacer is used with ST4920 Track Recoil Spring Disassembly and Assembly Tool. Spacer is installed on the bottom plate so force is applied to spring flange on cylinder and not to the piston

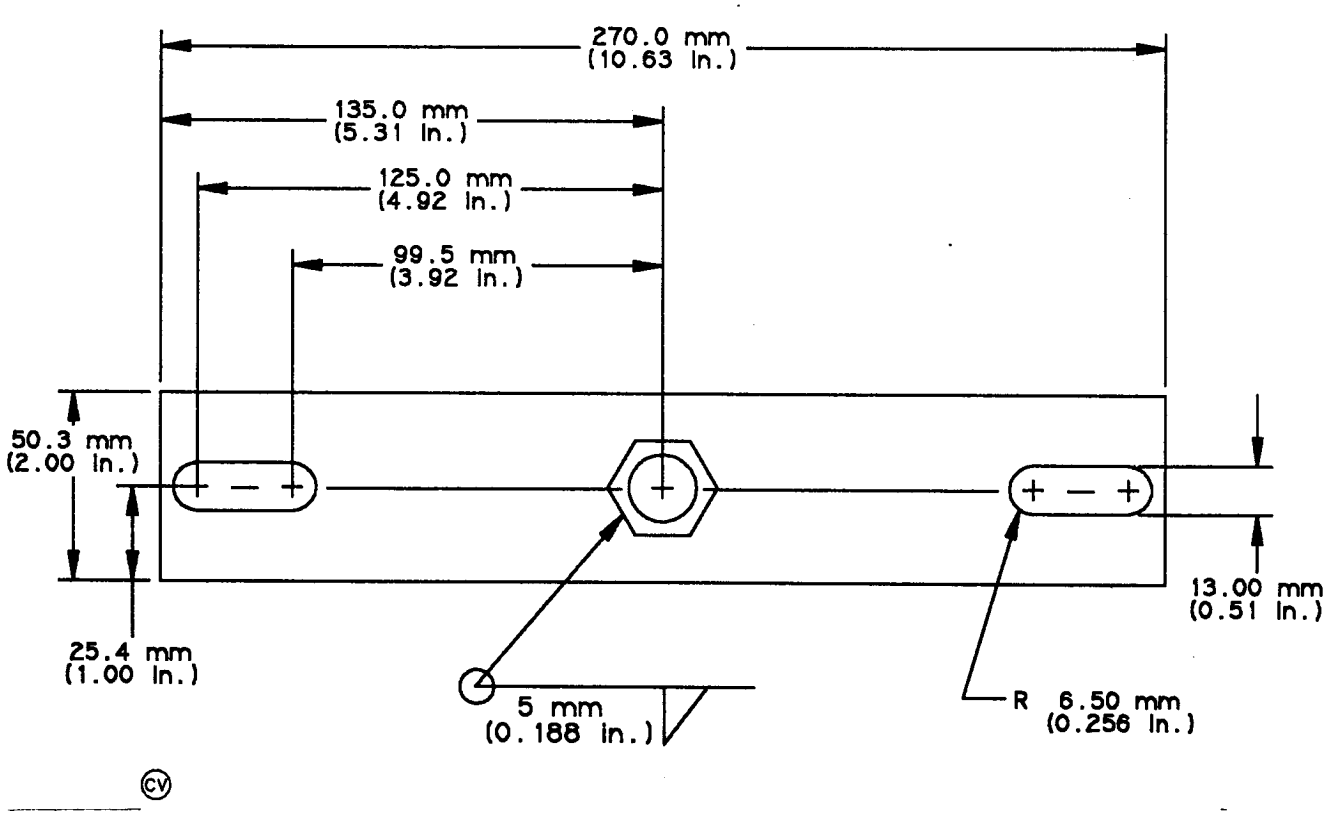
Cut the ends of spacer so they are parallel to each other.

Material Required:

- 133 x 108 x 76 mm (5.25 x 4.25 x 3.00 in.) Heavy Wall Steel Pipe

CED,OUOE023,2246 –19–29MAR97–1/1

## DF1036A PROPEL GEARBOX NUT WRENCH

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T7681FZ –UN–28FEB92

Propel Gearbox Nut Wrench is used to remove and install the hub-to-housing nut in the propel gearbox.

Material required:

- 16 mm (5/8 in.) flat bar stock
- M24 (1 in.) nut
- M10-1.5 x 60 mm cap screw (2 used)
- M10-1.5 nut (2 used)

CED,OUOE023,2247 –19–29MAR97–1/1

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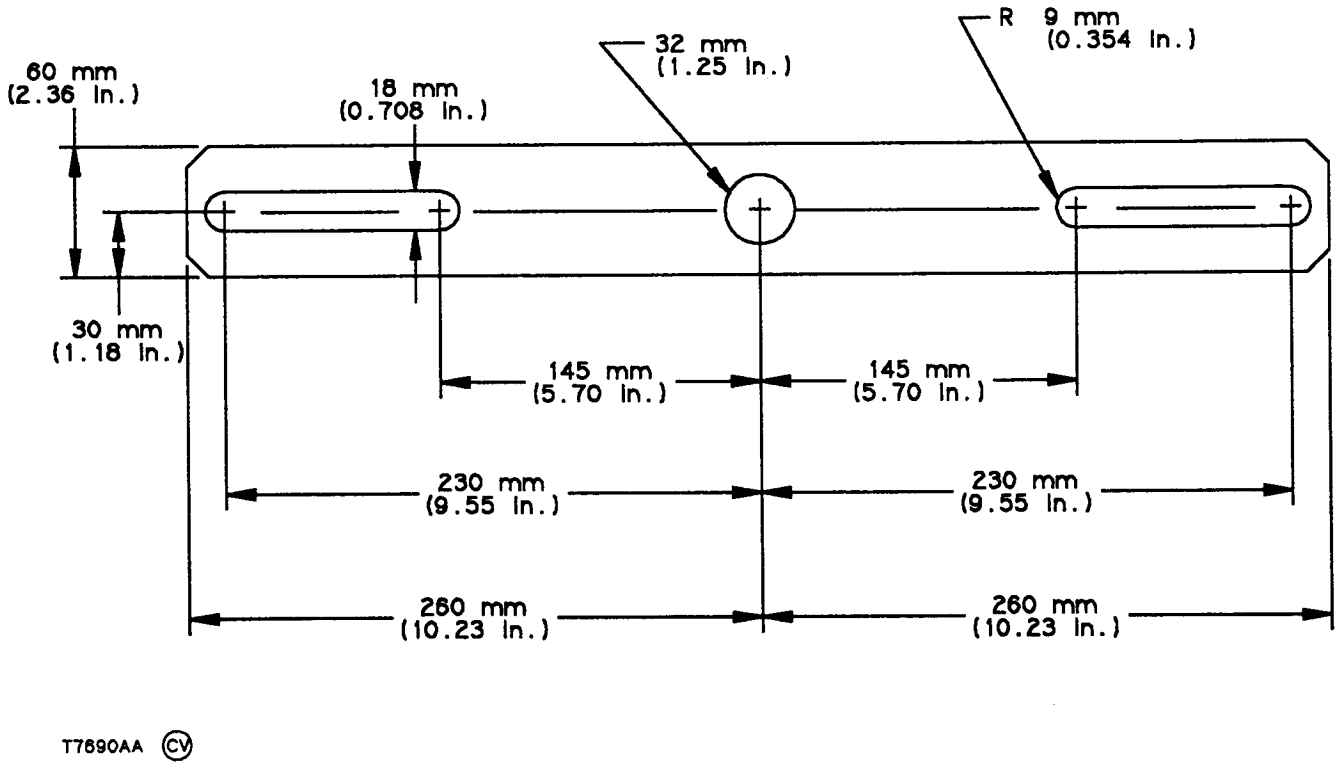
## DFT1109 HOLDING BAR




T7690AA –UN–27FEB92

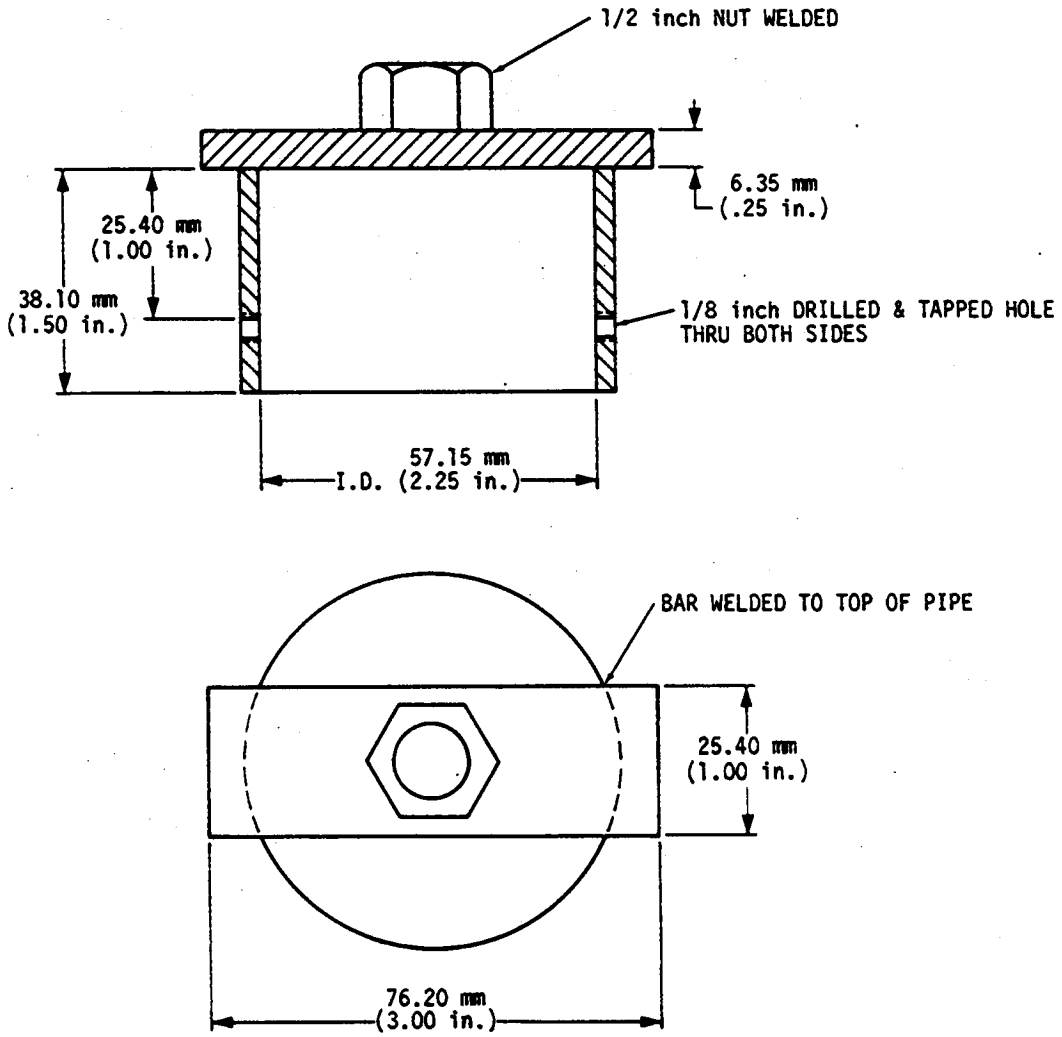
Holding Bar is used with the DF1036A Propel Gearbox Nut Wrench as a guide when loosening the hub-to-housing nut in the propel gearbox.

Material required:

- 16 mm (5/8 in.) flat bar stock

CED,OUOE023,2248 –19–29MAR97–1/1

## DF1037 HYDRAULIC PUMP TORQUE ADAPTER

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T6585XT –19–12JAN89

Hydraulic Pump Torque Adapter is used to check rolling drag torque on hydraulic pump shaft.

Material required

- 2.25 in. inside diameter (I.D.) pipe
- 1/4 in. flat steel stock
- 1/2 in. nut
- 1/8 in. adjusting screws (2 used)

CED,OUOE027,312 –19–08JUN98–1/1

*Dealer Fabricated Tools*

## ROTARY MANIFOLD LIFTING TOOL

Tool is used to remove and install rotary manifold.

Drill and tap disk in fitting cap to M8-1.25 mm threads (A).

Material required:

- 38H1416 Cap (—12)
- JT05548 8 mm Metric Lifting Eyebolt

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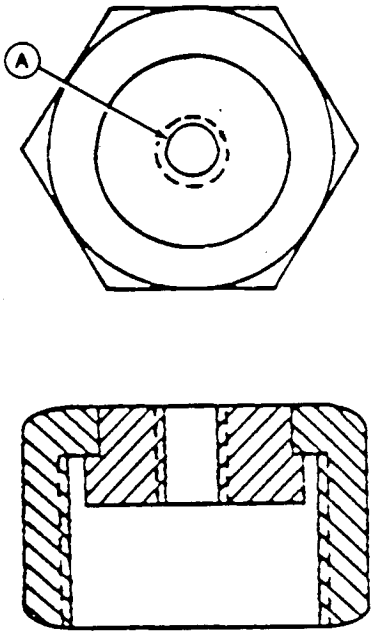



T6641DO –UN–24OCT88

**A—M8-1.25 mm Threads**

CED,OUOE023,2249 –19–29MAR97–1/1

## DFT1089 BARREL SUPPORT

Barrel supports are used to support the upperstructure when removing the undercarriage.

Material Required:

**CAUTION: Cutting tops off barrels that contained flammable or explosive material can cause serious injury or death.**

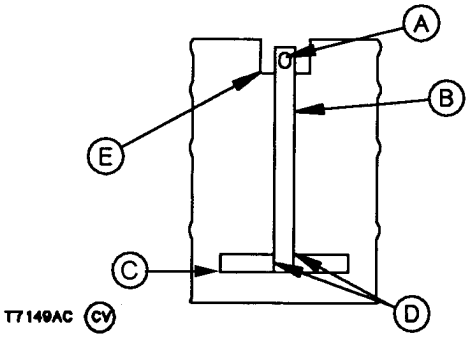
- Clean metal 55 gal barrels of equal height with lids removed. (Must be 34.5—35.5 in. height x 24 in. wide.)
- 1/2 x 4 x 24 in. 1020 CR Plate
- 1/2 x 4 x 12 in. 1020 CR Plate
- One empty 3 lb coffee can or equivalent
- Highway Cement (9 bag mix). Mix extra dry to aid curing time.

Insert hook assembly into barrel before cement is set. Hold assembly in position, using a steel plate or wire, until cement begins to cure.

Level off cement with top of barrels.

Cement must cure for a minimum of ten days.

The approximate weight of each barrel support is 545 kg (1200 lb). The approximate support capacity of each barrel support is 385 560 kg (850,000 lb).




T7149AC –UN–09JAN97

**A—2 x 4 in. Slotted Hole, Recessed**
**B—1/2 x 4 x 24 in. 1020 CR Plate**
**C—1/2 x 4 x 12 in. 1020 CR Plate**
**D—1/4 in. Fillet Weld**
**E—One empty 3 lb coffee can or equivalent**

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CED,OUOE023,2250 –19–29MAR97–1/1

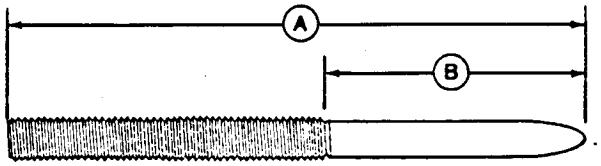
## GUIDE PIN

Guide pin is used to align cap screw holes in swing bearing and upperstructure.

Remove threads for a distance (B) and then grind a taper on same end.

Material Required:

- M27 x 2 x 150 mm Threaded Rod




T6641EK –UN–24OCT88

**A—150 mm (6 in.)**
**B—100 mm (4 in.)**

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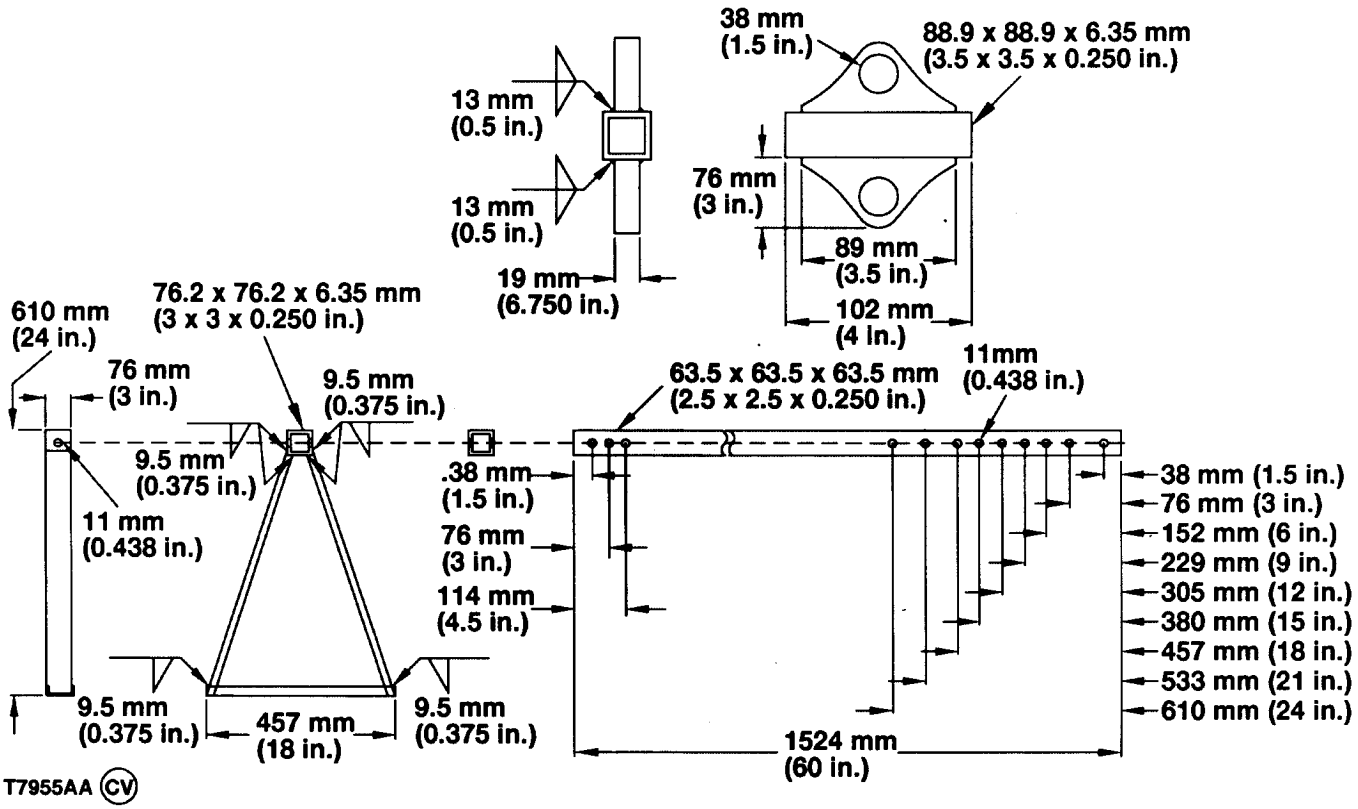
CED,OUOE023,2251 –19–29MAR97–1/1

## DFT1119 PUMP SUPPORT

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T7955AA –UN–23APR93

Pump support is used with a hand hoist to support a pump(s) when an engine is removed.

Two end stands are needed.

Drill the holes through the square steel tubing so they are centered.

Material required:

- C3 x 5 Steel Channel
- 88.9 x 88.9 x 6.35 mm (3.5 x 3.5 x 0.250 in.) Square Steel Tubing
- 76.2 x 76.2 x 6.35 mm (3 x 3 x 0.250 in.) Square Steel Tubing
- 63.5 x 63.5 x 6.35 mm (2.5 x 2.5 x 0.250 in.) Square Steel Tubing
- 19 mm (3/4 in.) Flat Bar Stock
- M10 x 89 mm or 3/8 x 3-1/2 in. D Grade (SAE Grade 5) Cap Screw (2 used)
- M10 or 3/8 in. D Grade (SAE Grade 5) Nut (2 used)

CED,OUOE023,2252 –19–29MAR97–1/1

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# APPENDIX A
# UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

## A-1. GENERAL

Preventive Maintenance Checks and Services (PMCS) are performed to keep the Hydraulic Excavator in operating condition. The checks are used to find, correct, or report problems. Pay attention to WARNING and CAUTION statements. A WARNING means someone could be hurt. A CAUTION means equipment could be damaged.

Once a week do Weekly PMCS. If Hydraulic Excavator has not been operated in a week, also do Before PMCS at the same time.

Do Monthly PMCS once a month. If Hydraulic Excavator has not been operated in a month, also do After PMCS at the same time.

If you are operating the Hydraulic Excavator for the first time, do your Weekly and Monthly PMCS the first time you do your Before PMCS.

If you find something wrong when performing PMCS, fix it if you can using troubleshooting procedures and/or maintenance procedures.

The right-hand column of the PMCS table lists conditions that make the Hydraulic Excavator not fully mission capable. Write up items not fixed on DA Form 2404 for direct support maintenance. For further information on how to use this form, see DA PAM 738-750.

## A-2. LEAKAGE DEFINITION

**CAUTION: Equipment operation is allowable with minor leakages (Class I or II) except for fuel leaks. Of course, consideration must be given to the fluid capacity of the item or system being checked. When in doubt, ask your supervisor.**

When operating with Class I or II leaks, continue to check fluid levels as required in the PMCS.

Class III leaks should be reported immediately to your supervisor.

It is necessary to know how fluid leakage affects the status of the Hydraulic Excavator. The following are definitions of the classes of leakage an operator or crewmember needs to know to be able to determine the condition of the leak. Learn and then be familiar with them, and REMEMBER-WHEN IN DOUBT, ASK YOUR SUPERVISOR.

Leakage Definitions for Unit PMCS:

CLASS I-Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

CLASS II-Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked.

CLASS III-Leakage of fluid great enough to form drops that fall from the item being checked.

## A-3. INSPECTION

Look for signs of a problem or trouble. Senses help here. You can feel, smell, hear, or see many problems. Be alert when on the Hydraulic Excavator.

Inspect to see if items are in good condition. Are they correctly assembled, stowed, secured, excessively worn, leaking, corroded, or properly lubricated? Correct any problems found or notify direct support maintenance.

There are some common items to check all over the Hydraulic Excavator. These include the following:

1. Bolts, clamps, nuts, and screws: Continuously check for looseness. Look for chipped paint, bare metal, rust, or corrosion around bolt and screw heads and nuts. Tighten them when you find them loose. If tools are not available, notify direct support maintenance.

2. Welds: Many items on the Hydraulic Excavator are welded. To check these welds, look for chipped paint, rust, corrosion, or gaps. When these conditions exist, notify direct support maintenance on DA Form 2404.

3. Electrical wires, connectors, and harnesses: Tighten loose connectors. Look for cracked or broken insulation, bare wires, and broken connectors. If any are found, notify direct support maintenance.

4. Hoses and fluid lines: Look for wear, damage, and leaks, and make sure clamps and fittings are tight. Wet spots mean a leak. A stain by a fitting or connector can also mean a leak. When you find a leak, notify direct support maintenance.

## A-4. LUBRICATION SERVICE INTERVALS-NORMAL CONDITIONS

For safer, more trouble-free operations, make sure that the Hydraulic Excavator is serviced in accordance with the proper lubrication and service intervals specified in the PMCS.

## A-5. LUBRICATION SERVICE INTERVALS-UNUSUAL CONDITIONS

The Hydraulic Excavator will require extra service and care when you operate under unusual conditions. High or low temperatures, long periods of hard use, or continued use, in sand, water, mud, or snow will break down the lubricant requiring you to add or change lubricant more often.

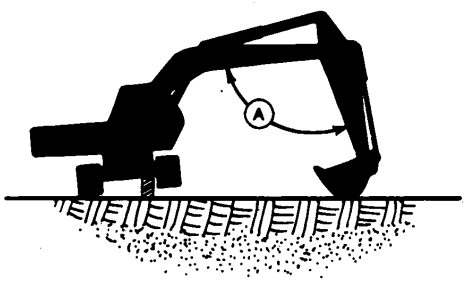
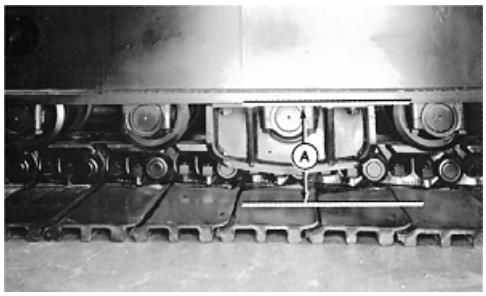
## A-6. AOAP SAMPLING

Engine oil must be sampled at 50 hours of operation or 90 days, and hydraulic oil must be sampled once a year as prescribed by DA PAM 738-750, Functional Users Guide for The Army Maintenance Management System (TAMMS). For equipment under manufacturer’s warranty, hard-time oil service intervals shall be followed. Intervals shall be shortened if lubricants are known to be contaminated, or if operation is under adverse conditions (such as longer-than-usual operating hours, extended idling periods, extreme dust).

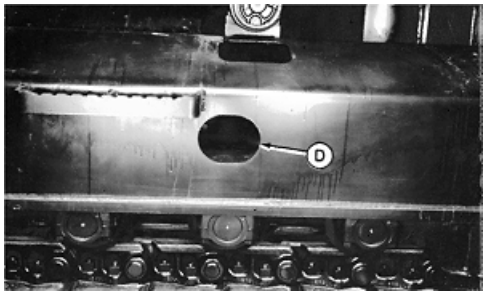
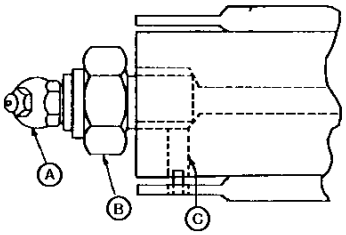
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | **WARNING: Always remember the CAUTIONS, WARNINGS, and NOTES before operating this machine and prior to PMCS.**<br><br>PREPARE MACHINE FOR MAINTENANCE<br><br>Before performing PMCS and before leaving the operator's seat, park the machine as described below unless another position is specified in the procedure.<br><br>(1) Park machine on a level surface.<br><br>(2) Lower bucket to the ground.<br><br>(3) Turn auto-idle switch off.<br><br>**CAUTION: Turbocharger may be damaged if engine is not properly shut down.**<br><br>(4) Run engine with engine rpm dial at 1/3 position without load for 2 minutes.<br><br>(5) Move engine rpm dial to slow idle position.<br><br>(6) Turn key switch to OFF. Remove key from switch.<br><br>(7) Pull pilot control shut-off lever to locked position. | |
| 1 | Weekly | Inspect Breaker Tool<br><br>(1) Remove tool.<br><br>(2) Inspect tool for damage and wear. Replace if necessary.<br><br>(3) Grease upper and lower bushings and retaining axles before installing tool (INDECO Supreme 1000 grease or other HD Moly Grease containing 3 to 5 percent Molybdenum Disulfide). | |
| 2 | Weekly | Inspect Breaker Upper and Lower Bushings<br><br>(1) Measure upper bushing for wear. Replace if inside diameter exceeds 158 mm (6.22 in.).<br><br>(2) Grease the bushings before reinstalling tool (INDECO Supreme 1000 grease or other HD Moly Grease containing 3 to 5 percent Molybdenum Disulfide). | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 3 | *As Required | Check Track Sag<br>  <br><br>(1) Swing upperstructure 90° and lower bucket to raise track off ground.<br>(2) Keep the angle (A) between 90—110° and position bucket's round side on the ground.<br>**CAUTION: Prevent possible injury from unexpected machine movement. Place blocks under frame to support machine while measuring track sag.**<br>(3) Place blocks under machine to support machine.<br>(4) Rotate track forward two full rotations and then in reverse two full rotations.<br>  <br><br>(5) Measure the distance (A) at middle track roller from bottom of track frame to top surface of track shoe.<br>**TRACK SAG SPECIFICATIONS**<br>Normal Ground Conditions 300—335 mm (11-13/16—13-3/16 in.) | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 4 | *As Required | Adjust Track Sag<br><br>**CAUTION: Prevent possible damage to track components. DO NOT use the grease fitting on the track-adjusting cylinder for lubrication. Use this fitting ONLY for track adjustment.**<br><br>  <br><br>  <br><br>(1) To tighten track, connect grease gun to grease fitting (A) (located through access hole [D] in track frame). Add grease until sag is within specifications (see Fuels and Lubricants, Chapter 1).<br><br>**WARNING: Prevent possible injury from high-pressure grease. Do not remove grease fitting (A) from nut (B).**<br><br>(2) To loosen track, slowly turn nut (B) counterclockwise; grease will escape through the bleed hole (C).<br><br>(3) When track sag is within specifications, torque nut (B) to 147 N•m (108 lb-ft).<br><br>**TRACK SAG SPECIFICATIONS**<br>Normal Ground Conditions 300—335 mm (11-13/16—13-3/16 in.) | Cannot adjust track sag |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 5 | *As Required | Check Breaker Tool Contact Areas for Proper Lubrication<br><br>(1) Check that the tool contact areas (especially the chuck housing) are well lubricated and smooth. A properly lubricated tool will show streaks of grease below the lower bushing on the tool shank. Remove any bumps or rough areas with a wire brush. | |
| 6 | Monthly | Clean Quick-Disconnect Hitch Cavity and Grease Safety Lock Pin<br><br>(1) Remove quick-disconnect hitch cover by removing four cap screws and washers.<br><br>(2) Clean dirt and debris from quick-disconnect hitch cavity.<br><br>(3) Apply grease to safety lock pin tube until grease is visible at ends of tube (see Fuels and Lubricants, Chapter 1).<br><br>(4) Install hitch cover. | |
| 7 | Monthly | Check Quick-Disconnect Hitch for Loose Bolts and Nuts<br><br>(1) Ensure that all bolts are within proper torque specifications. | |
| 8 | Monthly | Check Arctic Starter Glow Pin<br><br>(1) Check glow pin for wear or damage. Replace if necessary. | |
| 9 | Monthly | Check Arctic Starter Coolant Hoses and Clamps<br><br>(1) Check coolant hoses for wear, cracking, or leaks. Replace if necessary.<br><br>(2) Check clamp tightness and for wear or damage. Replace if necessary. | Any Class III leak evident |
| 10 | Monthly | Check All Arctic Starter Electrical Lines and Connections<br><br>(1) Visually check all electrical lines and connections for corrosion. Replace if necessary. | |

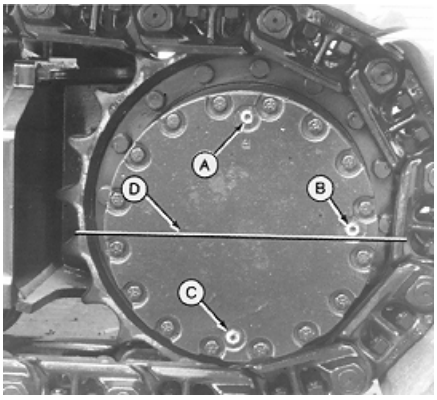
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 11 | Monthly | Change Engine Oil and Replace Filter<br><br>**NOTE: If fuel sulfur content exceeds 0.5 percent, change the engine oil at 1/2 the normal interval.**<br><br>**NOTE: If the engine has not run 250 hours before the season changes, change oil.**<br><br>(1) Run engine to warm oil.<br><br>(2) Park machine on level surface.<br><br>(3) Lower bucket to the ground.<br><br>(4) Turn auto-idle switch off.<br><br>**CAUTION: Turbocharger may be damaged if engine is not properly shut down.**<br><br>(5) Run engine with engine rpm dial at 1/3 position without load for 2 minutes.<br><br>(6) Move engine rpm dial to slow idle.<br><br>(7) Turn key switch to OFF. Remove key from switch.<br><br>(8) Attach a “Do Not Operate” tag on the right control lever.<br><br>(9) Pull pilot control shut-off lever to locked position.<br><br>  <br><br>(10) Remove cover from under the engine. Remove drain plug (A) from bottom of engine oil pan, or open drain valve on side of engine oil pan. Allow oil to drain into a container. Dispose of waste properly. | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (11) Turn filter (B) counterclockwise to remove. Clean mounting surface on base.<br><br>(12) Apply a thin film of oil to rubber gasket of new filter.<br><br>  <br><br>(13) Install new filter. Turn filter clockwise by hand until gasket touches mounting surface.<br><br>(14) Tighten filter 1/2—3/4 turns more.<br><br>(15) Install drain plug or close drain valve.<br><br>(16) Remove fill cap (C).<br><br>(17) Fill engine with oil (see Fuels and Lubricants, Chapter 11).<br><br>**SPECIFICATION**<br>Oil Capacity With Filter Change 19 L (20 qt)<br><br>(18) Install fill cap.<br><br>(19) Start engine.<br><br>**NOTE: Engine oil pressure indicator on monitor must go out within 15—20 seconds. If not, stop the engine immediately and find the cause.**<br><br>(20) Stop engine. Check oil level.<br><br>(21) Check for any leakage at filter. If so, tighten filter just enough to stop leakage and repeat steps 19 through 21.<br><br>(22) Install cover from under the engine. | |

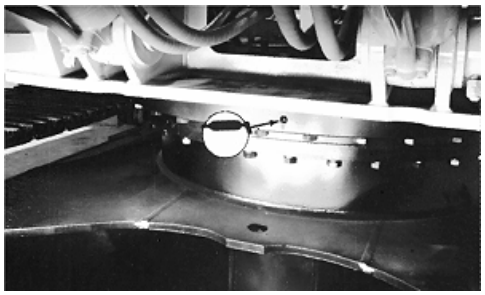
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 12 | Quarterly | Check Carrier Hydraulic Flow and Pressure | |
| 13 | Quarterly | Check Breaker Accumulator Charge | |
| 14 | Quarterly | Rotate Breaker Retaining Axles<br>(1) Use a screwdriver or similar tool to turn locking screws 180 degrees.<br>(2) Use a screwdriver or similar tool to push retaining axle out of breaker from opposite side.<br>(3) Rotate retaining axles 180 degrees, or replace if worn.<br>(4) Grease retaining axles and reinstall.<br>(5) Turn locking bolts 180 degrees to lock retaining axles in place. | |
| 15 | Quarterly | Check Propel Gearbox Oil<br>  <br>(1) Park machine on level ground rotating propel gearbox until bottom of the oil level check plug (B) is even with the horizontal centerline (D).<br>(2) Lower boom to the ground.<br>(3) Turn auto-idle switch off. | |

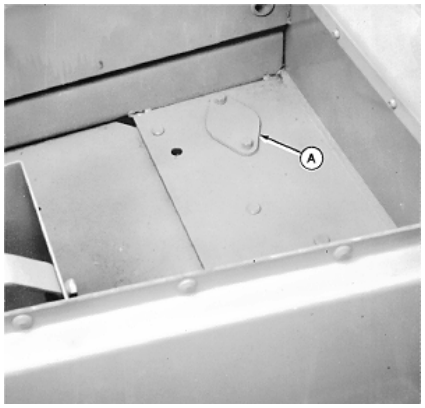
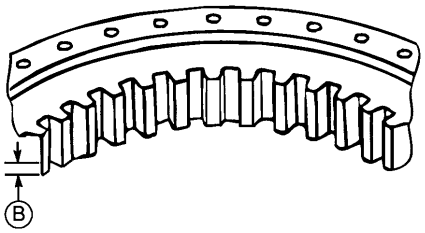
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (4) Run engine with engine rpm dial at 1/3 position without load for 2 minutes.<br><br>**CAUTION: Turbocharger may be damaged if engine is not properly shut down.**<br><br>(5) Move engine rpm dial to slow idle and turn key switch to OFF. Remove key from switch.<br><br>(6) Attach a “Do Not Operate” tag on the right control lever.<br><br>(7) Pull pilot control shut-off lever to locked position.<br><br>**WARNING: High-pressure release of fluids from pressurized system can cause serious burns. Wait for propel gearbox oil to cool. Keep body and face away from check plug. Gradually loosen check plug to release pressure.**<br><br>(8) After propel gearbox has cooled, slowly loosen check plug (B) to release pressure.<br><br>(9) Remove check plug (B). Oil must be to bottom of hole.<br><br>(10) If necessary, remove fill plug (A).<br><br>(11) Add oil until oil flows out of level check plug hole (see Fuels and Lubricants, Chapter 1).<br><br>(12) Wrap threads of check plug and fill plug with sealing-type tape. Install plugs. Tighten plugs to 49 N•m (430 lb-in.).<br><br>(13) Change oil of second propel gearbox. | |

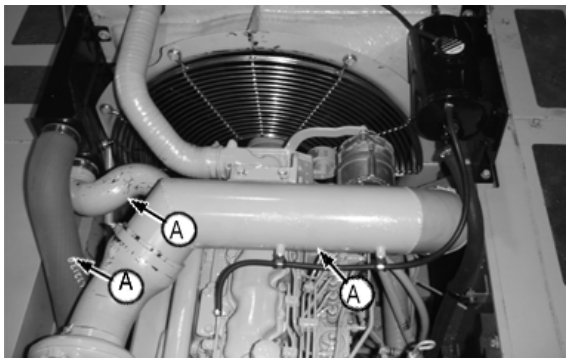
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 16 | Quarterly | Grease Swing Bearing<br><br>**WARNING: Prevent possible injury from unexpected machine movement if another person moves controls. One person must do lubricating swing bearing and rotating the upperstructure. Before you lubricate swing bearing, clear area of all personnel.**<br><br>  <br><br>(1) Park machine on level surface.<br><br>(2) Lower bucket to the ground.<br><br>(3) Turn auto-idle switch off.<br><br>**CAUTION: Turbocharger may be damaged if engine is not properly shut down.**<br><br>(4) Run engine with engine rpm dial at 1/3 position without load for 2 minutes.<br><br>(5) Move engine rpm dial to slow idle position.<br><br>(6) Turn key switch to OFF position. Remove key from switch.<br><br>(7) Attach a “Do Not Operate” tag on the right control lever.<br><br>(8) Pull pilot control shut-off lever to locked position.<br><br>(9) Lubricate swing bearing with 10 shots of grease at both grease fittings (see Fuels and Lubricants, Chapter 1).<br><br>(10) Start engine. Raise bucket several inches off the ground and rotate the upperstructure 45 degrees. | |

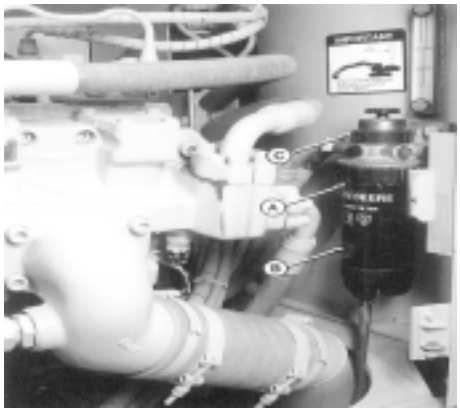
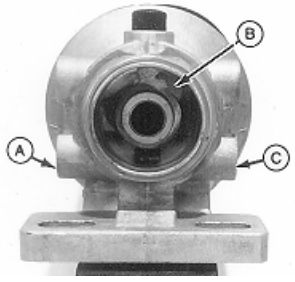
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (11) Repeat steps 2 through 9 three times.<br><br>**NOTE: It is not necessary to start the engine the last time.** | |
| 17 | Quarterly | Grease Swing Bearing Gear<br><br>**WARNING: Prevent possible injury from unexpected machine movement if another person moves controls. One person must do lubricating swing bearing and rotating the upperstructure. Before you lubricate swing bearing, clear area of all personnel.**<br><br>  <br><br><br>(1) Use a wrench to remove access cover (A) to swing gear.<br><br>  <br><br><br>(2) Check grease:<br><br>a. Grease must be 13—25 mm (1/2—1in.) (B) deep. Measured from the bottom of the swing gear. | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | b. The grease must be free of contamination by dirt and water. If the grease is contaminated, remove grease and replace with clean grease.<br><br>**NOTE: If water or mud is found in swing gear area, refer to "Operating in Water and Mud" in the Operating the Machine section.**<br><br>(3) Add grease as required (approximately 0.113 kg [1/4 lb] every 90°) (see Fuels and Lubricants, Chapter 1).<br><br>**CAUTION: Excessive grease can damage the swing gearbox seal.**<br><br>(4) Remove excessive grease that extrudes over the top of the swing drive pinion.<br><br>(5) Install access cover. | |
| 18 | Quarterly | Inspect Air Intake Hoses<br>  <br>(1) Inspect hoses (A) for cracks and leaks. Replace as necessary.<br>(2) Tighten clamps. | |
| 19 | Quarterly | Inspect Breaker Upper and Lower Bushings<br>(1) Measure upper bushing for wear. Replace if inside diameter exceeds 158 mm (6.22 in.).<br>(2) Grease the bushings before reinstalling tool. (INDECO Supreme 1000 grease or other HD Moly Grease containing 3 to 5 percent Molybdenum Disulfide). | |

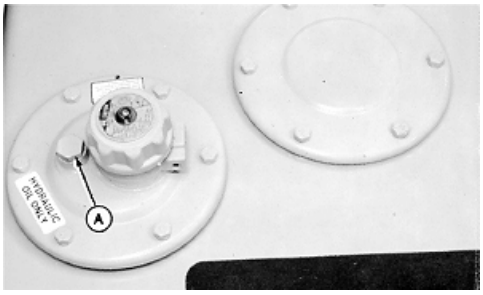
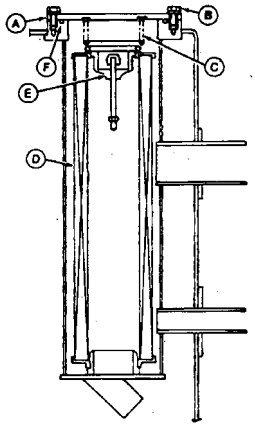
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 20 | Quarterly | Replace Primary Fuel Filter (Water Separator)  (1) Turn retaining ring (A) counterclockwise to remove filter (B). Allow sediment to drain into a container. Dispose of waste properly.<br>(2) Turn sediment bowl (C) counterclockwise to remove from assembly. Clean bowl.<br>(3) Remove hand primer from fuel filter base. Disassemble hand primer assembly.   (4) Remove fuel inlet line (A) and plug (C). | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (5) Flush any debris from filter base.<br><br>(6) Install fuel inlet plug and fuel inlet line.<br><br>(7) Assemble primer assembly and install onto fuel filter base.<br><br>(8) Install new filter. (Follow instructions on filter.)<br><br>(9) Install sediment bowl.<br><br>(10) Bleed fuel system. (Refer to Bleed the Fuel System in the Engine Repair chapter.) | |
| 21 | Quarterly | Replace Hydraulic Oil Filter<br><br>(1) Park machine on level surface.<br><br>(2) Position machine with arm cylinder fully retracted and bucket cylinder fully extended.<br><br>(3) Lower bucket to the ground.<br><br>(4) Turn auto-idle switch off.<br><br>**CAUTION: Turbocharger may be damaged if engine is not properly shut down.**<br><br>(5) Run engine with rpm dial at 1/3 position without load for 2 minutes.<br><br>(6) Move engine rpm dial to slow idle position.<br><br>(7) Turn key switch to OFF. Remove key from switch.<br><br>(8) Attach a “Do Not Operate” tag on the right control lever.<br><br>(9) Pull pilot control shut-off lever to locked position. | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | **WARNING: High-pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Do not remove vent plug (A). Release pressure by loosening vent plug.**<br><br>(10) Loosen vent plug (A) to release hydraulic pressure.<br><br>  <br><br><br>(11) Hold down filter cover against light spring load when removing the last two cap screws.<br><br>  <br><br><br>(12) Remove spring (C), valve (E), and element (D).<br><br>(13) Remove filter case and discard element and O-ring (F). | |

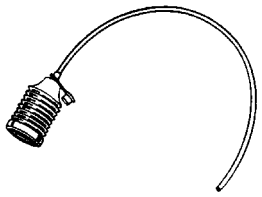
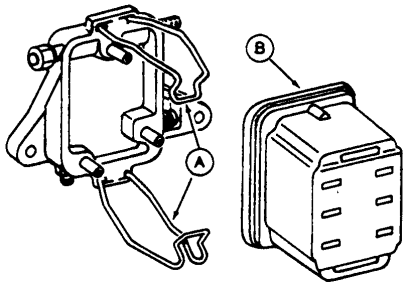
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | **WARNING: Prevent possible injury from flying chips if compressed air is more than 210 kPa (2.1 bar) (30 psi). Reduce compressed air to less than 210 kPa (2.1 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.**<br><br>**NOTE: Remove element and inspect for metal particles and debris in bottom of filter case. Excessive amounts of brass and steel particles can indicate a hydraulic pump, motor, or valve malfunction, or a malfunction in progress. A rubber type of material can indicate cylinder-packing problem.**<br><br>(14) Clean filter case with diesel fuel and dry with compressed air.<br><br>(15) Install filter case, valve (E), and spring (C) in reservoir.<br><br>(16) Install cover (A) and tighten cap screws (B).<br><br>**FILTER COVER SPECIFICATIONS**<br>Cap Screws, Cover 49 N•m (36 lb-ft)<br><br>(17) Tighten vent plug. | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 22 | Quarterly | Check Coolant Conditioner<br>  <br>**WARNING: Explosive release of fluids from pressurized cooling system can cause serious burns. Remove filler cap only when engine is cold or when cool enough to touch with bare hands.**<br>**CAUTION: John Deere Liquid Conditioner does not protect against freezing. Coolant conditioner prevents rust, scale, and liner cavitation.**<br>**NOTE: Check coolant every 500 hours or 3 months, or when replacing 1/3 or more coolant. Add coolant conditioner as necessary.**<br>(1) Turn cap slowly to first stop to release pressure and then remove cap. Test coolant solution using one of the following methods.<br>  <br>• **3-Way Heavy-Duty Coolant Test Kit (TY161775)** Coolant test strips provide an effective method to check freeze point and additive levels of engine coolant. Follow instructions on kit. | |

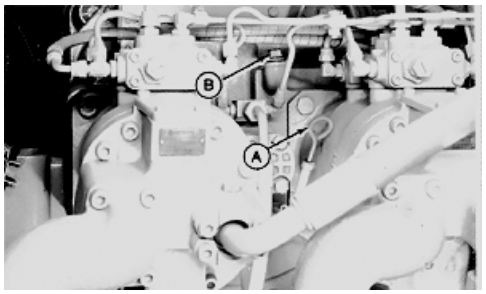
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | |  | |
| | | • **Coolscan Plus®**<br>For a more thorough evaluation of coolant, perform Coolscan Plus® analysis.<br><br>(2) Add TY16004 John Deere Coolant Conditioner or equivalent non-chromate conditioner/rust inhibitor, following instructions on container.<br><br>**COOLING SYSTEM SPECIFICATION**<br>Cooling System Capacity Approx. 30 L (8 gal) | |
| 23 | Quarterly | Check Battery Electrolyte Level<br>(Refer to Check Battery Electrolyte Level and Terminals in Electrical System chapter.) | |
| 24 | Semiannually | Replace Final Fuel Filter<br><br>  <br><br><br>(1) Unhook retaining ring (A) and remove filter. Allow sediment to drain into a container. Dispose of waste properly.<br><br>(2) Clean filter base.<br><br>(3) Install new filter.<br><br>(4) Bleed fuel system. (Refer to Bleed the Fuel System in the Engine Auxiliary Systems Repair chapter.) | |

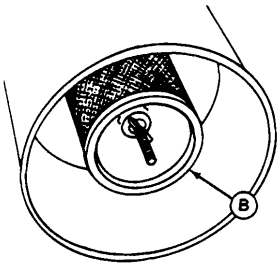
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 25 | Semiannually | Change Swing Gearbox Oil<br>  <br><br>(1) Remove plug (A) to drain oil into a container. Dispose of waste oil properly.<br>(2) Install plug.<br>(3) Remove filler cap (B) and add oil (see Fuels and Lubricants, Chapter 1).<br>**SPECIFICATION**<br>Swing Gearbox Oil Capacity 14 L (15 qt)<br>(4) Install filler cap.<br>(5) Check oil level on dipstick. | |

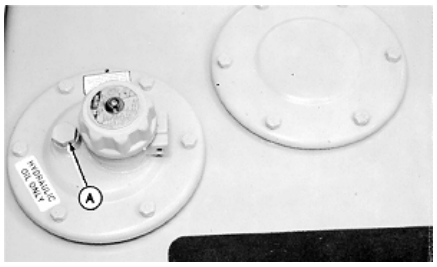
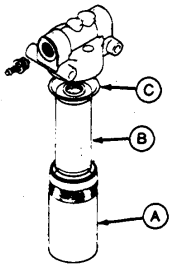
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 26 | Semiannually | Change Pump Drive Gearbox Oil<br>  <br><br>  <br><br>(1) Remove filler plug (B).<br>(2) Remove drain plug (C). Allow oil to drain into a container. Dispose of waste properly.<br>(3) Apply Liquid TEFLON® pipe thread sealant to drain plug. Install drain plug.<br>(4) Add oil (see Fuels and Lubricants, Chapter 1).<br>**SPECIFICATION**<br>Pump Gearbox Capacity 1.0 L (1.1 qt)<br>(5) Pull dipstick (A) and check oil level. Oil level must be approximately halfway below “H” (level) mark.<br>(6) Install filler plug and dipstick. | |
| 27 | Semiannually | Change Secondary Air Cleaner Element<br>(1) Open front service door.<br>(2) Loosen wing nut to remove cover and primary element. Clean primary element or replace if damaged. | |

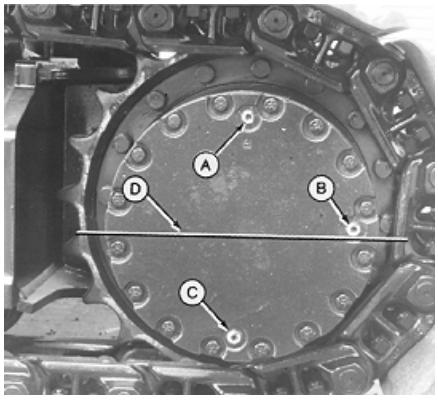
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | |  | |
| | | (3) Remove inner wing nut and secondary element (B). | |
| | | (4) Install new secondary element and primary element, making sure that the secondary element is centered in canister. | |
| | | (5) Install cover. | |
| 28 | Semiannually | Drain Fuel Tank | |
| 29 | Semiannually | Inspect Fan Belt | |
| | | (1) Check belt for wear, especially for cracks at the bottom of grooves and for frayed edges. | Belt is excessively worn or damaged |
| 30 | Semiannually | Replace Air Cleaner Dust Valve | Missing, damaged, or hardened dust valve |
| | | **NOTE: A missing, damaged, or hardened dust valve will cause the air filter elements to be ineffective.** | |
| | |  | |
| 31 | Semiannually | Disassemble, Inspect, and Assemble Hydraulic Breaker (Refer to Hydraulic Impact Breaker Repair chapter.) | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 32 | Semiannually | Change Pilot Control Oil Filter<br>  <br><br>**WARNING: High-pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Do not remove vent plug (A). Release pressure by loosening vent plug.**<br>  <br><br>(1) Loosen vent plug (A) to relieve air pressure.<br>(2) Remove filter case (A).<br>  <br><br>(3) Unscrew filter element (B).<br>(4) Remove O-ring (C).<br>(5) Install new O-ring and filter element.<br>(6) Install filter case (A).<br>**SPECIFICATION**<br>Filter Case Torque 20—30 N•m (15—22 lb-ft) | |

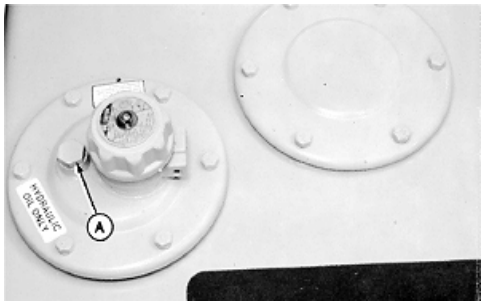
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (7) Tighten vent plug. | |
| 33 | Annually | Change Propel Gearbox Oil<br>  <br><br>(1) Park machine on level ground rotating propel gearbox until bottom of the oil level check plug (B) is even with the horizontal centerline (D).<br>(2) Lower boom to the ground.<br>(3) Turn auto-idle switch off.<br>(4) Run engine with engine rpm dial at 1/3 position without load for 2 minutes.<br>**CAUTION: Turbocharger may be damaged if engine is not properly shut down.**<br>(5) Move engine rpm dial to slow idle and turn key switch to OFF. Remove key from switch.<br>(6) Attach a “Do Not Operate” tag on the right control lever.<br>(7) Pull pilot control shut-off lever to locked position. | |

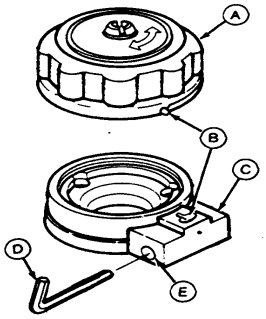
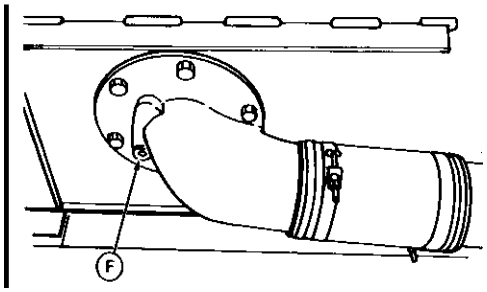
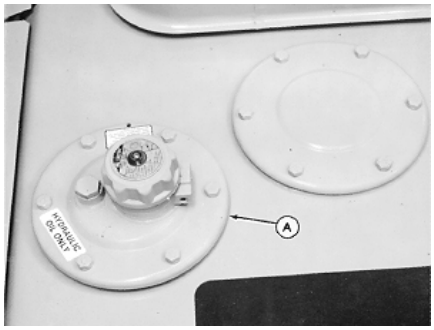
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | **WARNING: High-pressure release of fluids from pressurized system can cause serious burns. Wait for propel gearbox oil to cool. Keep body and face away from check plug. Gradually loosen check plug to release pressure.**<br><br>(8) After propel gearbox has cooled, slowly loosen check plug (B) to release pressure.<br><br>(9) Remove drain plug (C). Allow oil to drain into a container. Dispose of waste properly.<br><br>**SPECIFICATION**<br>Propel Gearbox Oil Capacity Approx. 6 L (6.5 qt) (each)<br><br>(10) Wrap threads of drain plug with a sealing-type tape. Install plug. Tighten to 49 N•m (430 lb-in.).<br><br>(11) Remove fill plug (A).<br><br>(12) Add oil until oil flows out of level check plug hole (see Fuels and Lubricants, Chapter 1).<br><br>(13) Wrap threads of check plug and fill plug with sealing-type tape. Install plugs. Tighten plugs to 49 N•m (430 lb-in.).<br><br>(14) Change oil of second propel gearbox. | |
| 34 | Annually | Change Hydraulic Oil<br><br>**CAUTION: DO NOT run engine without oil in the tank.**<br><br>  <br><br>(1) Park machine on level surface.<br><br>(2) Position machine with arm cylinder fully retracted and bucket cylinder fully extended. | |

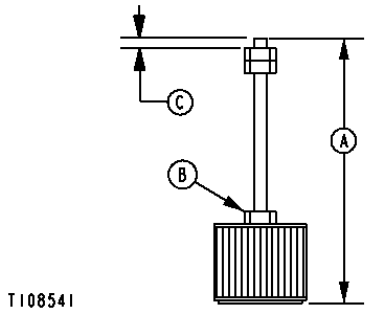
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (3) Lower bucket to the ground.<br><br>(4) Turn auto-idle switch off.<br><br>**CAUTION: Turbocharger may be damaged if engine is not properly shut down.**<br><br>(5) Run engine with rpm dial at 1/3 position without load for 2 minutes.<br><br>(6) Move engine rpm dial to slow idle position.<br><br>(7) Turn key switch to OFF. Remove key from switch.<br><br>(8) Attach a “Do Not Operate” tag on the right control lever.<br><br>(9) Pull pilot control shut-off lever to locked position.<br><br>**WARNING: High-pressure release of oil from pressurized system can cause serious burns or penetrating injury. The hydraulic tank is pressurized. Do not remove vent plug (A). Release pressure by loosening vent plug.**<br><br>  <br><br><br>(10) Loosen vent plug (A) to release hydraulic pressure. | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | |  <br>(11) Insert 4 mm (0.15 in.) Allen wrench (D) into hole (E) and turn counterclockwise.<br><br>(12) Slowly turn cap (A) counterclockwise and remove.<br><br>  <br>(13) Remove drain plug (F). Allow oil to drain into a container. Dispose of waste properly.<br><br>**SPECIFICATION**<br>Hydraulic Tank Oil Capacity 148 L (39 gal)<br><br>  <br>(14) Remove cover (A) with suction filter. | |

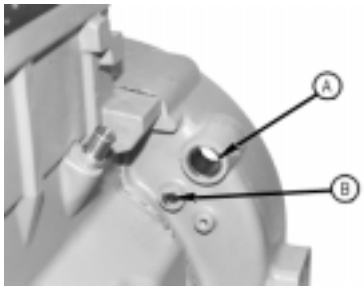
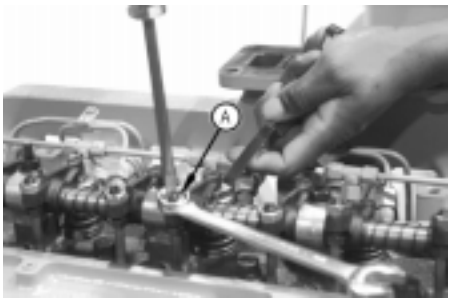
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (15) Clean inside of tank and suction filter.<br><br>(16) Change hydraulic oil filter. (Refer to Quarterly services.)<br><br>(17) Change pilot control oil filter. (Refer to Semi-Annual services.)<br><br>  <br><br><br>(18) Install suction screen with cover. Suction screen must seal against outlet pipe in bottom of tank. If necessary, loosen nut (B) to adjust rod length.<br><br>**SPECIFICATIONS**<br>Suction Screen Rod Length (A) 702 mm (26.4 in.)<br>Suction Screen Rod Torque 17 N•m (12.5 lb-ft)<br>Top of Rod to Top of Rod Nut (C) 20 mm (0.8 in.)<br>Cover Cap Screw Torque 49 N•m (36 lb-ft)<br><br>(19) Install tank drain plug and bottom guard.<br><br>  <br><br><br>(20) Add oil until it is between marks on sight glass (A) (see Fuels and Lubricants, Chapter 1).<br><br>**CAUTION: If the hydraulic pump is not filled with oil, it will be damaged when the engine is started.** | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

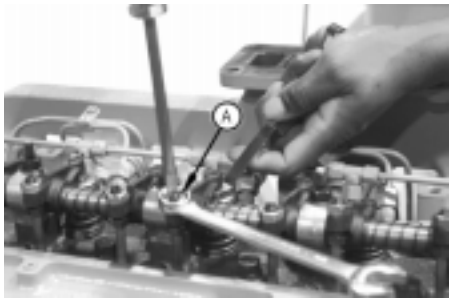
| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | |  <br>(21) Remove air bleed plugs (C) from hydraulic pump until oil flows from bleed lines.<br>(22) Install air bleed plugs in hydraulic pump.<br>(23) Install cap.<br>(24) Purge air from cylinders and swing motor by cycling hydraulic functions. | |
| 35 | Annually | Check and Adjust Engine Valve Lash (Clearance)<br>**CAUTION: Valve clearance MUST BE checked and adjusted with engine COLD.**<br>**CAUTION: Prevent accidental starting of engine while performing valve adjustments. Always disconnect NEGATIVE (-) battery terminal.**<br>(1) Remove rocker arm cover and engine crankcase ventilation tube. Clean tube with solvent or diesel fuel. Inspect rocker arm O-ring.<br>**NOTE: 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.**<br>**Rocker arms that exhibit excessive valve clearance should be inspected more thoroughly to identify damaged parts.** | |

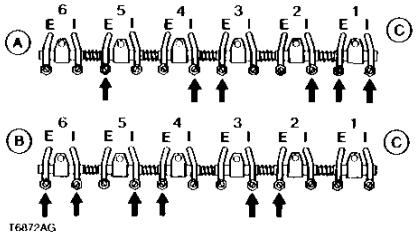
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | |  <br>(2) Remove plug (A). Install JDG 820 Flywheel Turning Tool. Remove cap screw (B). Install JDE-81-4 Timing Pin.<br><br>(3) Turn flywheel until timing pin goes into flywheel.<br><br>(4) Using engine rotation tool, rotate engine flywheel in running direction (clockwise viewed from front) until No. 1 cylinder is at “TDC” Compression stroke.<br><br>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.<br><br>To change piston position, remove timing pin and rotate flywheel.<br><br>(5) Check and adjust valve clearance to specifications as directed in following procedures.<br><br>  <br>(6) Loosen jam nut (A) and adjust clearance with a screwdriver, as shown. | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 36 | Annually | Adjust Valve Clearances | |




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

A - No. 1 TDC compression stroke
B - No. 1 TDC exhaust stroke
C - Fan end of engine

(1) Adjust No. 1, 3, and 5 exhaust valves and No. 1, 2, and 4 intake valves.

**VALVE CLEARANCE SPECIFICATIONS**

| | |
|---|---|
| Exhaust Valves (E) | 0.46 mm (0.018 in.) |
| Intake Valves (I) | 0.36 mm (0.014 in.) |

(2) Rotate engine 360° and repeat step 1 for the remaining intake and exhaust valves.

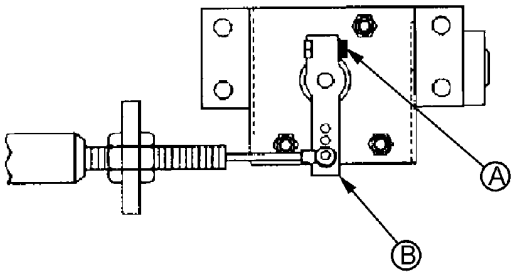
(3) Tighten jam nut to 27 N•m (20 lb-ft).

(4) Clean cylinder head and rocker arm cover mating surfaces.

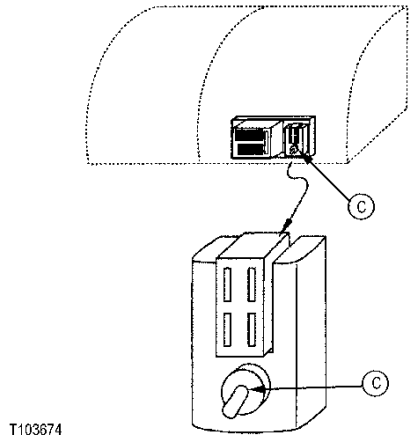
(5) Install rocker arm gasket. Do not use sealant on gasket.

(6) Install rocker arm cover. Tighten screws to 35 N•m (26 lb-ft). Do not overtighten cap screws.

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (7) Remove turning tool and timing pin.<br><br>(8) Install parts. Center muffler to turbocharger inlet tube before fastening muffler into place. | |
| 37 | Annually | Adjust Engine Control Motor and Sensor<br><br>**NOTE: When the following components are repaired or replaced, or when engine speeds deviate from specification, the engine speed learning procedure must be performed.**<br><br>• Engine<br>• Engine speed control cable<br>• Engine control motor and angle sensor<br>• Engine and pump controller<br><br>(1) Ensure that the fast idle and slow idle stop screws on the injection pump are adjusted to specification.<br><br>(2) Turn key switch ON.<br><br>(3) Turn the engine rpm dial to slow idle.<br><br>  <br><br><br>(4) Loosen cap screw (A) in engine control motor arm (B).<br><br>(5) Adjust the arm on the shaft so the injection pump lever just contacts the slow idle stop screw.<br><br>(6) Tighten cap screw to 13 N•m (115 lb-in.).<br><br>(7) Perform Engine Speed Learning Procedure. | |

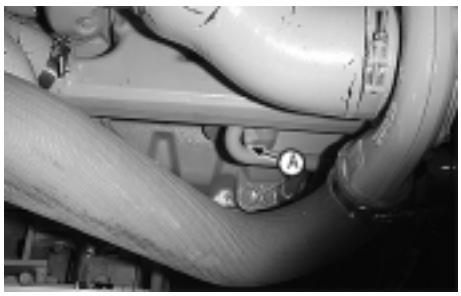
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 38 | Annually | Perform Engine Speed Learning Procedure<br>  <br><br>(1) Stop engine.<br>(2) Push engine learning switch (C) up to top position. Make sure that it is in the top position.<br>(3) Turn key switch ON. Wait 5 seconds.<br>(4) Turn key switch OFF. Wait 5 seconds.<br>(5) Push engine learning switch to middle position.<br>(6) Check engine speeds.<br>**SPECIFICATIONS**<br>Slow Idle 1000 ± 100 rpm<br>Auto Idle 1200 ± 100 rpm<br>E (Economy) Mode 1900 ± 100 rpm<br>Fast Idle in Standard Mode 2050 ± 75 rpm<br>**NOTE: If engine RPM is not to specifications, notify direct support maintenance.** | |
| 39 | Annually | Drain Cooling System<br>Drain and flush cooling system using commercial products. Replace thermostats and radiator cap, and refill with new coolant. | |

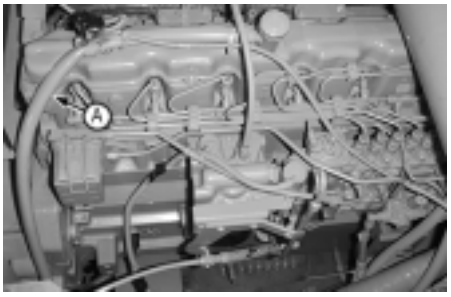
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | |  <br><br>(1) Check coolant hoses (A) for cracks and leaks. Replace if necessary.<br>(2) Tighten clamps.<br>(3) Check radiator and oil cooler for dirt, grease, leaks, and loose or broken mountings. Clean radiator and oil cooler fins.<br>**WARNING: Prevent possible injury from hot spraying water. DO NOT remove radiator cap unless engine is cool. Then turn cap slowly to the stop.**<br>(4) Release air to relieve pressure. Remove filler cap.<br>**COOLING SYSTEM SPECIFICATION**<br>Cooling Capacity Approx. 30 L (32 qt)<br>  | |

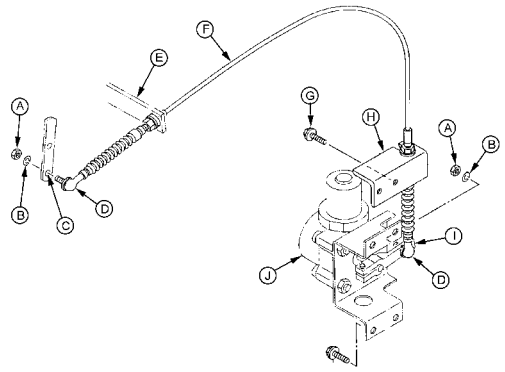
## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (5) Turn radiator petcock (A) counterclockwise to open valve. Allow coolant to drain into a container. Dispose of waste properly.<br>  <br>(6) Turn engine block drain cock (A) counter-clockwise to drain engine block. Drain coolant into a container. Dispose of waste properly. | |
| 40 | Annually | Perform Cooling System Fill and Deaeration Procedure<br>**COOLING SYSTEM SPECIFICATION**<br>Cooling Capacity Approx. 22 L (6 gal)<br>**CAUTION: Use only permanent-type low silicate ethylene glycol base antifreeze in coolant solution. Other types of antifreeze may cause damage to cylinder seals.**<br>**FREEZING TEMPERATURES**: Fill with permanent-type low silicate ethylene glycol base antifreeze (without stop-leak additive) and clean, soft water.<br>**FILL**<br>Fill radiator to the bottom of the radiator fill neck.<br>Fill the recovery tank to FULL mark.<br>**DEAERATION**<br>The cooling system requires several warm-up and cool down cycles to deaerate. It will NOT deaerate during normal operation. Only during warm-up and cool down cycles will the system deaerate.<br>(1) Start engine. Run engine until coolant reaches a warm temperature. | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| | | (2) Stop engine. Allow coolant to cool.<br><br>(3) Check coolant level at recovery tank.<br><br>(4) Repeat steps 1 through 3 until recovery tank is repeatedly at the same level (stabilized).<br><br>**NOTE: The level of the coolant in the cooling system MUST BE repeatedly checked after all drain and refill procedures to ensure that all air is out of the system which allows the coolant to stabilize. Check coolant level only when the engine is cold.**<br><br>(5) If necessary, fill recovery tank to FULL mark.<br><br>(6) Install recovery tank and radiator caps. | |
| 41 | Annually | Engine Crankcase Ventilation Tube<br><br>  <br><br><br>Clean the engine ventilation tube (A) when you measure and adjust engine valve clearance (lash). | |
| 42 | Annually | Check Engine Speeds<br><br>(1) Warm engine to normal operating temperature.<br><br>(2) Connect a tachometer to check engine speeds.<br><br>(3) Turn engine rpm dial to slow idle to check slow idle speed.<br><br>(4) Turn engine rpm dial to fast idle to check fast idle speed.<br><br>**SPECIFICATIONS**<br>Slow Idle 900 ± 25 rpm<br>Fast Idle in Standard Mode 2180 ± 25 rpm | |

## UNIT PREVENTIVE MAINTENANCE CHECKS AND SERVICES FOR HYDRAULIC EXCAVATOR 330LCR

| ITEM NO. | INTERVAL | ITEM TO BE INSPECTED PROCEDURE: DO THE PMCS AND HAVE ITEM REPAIRED, FILLED, OR ADJUSTED AS NEEDED | EQUIPMENT IS NOT READY/AVAILABLE IF: |
|---|---|---|---|
| 43 | Annually | Adjust Engine Speed Control Cable<br>  <br>**NOTE: The ball joints (D) are installed on the cable to full thread engagement. A ball joint can be used to lengthen a cable end, if needed, but must have at least 6 mm (1/4 in.) of thread engagement to avoid stripping the threads on cable end.**<br>(1) Install ball joints (D) to full thread engagement. Tighten nuts.<br>(2) Install speed control cable (F) in brackets (E and H). Tighten nuts so threaded portions of cable are centered in brackets. As needed, adjust cable in brackets to connect ball joint to lever or arm.<br>(3) Connect ball joint to the outer hole of engine control motor arm (I).<br>(4) Do engine control motor adjustment and then the engine speed learning procedure. | |
| 44 | Every 3 Years | Replace Seat Belt<br>(1) Replace the complete seat belt assembly regardless of appearance. A date label, to determine the age of the belt, is attached to each belt. | |

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# APPENDIX B
# MAINTENANCE ALLOCATION CHART
# FOR HYDRAULIC EXCAVATOR 330LCR

## Section I. INTRODUCTION

### B-1. GENERAL

This Maintenance Allocation Chart (MAC) designates responsibility for performance of maintenance repair functions at specified levels.

**a. Section I. INTRODUCTION.** This is a general explanation and definition of terms.

**b. Section II. MAINTENANCE ALLOCATION CHART.** This listing shows the maintenance level responsible and estimated work measurement time for specific functions.

**c. Section III. TOOLS AND TEST EQUIPMENT REQUIREMENTS.** This section lists common tool sets and the special tools, test, and support equipment required for each maintenance function shown in Section II.

**d. Section IV. REMARKS.** This lists the remarks referenced in Section II.

### B-2. EXPLANATION OF COLUMNS IN SECTION II

**a. Column (1) – Group Number.** Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

**b. Column (2) – Component/Assembly.** Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

**c. Column (3) – Maintenance Function.** Column 3 lists the functions to be performed on the item listed in Column 2.

**d. Column (4) – Maintenance Category.** Column 4 specifies, by the listing of a “work time” figure in the appropriate subcolumn(s), the level of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or level of the tasks within the listed maintenance function vary at different maintenance levels, appropriate work time figures will be shown for each level. The number of man-hours specified by the work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the MAC. This figure does not include any time for performance of preliminary tasks listed elsewhere in the MAC; e.g., removal of engine under repair of fuel pump, when the engine is listed separately in the MAC. The symbol designations for the various maintenance categories remain as follows:

C – Operator/Crew
O – Unit Maintenance
F – Direct Support Maintenance
H – General Support Maintenance
D – Depot Maintenance

**e. Column (5) – Tools and Equipment.** Column 5 specifies, by code those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated functions.

**f. Column (6) – Remarks.** Column 6 references any amplifying remarks.

## B-3. MAINTENANCE FUNCTIONS DEFINED

**a. Inspect.** To closely and critically examine (e.g., sight, sound, or feel) an item to detect errors, flaws, wear, etc., and to determine its condition and serviceability by comparing its physical mechanical/electrical characteristics within established standards.

**b. Test.** To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

**c. Service.** Operations required periodically to keep an item in proper operating condition: i.e. to clean (decontaminate), to preserve, to drain, to paint or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

**d. Adjust.** To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

**e. Align.** To adjust specified variable elements of an item to bring about optimum or desired performance.

**f. Calibrate.** To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

**g. Install.** The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

**h. Replace.** The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

**i. Repair.** The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

**j. Overhaul.** That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is the normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to a like-new condition.

## B-4. EXPLANATION OF COLUMNS IN SECTION III

**a. Column (1) – Tool or Test Equipment Reference Code.** The tool or test equipment reference code correlates with a code in Column 5 of the MAC.

**b. Column (2) – Maintenance Level.** The lowest level of maintenance authorized to use the tool or test equipment.

**c. Column (3) – Nomenclature.** Name or identification of the tool or test equipment.

**d. Column (4) – National/NATO Stock Number.** The NSN/NATO Stock Number of the tool or test equipment.

**e. Column (5) – Tool Number.** The manufacturer's part number, model number, or type number.

## B-5. EXPLANATION OF COLUMNS IN SECTION IV

**a. Column (1) – Reference Code.** The code recorded in Column 6 of the MAC.

**b. Column (2) – Remarks.** This column lists information pertinent to the maintenance function being performed as indicated in the MAC.

## B-6. JOHN DEERE FUNCTIONAL GROUP CODING

The MAC is arranged in accordance with the following John Deere functional group coding:

01 Tracks
02 Axles and Suspension Systems
04 Engine
05 Engine Auxiliary Systems
08 Splitter Drive
16 Electrical System
17 Frame, Chassis or Supporting Structure
18 Operator's Station
33 Excavator
43 Swing or Pivoting System

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| 01 | TRACKS | | | | | | | | |
| 0130 | Track System | Inspect | 0.5 | 0.5 | | | | 2 | |
| | | Service | 2.0 | 2.0 | | | | | |
| | | Adjust | 0.5 | 0.5 | | | | | |
| | | Repair | | | 6.0 | | | 1 | |
| | Track Adjuster | Replace | | | 2.0 | | | 1, 4 | |
| | Cylinder | Repair | | | 3.0 | | | 1, 4 | B |
| | Track Adjuster | Replace | | | 1.8 | | | 1, 4 | |
| | and Recoil Spring | Repair | | | 3.0 | | | 1, 4 | B |
| 0132 | Track Chain | Inspect | 0.5 | | | | | | C |
| | | Test | | | 0.5 | | | | |
| | | Replace | | | 7.8 | | | 1 | |
| | | Repair | | | 11.8 | | | 1 | |
| | Track Shoe | Inspect | 0.5 | | | | | | |
| | | Test | | | 0.5 | | | | |
| | | Replace | | | 7.8 | | | 1 | |
| | | Repair | | | 11.8 | | | 1 | |
| 0133 | Front Idler | Test | | | 1.0 | | | 3 | |
| | | Replace | | | 1.4 | | | 1 | |
| | | Repair | | | 4.0 | | | 1 | A |
| | Track Carrier Roller | Inspect | | | 0.5 | | | | |
| | | Test | | | 0.5 | | | | |
| | | Replace | | | 0.5 | | | 1 | |
| | | Repair | | | 12.3 | | | 1 | |
| | Track Roller | Inspect | | 0.5 | | | | | |
| | | Test | | 0.5 | | | | | |
| | | Replace | | | 7.8 | | | 1 | |
| | | Repair | | | 8.0 | | | 1 | A |
| 02 | AXLES AND SUSPENSION SYSTEMS | | | | | | | | |
| 0250 | Axle Shaft, | Inspect | | | 0.5 | | | | |
| | Bearings and | Replace | | | | 7.0 | | 1 | |
| | Reduction Gears | Repair | | | | 15.0 | | 1 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| | Propel Gearbox | Inspect | | 0.5 | | | | | |
| | | Service | | 0.5 | | | | | |
| | | Replace | | | 13.3 | | | 1 | |
| | | Repair | | | 14.8 | | | 1 | |
| 0260 | Hydraulic System | | | | | | | | |
| | Rotary Manifold | Test | | 0.5 | | | | | |
| | | Replace | | | 2.0 | | | 1 | |
| | | Repair | | | 2.4 | | | 1 | |
| 0262 | Propel Motor Brake Valve Housing | Test | | 0.5 | | | | 1 | |
| | | Replace | | | 2.0 | | | 1 | |
| | | Repair | | | 1.5 | | | 1 | |
| 0267 | Propel Motor and Park Brake | Replace | | | 2.0 | | | 1 | |
| | | Repair | | | 1.5 | | | 1 | |
| 04 | ENGINE (8.1L) | | | | | | | | |
| 0400 | Engine | Inspect | 0.2 | 1.0 | | | | | |
| | | Test | | 2.5 | | | | | |
| | | Service | 0.2 | 1.2 | | | | | |
| | | Adjust | | 1.0 | | | | | |
| | | Replace | | | 7.9 | | | 1, 5, 6, 32-35, 37-39 | |
| | | Repair | | | | 16.0 | | 1, 5, 6, 32-35, 37-39 | D |
| | | Overhaul | | | | | 36.5 | 1 | E |
| 0401 | Crankshaft, Main Bearings, and Flywheel | Inspect | | | | 0.5 | | | |
| | | Replace | | | | 13.7 | | 1, 6, 14-23 | |
| 0402 | Rocker Arm Shaft Assembly | Inspect | | | 0.5 | | | | |
| | | Replace | | | 8.0 | | | 1 | |
| | Camshaft and Timing Gear Train | Inspect | | | 0.5 | | | | |
| | | Replace | | | 11.8 | | | 1, 7, 19, 25 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR (Continued)

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| 0404 | Cylinder Block, Liners, Pistons, and Rods | Inspect | | | | 0.5 | | | |
| | | Replace | | | | 24.4 | | 1 | |
| | | Repair | | | | 6.9 | | 1 | |
| 0407 | Engine Oiling System | Inspect | | 1.0 | | | | | |
| | | Service | 0.3 | 0.5 | | | | | |
| | Engine Oil Pump | Inspect | | | 3.0 | | | | |
| | | Replace | | | 3.0 | | | 1 | |
| | Engine Oil Filter Base | Inspect | | 0.1 | | | | | |
| | | Replace | | 0.3 | | | | 1 | |
| | Engine Oil Filter Element | Replace | | 0.5 | | | | 1 | |
| | Filter Bypass Valve | Inspect | | | 0.5 | | | | |
| | | Replace | | | 1.0 | | | 1 | |
| | Cooler Bypass Valve | Inspect | | 0.5 | | | | | |
| | | Replace | | 1.0 | | | | 1 | |
| | Pressure Regulating Valve | Inspect | | 0.5 | | | | | |
| | | Replace | | 1.0 | | | | 1 | |
| 0409 | Cylinder Head and Valves | Inspect | | | 0.5 | | | | |
| | | Adjust | | | 2.0 | | | | |
| | | Replace | | | 11.4 | | | 1, 26-28 | |
| | | Repair | | | 1.0 | | | 1, 26-28 | |
| 0410 | Exhaust Manifold | Replace | | | 0.3 | | | 1 | |
| 0413 | Fuel Injection System | Service | | | 1.0 | | | | |
| | Fuel Injection Nozzle | Inspect | | 0.5 | | | | | |
| | | Test | | | 0.5 | | | 1 | F |
| | | Replace | | | 1.0 | | | 1, 12, 24, 29-31 | |
| | | Repair | | | 0.6 | | | 1, 12, 24, 29-31 | |
| | Fuel Supply Pump | Inspect | | 0.5 | | | | | |
| | | Test | | 0.5 | | | | | |
| | | Replace | | 1.0 | | | | 1 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR (Continued)

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| | Fuel Injection Pump | Replace | | | 2.0 | | | 1, 8 | |
| | | Repair | | | | | 4.0 | 1, 8 | |
| | Hydraulic Aneroid Activator | Service | | | 0.5 | | | | |
| | | Repair | | | 10 | | | 1 | |
| 0414 | Air Intake System | Inspect | 0.5 | 0.5 | | | | | |
| | | Test | | 0.3 | | | | | |
| 0416 | Turbocharger | Inspect | 0.3 | 0.3 | | | | | |
| | | Replace | | | 1.5 | | | 1 | |
| 0418 | Thermostats | Test | | 0.5 | | | | | |
| | | Replace | | 0.6 | | | | 1 | |
| 0419 | Engine Oil Cooler | Inspect | 0.2 | 0.5 | | | | | |
| | | Replace | | | 2.0 | | | 1 | |
| 0420 | Rectangular Fuel Filter Element | Inspect | 0.5 | 0.5 | | | | | |
| | | Replace | | 1.6 | | | | 1 | |
| 0421 | Fuel Supply Pump | Service | | 0.5 | | | | | |
| | | Replace | | 1.6 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 0429 | Belt | Inspect | 0.1 | 0.5 | | | | | |
| | | Replace | | | 0.6 | | | 1 | |
| | Fixed Fan Drive Assembly | Inspect | | 0.5 | | | | | |
| | | Replace | | | 1.0 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Adjustable Fan Drive Assembly | Inspect | | | 0.5 | | | | |
| | | Adjust | | | 1.0 | | | 1 | |
| | | Replace | | | 1.4 | | | 1 | |
| 05 | ENGINE AUXILIARY SYSTEMS | | | | | | | | |
| 0505B | Cold Weather Starting Aids | Inspect | | 0.5 | | | | | |
| | | Replace | | | 1.0 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 0510 | Cooling System | Inspect | 0.2 | 0.5 | | | | | |
| | | Service | 0.2 | 2.0 | | | | | |
| | | Repair | | | 2.0 | | | 1 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR (Continued)

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| 0511 | Radiator, Fan, Shroud, Screens, Surge Tank | Inspect | 0.2 | 0.2 | | | | | |
| | | Test | | 0.5 | | | | 1 | G |
| | | Service | | 1.0 | | | | | |
| | | Replace | | | 2.6 | | | 1 | |
| | | Repair | | | 2.0 | | | 1 | |
| 0512 | Engine Coolant Heater | Service | 0.5 | 0.5 | | | | | |
| 0515 | Engine Speed Control Cable | Adjust | | | 0.5 | | | | |
| | | Replace | | | 0.3 | | | 1 | |
| | Engine Control Motor and Sensor | Adjust | | 0.5 | | | | | |
| | | Replace | | | 0.5 | | | 1 | |
| | Fuel Shut-Off Solenoid Linkage | Adjust | | | 0.5 | | | | |
| | | Replace | | | 1.0 | | | | |
| 0521 | Air Intake Hoses | Inspect | 0.1 | 0.5 | | | | | |
| | | Replace | | 0.2 | | | | 1 | |
| | Air Cleaner | Inspect | 0.3 | 0.3 | | | | | |
| | | Service | 1.0 | 1.0 | | | | | |
| | | Replace | | 1.0 | | | | 1 | |
| 0560 | External Fuel Supply System | Service | 0.3 | | | | | | |
| | Fuel Tank Inlet Screen | Inspect | 0.1 | 0.5 | | | | | |
| | | Replace | | 0.3 | | | | 1 | |
| | Primary Fuel Filter (Water Separator) | Service | 0.1 | 0.1 | | | | | |
| | | Replace | | 0.6 | | | | 1 | |
| | | Repair | | 0.5 | | | | 1 | |
| 08 | SPLITTER DRIVE | | | | | | | | |
| 0841 | Splitter Housing | Replace | | | 1.0 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR (Continued)

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| 16 | ELECTRICAL SYSTEM | | | | | | | | |
| 1671 | Battery, Support and Cables | Inspect | 0.1 | 0.5 | | | | | |
| | | Test | | 0.5 | | | | | |
| | | Service | 0.3 | 0.5 | | | | | |
| | | Replace | | 0.5 | | | | 1 | |
| 1672 | Robert Bosch Alternators | Inspect | | 0.5 | | | | | |
| | | Test | | 0.5 | | | | 1 | |
| | | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | 2.4 | | | 1 | |
| 1674 | Travel Motion Alarm System | Inspect | | 0.5 | | | | | |
| | | Adjust | | 0.5 | | | | | |
| | | Replace | | 0.5 | | | | 1 | |
| 1677 | Robert Bosch Starting Motors | Inspect | | 0.5 | | | | | |
| | | Test | | 0.5 | | | | | |
| | | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | 2.4 | | | 1 | |
| 17 | FRAME, CHASSIS OR SUPPORTING STRUCTURE | | | | | | | | |
| 1740 | Frame Installation | Repair | | | | 8.0 | | 1 | |
| 18 | OPERATOR'S STATION | | | | | | | | |
| 1810B | Rifle Rack | Inspect | 0.1 | 0.1 | | | | | |
| | | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | 0.5 | | | 1 | |
| 1821 | Seat and Seat Belt | Repair | | | 1.9 | | | 1 | |
| | Seat | Adjust | 0.1 | | | | | | |
| | | Replace | | 1.3 | | | | 1 | |
| | Seat Belt | Inspect | 0.1 | 0.2 | | | | | |
| | | Replace | | 0.4 | | | | 1 | |
| 1830 | Heating and Air Conditioning | | | | | | | | |
| 1831 | Heater, Hoses, and Controls | Inspect | 0.1 | 0.3 | | | | | |
| | | Replace | | | 2.0 | | | 1 | |
| | | Repair | | | 0.5 | | | 1 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR (Continued)

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| 1832 | Air Conditioning Compressor | Inspect | | 0.5 | | | | | |
| | | Service | | | 2.0 | | | | |
| | | Replace | | | 2.0 | | | 1, 9-11 | |
| | | Repair | | | 1.0 | | | 1, 9-11 | |
| 33 | EXCAVATOR | | | | | | | | |
| 3301 | Quick-Disconnect Hitch | Inspect | 0.1 | 0.3 | | | | | |
| | | Service | | 0.3 | | | | | |
| | | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 3302 | Bucket Tooth Tip (Heavy Duty) | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | 0.5 | | | 1 | |
| | Bucket, Rock | Replace | | | 0.5 | | | 1 | |
| | | Repair | | | 0.5 | | | 1 | |
| | Bucket Tooth | Inspect | 0.1 | 0.5 | | | | | |
| | | Replace | | | 1.0 | | | 1 | |
| | Hydraulic Impact Breaker | Inspect | 0.5 | 0.5 | | | | | |
| | | Service | | 0.5 | | | | | |
| | | Adjust | | 0.5 | | | | | |
| | | Calibrate | | | 0.5 | | | | |
| | | Replace | | | 1.6 | | | 1, 36, 40 | |
| | | Repair | | | 3.8 | | | 1, 36, 40 | |
| 3340 | Arm and Boom Pins and Bushings | Inspect | 0.3 | 0.5 | | | | | |
| | | Replace | | | 2.0 | | | 1.0 | |
| | Frames | Repair | | | 1.0 | | | 1 | |
| 3360 | Hydraulic System | | | | | | | | |
| | Return Filter and Bypass Valve | Inspect | | 0.5 | | | | | |
| | | Service | | 0.3 | | | | | |
| | | Replace | | | 1.0 | | | 1 | |
| | Dig Function Pilot Controller | Replace | | | 0.5 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Hydraulic Pump Regulator | Replace | | | 0.5 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Radiator and Hydraulic Oil Cooler | Replace | | 2.0 | | | | 1 | |
| | | Repair | | | 2.0 | | | 1 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR (Continued)

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| | Pilot Pump | Repair | | | 1.0 | | | 1 | |
| | Propel Pilot Controller | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Pilot Pressure Regulating Valve and Filter | Service | | 0.3 | | | | | |
| | | Replace | | | 0.5 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 3361 | Main Hydraulic Pump | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | | 1.0 | | 1 | |
| 3362 | Flow Regulator Valve | Replace | | 0.5 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Pilot Shut-Off Valve | Adjust | | 0.5 | | | | | |
| | | Replace | | 1.0 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Proportional Solenoid Valve | Replace | | 1.0 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Auxiliary Hydraulics Control Valve | Replace | | 1.0 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Control Valve | Replace | | 1.0 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Auxiliary Hydraulics Pressure Reducing Valve | Replace | | 1.0 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 3364 | Hydraulic Oil Tank | Inspect | 0.1 | 0.3 | | | | | |
| | | Service | 0.3 | 0.3 | | | | | |
| | | Replace | | 1.0 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| | Hydraulic Oil Tank Relief Valve and Breather Filter Cap | Service | | 0.3 | | | | | |
| | | Replace | | 1.0 | | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 3365 | Right Boom Cylinder | Inspect | 0.5 | 0.5 | | | | | |
| | | Replace | | | 1.8 | | | 1, 13 | |
| | | Repair | | | 3.8 | | | 1, 13 | |

## Section II. MAINTENANCE ALLOCATION CHART FOR 330LCR (Continued)

| (1) GROUP NUMBER | (2) COMPONENT/ ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | UNIT | | DIRECT SUPPORT | GENERAL SUPPORT | DEPOT | | |
| | | | C | O | F | H | D | | |
| | Left Boom Cylinder | Inspect | 0.3 | 0.5 | | | | | |
| | | Replace | | | 1.8 | | | 1, 13 | |
| | | Repair | | | 3.8 | | | 1, 13 | |
| | Arm Cylinder | Inspect | 0.3 | 0.5 | | | | | |
| | | Replace | | | 1.8 | | | 1, 13 | |
| | | Repair | | | 3.8 | | | 1, 13 | |
| | Bucket Cylinder | Inspect | 0.3 | 0.5 | | | | | |
| | | Replace | | | 1.6 | | | 1, 13 | |
| | | Repair | | | 3.8 | | | 1, 13 | |
| 43 | SWING OR PIVOTING SYSTEM | | | | | | | | |
| 4351 | Swing Gearbox | Inspect | | 0.5 | | | | | |
| | | Service | | 1.0 | | | | | |
| | | Replace | | | 1.0 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 4353 | Swing Bearing | Inspect | | 0.5 | | | | | |
| | | Service | | 1.0 | | | | | |
| | | Replace | | | 1.0 | | | 1 | |
| | | Repair | | | 1.0 | | | 1 | |
| 4360 | Swing Motor and Park Brake | Replace | | | 3.6 | | | 1 | |
| | | Repair | | | 10.2 | | | 1 | |
| | Swing Motor Make-Up and Crossover Relief Valves | Repair | | | 1.0 | | | 1 | |
| | | Replace | | | 4.0 | | | 1 | |
| | Swing Motor Park Brake Relief Valve | Repair | | | 1.0 | | | 1 | |
| | | Replace | | | 4.0 | | | | |

## Section III. TOOLS AND TEST EQUIPMENT REQUIREMENTS FOR 330LCR

| (1) TOOL OR TEST EQUIPMENT REFERENCE CODE | (2) MAINTENANCE LEVEL | (3) NOMENCLATURE | (4) NATIONAL/NATO STOCK NUMBER | (5) TOOL NUMBER |
|---|---|---|---|---|
| 1 | O, F, H | Tool Kit, General Mechanic's SC5180-90-N26 | 5180-00-177-7033 | |
| | O | Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance, Common No. 1 SC4910-95-A74 | 4910-00-754-0654 | |
| | O | Shop Equipment, Automotive Maintenance and Repair: Organizational Maintenance, Supplemental No. 1 SC4910-95-A73 | 4910-00-754-0653 | |
| | F, H | Tool Kit, Automotive Fuel and Electrical System Repair SC5180-95-CL-B08 | 5810-00-754-0655 | |
| | F, H | Shop Equipment, General Purpose Repair, Semi-Trailer Mounted SC4940-95-B02 | 4940-00-287-4894 | |
| | O, F, H | Tool Kit, General Mechanic's SC5180-90-N05 | 5180-00-699-5273 | |
| | O | Shop Equipment, Organizational Repair, Light, Truck-Mounted SC4940-95-B03 | 4940-00-284-9516 | |
| | F, H | Shop Equipment, Welding SC4540-95-CL-B19 | | |
| 2 | O | Tool Kit, Undercarriage Inspection Service | | JT05518A |
| 3 | F | Leak Detector Kit, Rubber Stopper | | D05361ST |
| 4 | F | Spring, Track Recoil | | ST4920 |
| 5 | F | Lifting Sling | 4910-01-243-5558 | JDG23 |
| 6 | F | Flywheel Turning Tool | | JD820 |
| 7 | F | Timing Pin | | JDE81-4 |
| 8 | F | Injection Pump Timing Pin | | JDG886 |

## Section III. TOOLS AND TEST EQUIPMENT REQUIREMENTS FOR 330LCR (Continued)

| (1) TOOL OR TEST EQUIPMENT REFERENCE CODE | (2) MAINTENANCE LEVEL | (3) NOMENCLATURE | (4) NATIONAL/NATO STOCK NUMBER | (5) TOOL NUMBER |
|---|---|---|---|---|
| 9 | F | Recovery/Recycling and Charging Station | | JT02045 |
| 10 | F | Vacuum Pump | | D05267ST |
| 11 | F | Schrader Valve Tool | | JT02130 |
| 12 | F | Adapter and Slide Handle | | JDG716 |
| 13 | F | Cylinder Service Stand | | JT30043 |
| 14 | F | Front Wear Sleeve Installer Set | | JDE3 |
| 15 | F | Gear Driver | | JDH7 |
| 16 | F | Rear Crankshaft Oil Seal and Wear Sleeve Installer | | JDG476(85) |
| 17 | F | Seal Puller Adapter | | JDG719 |
| 18 | F | Seal Installer | | JDG720A |
| 19 | F | Damper Pulley Remover | | JDG721 |
| 20 | F | Front Wear Sleeve Puller | | JDG786 |
| 21 | F | Thread Protector | | JDG787 |
| 22 | F | Rear Wear Sleeve Puller Kit | | JDG790 |
| 23 | F | Main Bearing Cap Puller/Installer | | JDG1069 |
| 24 | F | Injection Nozzle Puller Set | | JDE38B |
| 25 | F | Injection Pump Serrated Wrench | | JDE90 |
| 26 | F | Valve Seat Pilot Driver | | JDE7 |
| 27 | F | Valve Seat Insert Adapter | | JDG605 |
| 28 | F | Starter Wrench | | JDG725 |
| 29 | F | Injection Nozzle Socket Wrench | | JDE92 |
| 30 | F | Injection Nozzle Seat Reamer | | JDG609 |
| 31 | F | Injection Nozzle Thread Tap | | JDF5 |

## Section III. TOOLS AND TEST EQUIPMENT REQUIREMENTS FOR 330LCR (Continued)

| (1) TOOL OR TEST EQUIPMENT REFERENCE CODE | (2) MAINTENANCE LEVEL | (3) NOMENCLATURE | (4) NATIONAL/NATO STOCK NUMBER | (5) TOOL NUMBER |
|---|---|---|---|---|
| 32 | F, H | Aftercooler (Two-Pass) Seal Ring Compression Tool | | JDG683 |
| 33 | F, H | Water Manifold Seal Driver | | JDG908 |
| 34 | F, H | Rear Oil Seal Housing Alignment Tool | | JDG796 |
| 35 | F, H | Tap | | JDG681A |
| 36 | F | Accumulator Charge Kit | | 2720000K |
| 37 | F, H | Software (Disc) | | JT07274 |
| 38 | F, H | Excavator to Computer Cable | | JT07273 |
| 39 | F, H | Wiper Test Harness | | JT07275 |
| 40 | F | Accumulator Charging Device | | 59832 |

## Section IV. REMARKS

| (1) REFERENCE CODE | (2) REMARKS |
|---|---|
| A | Measure for wear and test for oil leakage. |
| B | Make tool ST4920. |
| C | Measure for wear. |
| D | Engine weight is approximately 1800 lbs. |
| E | Requires removal of engine. |
| F | Test nozzle prior to disassembly to determine if nozzle can be reused. |
| G | Test consists of pressure check. |

# APPENDIX C
# REFERENCES

## C-1. SCOPE

This appendix lists forms, field manuals, technical manuals, and other publications either referenced in this manual or which apply to the operation and maintenance of the Hydraulic Excavator. Web sites which may be useful are also included in this appendix.

## C-2. DEPARTMENT OF THE ARMY PAMPHLETS

| | |
|---|---|
| Consolidated Index of Army Publications and Blank Forms | DA Pam 25-30 |
| Using Unit Supply System (Manual Procedures) | DA Pam 710-2-1 |
| Functional Users Manual for The Army Maintenance Management System (TAMMS) | DA Pam 738-750 |

## C-3. FORMS

| | |
|---|---|
| Recommended Changes to Publications and Blank Forms | DA Form 2028 |
| Recommended Changes to Equipment Technical Publications | DA Form 2028-2 |
| Organizational Control Record for Equipment | DA Form 2401 |
| Equipment Inspection and Maintenance Worksheet | DA Form 2404 |
| Equipment Inspection and Maintenance Worksheet (Electronic) | DA Form 5988E |
| Maintenance Request | DA Form 2407 |
| Preventive Maintenance Schedule and Record | DD Form 314 |
| Product Quality Deficiency Report (NSN 7540-00-105-0078) | SF 368 |

## C-4. FIELD MANUALS

| | |
|---|---|
| NBC Contamination Avoidance | FM 3-3 |
| NBC Protection | FM 3-4 |
| NBC Decontamination | FM 3-5 |
| NBC Handbook | FM 3-7 |
| Camouflage | FM 20-3 |
| Operation and Maintenance of Ordnance Materiel in Extreme Cold Weather (0° to -65°F) | FM 9-207 |

| | |
|---|---|
| Recovery and Battlefield Damage Assessment and Repair | FM 9-43-2 |
| Soldier's Manual for First Aid | FM 21-11 |
| Basic Cold Weather Manual | FM 31-70 |
| Northern Operations | FM 31-71 |
| Army Motor Transport Units and Operators | FM 55-30 |
| Desert Operations (How to Fight) | FM 90-3 |
| Operational Symbols | FM 101-5-1 |

## C-5. SUPPLY BULLETIN

| | |
|---|---|
| Storage Serviceability Standard – Tracked Vehicles, Wheeled Vehicles, and Component Parts | SB 740-98-1 |

## C-6. TECHNICAL BULLETINS

| | |
|---|---|
| Equipment Improvement Report and Maintenance Digest (US Army Tank-Automotive Command) Tank-Automotive Equipment | TB 43-001-39-Series |
| Color, Marking, and Camouflage Painting of Military Vehicles, Construction Equipment, and Materiels Handling Equipment | TB 43-0209 |
| Maintenance in the Desert | TB 43-0239 |
| Use of Antifreeze and Cleaning Compounds in Engine Cooling Systems | TB 750-651 |
| Inspection, Use and Tightening of Metal Fasteners Used on Tank-Automotive Equipment | TB 43-0218 |

## C-7. TECHNICAL MANUALS

| | |
|---|---|
| Operator's Manual, Hydraulic Excavator, John Deere Model 330LCR | TM 5-3805-281-10 |
| Unit Maintenance, Direct Support and General Support Maintenance With Parts List, Hydraulic Excavator, John Deere Model 330LCR | TM 5-3805-281-24P |
| Chemical, Biological, and Radiological (CBR) Decontamination | TM 3-220 |
| Inspection, Care, and Maintenance of Antifriction Bearings | TM 9-214 |
| Care and Use of Hand Tools and Measuring Tools | TM 9-243 |
| Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel and Related Items Including Chemicals | TM 9-247 |
| Tool Outfit Hydraulic System Test and Repair Unit (HYSTRU) | TM 9-4940-468-13 |

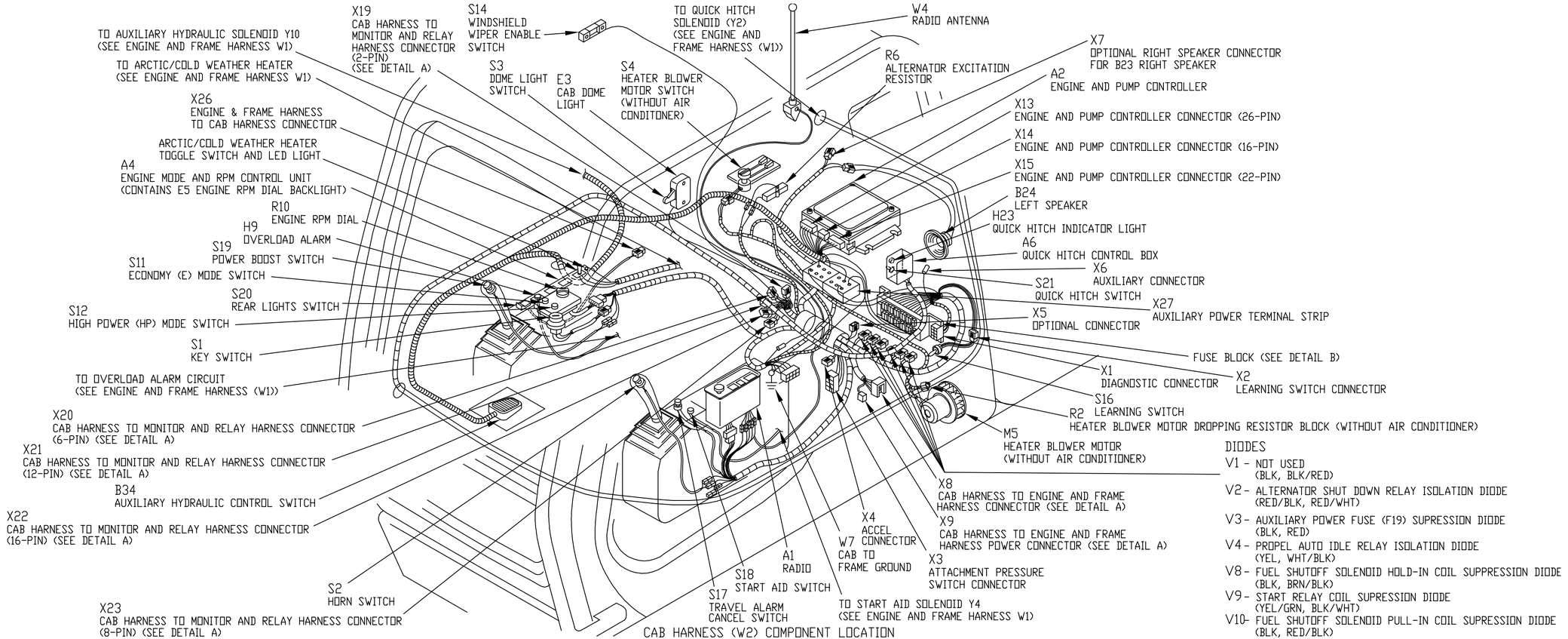
| | |
|---|---|
| Operator, Unit, Direct Support, and General Support Maintenance Manual for Lead Storage Batteries | TM 9-6140-200-14 |
| Preparing Hazardous Materials for Military Air Shipments | TM 38-250 |
| Principals of Automotive Vehicles | TM 9-8000 |
| Painting Instructions for Field Use | TM 43-0139 |
| Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use | TM 750-244-6 |

## C-8. OTHER PUBLICATIONS

| | |
|---|---|
| Army Logistics Readiness and Sustainability | AR 700-138 |
| Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items) | CTA 50-970 |
| Abbreviations and Acronyms | ASME Y14.38M |

## C-9. WEB SITES

| | |
|---|---|
| Military Traffic Management Command (MTMC) | http://www.tea.army.mil |
| Logistical Support Activity (LOGSA) | http://www.logsa.army.mil |
| US Army Tank-Automotive and Armaments Command (TACOM) | http://www.tacom.army.mil |


X19
CAB HARNESS TO
MONITOR AND RELAY
HARNESS CONNECTOR
(2-PIN)
(SEE DETAIL A)
S14
WINDSHIELD
WIPER ENABLE
SWITCH
TO QUICK HITCH
SOLENOID (Y2)
(SEE ENGINE AND
FRAME HARNESS (W1))
W4
RADIO ANTENNA
TO AUXILIARY HYDRAULIC SOLENOID Y10
(SEE ENGINE AND FRAME HARNESS W1)
TO ARCTIC/COLD WEATHER HEATER
(SEE ENGINE AND FRAME HARNESS W1)
S3
DOME LIGHT
SWITCH
E3
CAB DOME
LIGHT
S4
HEATER BLOWER
MOTOR SWITCH
(WITHOUT AIR
CONDITIONER)
R6
ALTERNATOR EXCITATION
RESISTOR
X7
OPTIONAL RIGHT SPEAKER CONNECTOR
FOR B23 RIGHT SPEAKER
A2
ENGINE AND PUMP CONTROLLER
X26
ENGINE & FRAME HARNESS
TO CAB HARNESS CONNECTOR
X13
ENGINE AND PUMP CONTROLLER CONNECTOR (26-PIN)
X14
ENGINE AND PUMP CONTROLLER CONNECTOR (16-PIN)
ARCTIC/COLD WEATHER HEATER
TOGGLE SWITCH AND LED LIGHT
A4
ENGINE MODE AND RPM CONTROL UNIT
(CONTAINS E5 ENGINE RPM DIAL BACKLIGHT)
X15
ENGINE AND PUMP CONTROLLER CONNECTOR (22-PIN)
B24
LEFT SPEAKER
R10
ENGINE RPM DIAL
H9
OVERLOAD ALARM
H23
QUICK HITCH INDICATOR LIGHT
A6
QUICK HITCH CONTROL BOX
S19
POWER BOOST SWITCH
S11
ECONOMY (E) MODE SWITCH
X6
AUXILIARY CONNECTOR
S21
QUICK HITCH SWITCH
S20
REAR LIGHTS SWITCH
X27
AUXILIARY POWER TERMINAL STRIP
S12
HIGH POWER (HP) MODE SWITCH
X5
OPTIONAL CONNECTOR
S1
KEY SWITCH
FUSE BLOCK (SEE DETAIL B)
TO OVERLOAD ALARM CIRCUIT
(SEE ENGINE AND FRAME HARNESS (W1))
X1
DIAGNOSTIC CONNECTOR
X2
LEARNING SWITCH CONNECTOR
S16
LEARNING SWITCH
X20
CAB HARNESS TO MONITOR AND RELAY HARNESS CONNECTOR
(6-PIN) (SEE DETAIL A)
R2
HEATER BLOWER MOTOR DROPPING RESISTOR BLOCK (WITHOUT AIR CONDITIONER)
M5
HEATER BLOWER MOTOR
(WITHOUT AIR CONDITIONER)
X21
CAB HARNESS TO MONITOR AND RELAY HARNESS CONNECTOR
(12-PIN) (SEE DETAIL A)
DIODES
V1 - NOT USED
(BLK, BLK/RED)
V2 - ALTERNATOR SHUT DOWN RELAY ISOLATION DIODE
(RED/BLK, RED/WHT)
V3 - AUXILIARY POWER FUSE (F19) SUPRESSION DIODE
(BLK, RED)
V4 - PROPEL AUTO IDLE RELAY ISOLATION DIODE
(YEL, WHT/BLK)
V8 - FUEL SHUTOFF SOLENOID HOLD-IN COIL SUPPRESSION DIODE
(BLK, BRN/BLK)
V9 - START RELAY COIL SUPRESSION DIODE
(YEL/GRN, BLK/WHT)
V10 - FUEL SHUTOFF SOLENOID PULL-IN COIL SUPRESSION DIODE
(BLK, RED/BLK)
B34
AUXILIARY HYDRAULIC CONTROL SWITCH
X8
CAB HARNESS TO ENGINE AND FRAME
HARNESS CONNECTOR (SEE DETAIL A)
X22
CAB HARNESS TO MONITOR AND RELAY HARNESS CONNECTOR
(16-PIN) (SEE DETAIL A)
X4
ACCEL
CONNECTOR
W7
CAB TO
FRAME GROUND
X9
CAB HARNESS TO ENGINE AND FRAME
HARNESS POWER CONNECTOR (SEE DETAIL A)
A1
RADIO
X3
ATTACHMENT PRESSURE
SWITCH CONNECTOR
S18
START AID SWITCH
S2
HORN SWITCH
S17
TRAVEL ALARM
CANCEL SWITCH
TO START AID SOLENOID Y4
(SEE ENGINE AND FRAME HARNESS W1)
X23
CAB HARNESS TO MONITOR AND RELAY HARNESS CONNECTOR
(8-PIN) (SEE DETAIL A)
CAB HARNESS (W2) COMPONENT LOCATION

T120574

**BLANK**

By order of the Secretary of the Army:

ERIC K. SHINSEKI
*General United States Army*
*Chief of Staff*

Official:
JOEL B. HUDSON
*Administrative Assistant to the*
*Secretary of the Army*
9930506

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|---|---|---|
| TM 5-2350-262-34 | Date of TM | M9 DS/GS MAINTENANCE MANUAL |

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| PAGE NO. | PARAGRAPH | FIGURE NO. | TABLE NO. | IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT: |
|---|---|---|---|---|
| 2-2 | | | | Fuel tank removal and installation is now a DS/GS task. Delete this task from the unit maintenance list. |
| 4-185 | B | | | There are three clamps securing air cleaner duct, not the two as shown. Suggest changing text and art to show three clamps. |
| B-5 | | 1 | | Road wheel jack does not have an NSN or P/N listed and cannot be found on AMDF. Request correct NSN and P/N be furnished. |



PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBERS
Joe Doe, SFC 555-1212

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|---|---|---|
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|---|---|---|---|
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**Rock Island, IL 61299-7630**

# THE METRIC SYSTEM AND EQUIVALENTS

## 'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

## 'VEIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

## LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

## SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

## CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

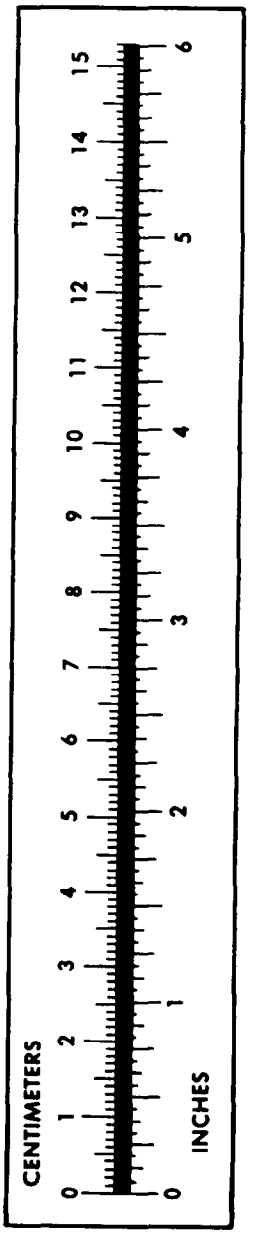
## TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

## APPROXIMATE CONVERSION FACTORS

| TO CHANGE | TO | MULTIPLY BY |
|---|---|---|
| Inches | Centimeters | 2.540 |
| Feet | Meters | 0.305 |
| Yards | Meters | 0.914 |
| Miles | Kilometers | 1.609 |
| Square Inches | Square Centimeters | 6.451 |
| Square Feet | Square Meters | 0.093 |
| Square Yards | Square Meters | 0.836 |
| Square Miles | Square Kilometers | 2.590 |
| Acres | Square Hectometers | 0.405 |
| Cubic Feet | Cubic Meters | 0.028 |
| Cubic Yards | Cubic Meters | 0.765 |
| Fluid Ounces | Milliliters | 29.573 |
| ıts | Liters | 0.473 |
| arts | Liters | 0.946 |
| allons | Liters | 3.785 |
| Ounces | Grams | 28.349 |
| Pounds | Kilograms | 0.454 |
| Short Tons | Metric Tons | 0.907 |
| Pound-Feet | Newton-Meters | 1.356 |
| Pounds per Square Inch | Kilopascals | 6.895 |
| Miles per Gallon | Kilometers per Liter | 0.425 |
| Miles per Hour | Kilometers per Hour | 1.609 |

| TO CHANGE | TO | MULTIPLY BY |
|---|---|---|
| Centimeters | Inches | 0.394 |
| Meters | Feet | 3.280 |
| Meters | Yards | 1.094 |
| Kilometers | Miles | 0.621 |
| Square Centimeters | Square Inches | 0.155 |
| Square Meters | Square Feet | 10.764 |
| Square Meters | Square Yards | 1.196 |
| Square Kilometers | Square Miles | 0.386 |
| Square Hectometers | Acres | 2.471 |
| Cubic Meters | Cubic Feet | 35.315 |
| Cubic Meters | Cubic Yards | 1.308 |
| Milliliters | Fluid Ounces | 0.034 |
| Liters | Pints | 2.113 |
| Liters | Quarts | 1.057 |
| ers | Gallons | 0.264 |
| ms | Ounces | 0.035 |
| ograms | Pounds | 2.205 |
| Metric Tons | Short Tons | 1.102 |
| Newton-Meters | Pounds-Feet | 0.738 |
| Kilopascals | Pounds per Square Inch | 0.145 |
| lometers per Liter | Miles per Gallon | 2.354 |
| meters per Hour | Miles per Hour | 0.621 |



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