V12

JOHN DEERE

237947

COMPONENT TECHNICAL MANUAL

RADIAL PISTON PUMPS

CTM7 (01MAY89) English

RADIAL
PISTON PUMPS

JOHN DEERE

COMPONENT TECHNICAL MANUAL

RADIAL
PISTON PUMPS

CTM7 (01MAY89) English

JOHN DEERE WATERLOO WORKS
CTM7 (01MAY89)

LITHO IN THE U.S.A.
ENGLISH

To The Dealer

This component technical manual contains necessary instructions to repair John Deere Radial Piston Pumps. This manual also includes theory of operation, diagnostic, and procedures for setting standby pressure.

Use this component technical manual in conjunction with the machine technical manual. See the machine technical manual for pump removal and installation.

This safety-alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

When you see this symbol on the machine or in this manual, be alert to the possibility of personal injury or death. Follow the instructions in the safety message.

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

R70,COV1 250489

Litho in U.S.A.

CTM-7 (5-89)

2R3,IFC, 3 110589

JOHN DEERE ENGINE OWNER:

Don't wait until you need warranty or other service to meet your local John Deere Engine Distributor or Service Dealer.

Learn who he is and where he is. At your first convenience, go meet him. He'll want to get to know you and to learn what your needs might be.

UTILISATEURS DE MOTEURS JOHN DEERE:

N'attendez pas d'être obligé d'avoir recours a votre Concessionnaire ou Point de Service le plus proche pour vous adresser a lui.

Renseignez-vous des que possible pour l'identifier et le localiser. A la premiere occasion, prenez contact avec lui et faites-vous connaître. Il sera lui aussi heureux de faire votre connaissance et de savoir que vous pourrez compter sur lui le moment venu.

AN DEN BESITZER DES JOHN DEERE MOTORS:

Warten Sie nicht auf einen evt. Reparaturfall um den nächstgelegenen John Deere Händler kennen zu lernen.

Machen Sie sich bei ihm bekannt und nutzen Sie sein "Service Angebot".

PROPRIETARIO DEL MOTORE JOHN DEERE:

Non aspetti fino a quando ha bisogno della garanzia o di un altro tipo di assistenza per incontrarsi con il Suo Concessionario che fornisce l'assistenza tecnica.

Impari a conoscere chi è e dove si trova. Alla Sua prima occasione cerchi d'incontrarlo. Egli desidera farsi conoscere e conoscere le Sue necessità.

PROPIETARIO DE EQUIPO JOHN DEERE:

No espere hasta necesitar servicio de garantía o de otro tipo para conocer a su Distribuidor de Motores John Deere o al Concesionario de Servicio.

Entérese de quién es, y dónde está situado. Cuando tenga un momento, vaya a visitarlo. A él le gustará conocerlo, y saber cuáles podrían ser sus necesidades.

JOHN DEERE MOTORÄGARE:

Vänta inte med att besöka Din John Deere återförsäljare till dess att Du behöver service eller garanti reparation.

Bekanta Dig med var han är och vem han är. Tag första tillfälle att besöka honom. Han vill också träffa Dig för att få veta vad Du behöver och hur han kan hjälpa Dig.

ABOUT THIS MANUAL

This is a revised CTM that replaces CTM-7 dated (2-88). This component technical manual should be used for the repair of John Deere Radial Piston Pumps.

This revised CTM adds repair procedures for "B" drive coupler option for 3000 Series pumps, as well as other minor revisions.

DISCARD — CTM-7 DATED (2-88)

RADIAL PISTON PUMPS
CTM-7 (5-89)

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R70;070300 1150 150589

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INTRODUCTION

This Component Technical Manual (CTM-7) covers recommended repair procedures for all John Deere Radial Piston Pumps. Before beginning repair of a hydraulic pump, clean external surfaces of pump and mount on pump holding fixture.

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

R70;070300 1149 250489

SAFETY AND YOU

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

AB6;T81389 053;TMSAFE 071085

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

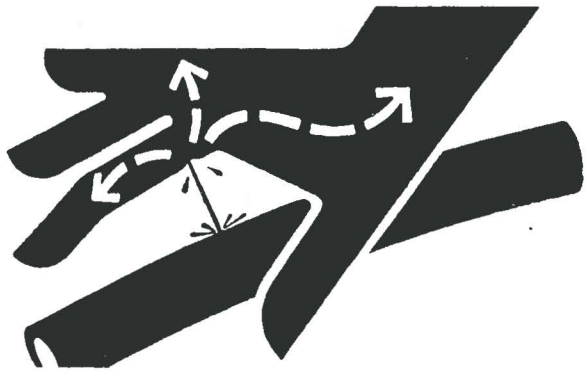
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

AB6;TS186 053;FIRE2 080785

AVOID HIGH-PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before unhooking hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure. Use a piece of cardboard to search for 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.

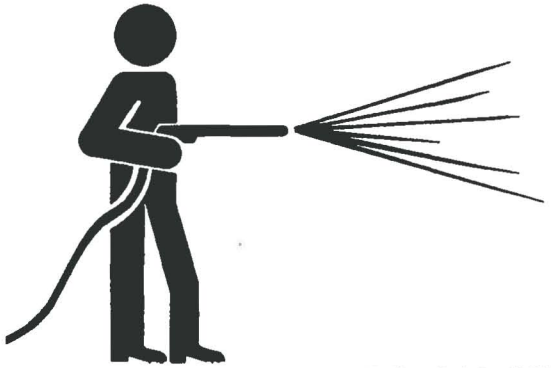


AB6;X9811 053;FLUID 180987

WORK IN CLEAN AREA

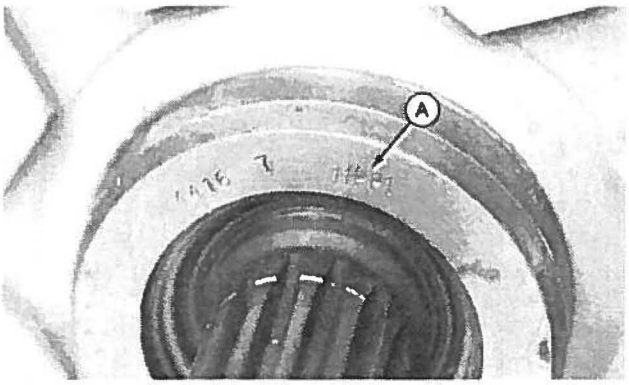
Before starting a job:

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



AB6;T6642E J 053;CLEAN 190188

NON-SERIALIZED HYDRAULIC PUMPS—1000 AND 2000 SERIES—(PR)



Some early designed 1000 and 2000 Series pumps will not have a serial number plate. A model number (A) will be stamped on the hub of the pump housing. This will aid in pump identification, however, design changes for non-serialized pumps are usually tied to the application or vehicle serial number.

Non-serialized and serialized 1000 Series pumps have different model numbers, however, the designs are the same.

Non-serialized 2000 Series pumps have different designed pressure compensator valves (stroke control valves) and pump shaft rotary assemblies than serialized pumps. Although the designs are somewhat different, the function is the same. Differences between NON-SERIALIZED and SERIALIZED 2000 Series pumps will be called out in this technical manual.

All current designed John Deere Radial Piston Hydraulic Pumps have serial number plates.

AW1;R39691 R70;070300 1049 080288

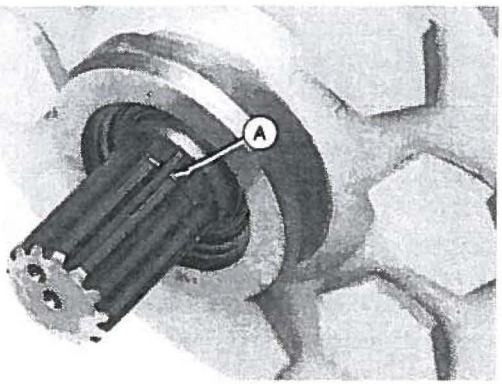
PUMP DISPLACEMENT

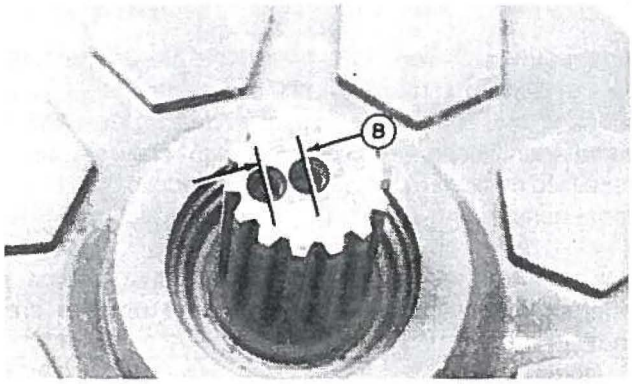
1000 SERIES (PR)

All 1000 Series four piston pumps have a displacement of 11 cm^3 (0.7 $in.^3$) and eight piston versions have a displacement of 23 cm^3 (1.4 $in.^3$).

R70;070300 1050 080288

2000 SERIES (PR)





The pump shaft eccentric cam and piston bore determines the displacement of the pump. Displacement can be identified by the number of grooves (A) machined at the base of the shaft splines and on single bank pumps by the measured distance (B) between the centering marks on the the end of the pump shaft.

NOTE: Centering mark measurements are from center-to-center.

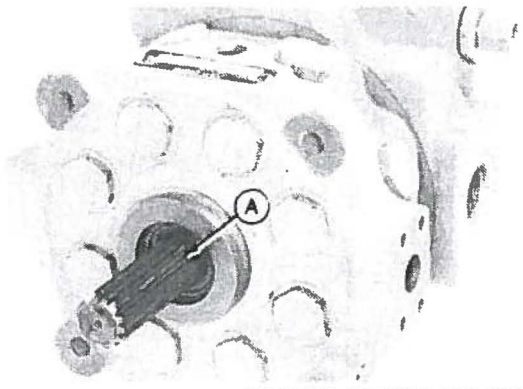
SINGLE BANK			*DOUBLE BANK*	
(A) Grooves	Displacement	(B) Distance Between Marks	(A) Grooves	Displacement
0	40 cm^3 (2.4 $in.^3$) (Non-Serialized)	6.5 mm	1	100 cm^3 (6 $in.^3$)
2	40 cm^3 (2.4 $in.^3$) (Serialized)	6.5 mm	0	130 cm^3 (8 $in.^3$)
1	50 cm^3 (3 $in.^3$)	8.0 mm		
0	65 cm^3 (4 $in.^3$)	8.7 mm		

AW1;R40103,R40148 R70;070300 1058 150589

3000 SERIES (HPR)

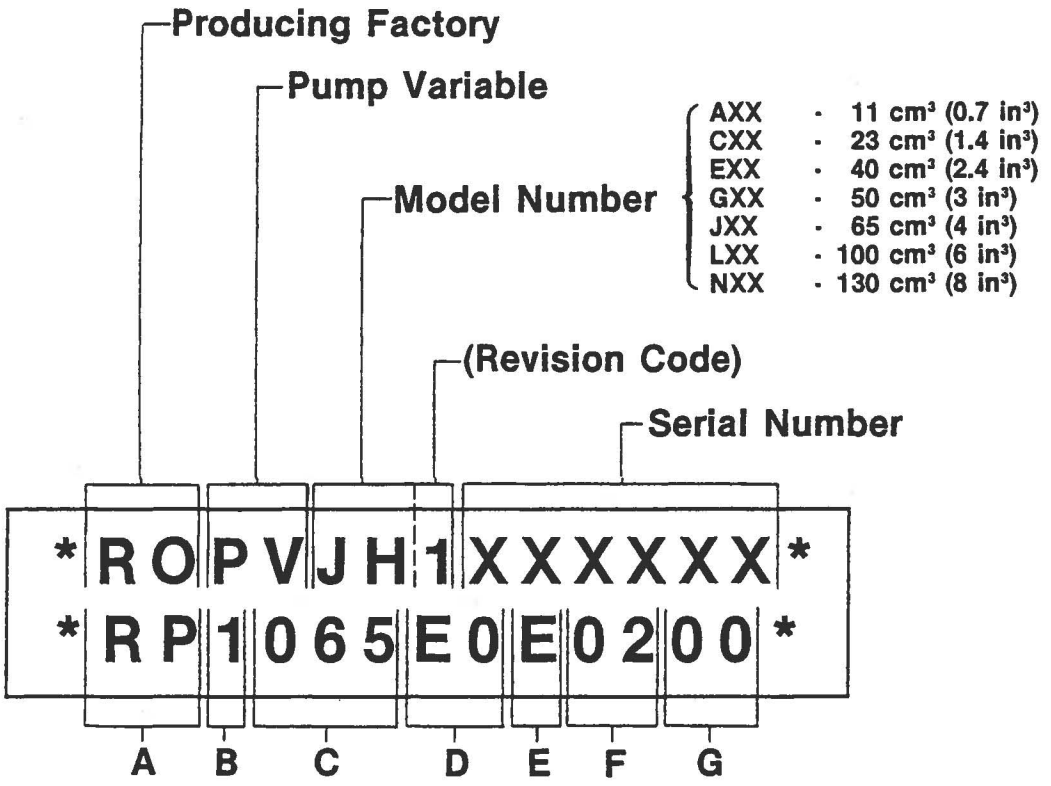
The pump shaft eccentric cam controls the displacement of the pump. Displacement can be determined by the number of grooves (A) machined on the shaft at the base of the splines.

SINGLE BANK	*DOUBLE BANK*
2—40 cm^3 (2.4 $in.^3$)	1—104 cm^3 (6 $in.^3$)
1—52 cm^3 (3 $in.^3$)	2—115 cm^3 (7 $in.^3$)
0—65 cm^3 (4 $in.^3$)	0—130 cm^3 (8 $in.^3$)



AW1;R39693 R70;070300 1162 011287

HYDRAULIC PUMP SERIAL NUMBER PLATE—1000 AND 2000 SERIES—(PR)

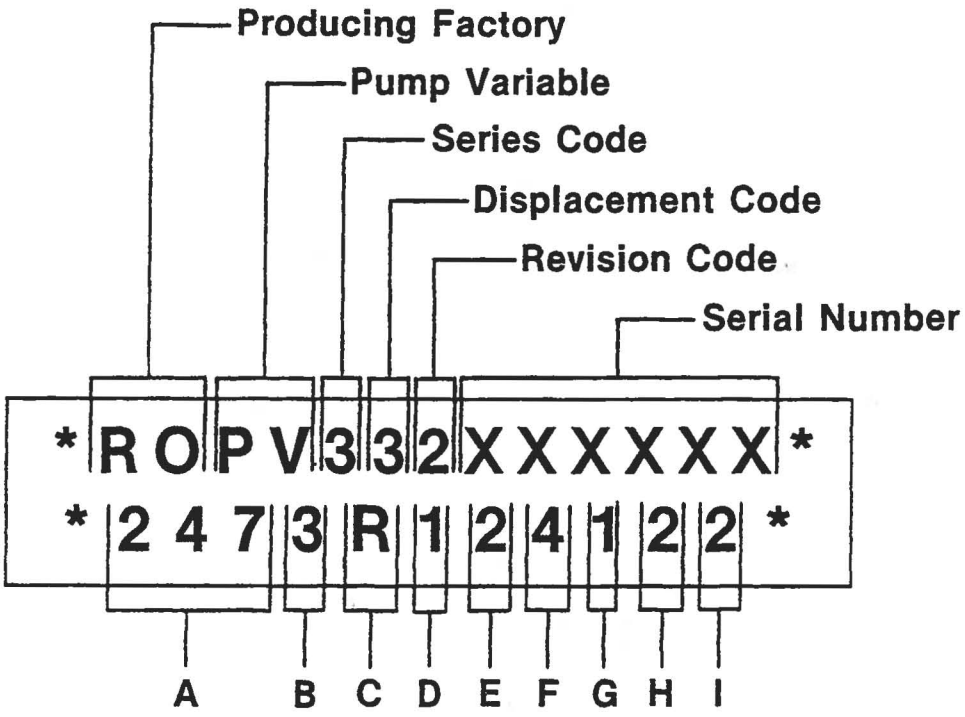


A—Radial Pump (RP)
B—Frame Size
C—Displacement in CM^3/Revolution
D—Ports in Primary (and Secondary) Housing(s)
E—Rotation
(E)—Either
(R)—Right
(L)—Left
F—Stroke Control Valve Option
G—Not Currently Used

The serial number plate on a 1000 Series hydraulic pump is located on the top of the pump housing cover. For 2000 Series pumps, the serial number plate is located on the top right hand side (viewing from the shaft end). The information on the serial number plate may be used to identify repair information in the Component Technical Manual.

AW1;R39942 R70;070300 1048 260188

HYDRAULIC PUMP SERIAL NUMBER PLATE—3000 SERIES—(HPR)



A—Master Machine Code (247)

B—Displacement (per rev.)
- 1—40 cm^3 (2.4 $in.^3$)
- 2—52 cm^3 (3 $in.^3$)
- 3—65 cm^3 (4 $in.^3$)
- 4—Not Currently Used
- 5—104 cm^3 (6 $in.^3$)
- 6—115 cm^3 (7 $in.^3$)
- 7—130 cm^3 (8 $in.^3$)

C—Manufacturing Unit (R)

D—Output Drive
- 1—None
- 2—Auxiliary SAE "B" Drive
- 3—Through Drive
- 4—Auxiliary Gear Pump
- 5—Not Currently Used

E—Inlet Port
- 1—Four Bolt Flange
- 2—O-Ring Port

F—Pressure Setting
- 1—10 000 kPa (100 bar) (1450 psi)
- 2—16 000 kPa (160 bar) (2300 psi)
- 3—17 500 kPa (175 bar) (2550 psi)
- 4—19 000 kPa (190 bar) (2750 psi)
- 5—22 500 kPa (225 bar) (3250 psi)

G—Control Type
- 1—Pressure Compensated
- 2—Not Currently Used
- 3—Pressure Compensated—External Control
- 4—Load Sense 1035 kPa (10 bar) (150 psi)
- 5—Load Sense 2070 kPa (20 bar) (300 psi)
- 6—Load Sense 3005 kPa (30 bar) (450 psi)

H—Input Drive
- 1—SAE "C" Mount
- 2—John Deere Mount

I—Destroke
- 1—None
- 2—Manual
- 3—Electric (6V)—(Normally Closed)
- 4—Electric (12V)—(Normally Closed)
- 5—Electric (12V)—(Normally Open)
- 6—Electric (24V)—(Normally Open)

The serial number plate on a 3000 Series pump is located on the top-center of the pump. Pump identity can be determined by the information (configuration code) on the second line of the serial number plate.

The information on the serial number plate may be used to identify repair information in the Component Technical Manual.

Some pumps will have a part number stamped on the SECOND LINE of the serial number plate instead of the information shown above.

AW1;R39943 R70;070300 1046 250489

BASIC PUMP SPECIFICATIONS—1000 SERIES

General	11CM^3 (0.7 IN.^{3})	23CM^3 (1.4 IN.^{3})
Number of Pump Housings	1	1
Number of Pistons	4	8
Pump Housing Bore ID	17.28-17.29 mm (0.6802-0.6808 in.)	17.28-17.29 mm (0.6802-0.6808 in.)
Piston OD	17.26-17.27 mm (0.6795-0.6799 in.)	17.26-17.27 mm (0.6795-0.6799 in.)
Rated Speed (rpm)	2500	2500
Rated Flow (gpm)	6.75	13.5
* Rated Pressure		
at No Flow (psi)	2750	2750
at Max Flow (psi)	2000	2000
Overall Dimensions		
Height (in.)	8.70 (max)	8.70 (max)
Width (in.)	9.67	9.67
Length (in.)	9.15	**9.15

*See Machine Manual for proper setting

**11.55 for pump with through drive

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BASIC PUMP SPECIFICATIONS—2000 SERIES

General	40CM^3 (2.4IN.^{3})	50CM^3 (3IN.^{3})	65CM^3 (4IN.^{3})	100CM^3 (6IN.^{3})	130CM^3 (8IN.^{3}
Number of Pump Housings	1	1	1	2	2
Number of Pistons	8	8	8	16	16
Pump Housing Bore ID	22.223-22.233mm (0.8749-0.8753in.)	22.223-22.233mm (0.8749-0.8753in.)	24.483-24.493mm (0.9639-0.9643in.)	22.223-22.233mm (0.8749-0.8753in.)	24.483-24.493m (0.9639-0.9643i
Piston OD	22.200-22.210mm (0.8740-0.8744in.)	22.200-22.210mm (0.8740-0.8744in.)	24.460-24.470mm (0.9630-0.9634in.)	22.200-22.210mm (0.8740-0.8744in.)	24.460-24.470m (0.9630-0.9634i
Rated Speed (rpm)	2500	2500	2500	2500	2200
Rated Flow (gpm)	23.3	30.2	39.5	64.9	80.0
*Rated Pressure					
at No Flow (psi)	2550	2550	2550	2550	2400
at Max Flow (psi)	2300	2300	2300	2300	2000
Overall Dimensions					
Height (in.)	9.50 (max)	9.50 (max)	9.50 (max)	9.50 (max)	9.50 (max)
Width (in.)	9.66	9.66	9.66	9.66	9.66
Length (in.)	**9.02	***9.02	***9.02	13.45	13.45

*See Machine Manual for proper setting
**12.48 for pump with through drive option
***11.76 for pump with auxiliary charge pump option

R70;070300 1160 0902

BASIC PUMP SPECIFICATIONS—3000 SERIES

General	40CM^3(2.4IN.^{3})	52CM^3(3IN.^{3})	65CM^3(4IN.^{3})	104CM^3(6IN.^{3})	115CM^3(7IN.^{3})	130CM^3(8IN.^{3})
Number of Pump Housings	1	1	1	2	2	2
Number of Pistons	8	8	8	16	16	16
Pump Housing Bore ID	25.395-25.405mm (0.9998-1.0001in.)	Same Same	Same Same	Same Same	Same Same	Same Same
Piston OD	25.363-25.373mm (0.9985-0.9989in.)	Same Same	Same Same	Same Same	Same Same	Same Same
Rated Speed (rpm)	3000	3000	2800	3000	2800	2800
Rated Flow (gpm)	34.8	45.3	53.3	90.7	94.2	106.4
* Rated Pressure						
at No Flow (psi)	3250	Same	Same	Same	Same	Same
at Max Flow (psi)	3000	Same	Same	Same	Same	Same
Overall Dimensions						
Height (in.)	**9.96(max)	**9.96(max)	**9.96(max)	**9.96(max)	**9.96(max)	**9.96(max)
Width (in.)	11.32(max)	11.32(max)	11.32(max)	11.32(max)	11.32(max)	11.32(max)
Length (in.)	***11.84(max)	***11.84(max)	***11.84(max)	17.72(max)	17.72(max)	17.72(max)

* See Machine Manual for proper setting

** 9.49 for non-unitized pumps (top line of serial number plate seventh digit from left is a "2")

*** 13.61 for pump with auxiliary SAE "C" through drive shaft
14.58 for pump with auxiliary charge pump option

R70;070300 1161 150288

PUMP APPLICATION CHART

John Deere Agricultural Equipment

Machine Model No.	1000 Series 11 cm^3	1000 Series 23 cm^3	2000 Series — Single Bank 40 cm^3	2000 Series — Single Bank 50 cm^3	2000 Series — Single Bank 65 cm^3	2000 Series — Double I 100 cm^3	2000 Series — Double I 130 c
Row Crop and Utility Tractors							
2510			X*				
3010			X	X			
4010			X	X			
5010			X	X			
1020	X	X					
1520	X	X					
2020	X	X					
2520			X*				
3020			X	X			
4000				X	X		
4020				X	X		
4320				X	X		
4520				X	X		
4620				X	X		
5020				X			
1530		X					
2030		X	X				
2630		X	X				
4030			X				
4230				X	X		
4430				X	X		
4630				X	X		
6030				X			
2040		X					
2240		X					
2440		X	X				
2640		X	X				
2840			X				
2940			X				
4040				X	X		
4240				X	X		
4440				X	X		
4640				X	X		
4840				X			

*Replacement Pump - original pump is a 4 piston 2000 series pump

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John Deere Agricultural Equipment - Continued

Machine Model No.	1000 Series 11 cm³	1000 Series 23 cm³	2000 Series — Single Bank 40 cm³	2000 Series — Single Bank 50 cm³	2000 Series — Single Bank 65 cm³	2000 Series — Double Bank 100 cm³	2000 Series — Double Bank 130 cm³
Row Crop and Utility Tractors—Continued							
2150		X					
2155		X					
2255		X					
2350		X	X				
2355N		X	X				
2550		X	X				
2555		X	X				
2750		X	X				
2755		X	X				
2855N			X				
2950			X				
2955			X				
3150			X				
3155			X				
4050				X			
4055				X			
4250				X			
4255				X			
4450				X			
4455				X			
4555					X		
4650					X		
4755					X		
4850					X		
4955					X		
Four Wheel Drive Tractors							
7020				X			
7520				X			
8430					X		
8630					X		
8440					X		
8640					X		
8450					X		
8650					X		
8850						X	

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John Deere Agricultural Equipment - Continued

Machine Model No.	1000 Series		2000 Series — Single Bank			2000 Series — Double I	
	11 cm^3	23 cm^3	40 cm^3	50 cm^3	65 cm^3	100 cm^3	130 c
Cotton Pickers/Strippers							
7440		X					
7445		X					
9920		X					
9930		X					
9940		X					
9950		X	X				
9960			X				

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John Deere Agricultural Equipment

Machine Model No.	3000 Series—Single Bank			3000 Series—Double Bank		
	40 cm^3	52 cm^3	65 cm^3	104 cm^3	115 cm^3	130 cr
Four Wheel Drive Tractors						
8560			X			
8760			X			
8960			X			

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John Deere Industrial Equipment

Machine Model No.	1000 Series 11 cm^3	1000 Series 23 cm^3	2000 Series — Single Bank 40 cm^3	2000 Series — Single Bank 50 cm^3	2000 Series — Single Bank 65 cm^3	2000 Series — Double Bank 100 cm^3	2000 Series — Double Bank 130 cm^3
Tractors							
JD300	X	X	X	X			
JD301	X	X					
301A		X					
302		X					
JD400	X	X		X			
JD401	X	X					
401B		X					
401D		X		X			
JD500				X			
JD600				X			
JD700A				X			
Backhoe Loaders							
300B				X			
302A				X			
401C				X			
JD310				X			
310A				X			
310B					X		
410					X		
410B				X			
JD500A				X			
JD500B				X			
500C					X		
510				X		X	
510B					X		
610B					X		
710B						X	

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John Deere Industrial Equipment - Continued

Machine Model No.	1000 Series 11 cm^3	1000 Series 23 cm^3	2000 Series — Single Bank 40 cm^3	2000 Series — Single Bank 50 cm^3	2000 Series — Single Bank 65 cm^3	2000 Series — Double E 100 cm^3	2000 Series — Double E 130 cı
Graders							
JD570				X			
570A				X			
570B				X			
JD670					X		
670A					X	X	
672A					X	X	
670B					X	X	
672B					X	X	
770						X	
770A					X	X	
772A					X	X	
770B					X	X	
772B					X	X	
Forestry							
340D				X			
JD440			X	X			
JD440A				X			
JD440B				X			
440C				X			
440D				X			
448D				X			
JD540				X			
JD540A				X			
540B				X			
540D				X			
548D				X			
640				X	X	X	
640D				X			
648D						X	
JD740					X	X	
JD740GS						X	
740A					X		
740AGS						X	
JD743							X
743A							X

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John Deere Industrial Equipment - Continued

Machine Model No.	1000 Series 11 cm^3	1000 Series 23 cm^3	2000 Series — Single Bank 40 cm^3	2000 Series — Single Bank 50 cm^3	2000 Series — Single Bank 65 cm^3	2000 Series — Double Bank 100 cm^3	2000 Series — Double Bank 130 cm^3
Four Wheel Drive Loaders							
JD444				X			
444C				X			
JD544				X			
JD544A				X			
JD544B				X			
544C				X			
JD644				X			
JD644A				X			
JD644B				X			
644C					X		
JD646				X			
JD646B				X			
646C					X		
Scrapers							
JD760				X			
JD760A				X			
JD762					X		
762A					X		
762B					X		
862							X
862B							X

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John Deere Industrial Equipment - Continued

Machine Model No.	3000 Series—Single Bank 40 cm^3	52 cm^3	65 cm^3	3000 Series—Double Bank 104 cm^3	115 cm^3	130 cm^3
Backhoe Loaders						
410C			X			
510C			X			
610C			X			
710C				X		
Forestry						
648D				X		

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OEM Applications

Application	1000 Series 11 cm^3	23 cm^3	2000 Series—Single Bank 40 cm^3	50 cm^3	65 cm^3	2000 Series—Double Bank 100 cm^3	130 cm^3
OEM		X	X	X	X	X	X

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OEM Applications

Application	3000 Series—Single Bank 40 cm^3	52 cm^3	65 cm^3	3000 Series—Double Bank 104 cm^3	115 cm^3	130 cm^3
OEM	X	X	X	X	X	X

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METRIC SERIES TORQUE CHART

CAUTION: Use only metric tools on metric hardware. Other tools may not fit properly. They may slip and cause injury.

DO NOT use these values if a different torque value or tightening procedure is listed for a specific application. Torque values listed are for general use only.

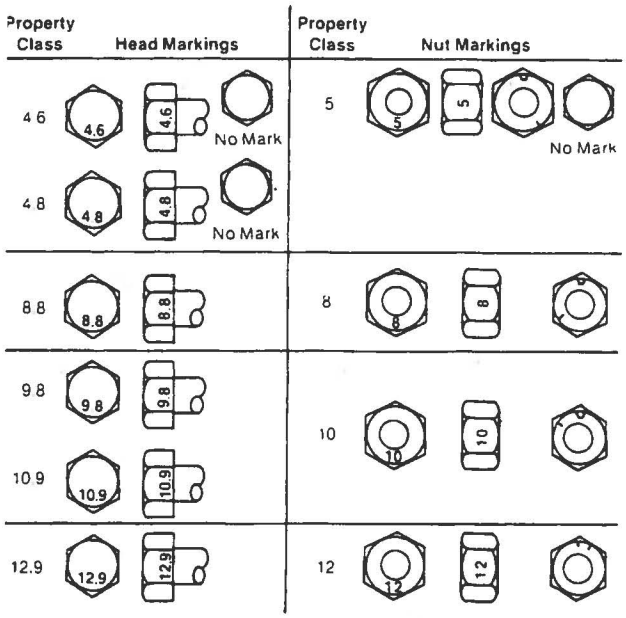
Check tightness of cap screws periodically.

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

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

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

Tighten cap screws with plastic insert or crimped steel-type lock nuts to approximately 50 percent of amount shown in chart. Tighten toothed or serrated-type lock nuts to full torque value.



DIA.	WRENCH SIZE	4.6		4.8		8.8		9.8		10.9		12.9	
		OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY
		N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-in)	N·m(lb-in)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)	N·m(lb-ft)
M5	8mm	1.5(1)	2.5(1.5)	2.5(1.5)	3.0(2)	4.5(3.5)	6.0(4.5)	5.0(3.5)	7.0(5)	6.5(4.5)	9.0(6.5)	7.5(5.5)	10.0(7.5)
M6	10mm	3.0(2)	4.0(3)	4.0(3)	5.5(4)	7.5(5.5)	10.0(7.5)	8.5(6)	12.0(9)	11.0(8)	15.0(11)	13.0(9.5)	18.0(13)
M8	13mm	7.0(5)	9.5(7)	10.0(7.5)	13.0(10)	18.0(13)	25(18)	21.0(15)	30(22)	25(18)	35(26)	30(22)	45(33)
M10	16mm	14.0(10)	19.0(14)	20.0(15)	25(18)	35(26)	50(37)	40(30)	55(41)	55(41)	75(55)	65(48)	85(63)
M12	18mm	25(18)	35(26)	35(26)	45(33)	65(48)	85(63)	70(52)	100(74)	95(70)	130(97)	110(81)	150(111)
M14	21mm	40(30)	50(37)	55(41)	75(55)	100(74)	140(103)	115(85)	155(114)	150(111)	205(151)	175(129)	240(177)
M16	24mm	60(44)	80(59)	85(63)	115(85)	160(118)	215(159)	180(133)	245(180)	235(173)	315(232)	275(203)	370(273)
M18	27mm	80(59)	110(81)	115(85)	160(118)	225(166)	305(225)			320(236)	435(321)	375(277)	510(376)
M20	30mm	115(85)	160(118)	165(122)	225(166)	320(236)	435(321)			455(356)	620(457)	535(395)	725(535)
M22	33mm	160(118)	215(159)	225(167)	305(225)	435(321)	590(435)			620(457)	840(620)	725(535)	985(726)
M24	36mm	200(148)	275 (203)	285(210)	390(288)	555(409)	750(553)			790(583)	1070(789)	925(682)	1255(926)
M27	41mm	295(218)	400 (295)	415(306)	565(417)	810(597)	1100(811)			1155(852)	1565(1154)	1350(996)	1835(1353)
M30	46mm	400(295)	545(402)	565(417)	770(568)	1100(811)	1495(1103)			1570(1158)	2130(1571)	1835(1353)	2490(1837)
M33	51mm	545(402)	740(546)	770(568)	1050(774)	1500(1106)	2035(1500)			2135(1575)	2900(2139)	2500(1844)	3390(2500)
M36	55mm	700(516)	950(700)	990(730)	1345(992)	1925(1420)	2610(1925)			2740(2021)	3720(2744)	3205(2364)	4355(3212)

AB6;TS234, TS235 053;TORQ4. 090888

INCH SERIES TORQUE CHART

DO NOT use these values if a different torque value or tightening procedure is listed for a specific application. Torque values listed are for general use only.

Check tightness of cap screws periodically.

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

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

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

Tighten cap screws with plastic insert or crimped steel-type lock nuts to approximately 50 percent of amount shown in chart. Tighten toothed or serrated-type lock nuts to full torque value.

SAE Grade	Head Markings	SAE Grade	Nut Markings
SAE GRADE 1 SAE GRADE 2	No Mark	2	No Mark
SAE GRADE 5 SAE GRADE 5.1 SAE GRADE 5.2		5	
SAE GRADE 8 SAE GRADE 8.2		8	

DIA.	WRENCH SIZE	SAE GRADE 1		SAE GRADE 2		SAE GRADE 5		SAE GRADE 8	
		OIL	DRY	OIL	DRY	OIL	DRY	OIL	DRY
		N•m(lb-in)	N•m(lb-in)	N•m(lb-in)	N•m(lb-in)	N•m(lb-in)	N•m(lb-in)	N•m(lb-in)	N•m(lb-in)
#6		0.5 (4.5)	0.7(6)	0.8(7)	1(10)	1.4(12)	1.7(15)		
#8		0.9(8)	1.2(11)	1.5(13)	2(18)	2.4(21)	3.2(28)		
#10		1.4(12)	1.8(16)	2(19)	2.8(25)	3.4(30)	4.6(41)		
#12		2(19)	2.8(25)	3.4(30)	4.5(40)	5.4(48)	7.3(65)		
		N•m(lb-ft)	N•m(lb-ft)	N•m(lb-ft)	N•m(lb-ft)	N•m(lb-ft)	N•m(lb-ft)	N•m(lb-ft)	N•m(lb-ft)
1/4	7/16	3.5(2.5)	4(3.0)	5(4.0)	7(5.0)	8(6.0)	11(8.0)	12(8.5)	16(12)
5/16	1/2	7(5.0)	9(6.5)	10(7.5)	14(10.0)	16(12.0)	23(17.0)	24(18.0)	33(24)
3/8	9/16	12(8.5)	16(12.0)	19(14.0)	24(18.0)	30(22.0)	41(30)	41(30)	54(40)
7/16	5/8	19(14.0)	26(19.0)	30(22.0)	41(30)	47(35)	68(50)	68(50)	95(70)
1/2	3/4	24(21.0)	41(30)	47(35)	61(45)	75(55)	102(75)	102(75)	142(105)
9/16	13/16	41(30)	54(40)	68(50)	88(65)	108(80)	142(105)	149(110)	203(150)
5/8	15/16	54(40)	75(55)	88(65)	122(90)	149(110)	197(145)	203(150)	278(205)
3/4	1-1/8	102(75)	136(100)	163(120)	217(160)	258(190)	353(260)	366(270)	495(365)
7/8	1-5/16	163(120)	224(165)	163(120)	224(165)	414(305)	563(415)	590(435)	800(590)
1	1-1/2	244(180)	332(245)	244(180)	332(245)	624(460)	848(625)	881(650)	1193(880)
1-1/8	1-11/16	346(255)	468(345)	346(255)	468(345)	780(575)	1058(780)	1248(920)	1695(1250)
1-1/4	1-7/8	488(360)	664(490)	488(360)	665(490)	1098(810)	1492(1100)	1763(1300)	2393(1765)
1-3/8	2-1/16	637(470)	868(640)	637(470)	868(640)	1438(1061)	1953(1440)	2312(1705)	3140(2315)
1-1/2	2-1/4	848(625)	1153(850)	848(625)	1153(850)	1912(1410)	2590(1910)	3065(2260)	4163(3070)

AB6;TS236, TS237 053;TORQ3. 090888

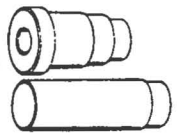
ESSENTIAL TOOLS

NOTE: Order tools from your SERVICE-GARD™ Catalog. Some tools may be available from a local supplier.

053;TOOLS 160187

Hydraulic Pump Seat Installing Tool Set JDH39B

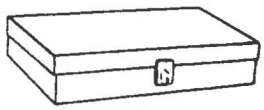
Install and remove discharge valve seats



AB6;R40104 R53;JDH39B 250489

Blind-Hole Puller Set D01061AA

Remove valve seats and bearings



AB6;R40105 R53;D01061 AA 250489

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools from your Service-Gard™ Catalog. Some tools may be available from a local supplier.

Name	Use
Pump Holding Fixture	Hold pump during repair
Bushing, Bearing and Seal Driver Set	Aid in the installation of bearings and seals
O-Ring Seal Tool Kit	Remove and install O-rings and sealing rings
Hydraulic Pump Parts Tray	Organize, identify and protect pump parts during repair

R70;070300 1163 250489

HYDRAULIC PUMP SPECIFICATIONS—1000 SERIES PUMP

Item	Measurement	Specification
Pump Shaft		
Standard Drive	End Play	0.152—0.941 mm (0.006—0.037 in.)
Through Drive	End Play	0.0254—0.0762 mm) (0.001—0.003 in.)
Piston	OD	17.259—17.269 mm (0.6795—0.6799 in.)
Piston Bore	ID	17.277—17.292 mm (0.6802—0.6808 in.)
Shaft Journal	OD	37.770—37.783 mm (1.4870—1.4875 in.)
Shaft Bearing Race	ID	45.730—45.746 mm (1.8004—1.8010 in.)
Shaft Bearing Race	OD	56.77—57.03 mm (2.235—2.245 in.)
Shaft Needle Rollers	OD	3.962—3.967 mm (0.1560—0.1562 in.)
Thrust Washer (Standard Drive)	Thickness (new)	2.21—2.31 mm (0.087—0.091 in.)
Thrust Washer (Through Drive)	Thickness (new)	3.13—3.23 mm (0.123—0.127 in.)
Piston Spring	Free Length	48 mm (1.9 in.) (approx.)
	Test Length	32 mm at 80—100 N (1.3 in. at 18—22 lb force)
Discharge Valve Spring	Free Length	12.2 mm (0.5 in.) (approx.)
	Test Length	7.6 mm at 11—14 N (0.3 in. at 2.5—3 lb force)
Inlet Valve Spring	Free Length	13 mm (0.5 in.) (approx.)
	Test Length	8 mm at 1.4—1.8 N (0.3 in. at 0.3—0.4 lb force)
Pressure Compensator Valve Spring	Free Length	71 mm (2.8 in.) (approx.)
	Test Length	63.3 mm at 701—857 N (2.5 in. at 158—193 lb force)
Crankcase Outlet Valve	Free Length	63.5 mm (2.5 in.) (approx.)
	Test Length	52.5 mm at 196—240 N (2.1 in at 44—54 lb force)
Piston Plug	Torque	122 N·m (90 lb-ft)
Inlet Valve Seats	Torque	68 N·m (50 lb-ft)
Cover-to-Pump Housing	Torque	47 N·m (35 lb-ft)

R70;070300 1164 170589

DIAGNOSING MALFUNCTIONS

No Pump Output
- Broken pump drive shaft
- Pressure compensator valve malfunction
- Improper compensator valve adjustment
- Excessive charge circuit leakage
- Crankcase outlet valve failure
- No oil to pump inlet

Low Pump Output
- Low deadhead pressure
- Compensator valve, seat, or spring failure
- Worn or scored pistons and bores
- Broken discharge valve or spring
- Leaking inlet valve
- Restricted inlet
- Insufficient inlet oil

Hydraulic Functions Slow
- Low deadhead pressure
- Plugged hydraulic filter or return filter
- Compensator valve, seat, or spring failure
- Crankcase outlet valve stuck closed

Slow Pump Response
- Weak crankcase outlet valve spring
- Failure of charge pump or charge leak
- Plugged return oil filter

Excessive Pump Pressure
- Improper compensator valve adjustment

Function Chatter
- Insufficient inlet oil (cavitation)
- Sticking pump pistons
- Broken discharge valve or spring
- Broken inlet valve
- Charge system leakage
- Charge pump suction air leak

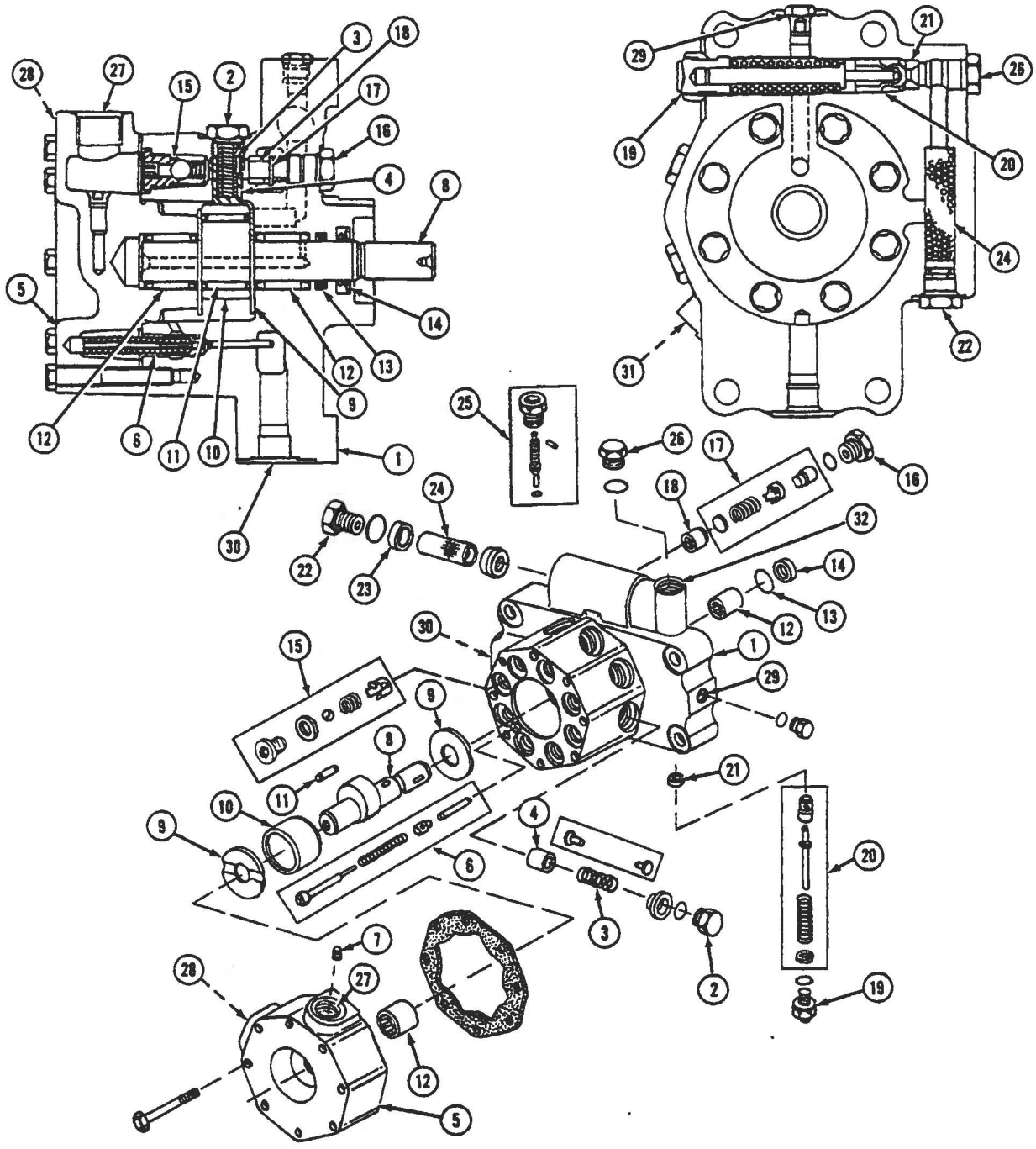
Pump and Oil Line Vibration
- Crankcase outlet valve spring too strong
- Broken discharge valve or spring
- Leaking inlet valve
- Broken inlet valve

Pump Shaft Seal Failure
- Broken discharge valve
- Overpressurized seal drain line

Pump Noise or Squeal
- Low deadhead pressure
- Pressure compensator valve binding
- Crankcase outlet valve spring too strong
- Leaking inlet valve
- Air leak at inlet connections (inspect)
- Insufficient inlet oil (cavitation)

R70;070300 1165 080288

CROSS-SECTION AND EXPLODED VIEW—1000 SERIES PUMP

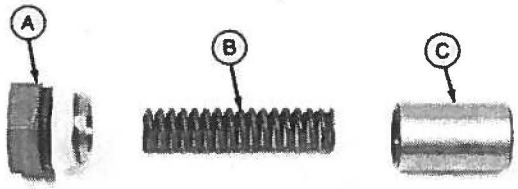


(Standard Drive Pump Shown)

1—Pump Housing
2—Piston Plug (8 used)
3—Piston Spring (8 used)
4—Piston (8 used)
5—Cover
6—Crankcase Outlet Valve
7—Orifice Plug
8—Shaft
9—Thrust Washer
10—Race
11—Needle Rollers (33 used)
12—Needle Bearing (2 used)
13—Quad Ring
14—Oil Seal
15—Inlet Valve (8 used)
16—Plug (8 used)
17—Discharge Valve (8 used)
18—Valve Seat (8 used)
19—Adjusting Screw
20—Pressure Compensator Valve Assembly
21—Valve Seat
22—Plug
23—Packing (2 used)
24—Filter
25—Manual Destroke (Option)
26—Plug
27—Inlet Port (I2)
28—Inlet Port (I1)
29—Crankcase Pressure Port (C1)
30—Discharge Port (S1)
31—Drain Port (D1)
32—Shut-Off Screw Port (E1)

AW1;R40113 R70;070300 1166 090288

REMOVE AND INSPECT PISTON ASSEMBLIES



IMPORTANT: Pistons must be installed in their original bores if they are reused. Write numbers on piston plugs, discharge valve plugs and pump housing for identification.

1. Remove piston assemblies and put them in a parts tray to insure installation into the same bores from which they were removed.

2. Inspect piston plugs (A) for thread damage.

3. Inspect face and skirt of pistons (C) for metal transfer, galling or scoring. Replace housing and all eight pistons if these conditions exist.

IMPORTANT: All springs must be the same color code.

4. Inspect springs (B) for wear or damage. Replace ALL springs as a set if required.

NEW SPRING SPECIFICATION

Free Length	48 mm (1.9 in.) (approximate)
Test Length	32 mm at 80—100 N (1.3 in. at 18—22 lb force)

AW1;R40135 R70;070300 1167 100589

INSTALL PISTON ASSEMBLIES

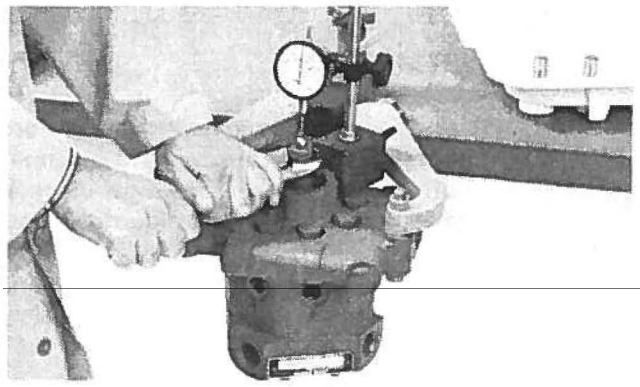
1. Install new O-rings and plastic shields on piston plugs.

IMPORTANT: To prevent damage to O-rings and shields, DO NOT use an air-operated wrench to tighten piston plugs; use a torque wrench.

2. Install piston assemblies and tighten piston plugs to 122 N·m (90 lb-ft).

R70;070300 1168 080288

CHECK SHAFT END PLAY



1. Remove piston assemblies. (See, Remove and Inspect Piston Assemblies in this group.)

NOTE: Use vice grip with curved jaw for better clamping.

2. Install vice grips as tightly as possible on pump shaft approximately 5/8 in. from pump housing hub.

3. Put a dial indicator base on pump housing and indicator contact point on steel ball placed in center of pump shaft.

4. Turn shaft back and forth while pushing down to align bearings inside the pump housing.

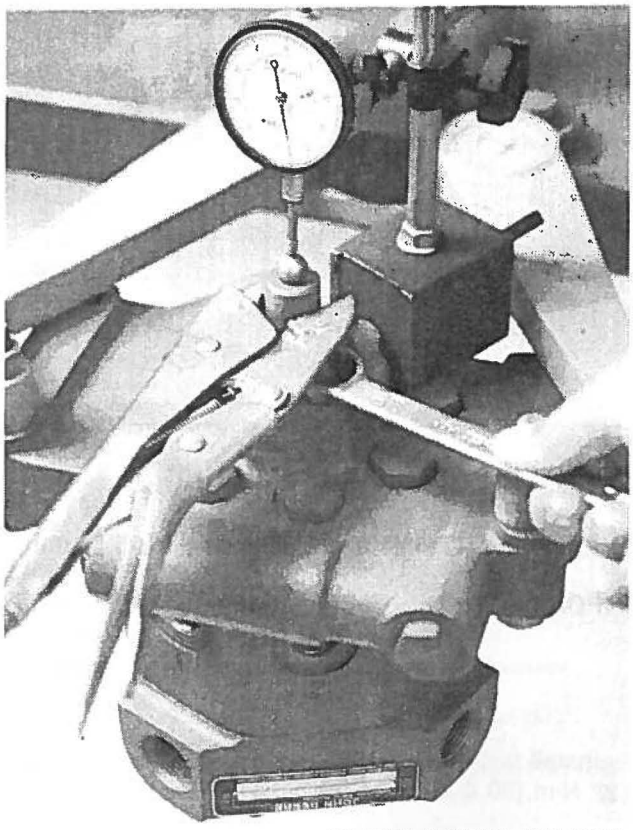
AW1;R40125 R70;070300 1169 290188

5. Zero the indicator.

6. Pry upward on vice grips using a long (3/4 in. minimum) box-end wrench noting indicator reading. If end play is more than specification, check thrust washers (on standard drive) or tapered roller bearings (on through drive) for wear. Increase number or size of shims in pump housing on through drive pump if end play is greater than 0.076 mm (0.003 in.).

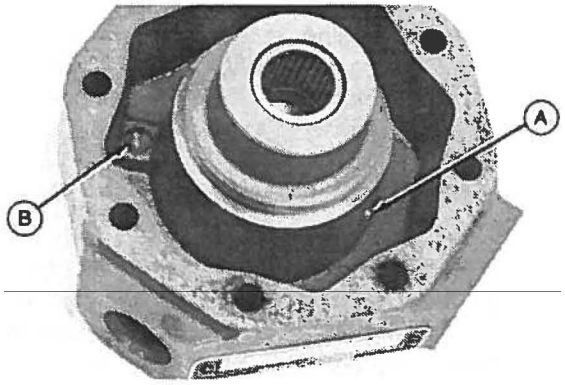
END PLAY SPECIFICATION

Standard Drive	0.152—0.941 mm (0.006—0.037 in.)
Through Drive	0.025—0.076 mm (0.001—0.003 in.)



AW1;R40126 R70;070300 1170 011287

REMOVE AND INSTALL PUMP COVER



1. Remove cover and discard gasket.

2. Inspect crankcase orifice (A) to make sure it is open.

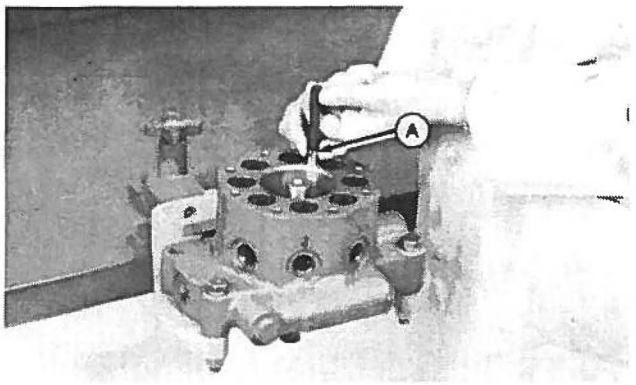
IMPORTANT: For THROUGH DRIVE use cover to install bearing cup on end of pump shaft. DO NOT install shims or new oil seal in cover until bearing cup has been installed.

3. Install cover with new gasket making sure crankcase outlet valve in pump housing properly aligns with hole (B) in cover.

4. Install and tighten cap screws alternately to 47 N·m (35 lb-ft).

AW1;R40189 R70;070300 1195 250489

REMOVE AND INSTALL PUMP SHAFT



IMPORTANT: Pistons must be installed in their original bores if they are reused.

1. Remove piston assemblies. (See Remove and Inspect Piston Assemblies in this group.)

2. Remove pump cover and gasket from pump housing.

3. Remove crankcase outlet valve (A) from pump housing.

AW1;R40127 R70;070300 1171 270188

4. Turn shaft in housing to check for smooth bearing operation. Replace bearings (and bearing cups on through drive shaft) if they stick or are noisy. (See Remove and Install Bearings (Standard Drive) in this group.)

5. Remove pump shaft assembly as shown for standard drive.

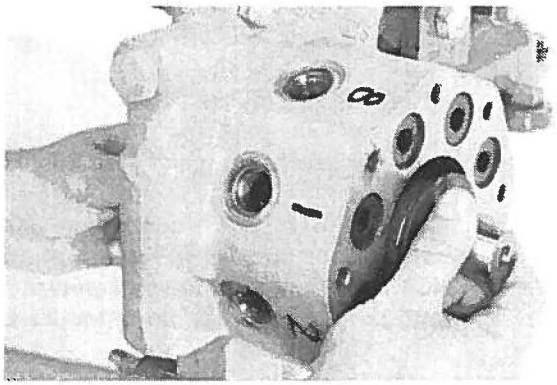
NOTE: For through drive shaft tap end of shaft with a hammer to remove bearing cup and shaft assembly from housing. Make sure shaft is supported during removal procedure.

6. Install new quad ring and oil seal in pump housing. (See Remove and Install Oil and Quad-Ring Seals in this group.)

IMPORTANT: DO NOT install new oil seal in cover for through drive shaft until bearing cup on end of pump shaft has been installed. Cover is used to install bearing cup and seal damage could result during cup installation.

7. Carefully install shaft assembly.

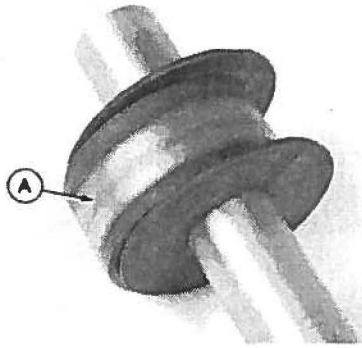
8. Install bearing cup on through drive shaft.(See Remove and Install Pump Cover in this group.)



0AV;T88609 R70;070300 1172 090288

DISASSEMBLE AND INSPECT PUMP SHAFT

1. Slowly turn race (A) on shaft. Race must turn smoothly. Replace parts as required if assembly is sticking or noisy.



AW1;R40134 R70;070300 1173 110188

NOTE: For THROUGH DRIVE, remove bearing cones on shaft using a bearing puller.

2. Disassemble pump shaft.

3. Inspect pump shaft (A). Replace if shaft journal is pitted, scored or discolored. Needle rollers and race may also need to be replaced.

4. Inspect needle rollers (B). Replace ALL needle rollers if any are discolored, pitted or scratched.

5. Inspect race (C). Replace race and pistons if race is discolored, pitted or scored.

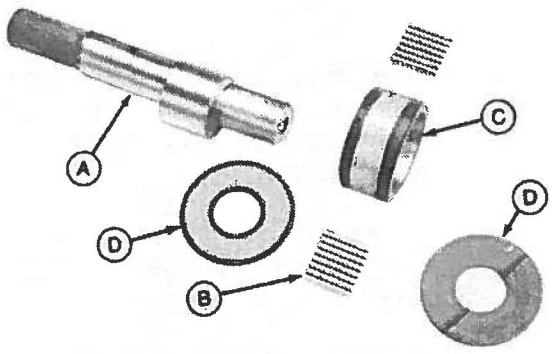
6. Inspect thrust washers (D) (and spacers (E) on through drive) for wear or damage. Replace as required.

NEW PART SPECIFICATION

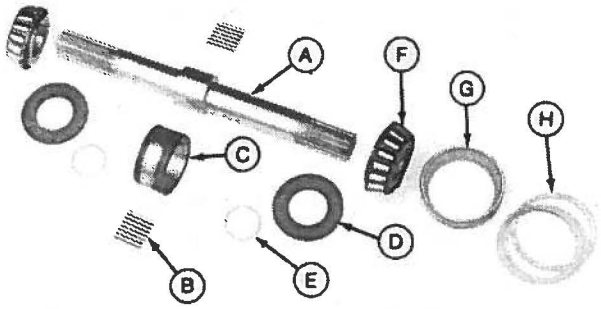
Standard Drive	2.21—2.31 mm (0.087—0.091 in.)
Through Drive	3.13—3.23 mm (0.123—0.127 in.)

NOTE: Bearing cones and cups on through drive shaft should be replaced as a set.

7. Inspect bearing cones (F) on through drive shaft. Replace bearing cone and cup if spacer wear exists on shoulder surface of cone or if rollers are pitted or cage is damaged.



Standard Drive Shaft



Through Drive Shaft

A—Pump Shaft
B—Needle Rollers (33 used)
C—Race
D—Thrust Washer (2 used)
***E—Spacer (2 used)**
***F—Bearing Cone (2 used)**
***G—Bearing Cup (2 used)**
***H—Shims (as required)**

***Through Drive Only**

AW1;R40131,R40132 R70;070300 1174 250489

ASSEMBLE PUMP SHAFT

IMPORTANT: DO NOT use grease to hold needle rollers. Doing so can restrain roller movement and cause pump failure. Use only clean hydraulic oil.

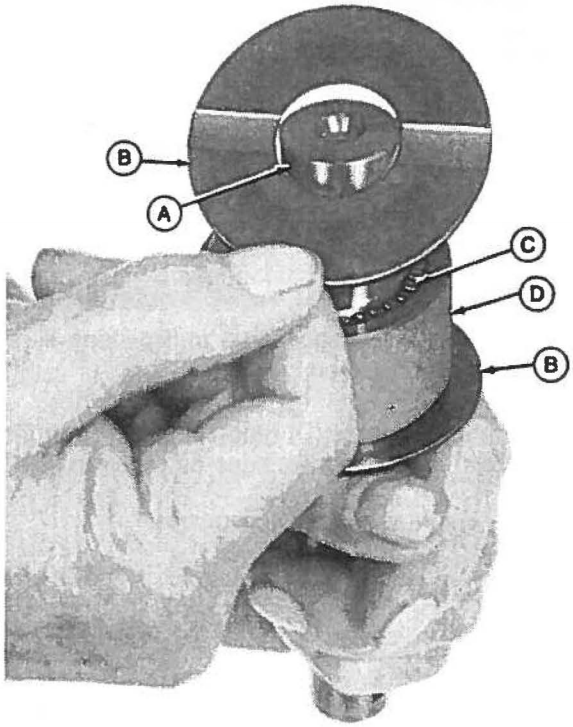
IMPORTANT: Thrust washers on standard drive shaft must be installed with flat side against race.

IMPORTANT: Spacers on through drive shaft must be installed with chamfered ID toward the shaft journal.

1. Assemble shaft using 33 needle rollers (C) between race (D) and shaft journal.

IMPORTANT: Taper roller bearings on THROUGH DRIVE SHAFT must be pressed onto pump shaft even if shaft has not been disassembled. This assures correct pump shaft end play.

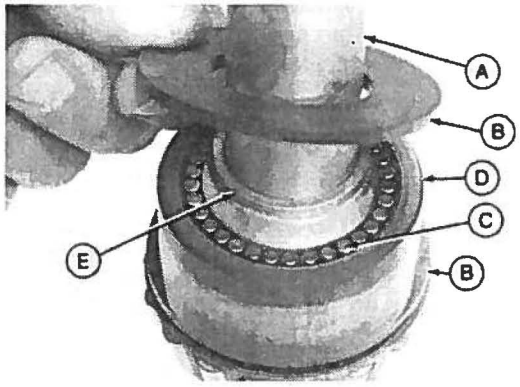
2. For through drive pump shaft, install smaller bearing cone on long splined end of shaft and larger bearing cone on short splined end of shaft.



Standard Drive Shaft

A—Pump Shaft
B—Thrust Washers
C—Needle Rollers
D—Race
***E—Spacer**

***Through Drive Only**



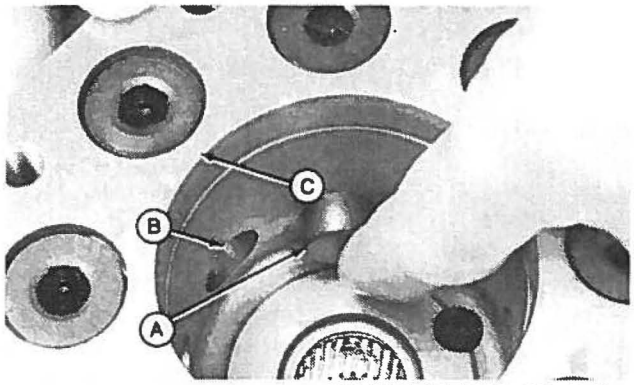
Through Drive Shaft

0AV;T88610 AW1;R40133 R70;070300 1175 150288

INSPECT PUMP HOUSING

1. Inspect piston bores (B) for scoring. If scoring is felt, replace pump housing and all pistons.

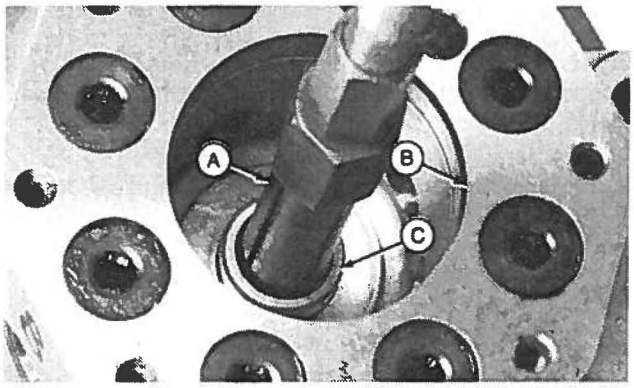
2. Install each piston (A) into its bore so it extends approximately 13 mm (0.50 in.) into the crankcase. Pistons must slide smoothly and have no side play. Replace pump housing and all pistons if side play exists or if piston sticks in bore.



0AV;T88613 R70;070300 1176 081287

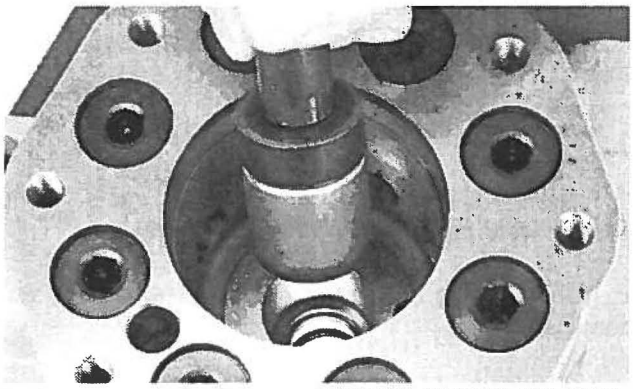
REMOVE AND INSTALL BEARINGS (STANDARD DRIVE)

1. Remove bearing (C) from pump housing (B) and pump cover using blind-hole puller (A) from D01061AA Blind-Hole Puller Set.



0AV;T88621 R70;070300 1177 250489

2. Install bearing into pump housing and cover 0.5 mm (0.02in.) below finished surface of crankcase using a 1" and 1-5/8 " disk from a Bushing, Bearing, and Seal Driver Set.



0AV;T88625 R70;070300 1178 250489

REMOVE AND INSTALL OIL AND QUAD-RING SEALS

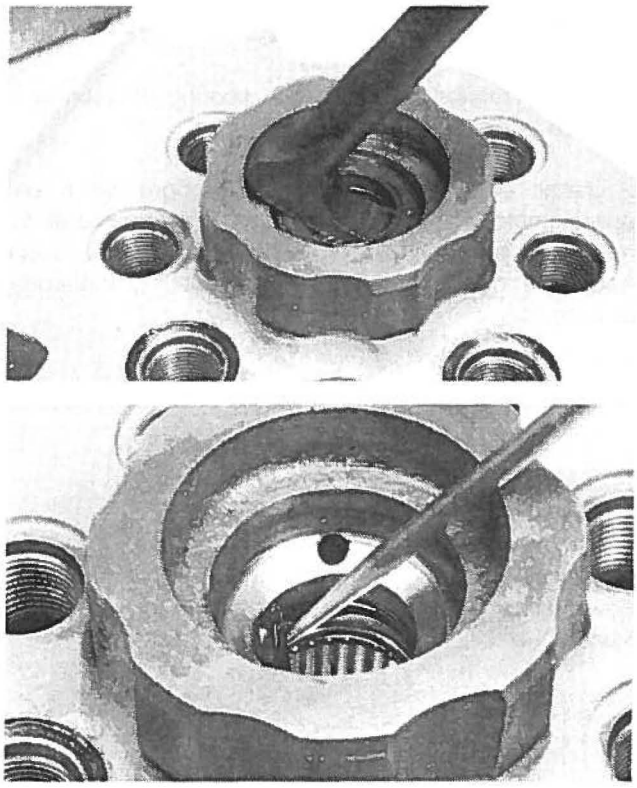
1. Remove oil seal.

2. Remove and install new quad-ring seal using an O-Ring Seal Tool Kit.

IMPORTANT: If shaft on THROUGH DRIVE has been removed, DO NOT install new oil seal in cover until bearing cup on end of pump shaft has been installed. Pump cover is used to install bearing cup. (See Remove and Install Cover in this group.)

3. Install new seal with lip (spring side) toward inside of housing using disks from a Bushing, Bearing, and Seal Driver Set.

4. Apply petroleum jelly to lip of quad-ring seal and oil seal for initial lubrication.



OAV;T88617,T88618 R70;070300 1179 150589

REMOVE, INSPECT AND INSTALL INLET VALVES

1. Remove inlet valves from pump housing.

2. Inspect valve seats (B) and balls (C) for scratches or uneven wear pattern. Replace if necessary.

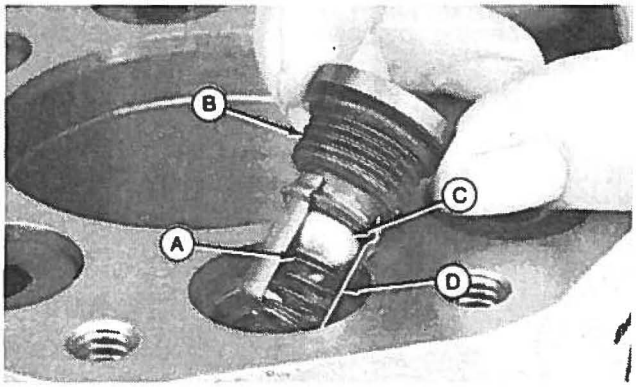
3. Inspect spring (A) and guide (D) for excessive wear or damage.

NEW SPRING SPECIFICATION

Free Length	13 mm (0.5 in.) (approximate)
Test Length	8 mm at 1.4—1.8 N (0.3 in. at 0.3—0.4 lb force)

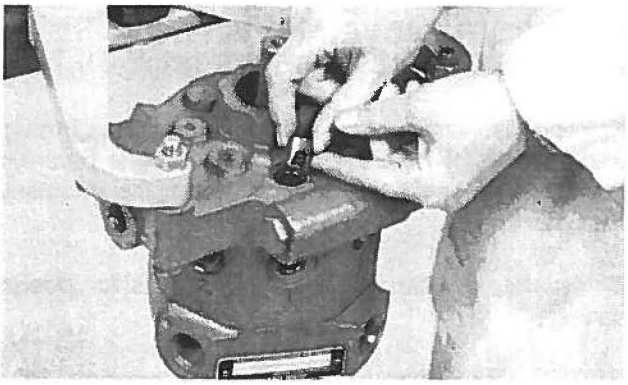
4. Install new O-rings on valve seats.

5. Install inlet valves. Tighten valve seats to 68 N·m (50 lb-ft).



OAV;T88616 R70;070300 1180 250489

REMOVE, INSPECT AND INSTALL DISCHARGE VALVES



IMPORTANT: Discharge valves must be installed in their original bores.

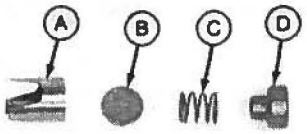
1. Write numbers on discharge valve plugs and housing for identification.

2. Remove discharge valves and put them in a parts tray to insure installation into the same bores from which they were removed.

3. Inspect valve guide (A) for fatigue cracks at tabs and radius of legs.

4. Inspect stop (D) for wear or damage.

5. Inspect spring (C) for excessive wear to coils and end surface of coils. Replace spring if wear is questionable.



NEW SPRING SPECIFICATION

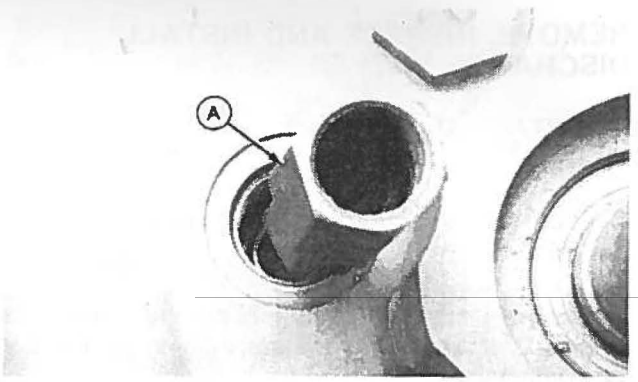
Free Length	12.2 mm (0.5 in.) (approximate)
Test Length	7.6 mm at 11—14 N (0.3 in. at 2.5—3 lb force)

6. Inspect valve disk (B) for erosion, pitting or excessive wear. Replace valve disk and discharge valve seat if wear is excessive.

7. Install discharge valves into their original bores.

AW1;R40136,R40137 R70;070300 1181 100589

INSPECT, REMOVE AND INSTALL DISCHARGE VALVE SEATS



1. Wipe discharge valve seats accessing seat through the discharge valve bore. This should be done before visual inspection since oil on valve seat may give impression of seat damage.

2. Visually inspect discharge valve seats for peening or damage.

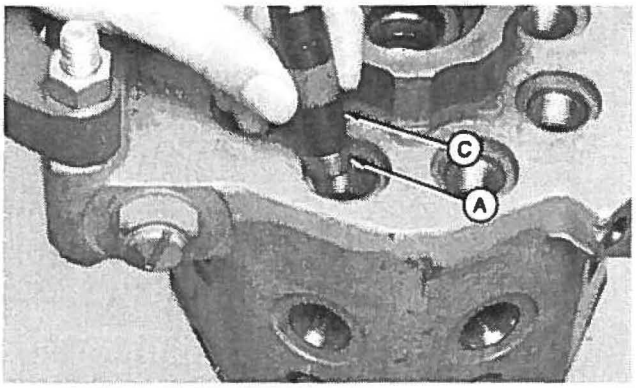
IMPORTANT: Press fit is critical for sealing. DO NOT remove discharge valve seats unless replacement is absolutely necessary.

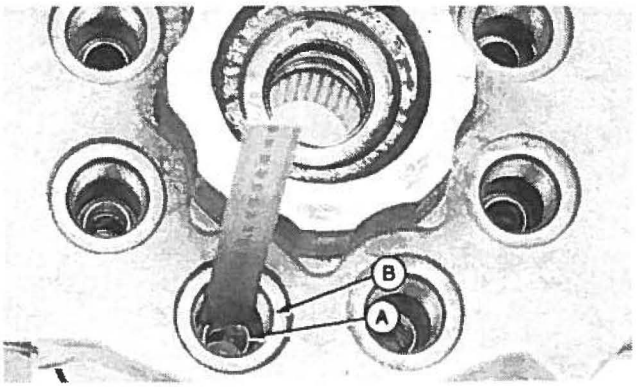
3. Remove seats using a puller (A) from D01061AA Blind-Hole Puller Set.

AW1;R40149 R70;070300 1182 260188

4. Install valve seat (A) using JDH39-1 Installation Tool (C) from JDH39B Hydraulic Pump Seat Installing Tool Set.

5. Push on shoulder of seat (A) until seat surface is 29.4—29.9 mm (1.15—1.18 in.) below spotface surface (B).





0AV;T88620,T88626 R70;070300 1183 250489

REMOVE, INSPECT AND INSTALL CRANKCASE OUTLET VALVE

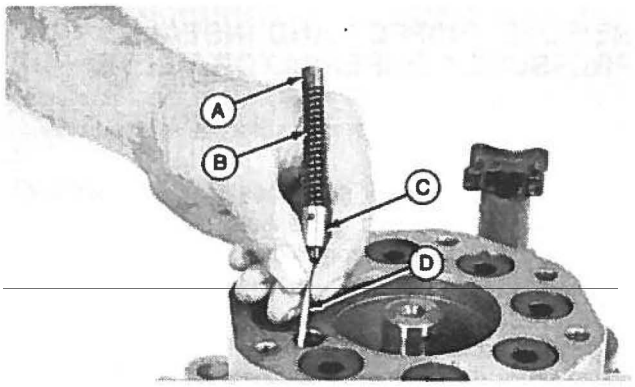
1. Remove cover and discard gasket.

2. Inspect crankcase outlet valve spring guide (A), spring (B), valve (C), and pin (D) for wear or damage. Replace parts as necessary.

NEW SPRING SPECIFICATION

Free Length	63.5 mm (2.5 in.) (approximate)
Test Length	52.5 mm at 196—240 N (2.1 in. at 44—54 lb force)

3. Install crankcase outlet valve making sure end of pin (D) fits into blind hole inside cover.



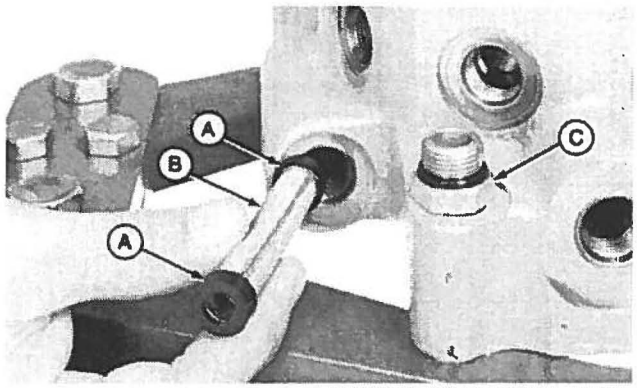
0AV;T88608 R70;070300 1184 100588

REMOVE, INSPECT AND INSTALL FILTER

1. Remove plug (C) to remove packings (A) and filter screen (B).

2. Inspect screen for debris or damage. Clean or replace as required.

3. Install filter screen with new packings (A) and new O-ring on plug (C).



0AV;T88623 R70;070300 1185 080288

REMOVE, INSPECT AND INSTALL PRESSURE COMPENSATOR VALVE

1. Remove pressure compensator valve assembly.

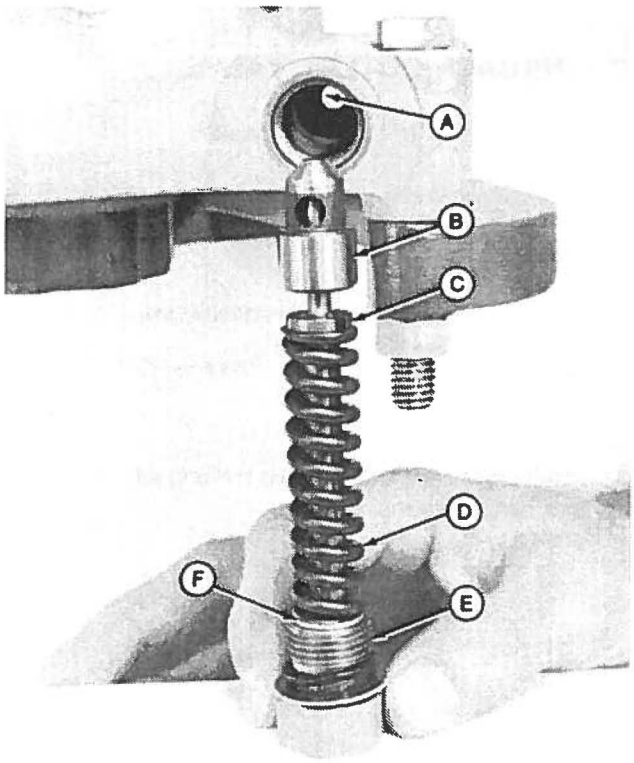
2. Inspect valve (B) for scratches or uneven wear pattern. Replace valve (B) and valve seat (A) if uneven wear or damage exists. Use a wooden dowel or brass drift to remove valve seat (A).

3. Inspect valve guide (C), spring (D), adjusting screw (E), and washer (F) for wear or damage. Replace as required.

NEW SPRING SPECIFICATION

Free Length	71 mm (2.8 in.) approximate)
Test Length	63.3 mm at 701—857 N (2.5 in. at 158—193 lb force)

4. Apply clean hydraulic oil to all parts. Replace O-ring on adjusting screw and install pressure compensator valve assembly.



0AV;T88624 R70;070300 1186 250489

ESSENTIAL TOOLS

NOTE: Order tools from your SERVICE-GARD™ Catalog. Some tools may be available from a local supplier.

053;TOOLS 160187

Spline Protector JDG494

Install pump shaft

AB6;R40151 R53;JDG494 250489

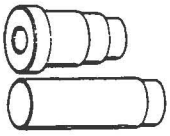
Adjusting Tool JDH19C

Adjust crankcase outlet valve (Non-Serialized Hydraulic Pumps)

AB6;R40152 R53;JDH19C 250589

Hydraulic Pump Seat Installing Tool Set JDH39B

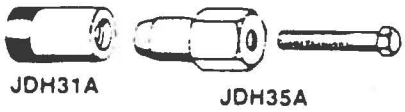
Install and remove discharge valve seats



AB6;R40104 R53;JDH39B 250489

Hydraulic Pump Seal Replacement Set JDH32

Remove and install oil seal without pump disassembly



AB6;R40154 R53;JDH32 250489

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools from your Service-Gard™ Catalog. Some tools may be available from a local supplier.

Name	Use
Pump Holding Fixture	Hold pump during repair
Bushing, Bearing and Seal Driver Set	Aid in the installation of bearings and seals
O-Ring Seal Tool Kit	Remove and install O-rings and sealing rings
Bearing Cup Puller	Remove bearing cup from pump housing
Shaft Seal Sizer	Aid shaft sealing ring installation
O-Ring Seal Hook	Aid removal and installation of O-rings and backup rings in pressure compensator housing
Hydraulic Pump Parts Tray	Organize, identify and protect pump parts during repair
*DFRW52 Pressure Compensator Valve Installation and Removal Tool	Remove and install pressure compensator valve and sleeve in through drive pump

*Fabricated Tool—See Group 99

R70;070300 1190 150589

HYDRAULIC PUMP SPECIFICATIONS—2000 SERIES

Item	Measurement	Specification
Pump Shaft	End Play	0.025—0.100 mm (0.001—0.004 in.)
Piston		
40 cm^3 (2.4 $in.^3$) - 50 cm^3 (3 $in.^3$) and 100 cm^3 (6 $in.^3$)	OD	22.2001—22.210 mm (0.8740—0.8744 in.)
65 cm^3 (4 $in.^3$) - 130 cm^3 (8 $in.^3$)	OD	24.460—24.470 mm (0.9630—0.9634 in.)
Piston Bore		
40 cm^3 (2.4 $in.^3$) - 50 cm^3 (3 $in.^3$) and 100 cm^3 (6 $in.^3$)	ID	22.223—22.233 mm (0.8749—0.8753 in.)
65 cm^3 (4 $in.^3$) - 130 cm^3 (8 $in.^3$)	ID	24.483—24.493 mm (0.9639—0.9643 in.)
Shaft Journal		
Non-Serialized 40 cm^3 (2.4 $in.^3$) and 50 cm^3 (3 $in.^3$)	OD	49.865—49.881 mm (1.9632—1.9638 in.)
Non-Serialized 100 cm^3 (6 $in.^3$)	OD	46.317—46.333 mm (1.8235—1.8241 in.)
All Others	OD	44.302—44.318 mm (1.7442—1.7448 in.)
Shaft Bearing Race		
Non-Serialized 40 cm^3 (2.4 $in.^3$) and 50 cm^3 (3 $in.^3$)	ID	59.436—59.452 mm (2.3400—2.3406 in.)
Non-Serialized 100 cm^3 (6 $in.^3$)	ID	59.057—59.073 mm (2.3251—2.3257 in.)
All Others	ID	57.041—57.061 mm (2.2457—2.2465 in.)
Shaft Bearing Race		
Non-Serialized 40 cm^3 (2.4 $in.^3$) and 50 cm^3 (3 $in.^3$)	OD	72.890—73.150 mm (2.8700—2.8800 in.)
Non-Serialized 100 cm^3 (6 $in.^3$)	OD	72.890—73.150 mm (2.8700—2.8800 in.)
All Others	OD	71.475—71.525 mm (2.8140—2.8159 in.)
Shaft Needle Rollers		
Non-Serialized 40 cm^3 (2.4 $in.^3$) and 50 cm^3 (3 $in.^3$)	OD	4.76 mm (0.187 in.)
All Others	OD	6.35 mm (0.250 in.)
Inlet Valve	Lift	2.0—3.0 mm (0.078—0.120 in.)

Continued on next page

R70;070300 1036 210486

HYDRAULIC PUMP SPECIFICATIONS—2000 SERIES - Continued

Item	Measurement	Specification
40 cm³ (2.4 in.³)—50 cm³ (3 in.³)—100 cm³ (6 in.³)		
Piston Spring	Free Length	62 mm (2.4 in.) (approx.)
	Test Length	41.1 mm at 151—178 N (1.6 in. at 34—40 lb force)
65 cm³ (4 in.³)—130 cm³ (8 in.³)		
Single Spring Design		
Piston Spring	Free Length	69.5 mm (2.7 in.) (approx.)
	Test Length	45.2 mm at 209—236 N (1.8 in. at 47—53 lb force)
Double Spring Design		
Outer Piston Spring	Free Length	70 mm (2.8 in.) (approx.)
	Test Length	45.2 mm at 129—156 N (1.8 in. at 29—35 lb force)
Inner Piston Spring	Free Length	69.5 mm (2.7 in.) (approx.)
	Test Length	45.2 mm at 76—93 N (1.8 in. at 17—21 lb force)
Discharge Valve Spring		
Single Bank Early Design	Free Length	13.5 mm (0.5 in.) (approx,)
	Test Length	12mm at 6—7 N (0.5 in. at 1.4—1.7 lb force)
Single Bank Current Design and Non-Serialized Double Bank	Free Length	12.2 mm (0.48 in.) (approx.)
	Test Length	7.6 mm at 11—14 N (0.3 in. at 2.5—3 lb force)
Serialized Double Bank	Free Length	40.6 mm (1.6 in.) (approx.)
	Test Length	29.7 mm at 39—48 N (1.2 in. at 9—11 lb force)
Inlet Valve Plug	Torque	136 N·m (100 lb ft)
Piston Plug (Internal Hex)	Torque	136 N·m (100 lb-ft)
Piston Plug	Torque	185 N·m (135 lb-ft)

R70;070300 1037 170589

PRESSURE COMPENSATOR SPECIFICATIONS—2000 SERIES

Item	Measurement	Specification
Pressure Compensator Valve Spring		
Used with long spring guide	Free Length	92 mm (3.6 in.) approx.)
	Test Length	84 mm at 556—690 N (3.3 in. at 125—155 lb force)
Used with short spring guide	Free Length	90 mm (3.5 in.) (approx.)
	Test Length	75 mm at 801—979 N (3.0 in. at 180—220 lb force)
Pressure Compensator Valve Spring Guide	OD	
Long		23.595—23.645 mm (0.9289—0.9309 in.)
Short		19.1 mm (0.75 in.)
Pressure Compensator Valve Stem	OD	6.759—6.769 mm (0.2661—0.2665 in.)
Pressure Compensator Valve Sleeve	ID	6.7740—6.7900 mm (0.2667—0.2673 in.)
NON-SERIALIZED PUMP		
Crankcase Outlet Valve Spring	Free Length	73.5 mm (2.9 in.) (approx.)
	Test Length	56 mm at 200—245 N (2.2 in. at 45—55 lb force)
Crankcase Outlet Valve	OD (upper)	11.882—11.892 mm (0.4678—0.4682 in.)
	OD (lower)	11.095—11.105 mm (0.4368—0.4372 in.)
Crankcase Outlet Valve Sleeve	ID (upper)	11.897—11.913 mm (0.4684—0.4690 in.)
	ID (lower)	11.110—11.126 mm (0.4374—0.4380 in.)
SERIALIZED PUMP		
Crankcase Outlet Valve Spring	Free Length	87 m (3.4 in.) (approx.)
	Test Length	74.5 mm at 63—77 N (3.0 in. at 14—17 lb force)
Crankcase Outlet Valve	OD	13.990—14.010 mm (0.5507—0.5515 in.)
Crankcase Outlet Valve Pin	OD	3.165—3.170 mm (0.1246—0.1248 in.)

Continued on next page

R70;070300 1038 100589

PRESSURE COMPENSATOR SPECIFICATIONS—2000 SERIES - Continued

Item	Measurement	Specification
THROUGH DRIVE PRESSURE COMPENSATOR		
Pressure Compensator Valve		
Dampening Spring	Free Length	20.6 mm (0.8 in.) (approx.)
	Test Length	13.7 mm at 200—247 N (0.5 in. at 45—55 lb force)
Pressure Compensator Valve Spring		
Outer Spring	Free Length	97 mm (3.8 in.) (approx.)
	Test Length	78 mm at 1340—1640 N (3.1 in at 300—370 lb force)
Inner Spring	Free Length	92 mm (3.6 in.) (approx.)
	Test Length	79 m at 495—605 N (3.1 in. at 110—135 lb force)
Pressure Compensator Valve Housing-to-Pump	Torque	115 N·m (85 lb-ft)
Test Port Plug	Torque	34 N·m (25 lb-ft)
Destroke Port Plug (if used)	Torque	61 N·m (45 lb-ft)
Destroke Solenoid Valve (if used)	Torque	34 N·m (25 lb-ft)

R70;070300 1041 170589

DIAGNOSING MALFUNCTIONS

No Pump Output
- Broken pump drive shaft
- Compensator valve malfunction
- Improper stroke control valve adjustment
- Excessive charge circuit leakage
- Crankcase outlet valve failure

Low Pump Output
- Low deadhead pressure
- Compensator valve, seat, spring, or packing failure
- Worn or scored pistons and bores
- Broken discharge valve or spring
- Restricted inlet
- Insufficient inlet oil

Hydraulic Functions Slow
- Low deadhead pressure
- Plugged hydraulic filter or return filter
- Compensator valve, seat, spring, or packing failure
- Crankcase outlet valve stuck closed

Slow Pump Response
- Weak crankcase outlet valve spring
- Failure of charge pump or charge leak
- Plugged return oil filter

Excessive Pump Pressure
- Improper compensator valve adjustment

Function Chatter
- Insufficient inlet oil (cavitation)
- Sticking pump pistons
- Broken discharge valve or spring
- Broken inlet valve
- Charge system leakage
- Charge pump suction air leak

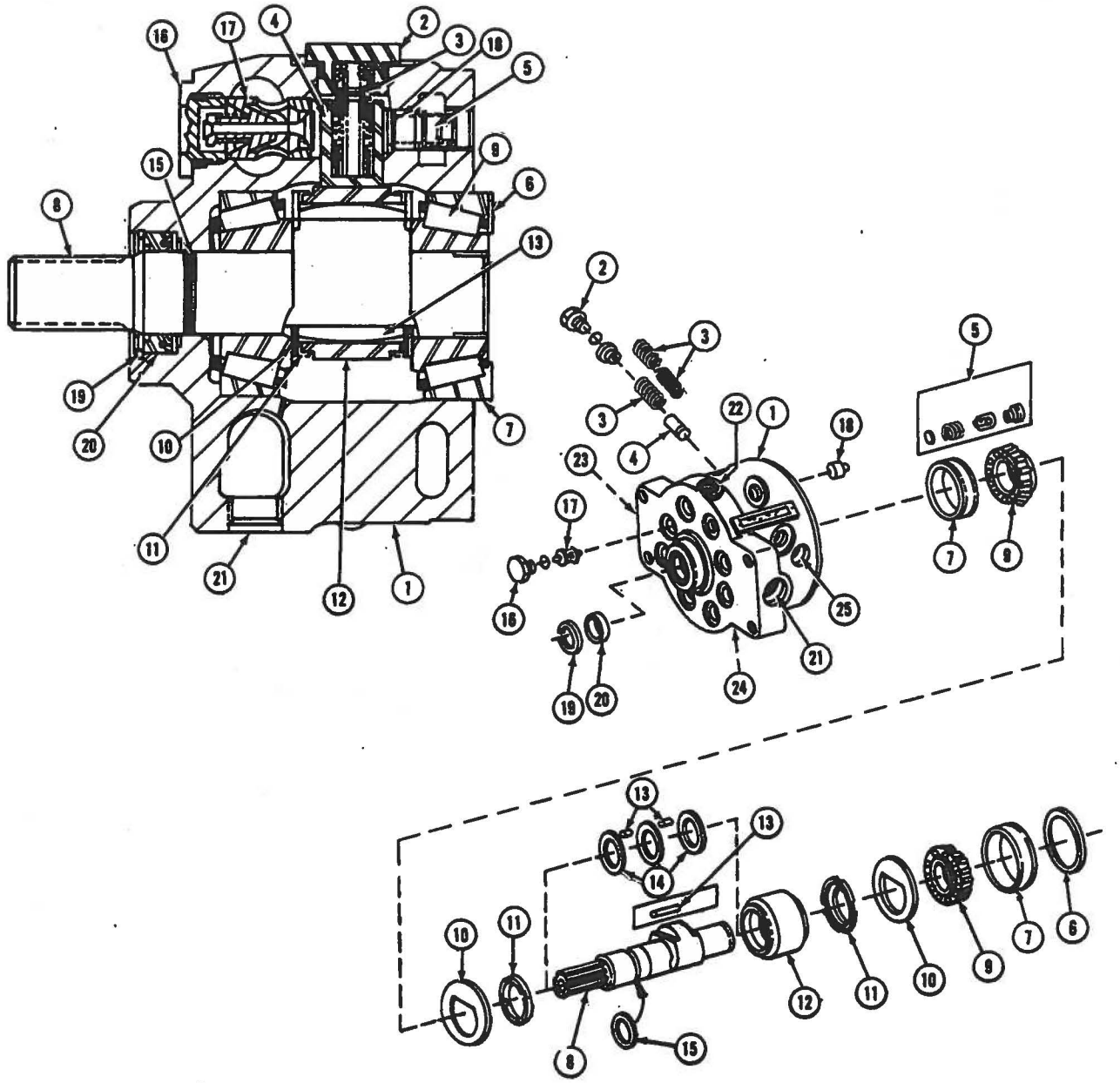
Pump and Oil Line Vibration
- Crankcase outlet valve spring too strong
- Broken discharge valve or spring
- Leaking inlet valve
- Broken inlet valve

Pump Shaft Seal Failure
- Broken discharge valve
- Overpressurized seal drainline

Pump Noise or Squeal
- Low deadhead pressure
- Compensator valve, seat, spring, or packing failure
- Crankcase outlet valve spring too strong
- Leaking inlet valve
- Air leak at inlet connections (inspect)
- Insufficient inlet oil (cavitation)

R70;070300 1146 080288

CROSS-SECTION AND EXPLODED VIEW—SINGLE BANK PUMP—2000 SERIES



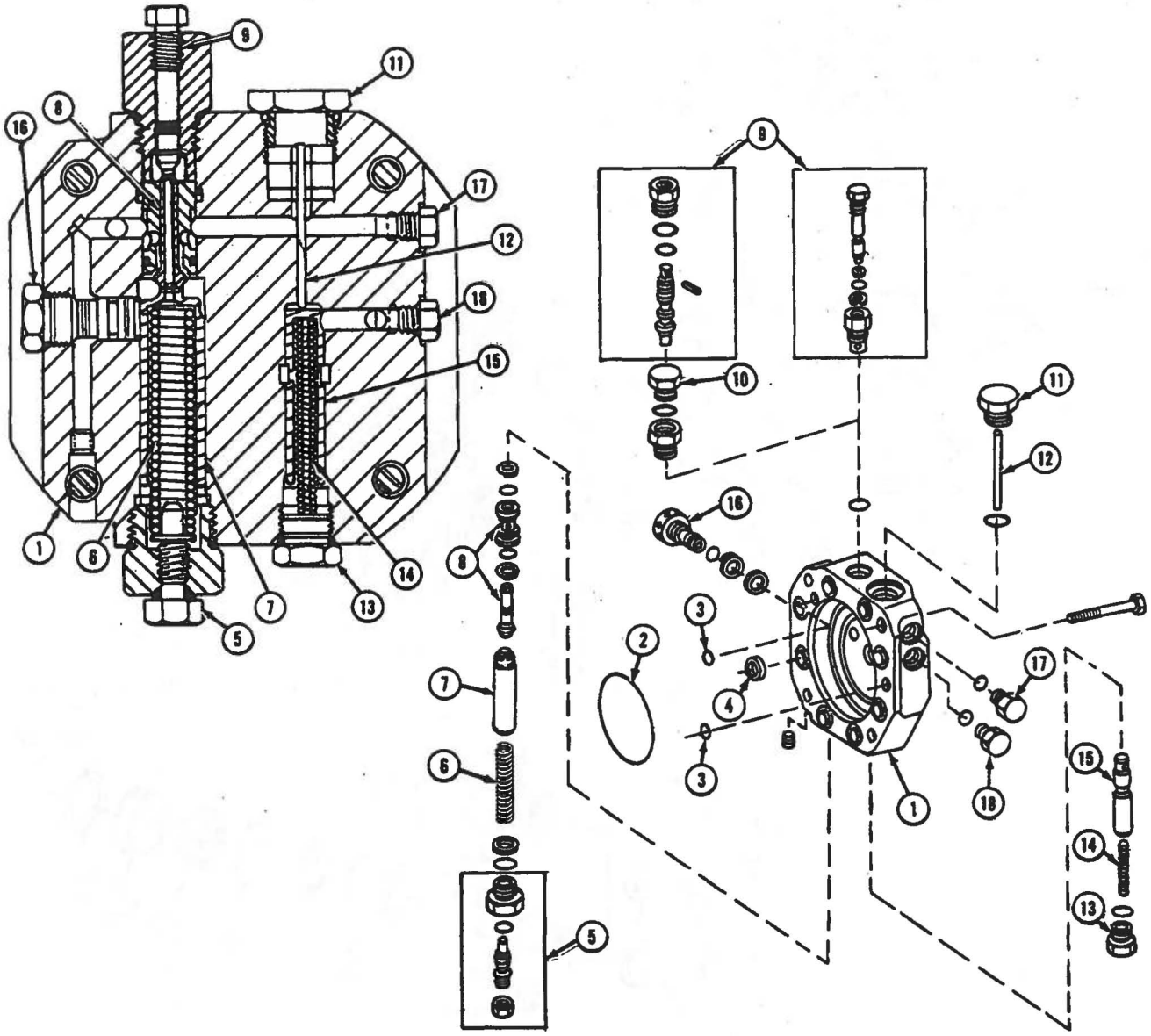
(Serialized Standard Drive Pump Shown)

1—Pump Housing
2—Piston Plug (8 used)
3—Piston Spring (8 or 16 used)
4—Piston (8 used)
5—Discharge Valve (8 used)
6—Shims (as required)
7—Bearing Cup (2 used)
8—Shaft
9—Bearing Cone (2 used)
10—Spacer (2 used)
11—Thrust Washer (2 used)
12—Race
13—Needle Rollers (25 or 50 used)
*14—Spacer (3 used)
15—Sealing Ring
16—Inlet Valve Plug (8 used)
17—Inlet Valve (8 used)
18—Discharge Valve Seat (8 used)
19—Snap Ring
20—Oil Seal
21—Inlet Port (I1)
22—Inlet Port (V1)
23—Inlet Port (I2)
24—Drain Port (D1)
25—Discharge Port (S1)

*Used with 50 needle rollers

AW1;R40155 R70;070300 1191 260188

CROSS-SECTION AND EXPLODED VIEW—SINGLE BANK—2000 SERIES PRESSURE COMPENSATOR
(Standard Drive Pump)

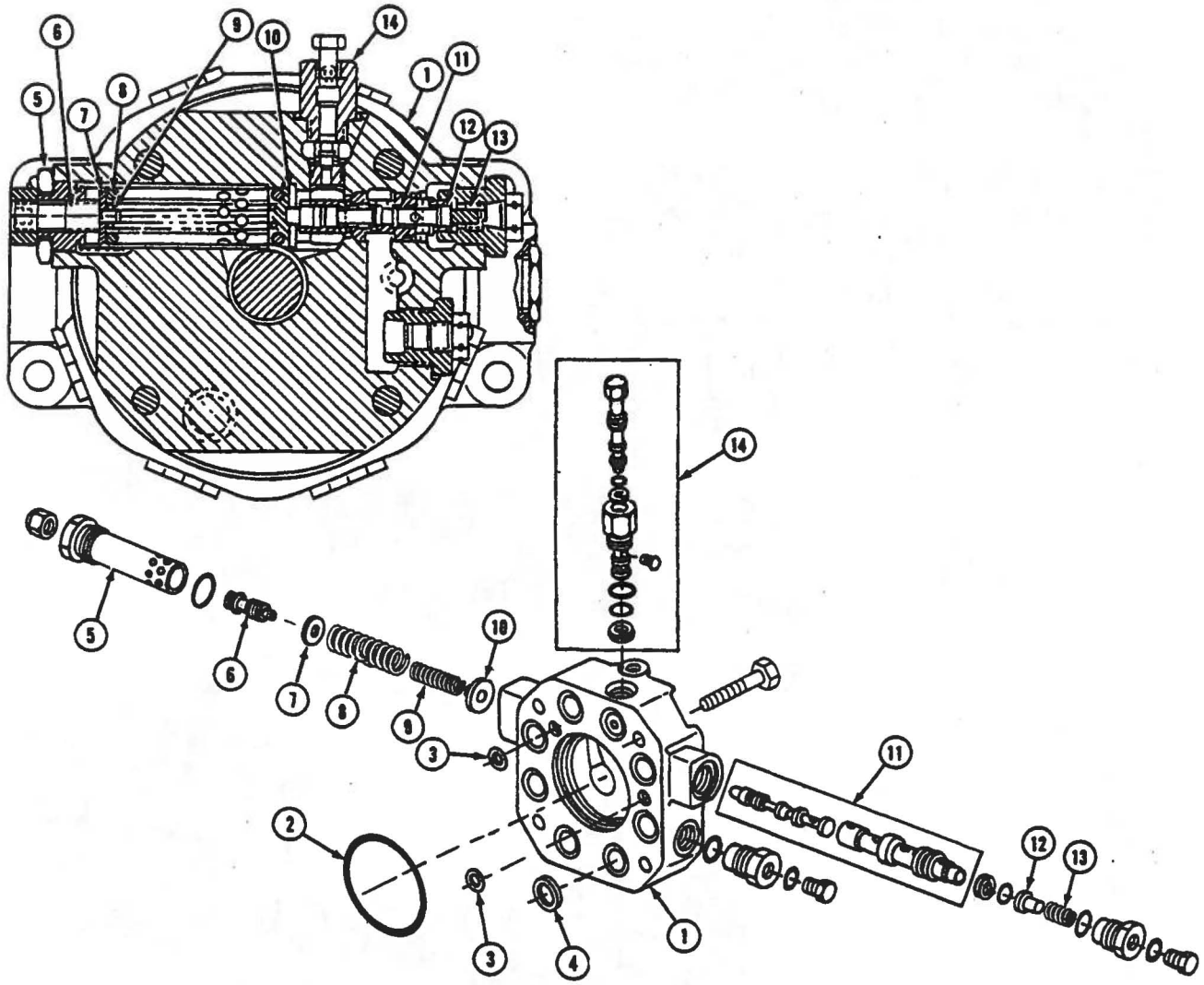


1—Compensator Housing
2—O-Ring
3—Packing (2 used)
4—Packing (6 used)
5—Adjusting Screw
6—Spring
7—Spring Guide
8—Pressure Compensator Valve
9—Manual Destroke Screw
10—Plug (Less Manual Destroke Screw)
11—Plug
12—Pin
13—Plug
*14—Spring
15—Crankcase Outlet Valve or Secondary Orifice
16—Destroke Port Plug
17—Outlet Pressure Plug (T1)
18—Inlet Pressure Plug (T2)

*Not used with secondary orifice

AW1;R40156 R70;070300 1192 090288

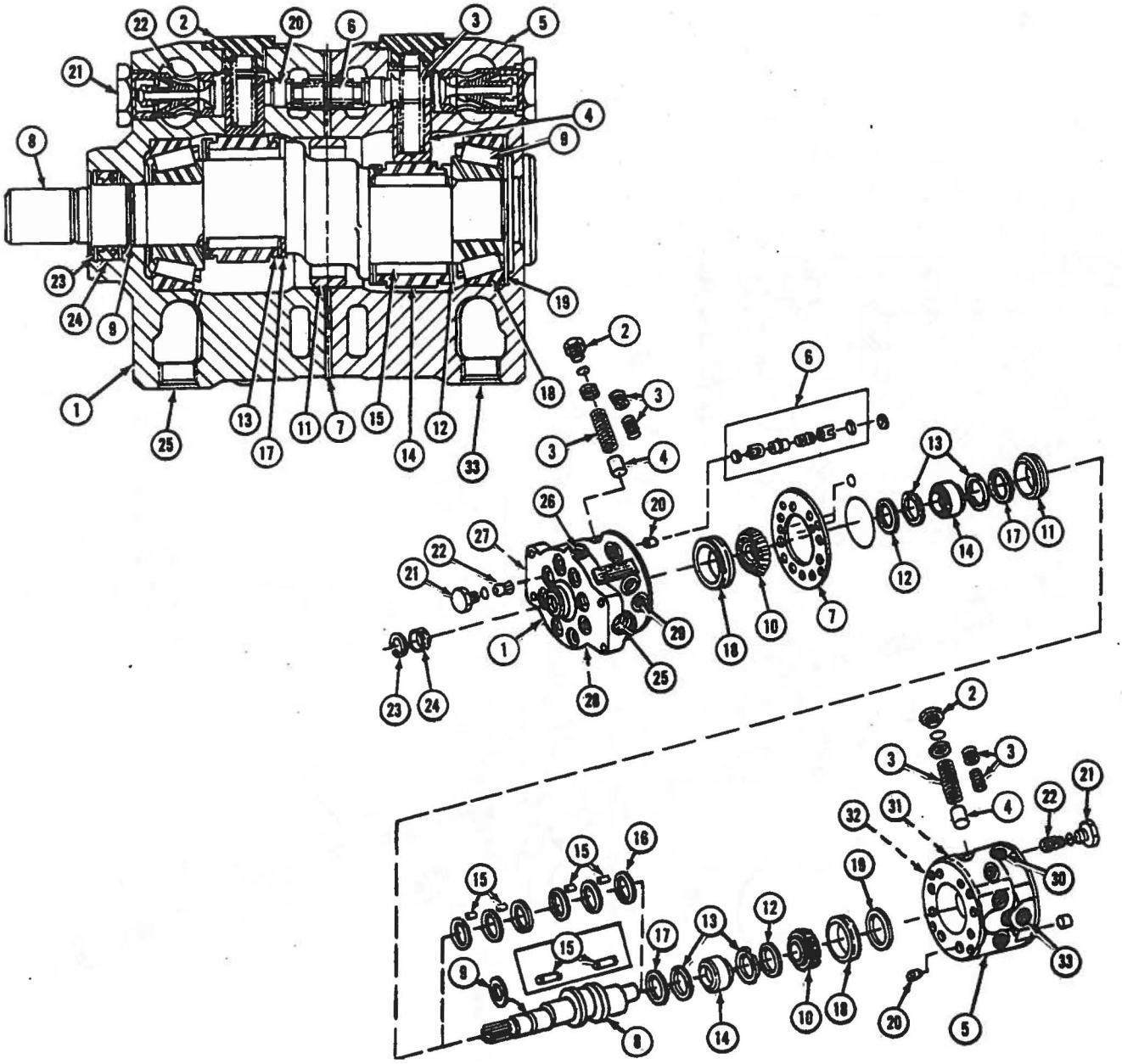
CROSS-SECTION AND EXPLODED VIEW—SINGLE BANK—2000 SERIES PRESSURE COMPENSATOR
(Through Drive Pump)



1—Compenstaor Housing
2—O-Ring
3—Packing (2 used)
4—Packing (8 used)
5—Bushing with Stop
6—Adjusting Screw
7—Washer
8—Outer Spring
9—Inner Spring
10—Spring Guide
11—Pressure Compensator Valve
12—Check Valve
13—Spring
14—Manual Destroke Screw

AW1;R40166 R70;070300 1086 080288

CROSS-SECTION AND EXPLODED VIEW—DOUBLE BANK PUMP—2000 SERIES

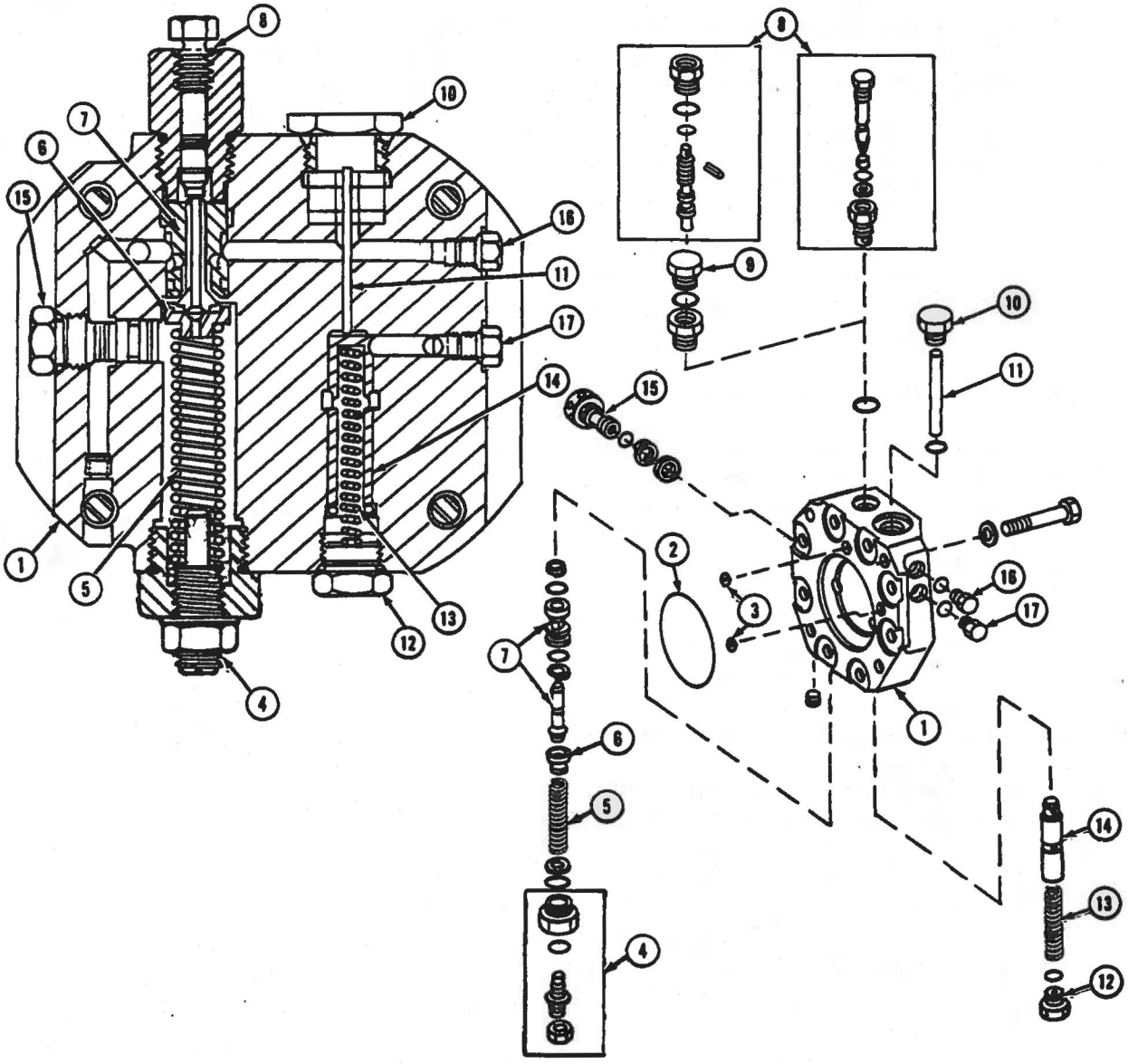


(Serialized Pump Shown)

1—Primary Housing
2—Piston Plug (16 used)
3—Piston Spring (16 or 32 used)
4—Piston (16 used)
5—Secondary Housing
6—Discharge Valve (8 used)
7—Plate
8—Shaft
*Used with 100 needle rollers
9—Sealing Ring
10—Bearing Cone (2 used)
11—Sleeve
12—Washer (2 used)
13—Thrust Washer (4 used)
14—Bearing Race (2 used)
15—Needle Roller (50 or 100 used)
*16—Spacer (6 used)
17—Thrust Washer (2 used)
18—Bearing Cup (2 used)
19—Shims (as required)
20—Discharge Valve Seat (16 used)
21—Inlet Valve Plug (16 used)
22—Inlet Valve (16 used)
23—Snap Ring
24—Oil Seal
25—Inlet Port (i1)
26—Inlet Port (V1)
27—Inlet Port (I2)
28—Drain Port (D1)
29—Discharge Port (S1)
30—Inlet Port (V2)
31—Inlet Port (I4)
32—Discharge Port (S2)
33—Inlet Port (i3)

AW1;R40187 R70;070300 1193 090288

CROSS-SECTION AND EXPLODED VIEW—DOUBLE BANK—2000 SERIES PRESSURE COMPENSATOR



(Serialized Standard Drive Pump Shown)

1—Compensator Housing
2—O-Ring
3—Packing (2 used)
4—Adjusting Screw
5—Spring
6—Spring Guide
7—Pressure Compensator Valve
8—Manual Destroke Screw
9—Plug (Less Manual Destroke Screw)
10—Plug
11—Pin
12—Plug
13—Spring
14—Crankcase Outlet Valve
15—Destroke Port Plug
16—Outlet Pressure Plug (T1)
17—Inlet Pressure Plug (T2)

AW1;R40188 R70;070300 1194 080288

REMOVE AND INSPECT PISTON ASSEMBLIES

IMPORTANT: Pistons must be installed in their original bores if they are reused. Write numbers on piston plugs, inlet valve plugs and pump housing for identification.

1. Remove piston assemblies and put them in a parts tray to insure installation into the same bores from which they were removed.

NOTE: Early design (TOP ASSEMBLY IN UPPER PHOTO) for 40 cm³ (2.4 in³) and 50 cm³ (3 in³) pumps will require ALL new current design piston plugs if piston springs are replaced.

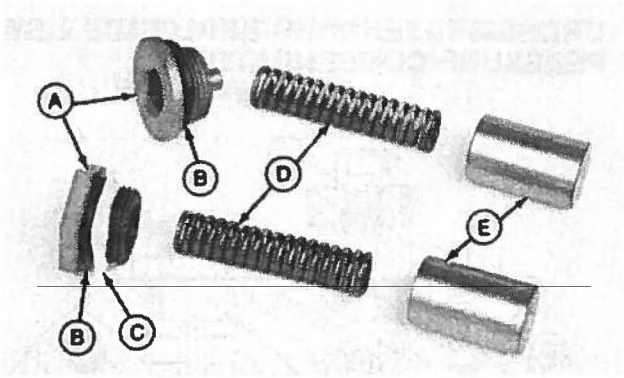
2. Inspect piston plugs (A) for thread damage.

NOTE: Replacement of early design pistons (TOP ASSEMBLY IN LOWER PHOTO) for 65 cm³ (4 in³) and 130 cm³ (8 in³) requires a kit which includes current design (BOTTOM ASSEMBLY IN LOWER PHOTO) pistons, double springs and piston plugs.

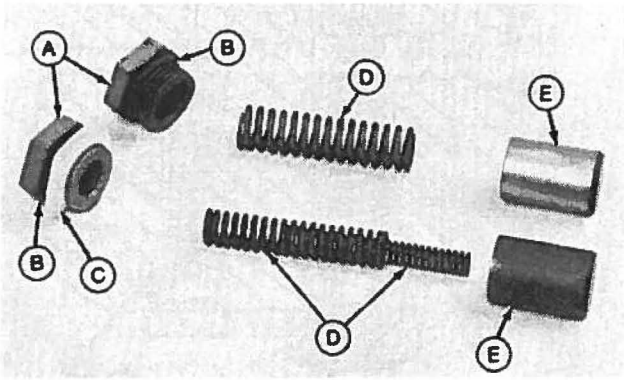
3. Inspect face and skirt of pistons (E) for metal transfer, galling or scoring. Replace housing(s) and all pistons or replace entire pump assembly if these conditions exist.

IMPORTANT: All springs must be the same color code.

4. Inspect springs (D) for excessive wear or damage to coils. Replace ALL piston springs as a set if springs are questionable.



40 cm³ (2.4 in³) - 50 cm³ (3 in³) - 100 cm³ (6 in³)

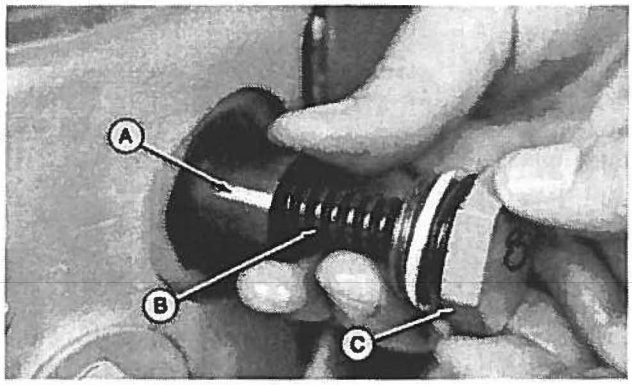


65 cm³ (4 in³) - 130 cm³ (8 in³)

A—Piston Plugs
B—O-Rings
C—Shields
D—Piston Springs
E—Pistons

AW1;R39735,R39944 R70;070300 1063 260489

INSTALL PISTON ASSEMBLIES



1. Install new O-rings and plastic shields on piston plugs.

IMPORTANT: To prevent damage to shields, DO NOT use an air-operated wrench to tighten piston plugs; use a torque wrench.

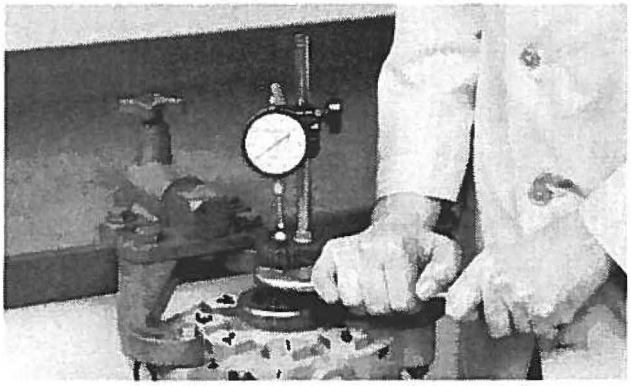
2. Install piston assemblies. For easier assembly, turn pump shaft so piston being installed is on the low side of cam.

NOTE: Early design (recessed hex) piston plug torque specification is 136 N·m (100 lb-ft).

3. Tighten piston plugs to 185 N·m (135 lb-ft).

AW1;R39702 R70;070300 1111 010388

CHECK SHAFT END PLAY



1. Remove piston assemblies. (See Remove and Install Piston Assemblies in this group.)

NOTE: Use vice grip with curved jaw for better clamping.

2. Install vice grips as tightly as possible on pump shaft approximately 5/8 in. from housing hub.

3. Put a dial indicator base on pump housing and indicator contact point on steel ball placed in center of pump shaft.

4. Turn shaft back and forth while pushing down to align the tapered roller bearings inside pump housing.

AW1;R39703 R70;070300 1061 010388

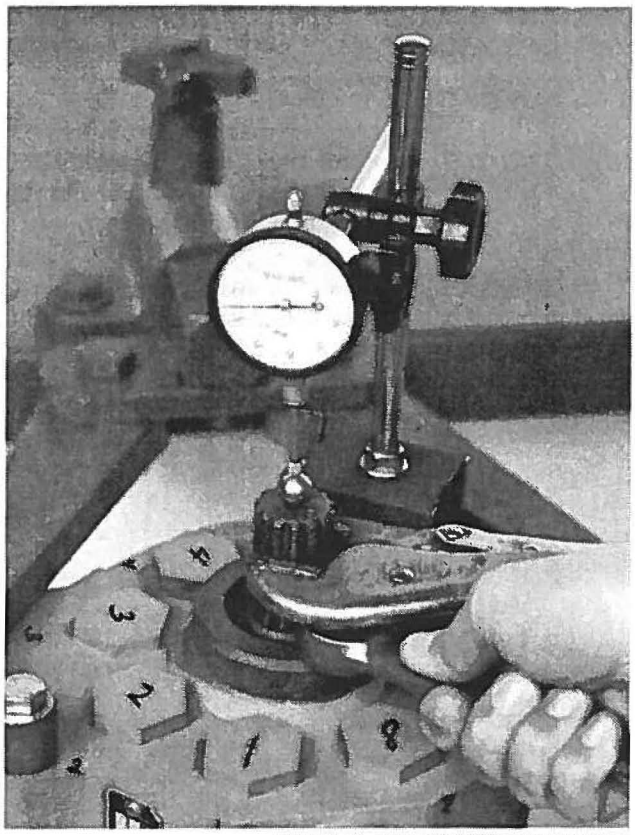
5. Zero the indicator.

6. Pry upward on vice grips using a long (3/4 in. minimum) box-end wrench noting indicator reading. If end play is more than specification, check bearings for wear.

END PLAY SPECIFICATION

Acceptable	0.025—0.100 mm (0.001—0.004 in.)

7. Increase number or size of shims in pressure compensator housing on single bank or secondary housing on double bank pump to obtain correct specification.



AW1;R39704 R70;070300 1062 080288260188

REMOVE, INSPECT AND INSTALL DISCHARGE VALVES

1. Remove pressure compensator housing on single bank pump or secondary housing with pressure compensator housing on double bank pump. (See Remove and Install Pressure Compensator Housing in this group.)

IMPORTANT: Discharge valves must be installed in their original bores.

2. Remove discharge valves and put them in a parts tray to insure installation into the same bores from which they were removed.

SINGLE BANK PUMP—(Middle Photograph)

NOTE: Early design discharge valve assembly is shown at TOP of photograph and current design discharge valve assembly is shown at BOTTOM.

DOUBLE BANK PUMP—(Bottom Photograph)

NOTE: Early design (non-serialized pump) discharge valve assembly is shown in TOP of photograph and current design (serialized pump) discharge valve assembly is shown in BOTTOM of photograph.

3. Inspect valve guide (A) for fatigue cracks at tabs and radius of legs.

4. Inspect stop (D) for wear or damage.

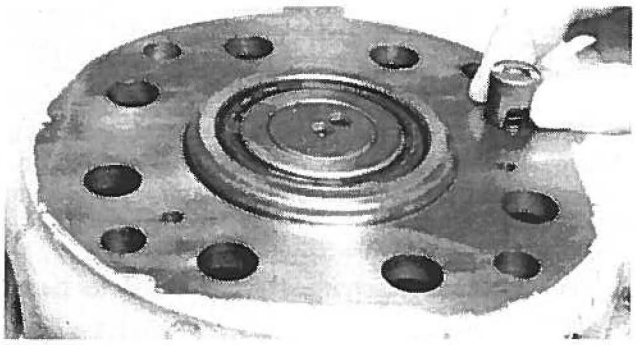
5. Inspect springs (C) for excessive wear to coils and end surface of coils. Replace spring if wear is questionable.

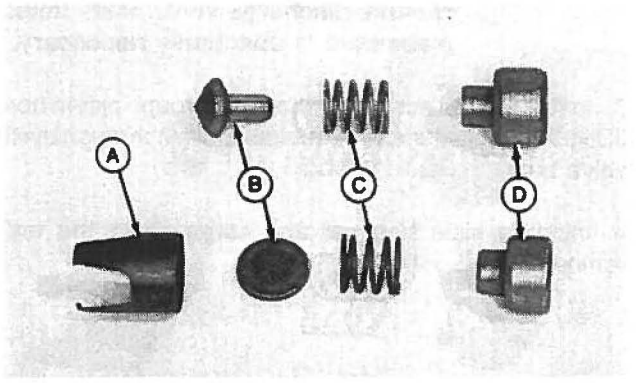
NEW SPRING SPECIFICATION

Single Bank-Early Design	
Free Length	13.5 mm (0.5 in.) (approximate)
Test Length	12mm at 6—7 N (1.4—1.7 lb force)
Single Bank-Current Design and Non-Serialized Double Bank	
Free Length	12.2 mm (0.48 in.) (approximate)
Test Length	7.6 mm at 11—14 N (0.3 in at 2.5—3 lb force)
Serial Double Bank	
Free Length	40.6 mm (1.6 in.) (approximate)
Test Length	29.7 mm at 39—48 N (1.2 in. at 9—11 lb force)

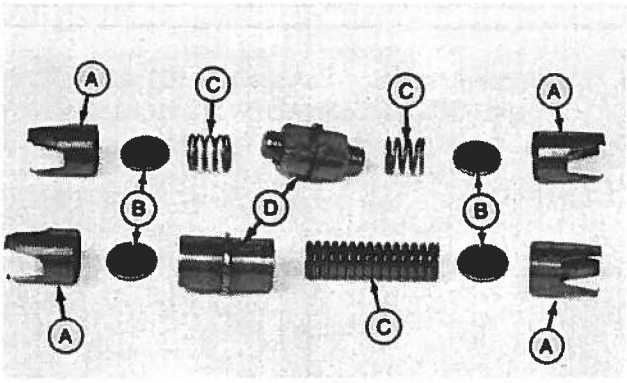
6. Inspect valve (B) for erosion, pitting or excessive wear. Replace valve if wear is excessive. Discharge valve seat should also be checked for wear. (See Inspect, Remove, and Install Discharge Valve Seats in this group.)

7. Install discharge valves into their original bores.





Single Bank Valve



Double Bank Valve

A—Valve Guide
B—Discharge Valve
C—Spring
D—Discharge Valve Stop

AW1;T85250,R39749,R39750 R70;070300 1082 150589

INSPECT, REMOVE AND INSTALL DISCHARGE VALVE SEATS

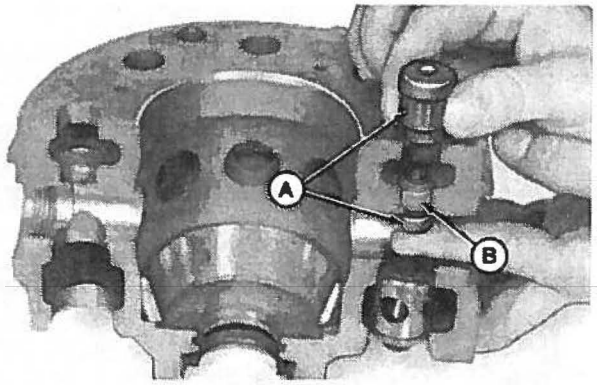
1. Wipe discharge seats (B) with your finger accessing seat through the discharge valve bores. This should be done before inspection since oil on valve seat may give impression of seat damage.

2. Visually inspect discharge valve seats (B) for peening or damage.

IMPORTANT: Press fit is critical for sealing. DO NOT remove discharge valve seats unless replacement is absolutely necessary.

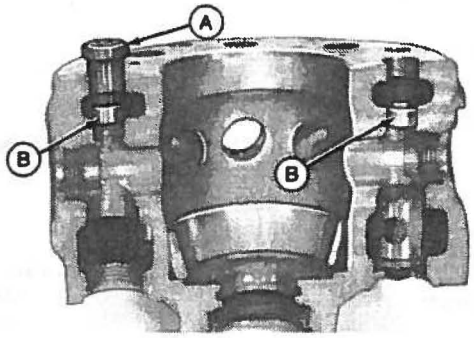
3. Install special screw (A) into seat through piston bore and JDH39B-1 Installer and Removal Tool (A) through discharge valve bore.

4. Install a slide hammer and adapter into the tool and remove seat.



AW1;T85262 R70;070300 1084 260489

5. Install new discharge valve seats (B) using JDH39B-1 Installer and Removal Tool (A). Drive seat into housing until flange of tool is against face of housing.



AW1;T85284 R70;070300 369 260489

REMOVE AND INSTALL PUMP SHAFT

IMPORTANT: Pistons must be installed in their original bores if they are reused.

1. Remove piston assemblies. (See Remove and Inspect Piston Assemblies in this group.)

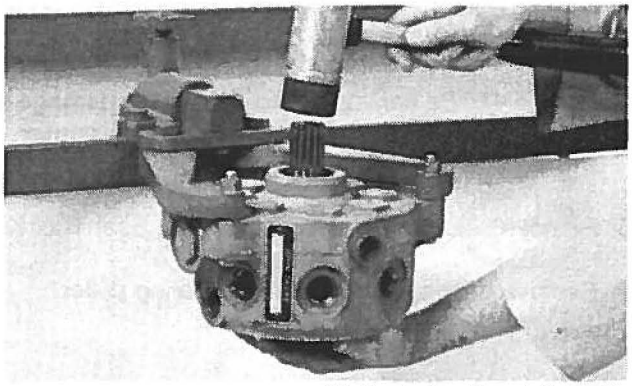
2. Remove pressure compensator housing (and auxiliary gear-driven charge pump if so equipped on single bank pump) and secondary housing on double bank pump. (See Remove and Install Pressure Compensator Housing in this group.)

R70;070300 1066 080288

IMPORTANT: Discharge valves must be installed in their original bores.

3. Remove discharge valve assemblies and put them in a parts tray.

4. Remove pump shaft on single bank pump using a hammer to remove bearing cup. Lift shaft from primary housing on double bank pump.

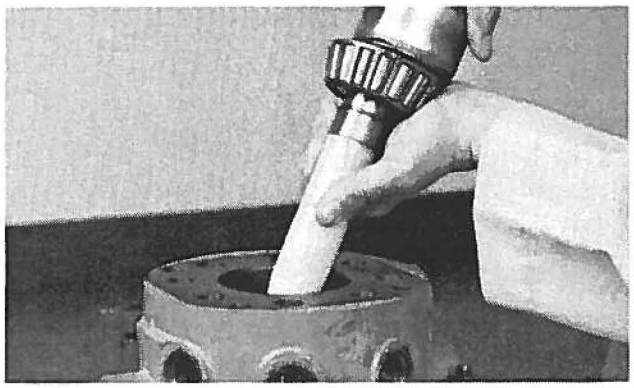


AW1;R39785 R70;070300 1071 171287

5. Replace oil seal (and quad ring and backup ring on non-serialized pumps) before installing pump shaft. (See Remove and Install Oil Seal-*Pump Disassembled* in this group.)

6. Install pump shaft in primary housing using JDG494 Spline Protector to prevent seal damage.

NOTE: Install bearing cup on single bank pump leaving cup partially away from bearing cone. Installation of shims and pressure compensator housing will properly align bearing cup and cone.



AW1;R39758 R70;070300 1097 260489

2R3; 010 17 110589

DISASSEMBLE AND INSPECT PUMP SHAFT

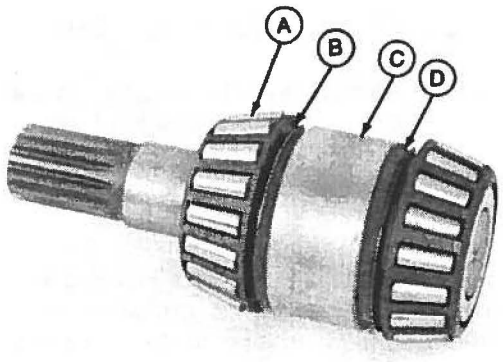
NOTE: Standard drive shaft for serialized single bank pump is shown.

1. Visually inspect taper bearing cones (A) for damaged cage or rollers.

2. Visually inspect spacers (B) and thrust washers (D) for wear or damage.

3. Inspect race (C) for nicks, scratches, pitting or metal discoloration. Replace race and pistons if external damage exists.

4. Hold pump shaft and slowly turn race (C). If assembly is sticking or noisy, replace all needle rollers between race and pump journal.



A—Bearing Cone
B—Spacer
C—Race
D—Thrust Washer

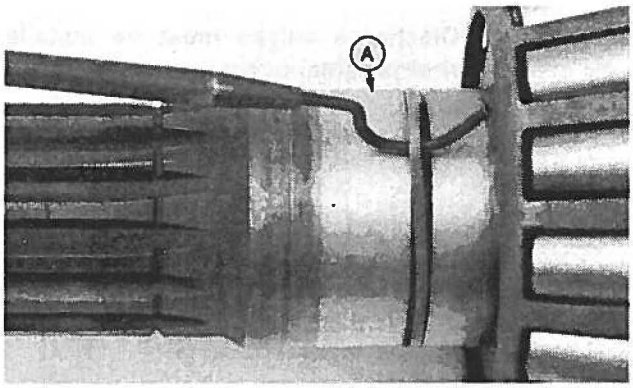
AW1;R36313 R70;070300 1072 280188

NOTE: Not all pump shafts will have a sealing ring.

IMPORTANT: Be careful not to scratch or damage shaft surface (A). This could cause seal leakage.

5. Remove sealing ring using an O-Ring Seal Tool Kit.

6. Remove bearing cones using a bearing puller.



AW1;R39945 R70;070300 1075 150589

For SINGLE BANK PUMP, perform Steps 7, 8, 9, 10, 11, 12, and 13.

NOTE: Non-serialized 65 cm^3 (4 in.^{3}) pump shaft assembly (TOP photograph) using bronze thrust washers should be updated to design shown in MIDDLE photograph. Kits are available.

7. Disassemble pump shaft.

8. Inspect bearing (A) shoulder surface. Replace if spacer wear exists.

NOTE: Some serialized pumps use a double row of needle rollers with a spacer between and on the ends of the rollers as shown in the BOTTOM photograph.)

9. Inspect spacers (B). Replace if worn, scored, or discolored.

NOTE: Refer to specifications for shaft journal OD. Most shafts will not have a lubrication hole in center of journal.

10. Inspect pump shaft journal (C). Replace if pitted, scored, or discolored.

*NOTE: *VESPEL® thrust washers on serialized pump (bottom photograph) may require magnification for inspection.*

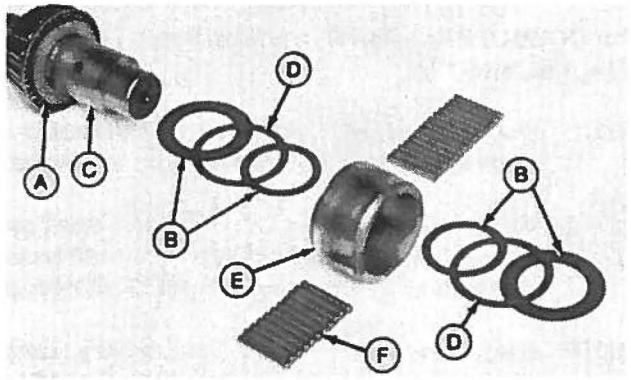
11. Inspect thrust washers (D). Replace if worn or damaged.

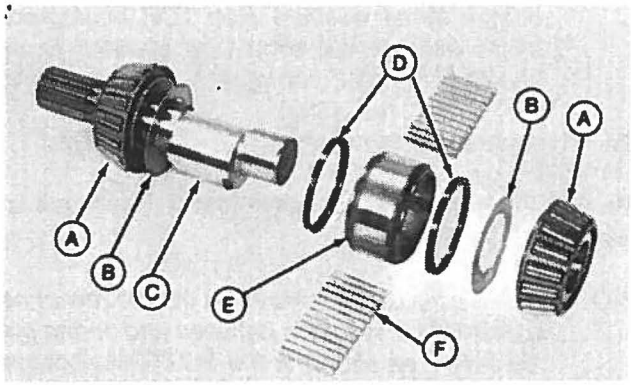
NOTE: Refer to specifications for needle roller OD and race OD and ID.

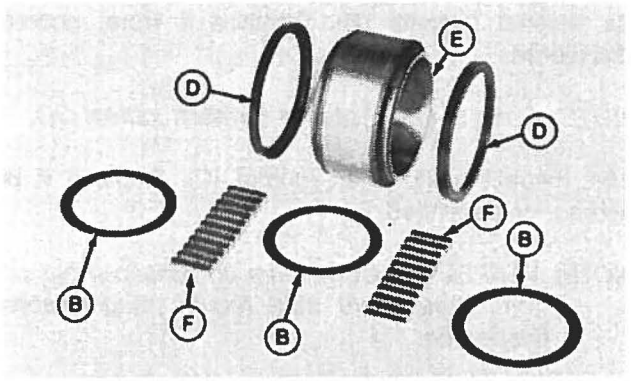
12. Inspect race (E). Replace if scored or discolored.

13. Inspect needle rollers (F). Replace ALL needle rollers if any are scratched, pitted or discolored.

*VESPEL® is a trademark of the DuPont Corporation.







A—Bearing
B—Spacers
C—Pump Shaft
D—Thrust Washers
E—Race
F—Needle Rollers

AW1;R39748,R38496,R39946 R70;070300 1077 290188

For DOUBLE BANK PUMP, perform Steps 7a, 8a, 9a, 10a, 11a, 12a, and 13a.

NOTE: Shafts shown with one race disassembled. Both races should be disassembled and inspected.

NOTE: Non-serialized 100 cm^3 (6 in.^{3}) pump shaft assembly is shown in TOP photograph and shaft assembly for serialized pump is shown in MIDDLE photograph.

NOTE: Spacer and thrust washer designs vary. Early designed non-serialized 130 cm^3 (8 in.^{3}) shafts using bronze thrust washers (see TOP photograph for single bank pump) should be updated to design shown in MIDDLE photograph. Kits are available.

7a. Disassemble pump shaft.

8a. Inspect bearing (A) shoulder surface. Replace if spacer wear exists.

NOTE: Some serialized pumps use a double row of needle rollers with a spacer in between and on the ends of the rollers as shown in the BOTTOM photograph.

9a. Inspect spacers (B). Replace if worn, scored, or discolored.

NOTE: Refer to specifications for shaft journal OD.

10a. Inspect pump shaft journal (C). Replace if pitted, scored, or discolored.

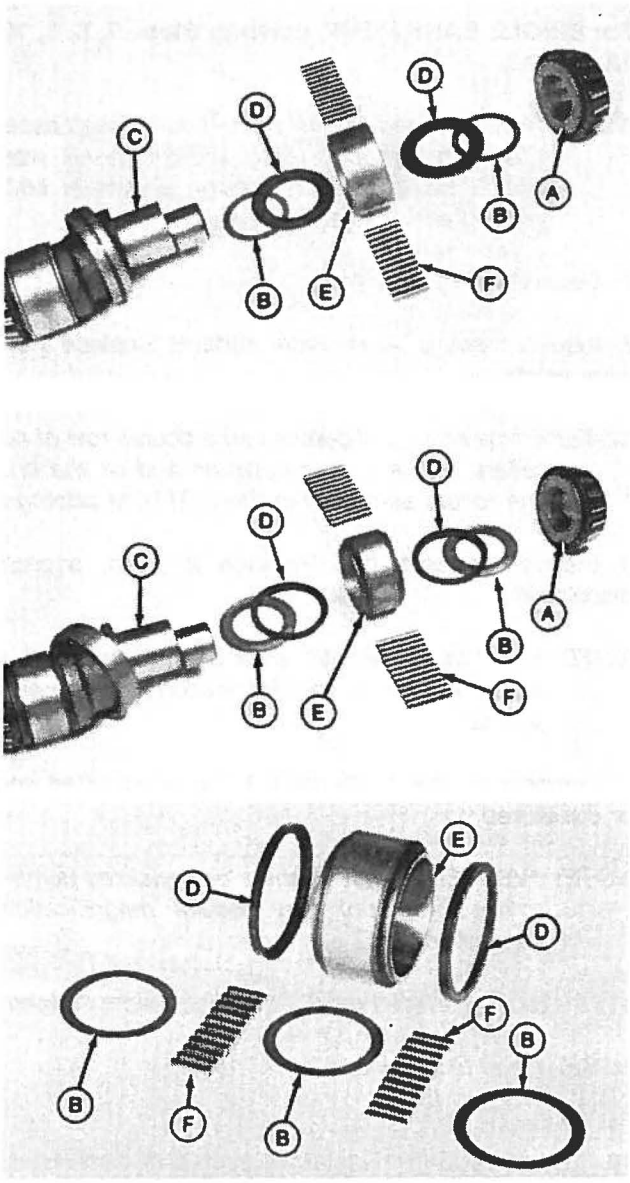
NOTE: VESPEL® thrust washers on serialized pump (bottom photograph) may require magnification for inspection.

11a. Inspect thrust washers (D). Replace if worn or damaged.

NOTE: Refer to specifications for needle roller OD and race OD and ID.

12a. Inspect race (E). Replace if scored or discolored.

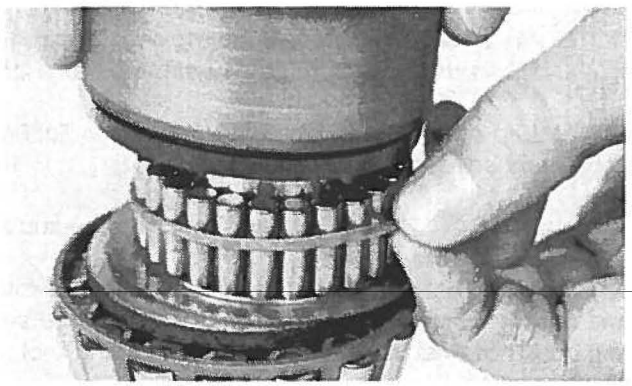
13a. Inspect needle rollers (F). Replace ALL needle rollers if any are scratched, pitted or discolored.



A—Bearing
B—Spacers
C—Pump Shaft
D—Thrust Washers
E—Race
F—Needle Rollers

AW1;R39739, R39756, R39946 R70;070300 1078 150589

ASSEMBLE PUMP SHAFT— *SINGLE BANK PUMP*



NOTE: Standard drive shaft for serialized pump is shown.

NOTE: 36 needle rollers are used on NON-SERIALIZED 40 cm^3 (2.4 $in.^3$) and 50 cm^3 (3 $in.^3$) pumps. 25 are used on all other single bank pumps with single row needle rollers. 50 needle rollers are used on single bank pumps with double row needle rollers.

IMPORTANT: DO NOT use grease to hold needle rollers. Doing so can restrain roller movement and cause pump failure. Use only clean hydraulic oil.

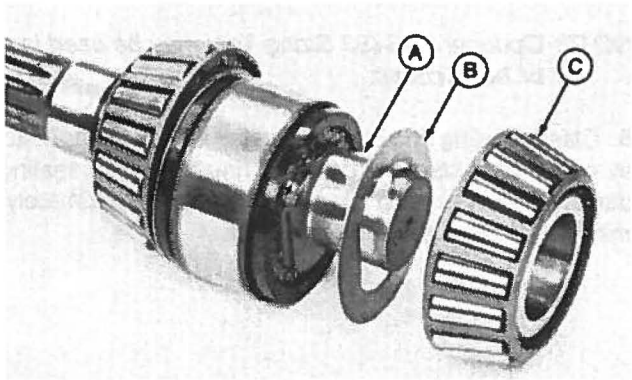
IMPORTANT: Three small spacers must be installed in between and on both ends of needle rollers for pumps using double row needle rollers.

1. Assemble shaft needle rollers using a rubber band to aid installation.

2. Install spacers (B) on shaft (A) making sure spacers are properly aligned.

IMPORTANT: Taper roller bearings must be pressed onto pump shaft even if shaft has not been disassembled. This assures correct pump shaft end play.

3. Install bearing cones (C) using a bearing press, making sure cone is pressed against shaft journal.



AW1;R39600, R38497 R70;070300 1089 290188

NOTE: Not all shafts will have a sealing ring. Through drive shafts use sealing rings on both ends of shaft.

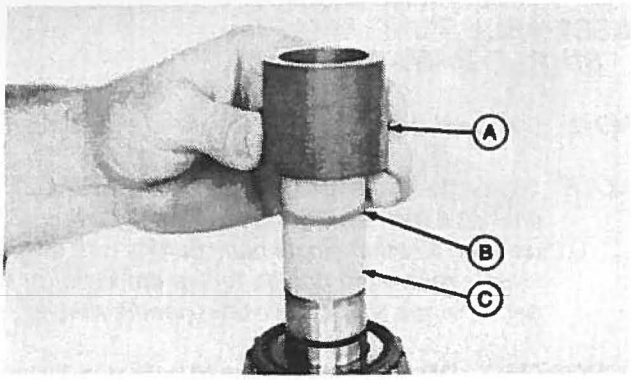
NOTE: Use optional JDG493 Shaft Seal Sizer Tool (A) to aid sealing ring installation.

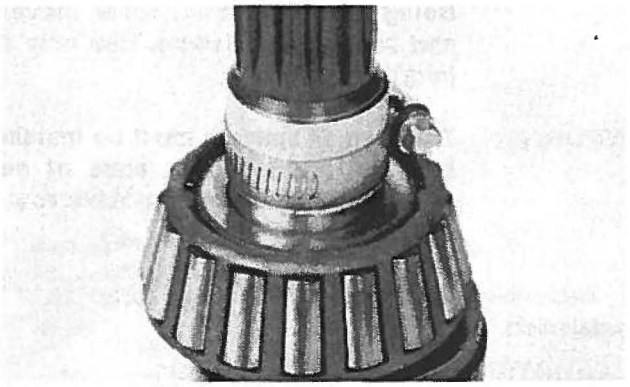
4. Install JDG494 Spline Protector Tool (C) on pump shaft.

5. Carefully slide new sealing ring (B) over spline protector and down into groove on pump shaft making sure sealing ring does not twist. Use optional JDG493 sizing tool (A) to aid installation.

NOTE: Optional JDG493 Sizing Tool may be used in place of hose clamp.

6. Clamp sealing ring in groove using a hose clamp. Put shim stock between clamp and sealing ring to prevent sealing ring damage. Leave hose clamp in place approximately five minutes to allow sealing ring to set.





AW1;R37912, R39604 R70;070300 1095 260489

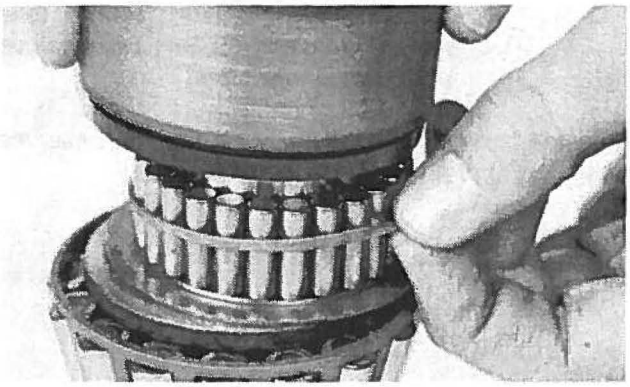
ASSEMBLE PUMP SHAFT— *DOUBLE BANK PUMP*

NOTE: 26 needle rollers per race assembly are used on 100 cm^3 (6 $in.^3$) NON-SERIALIZED pumps. 25 or 50 needle rollers per race are used on all other double bank pumps.

IMPORTANT: DO NOT use grease to hold needle rollers. Doing so can restrain roller movement and cause pump failure. Use only clean hydraulic oil.

IMPORTANT: Three small spacers must be installed between and on both ends of needle rollers for serialized pumps using double row needle rollers.

1. Assemble shaft needle rollers using a rubber band to aid installation. (See procedure for single bank pump shaft assembly.)



AW1;R39600 R70;070300 1090 260489

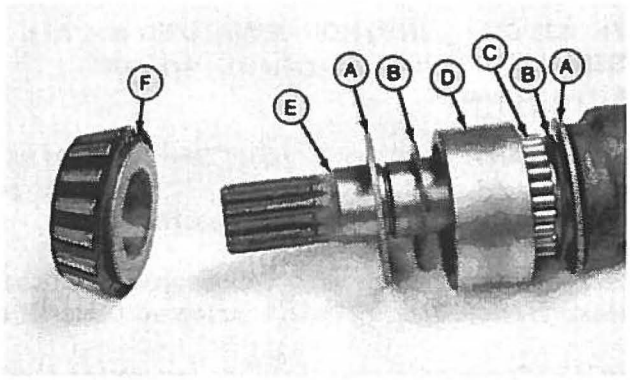
For 100 CM^3 (6 IN.^{3}) NON-SERIALIZED double bank pump, perform Steps 2a and 3a.

IMPORTANT: Bronze thrust washer MUST be installed with ID radius of thrust washer in alignment with radius on inside of shaft journal.

2a. Assemble shaft installing thick bronze thrust washer (A) on shaft (E) making sure ID radius of thrust washer is toward center of shaft.

NOTE: Center collar sleeve must be installed on shaft prior to pressing bearing cone in place.

3a. Install bearing cones (F) using a bearing press, making sure cone is pressed against shaft journal.



A—Bronze Thrust Washers
B—Spacers
C—Needle Rollers
D—Race
E—Shaft
F—Bearing Cone

AW1;R39789 R70;070300 1091 290188

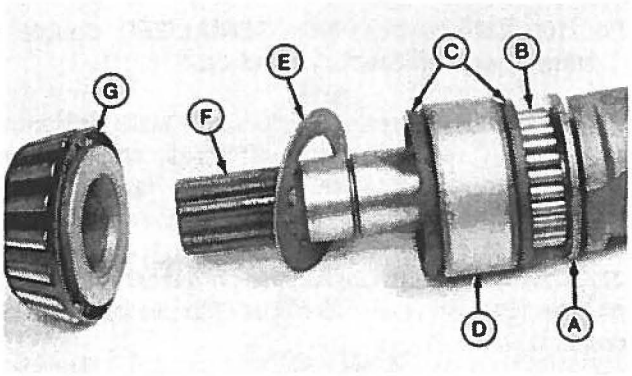
For 130 CM^3 (8 IN.^{3}) NON-SERIALIZED and ALL SERIALIZED double bank pumps, perform Steps 2b and 3b.

IMPORTANT: Thick spacer MUST be installed with ID radius of spacer in alignment with radius on inside of shaft journal.

2b. Assemble shaft installing thick spacer (A) on shaft (F) making sure ID radius of spacer is toward center of shaft.

NOTE: Center collar sleeve must be installed on shaft prior to pressing bearing cone in place.

3b. Install bearing cones (G) using a bearing press making sure cone is pressed against shaft journal.



A—Thick Spacer
B—Needle Rollers
C—Thrust Washer
D—Race
E—Spacer
F—Shaft
G—Bearing Cone

AW1;R39757 R70;070300 1092 150589

NOTE: Not all shafts will have a sealing ring. Through drive shafts use sealing rings on both ends of shaft.

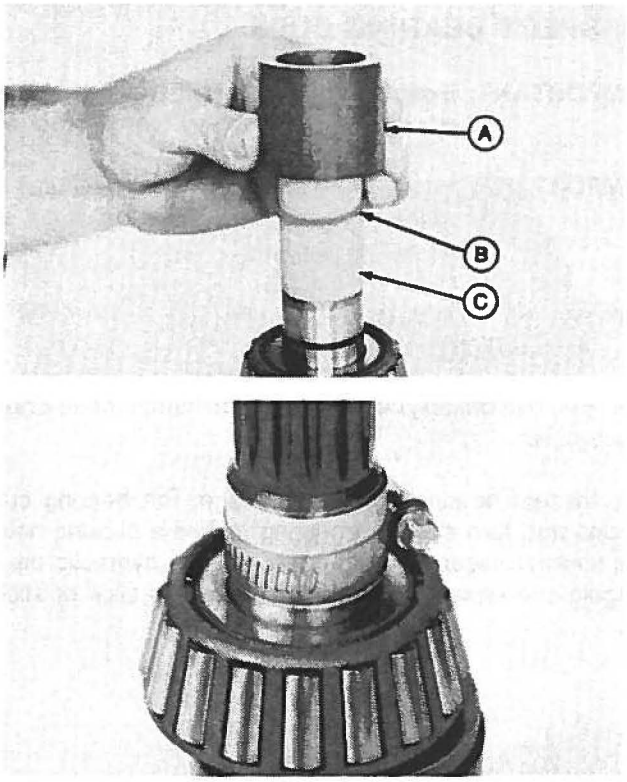
NOTE: Use optional JDG493 Shaft Seal Sizer Tool (A) to aid sealing ring installation.

4. Install JDG494 Spline Protector Tool (C) on pump shaft.

5. Carefully slide new sealing ring (B) over spline protector and down into groove on pump shaft making sure sealing ring does not twist. Use optional JDG493 sizing tool (A) to aid installation.

NOTE: Optional JDG493 Sizing Tool may be used in place of hose clamp.

6. Clamp sealing ring in groove using a hose clamp. Put shim stock between clamp and sealing ring to prevent sealing ring damage. Leave hose clamp in place approximately five minutes to allow sealing ring to set.

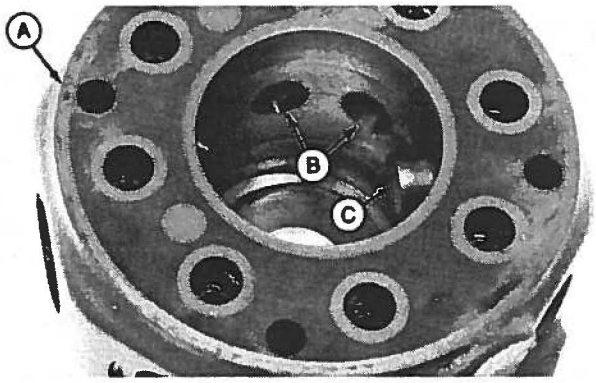


AW1;R37912, R39604 R70;070300 1095 260489

INSPECT PUMP HOUSING

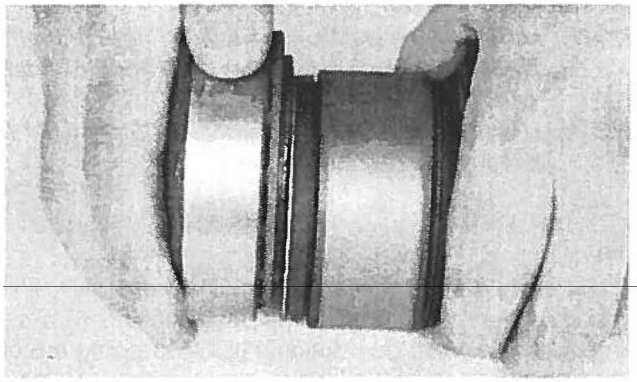
1. Inspect piston bores (B) in pump housing (A). Replace housing and pistons if scoring, galling or metal transfer exists.

2. After visual inspection, install each piston (C) into its bore so it extends approximately 13 mm (0.5 in.) into crankcase. Pistons must slide smoothly and have no side play. If any side play is found, replace housing and pistons.



AW1;RW3528 R70;070300 1079 171287

INSPECT BEARING CUPS



IMPORTANT: Bearing cups must be used with the same cone from which they were removed.

IMPORTANT: Pump housing, bearing cones and cups must be replaced if bearing cups show signs of spinning.

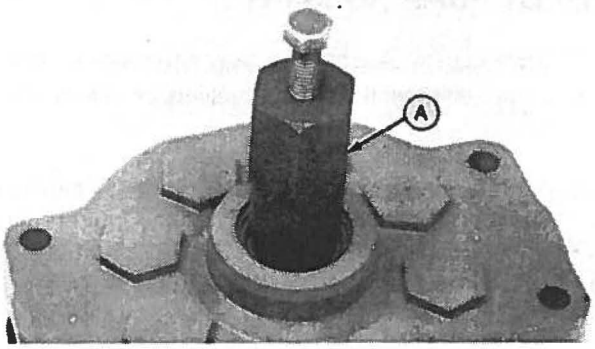
NOTE: Save shims from secondary housing on double bank pump for reassembly.

1. Remove bearing cups using a slide hammer and a bearing cup puller.

2. Inspect bearing cups for damage. Put bearing cup on cone and turn slowly. If bearing makes a clicking noise or is sticking, clean and dip cone in clean hydraulic oil. Turn again and replace if bearing continues to click or stick.

AW1;R39503 R70;070300 1074 150589

REMOVE AND INSTALL OIL SEAL— *PUMP ASSEMBLED*



NOTE: Preferred method of changing oil seal is to have pump disassembled since shaft sealing ring (serialized pump) or quad ring and backup ring (non-serialized pump) in housing should be changed. Use this method ONLY if pump can not be disassembled.

1. Remove oil seal retaining snap ring in housing.

2. Put JDH35A Seal Puller from JDH32 Hydraulic Pump Seal Replacement Set on pump shaft.

3. Screw body (A) of puller into gland of oil seal as far as possible.

4. Remove seal by tightening screw in puller.

AW1;R39947 R70;070300 1059 260489

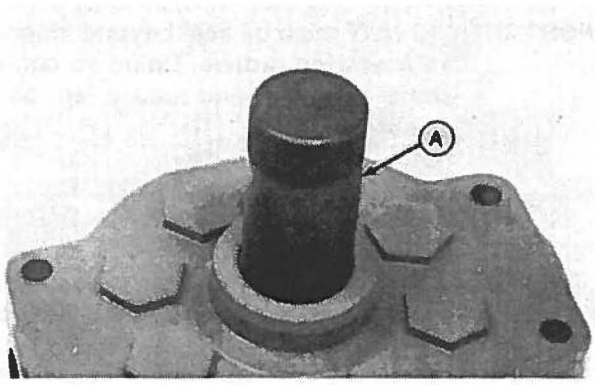
IMPORTANT: DO NOT push oil seal beyond inner edge of snap ring groove. Doing so can close drain passage and cause an oil seal failure.

5. Put JDG494 Spline Protector on shaft to prevent seal damage.

6. Apply petroleum jelly to lips of new oil seal siding seal with lip (spring side) toward inside of pump down over spline protector.

7. Remove spline protector and use JDH31A Seal Driver (A) from JDH32 Hydraulic Pump Seal Replacement Set to install oil seal. Oil seal should be installed just far enough to install retaining snap ring.

8. Install retaining snap ring.



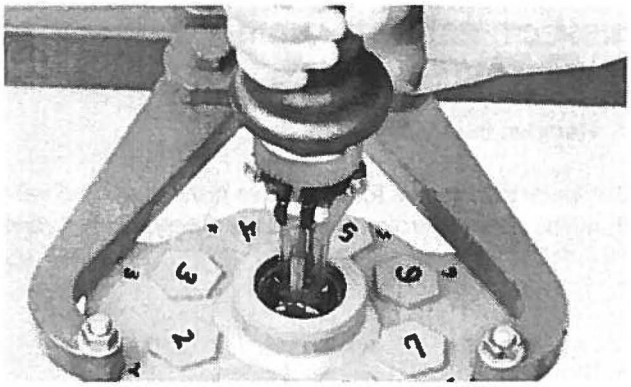
AW1;R39948 R70;070300 1060 080288

REMOVE AND INSTALL OIL SEAL— *PUMP DISASSEMBLED*

NOTE: Through drive pump shaft uses oil seals on both ends of pump shaft.

1. Remove oil seal retaining snap ring.

2. Remove oil seal using a puller and slide hammer.

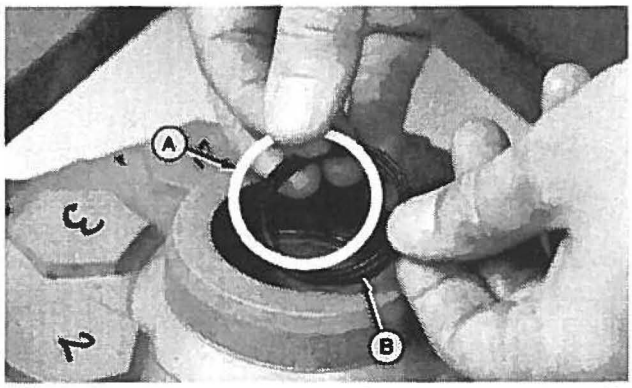


AW1;R39751 R70;070300 1085 290188

For NON-SERIALIZED single bank pump, perform Steps 2a and 2b.

2a. Remove and discard backup ring (A) and quad ring (B).

2b. Install new backup ring (A) and quad ring (B) into groove inside pump housing. Quad ring should be toward inside of housing.



AW1;R39752 R70;070300 1083 170589

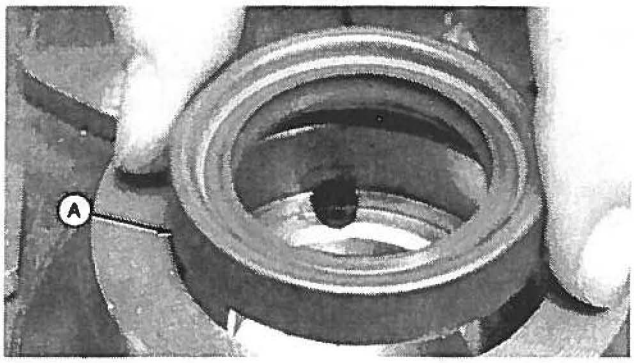
IMPORTANT: DO NOT push oil seal beyond inner edge of snap ring groove. Doing so can close drain passage and cause an oil seal failure.

NOTE: Use a 1-15/16 in. disk from a Bushing, Bearing and Seal Driver Set to aid installation.

3. Install oil seal (A) with lip (spring side) toward inside of pump housing making sure drain passage is not blocked.

4. Apply petroleum jelly to lips of oil seal for lubrication when shaft is installed.

5. Install retaining snap ring.

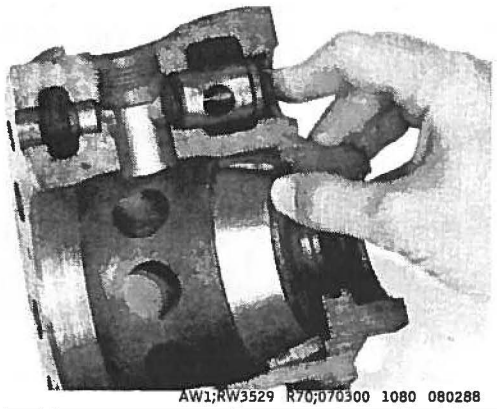


AW1;T85279 R70;070300 1087 260489

INSPECT, REMOVE AND INSTALL INLET VALVES

1. Remove inlet valve plugs.

2. Check inlet valves for free valve movement and valve lift. If valves are not broken and move freely, do not remove.



AW1;RW3529 R70;070300 1080 080288

IMPORTANT: Removed inlet valves must be replaced with new valves since press fit is critical for sealing.

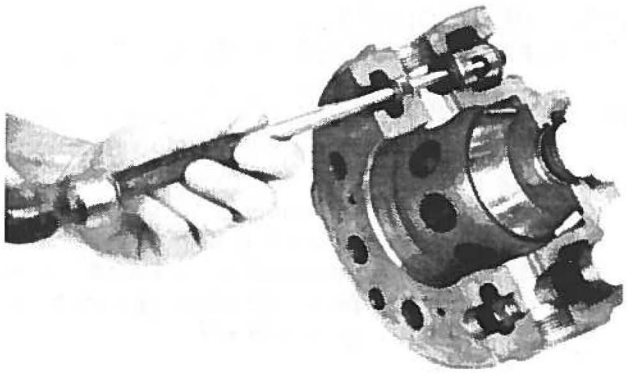
NOTE: For double bank pump, reinstalling secondary housing onto primary may aid in removing inlet valve plugs.

3. Remove inlet valves.

4. Install new inlet valve assemblies using valve plugs to push inlet valves into their bores.

5. Tighten inlet valve plugs (A) to 136 N·m (100 lb-ft).

6. Loosen plugs and retighten to 136 N·m (100 lb-ft) to seat inlet valves.



AW1;RW3530 R70;070300 1081 080288

REMOVE AND INSTALL PRESSURE COMPENSATOR HOUSING

IMPORTANT: Disassemble pressure compensator only if there is evidence of malfunction.

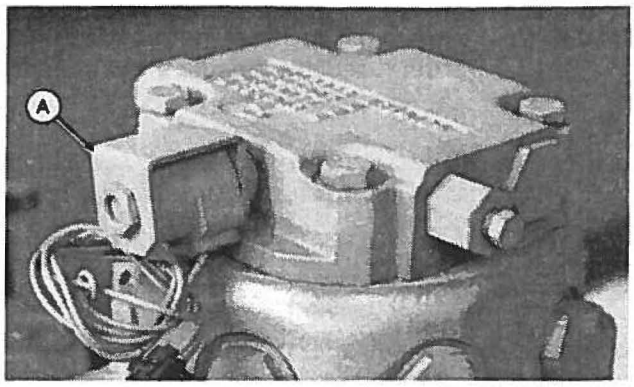
CAUTION: For double bank pump—remove pressure compensator housing only when pump is mounted on a bench fixture. Cap screws for pressure compensator housing also hold secondary housing to primary housing.

NOTE: Pressure compensator housing does not have to be removed from pump for servicing.

1. Thoroughly clean outside surface before removing housing.

2. Remove electric destroke solenoid (A), if so equipped, to prevent damage to solenoid during pressure compensator repair.

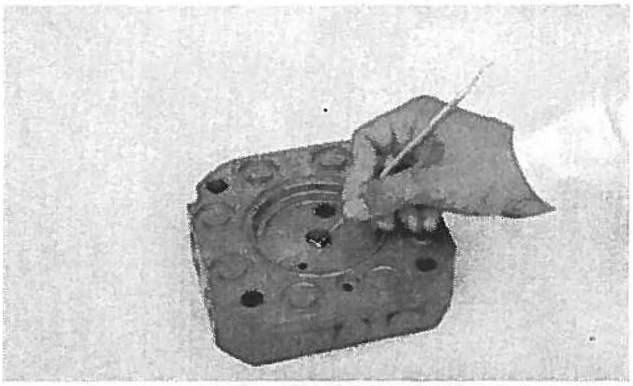
3. Loosen plugs then remove pressure compensator housing.



AW1;R39763 R70;070300 1112 090288

For pump with auxiliary gear-driven charge pump, perform Step 3a.

3a. Install new charge pump drive seal in pressure compensator housing.



AW1;R37618 R70;070300 1100 080288

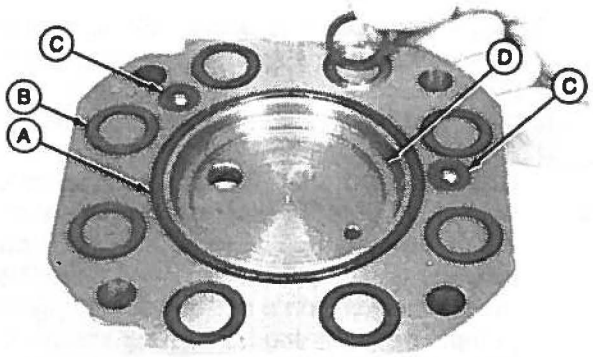
NOTE: Standard drive single bank pressure compensator housing is shown. Double bank pressure compensator housing does not use packings (B) or shims (D).

IMPORTANT: DO NOT install O-rings or packings if end play was out of specification, or bearing cones and cups have been replaced. Install O-rings and packings after correct end play is established.

NOTE: Apply a small amount of petroleum jelly to O-ring, packings and shims to hold them in place during assembly.

4. Install shims to check end play specification.

5. Install new O-rings and packings (A—C).



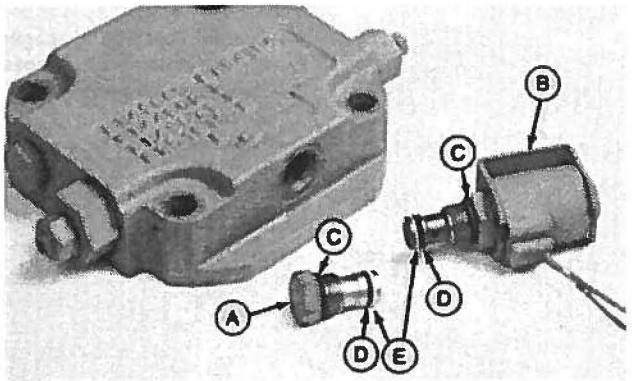
A—O-Ring
B—Packings
C—Packings
D—Shims

AW1;T85462 R70;070300 1142 080288

6. Install new O-rings (C—D) and backup ring (E) on destroke plug (A) or electric destroke solenoid valve (B).

IMPORTANT: Torque specification for solenoid valve (34 N·m (25 lb-ft)) is different than destroke plug (61 N·m (45 lb-ft)). Over torquing electric destroke solenoid may cause pump to malfunction.

7. Install destroke plug (A) or electric destroke solenoid valve (B) into housing.



A—Destroke Plug
B—Electric Destroke Solenoid
C—O-Rings
D—O-Rings
E—Backup Rings

AW1;R39770 R70;070300 1141 260489

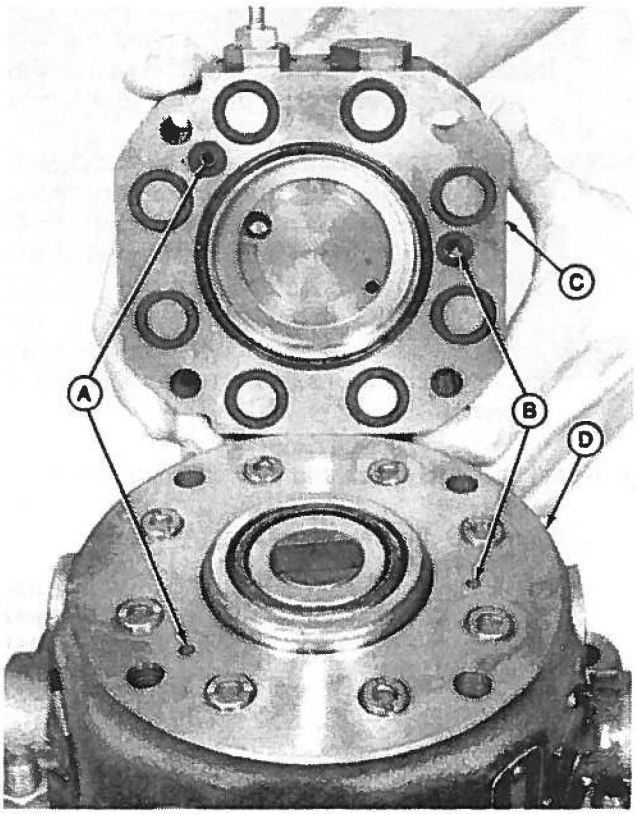
NOTE: Single bank pump is shown. Some double bank pumps may have a special dowel pin between the pressure compensator housing and secondary pump housing to insure proper alignment.

⚠ **CAUTION: DO NOT INSTALL a current design (serialized pump) pressure compensator housing on an early design (non-serialized) pump or an early design pressure compensator housing (non-serialized) on a current design (serialized) pump. The mounting holes are common, but the HIGH-PRESSURE PASSAGES WILL NOT ALIGN. Failure to align the high-pressure passages will keep the pump in full stroke. This could result in hydraulic system damage and possibly a high-pressure leak which could create a risk of personal injury.**

NOTE: Pressure passage location will differ between single bank and double bank pumps. They also differ between non-serialized and serialized pumps.

8. Install pressure compensator housing (C) to pump housing (D) making sure system-pressure passages (A) and charge-pressure passages (B) are aligned.

9. Tighten cap screws to 70 N·m (50 lb-ft). Continue tightening cap screws alternately to 115 N·m (85 lb-ft).



A—System Pressure Passages
B—Charge Pressure Passages
C—Pressure Compensator Housing
D—Pump Housing

AW1;T86280 R70;070300 1109 070388

DISASSEMBLE, INSPECT AND ASSEMBLE PRESSURE COMPENSATOR VALVE— *STD. AND AUX. GEAR DRIVE PUMPS*

NOTE: Two manual destroke screws and two spring and spring guide assemblies are shown.

IMPORTANT: Remove adjusting screw and bushing assembly (A) prior to removing manual destroke screw (or plug if manual destroke is not used). Pressure compensator valve sleeve packings will be damaged if adjusting screw and bushing assembly are not removed first.

1. Remove adjusting screw and bushing assembly (A), special washer(s) (B), spring (C or D), spring guide (E or F) and stroke control valve (G).

NOTE: Spring (C) uses long spring guide (E) and spring (D) uses short spring guide (F).

2. Inspect spring (C or D) for excessive wear or damage.

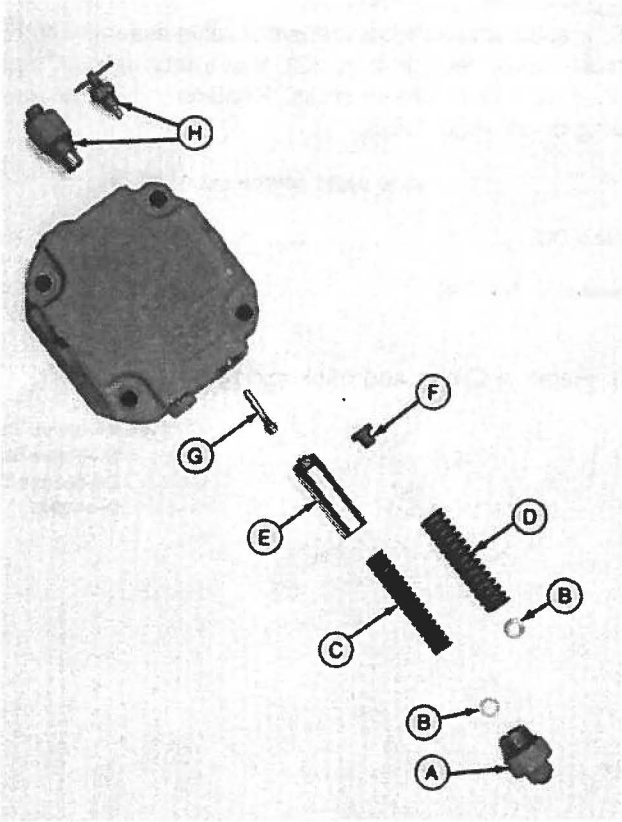
NEW SPRING SPECIFICATION

Spring (C)
Free Length ..... 92 mm (3.6 in.) (approximate)
Test Length ..... 84 mm at 556—690 N (3.3 in. at 125—155 lb force)

Spring (D)
Free Length ..... 90 mm (3.5 in.) (approximate)
Test Length ..... 75 mm at 801—979 N (3.0 in. at 180—220 lb force)

3. Inspect spring guide (E or F) for wear.

A—Adjusting Screw and Bushing
B—Special Washers
C—Spring
D—Spring
E—Spring Guide
F—Spring Guide
G—Pressure Compensator Valve
H—Manual Destroke Screws

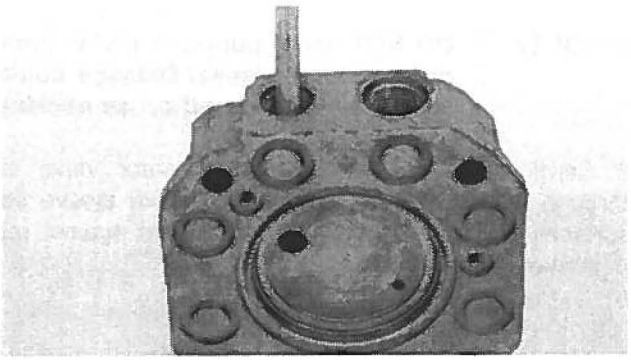


AW1;R39764 R70;070300 1114 100589

NOTE: Standard drive single bank pressure compensator housing is shown.

IMPORTANT: DO NOT use a punch to remove pressure compensator valve sleeve (and crankcase outlet valve sleeve or fixed orifice sleeve in non-serialized pumps).Sleeve(s) could be damaged and cause sticking.

4. Carefully remove pressure compensator valve sleeve using a wood or brass dowel. Remove from manual destroke opening toward adjusting screw opening.



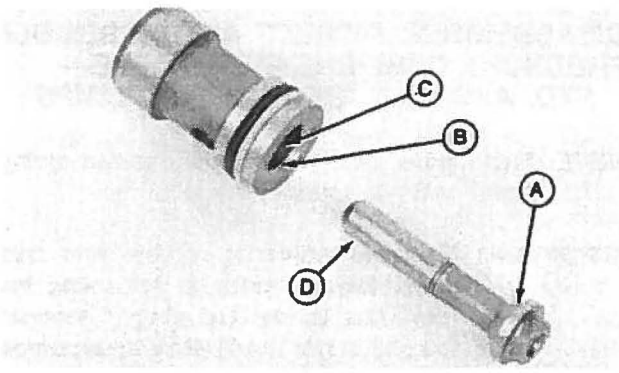
AW1;R37715 R70;070300 1122 090288

5. Inspect pressure compensator valve assembly. Valve (D) must move freely in bore (C). Valve face (A) and seat (B) must be free of pits or nicks. Replace valve and sleeve if drag or damage exists.

NEW PART SPECIFICATION

Valve OD	6.759—6.769 mm (0.2661—0.2665 in.)
Sleeve ID (Top End)	6.7740—6.7900 mm (0.2667—0.2673 in.)

6. Replace O-ring and backup ring on sleeve.



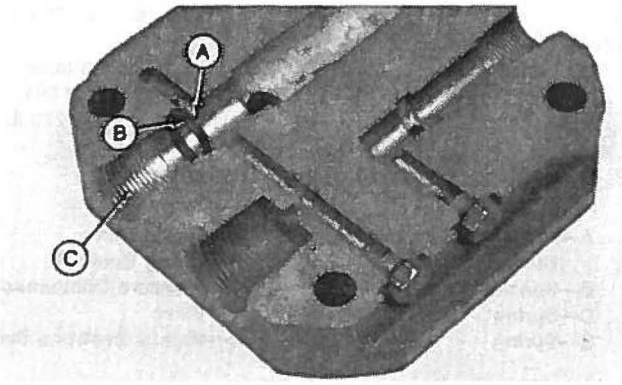
A—Valve Face
B—Valve Seat
C—Sleeve Bore
D—Valve

AW1;R37639 R70;070300 1123 080288

IMPORTANT: All pressure compensator valve parts must be thoroughly cleaned. All passage holes in parts must be open and clean.

NOTE: Cutaway section of serialized pressure compensator housing is shown.

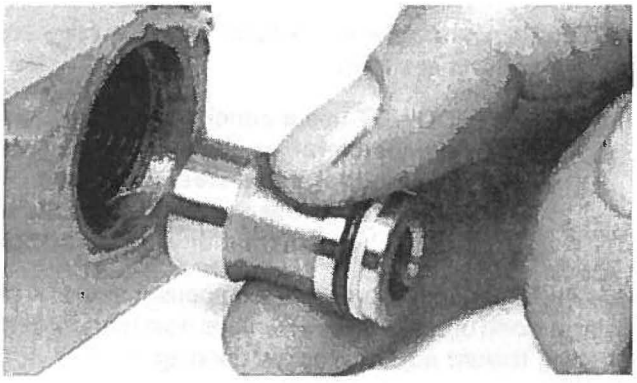
7. Install new O-ring (A) (and backup ring (B) in serialized pump) through manual destroke port (C) in pressure compensator housing. Use an O-ring seal hook to aid installation.



AW1;R39771 R70;070300 1127 150589

IMPORTANT: DO NOT use a punch to install pressure compensator sleeve. Damage could occur to the sleeve and cause sticking.

8. Carefully install pressure compensator valve sleeve through adjusting screw port making sure sleeve seating surfaces are not damaged. Push sleeve against manual destroke using a wood or brass dowel.



AW1;T85474 R70;070300 1131 080288

9. Install manual destroke or plug with new O-rings into pressure compensator housing.

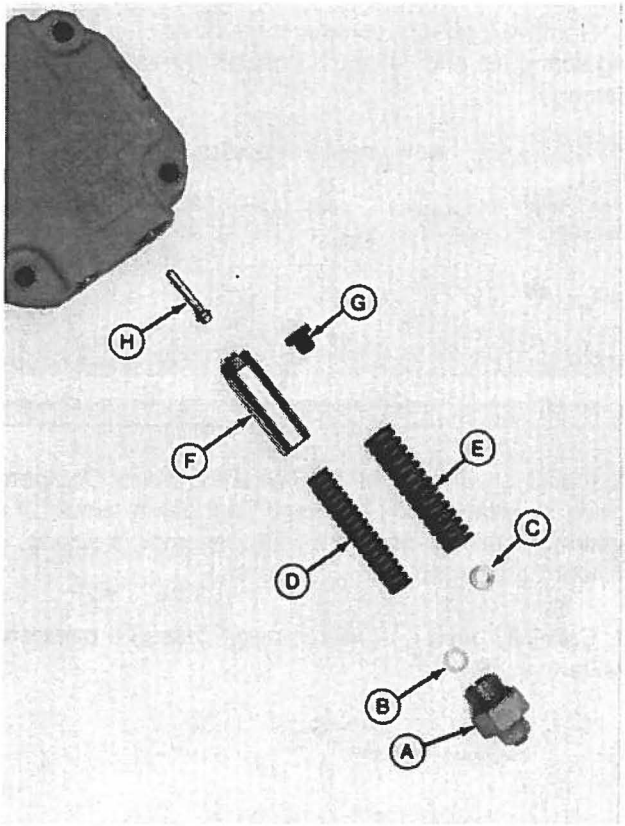
10. Install pressure compensator valve (H) into sleeve in housing.

11. Install long spring guide (F) with spring (D) or short spring guide (G) with spring (E).

NOTE: Copper washer (B) is used with spring (D) and spring guide (F), and thick washer (C) is used with spring (E) and spring guide (G). Some applications may use both washer (B and C).

12. Install adjusting screw and bushing assembly (A) with copper washer (B) or thick washer (C).

A—Adjusting Screw and Bushing
B—Copper Washer
C—Thick Washer
D—Spring
E—Spring
F—Spring Guide
G—Spring Guide
H—Pressure Compensator Valve



AW1;R39775 R70;070300 1134 080288

DISASSEMBLE, INSPECT AND ASSEMBLE PRESSURE COMPENSATOR VALVE— *THROUGH DRIVE PUMP*

1. Slowly loosen pressure adjusting screw (A) to relieve any crankcase pressure.

2. Remove adjusting screw and sleeve assembly (B).

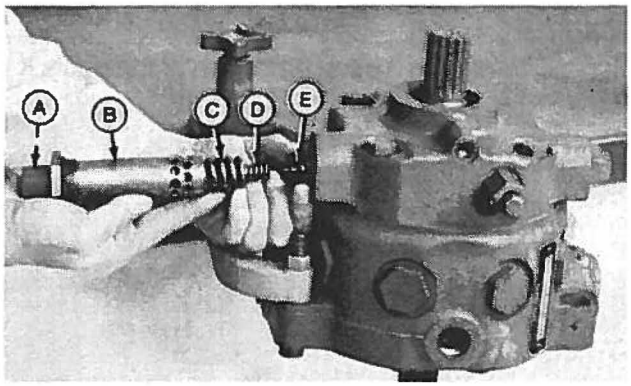
NOTE: Not all pressure adjusting assemblies will use the smaller inner spring (D).

3. Inspect springs (C and D) and spring guide (E) for wear or damage.

NEW SPRING SPECIFICATION

Spring (C)
Free Length ..... 97 mm (3.8 in.) (approximate)
Test Length ..... 78 mm at 1340—1640 N
(3.1 in at 300—30 lb force)

Spring (D)
Free Length ..... 92 mm (3.6 in.) (approximate)
Test Length ..... 79 mm at 495—605 N
(3.1 in. at 110—135 lb force)

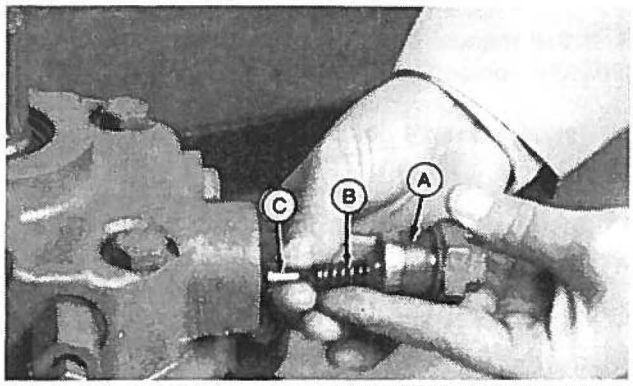


AW1;R39949 R70;070300 1113 100589

4. Remove pressure compensator valve plug (A), dampening spring (B) and valve (C). Inspect for excessive wear or damage.

NEW SPRING SPECIFICATION

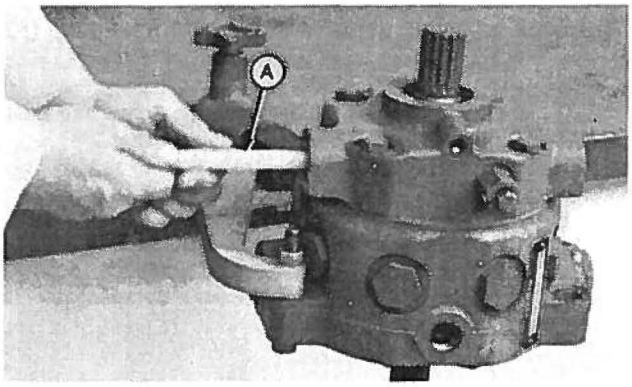
Free Length	20.6 (0.8 in.) (approximate)
Test Length	13.7 mm at 200—247 N (0.5 in. at 45—55 lb force)



AW1;R39950 R70;070300 1115 260489

5. Install small end of DFRW52 Pressure Compensator Valve Installation and Removal Tool (A) in center of valve assembly inside pressure compensator housing. (See Dealer Fabricated Tools, Group 99.)

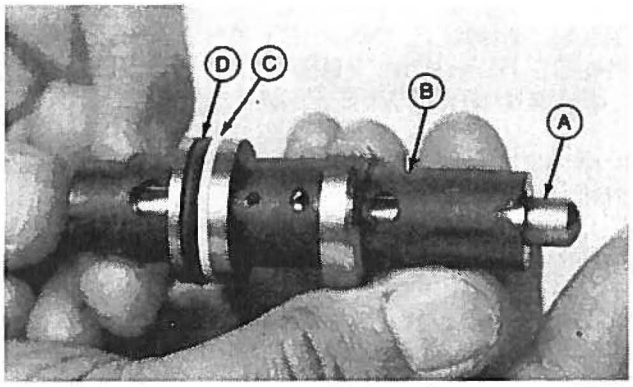
6. Carefully push on tool removing pressure compensator valve assembly (B).



AW1;R40164 R70;070300 1116 100589

7. Inspect pressure compensator valve assembly. Valve (A) must slide freely in sleeve (B). Replace assembly if valve sticks or hangs up in sleeve.

8. Replace back-up ring (C) and O-ring (D).



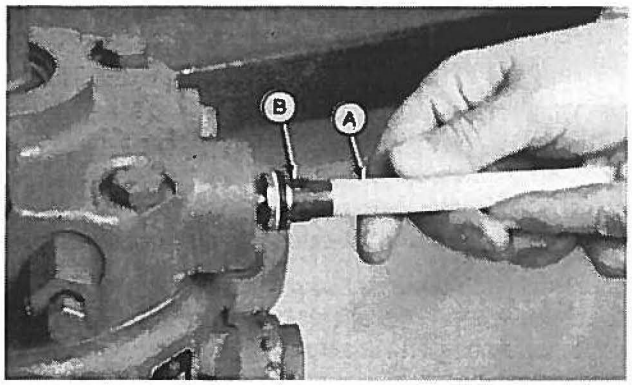
AW1;R39616 R70;070300 1117 080288

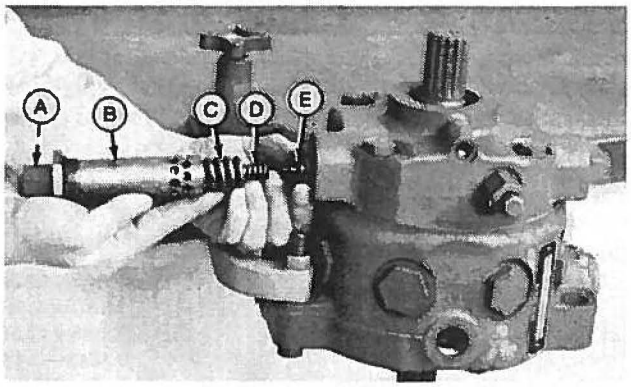
IMPORTANT: Make sure valve and sleeve are assembled correctly. Misassembly will cause pump malfunction.

9. Carefully install valve assembly into housing using Pressure Compensator Valve Installation and Removal Tool. Push until valve bottoms out in housing.

10. Install pressure compensator valve plug assembly.

11. Install spring guide (E), spring(s) (C and D), sleeve assembly (B) and adjusting screw (A). Adjusting screw should be set to a minimum depth to prevent excessive deadhead pressure at start up.





A—Adjusting Screw
B—Sleeve Assembly
C—Outer Spring
D—Inner Spring
E—Spring Guide

AW1;R40165,R39949 R70;070300 1130 080288

REMOVE, INSPECT AND INSTALL CRANKCASE OUTLET VALVE— *NON-SERIALIZED PUMPS*

1. Remove crankcase outlet valve plug (A) with shims (B), spring (C) and spring retainer (D).

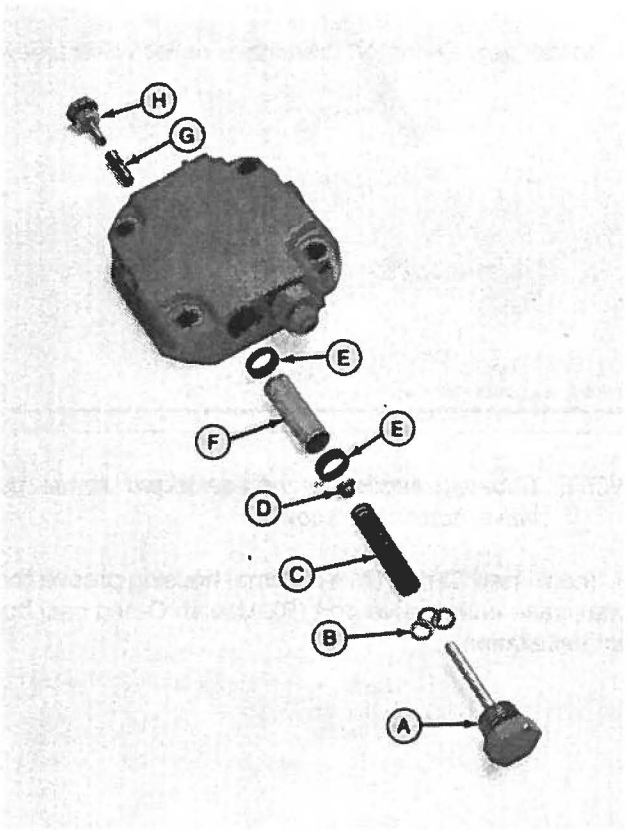
2. Remove filter (F) from housing and clean or replace.

3. Inspect spring (C) for excessive wear or damage.

NEW SPRING SPECIFICATION

Free Length	73.5 mm (2.9 in.) (approximate)
Test Length	56 mm at 200—245 N (2.2 in. at 45—55 lb force)

4. Remove plug (H) and crankcase outlet valve (G) from housing.



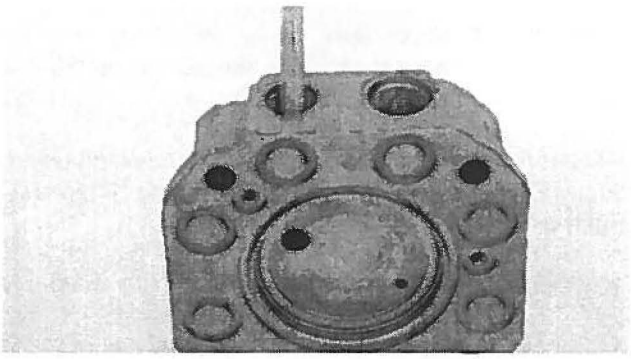
A—Plug
B—Shims
C—Spring
D—Spring Retainer
E—Packings
F—Filter
G—Crankcase Outlet Valve
H—Plug

AW1;R39776 R70;070300 1118 100589

NOTE: Single bank pressure compensator housing is shown.

IMPORTANT: DO NOT use a punch to remove pressure compensator valve sleeve (and crankcase outlet valve sleeve or fixed orifice sleeve in non-serialized pumps).Sleeve(s) could be damaged and cause sticking.

5. Carefully remove crankcase outlet valve sleeve (or fixed orifice sleeve) through other bore in pressure compensator housing. Remove in the same direction as pressure compensator valve sleeve.

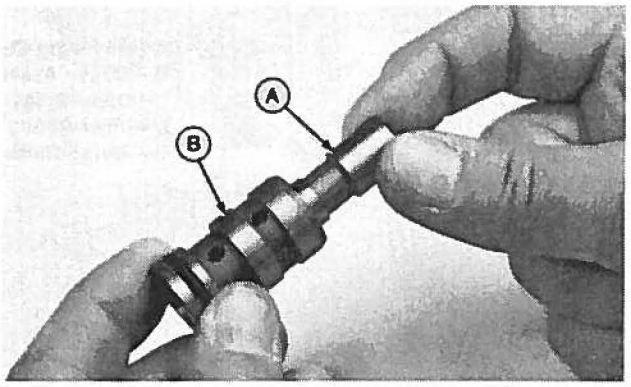


AW1;R37715 R70;070300 1110 090288

6. Inspect crankcase outlet valve assembly. Valve (A) must move freely in bore of sleeve (B). Replace valve and sleeve if drag or damage exists.

NEW PART SPECIFICATION

Crankcase Outlet Valve	
OD (upper)	11.882—11.892 mm (0.4678—0.4682 in.)
OD (lower)	11.095—11.105 mm (0.4368—0.4372 in.)
Crankcase Outlet Valve Sleeve	
ID (upper)	11.897—11.913 mm (0.4684—0.4690 in.)
ID (lower	11.110—11.126 mm (0.4374—0.4380 in.)

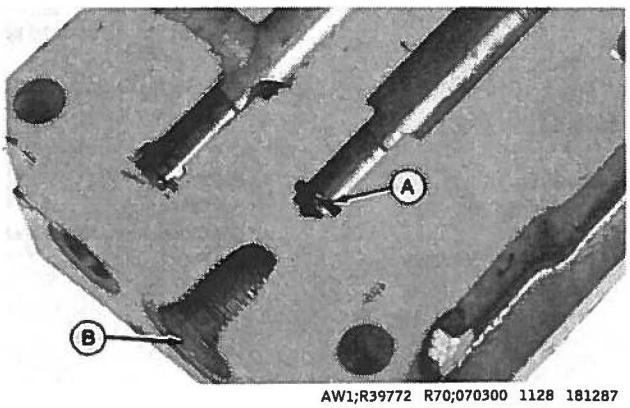


AW1;R39769 R70;070300 1124 181287

7. Install new O-ring on crankcase outlet valve sleeve.

NOTE: Cutaway section of non-serialized stroke control valve housing is shown.

8. Install new O-ring (A) in internal housing groove through crankcase outlet valve port (B). Use an O-ring seal hook to aid installation.

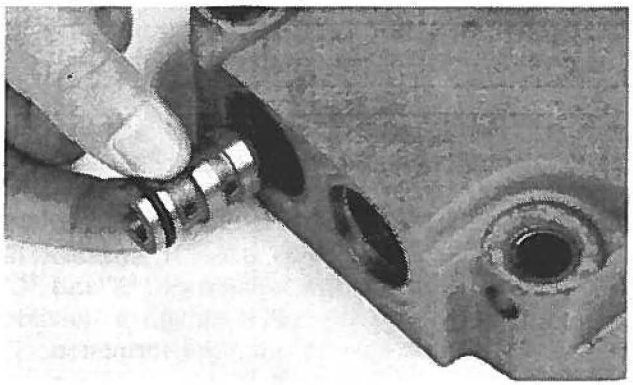


AW1;R39772 R70;070300 1128 181287

9. Install O-ring on crankcase outlet valve sleeve (or fixed orifice sleeve).

IMPORTANT: Do not use a punch to install crankcase outlet valve sleeve (or orifice sleeve). Damage could occur to sleeve.

10. Carefully install crankcase outlet valve sleeve (or fixed orifice sleeve) through port next to adjusting screw port making sure sleeve seating surfaces are not damaged. Push sleeve against internal housing stop using a wood or brass dowel.



AW1;R39774 R70;070300 1132 181287

11. Put new O-rings on crankcase outlet valve plug (A) and plug with pin (H).

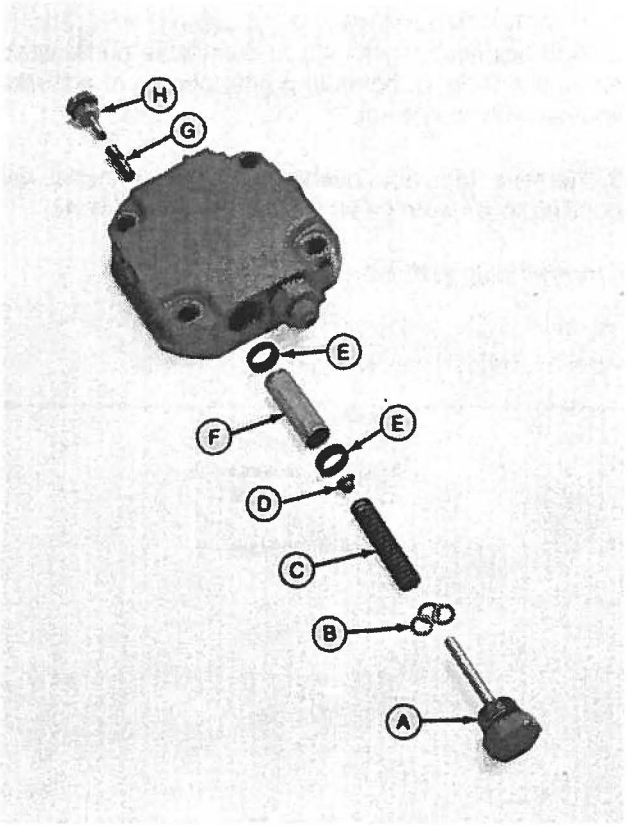
12. Put new packings (E) on filter (F) and install filter assembly into pressure compensator housing.

13. Install shims (B), spring (C) and spring retainer (D) on crankcase outlet valve plug with pin (A). Install into housing.

NOTE: DO NOT install plug with pin (H). Crankcase outlet valve must be adjusted.

14. Carefully install crankcase outlet valve (G) into sleeve in housing.

A—Crankcase Outlet Valve Plug
B—Shims
C—Spring
D—Spring Retainer
E—Packings
F—Filter
G—Crankcase Outlet Valve
H—Plug With Pin



AW1;R39776 R70;070300 1138 080288

ADJUST CRANKCASE OUTLET VALVE— *NON-SERIALIZED PUMPS*

NOTE: Cutaway section of non-serialized pump stroke control valve housing is shown.

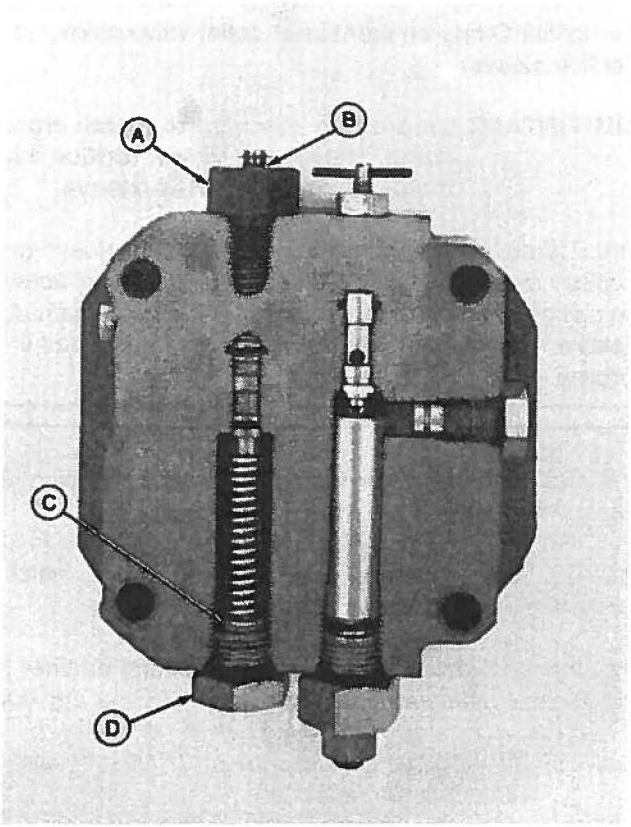
IMPORTANT: Early version tools JDH19 and JDG19A use a washer, JDH19B and JDG19C do not. Using a washer on "B"and "C" version tools will result in a considerable decrease in pump performance.

1. Install JDH19C Adjusting Tool (A) to adjust crankcase outlet valve.

2. Add or deduct shims (C) to crankcase outlet valve plug (D) until bottom of notch in center pin (B) of adjusting tool is even with top of nut.

3. Remove tool and push on crankcase outlet valve in housing to be sure valve moves freely in sleeve.

4. Install plug with pin (not shown).



AW1;R39777 R70;070300 1139 260489

REMOVE, INSPECT AND INSTALL CRANKCASE OUTLET VALVE— *SERIALIZED PUMPS*

1. Remove crankcase outlet valve plug (A), spring (B) and crankcase outlet valve (C) from housing.

NOTE: Spring, in some applications, may have been removed for circuits that use external pump control.

2. Inspect spring (B) for excessive wear or damage.

NEW SPRING SPECIFICATION

Free Length	87 mm (3.4 in.) (approximate)
Test Length	74.5 mm at 63—77 N (3.0 in. at 14—17 lb force)

3. Remove resonator plug (E) and pin (D) from housing.

IMPORTANT: Pin (D) and crankcase outlet valve (C) must slide freely in their bores.

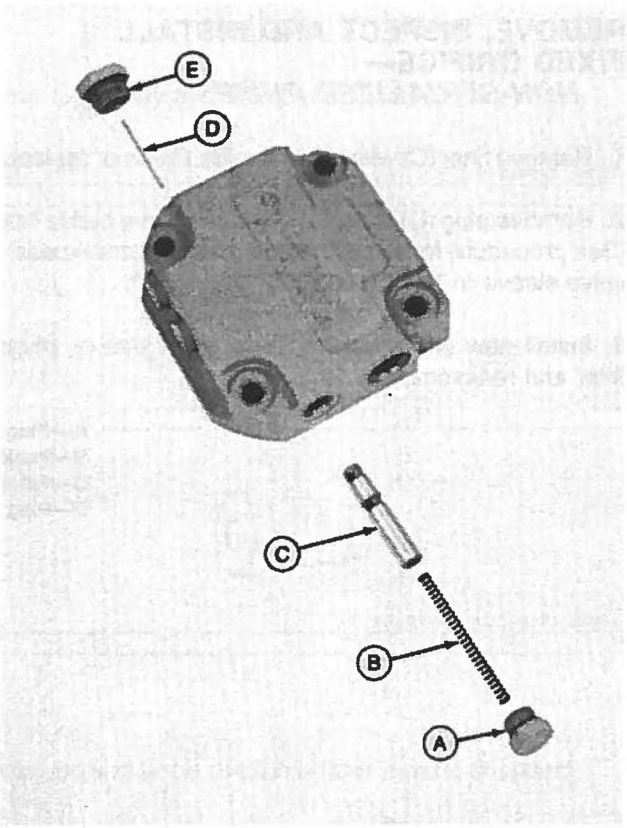
4. Inspect crankcase outlet valve (C) and pin (D) for wear.

NEW PART SPECIFICATION

Crankcase Outlet Valve OD	13.990—14.010 mm (0.5507—0.5515 in.)
Pin OD	3.165—3.170 mm (0.1246—0.1248 in.)

5. Install new O-rings on crankcase outlet valve plug (A) and resonator plug (E).

6. Carefully install crankcase valve assembly into housing.



A—Crankcase Outlet
B—Spring
C—Crankcase Outlet Valve
D—Pin
E—Resonator Plug

AW1;R39767 R70;070300 1120 080288

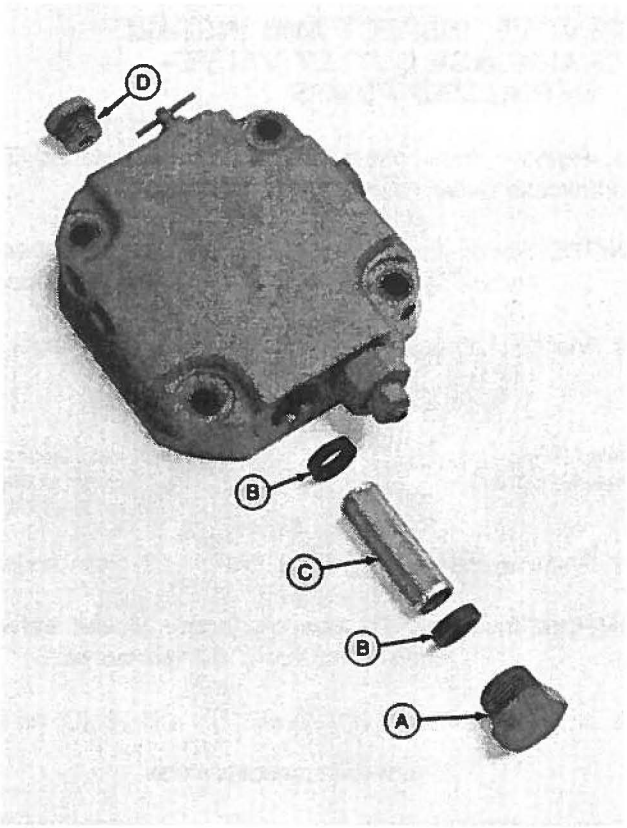
REMOVE, INSPECT AND INSTALL FIXED ORIFICE— *NON-SERIALIZED PUMPS*

1. Remove filter (C) with packings (B). Clean or replace filter.

2. Remove plug (D) to remove orifice sleeve inside housing. (See procedure for removing and installing crankcase outlet valve sleeve in this group.)

3. Install new packings and O-rings on sleeve, plugs and filter and reassemble.

A—Plug
B—Packings
C—Filter
D—Plug



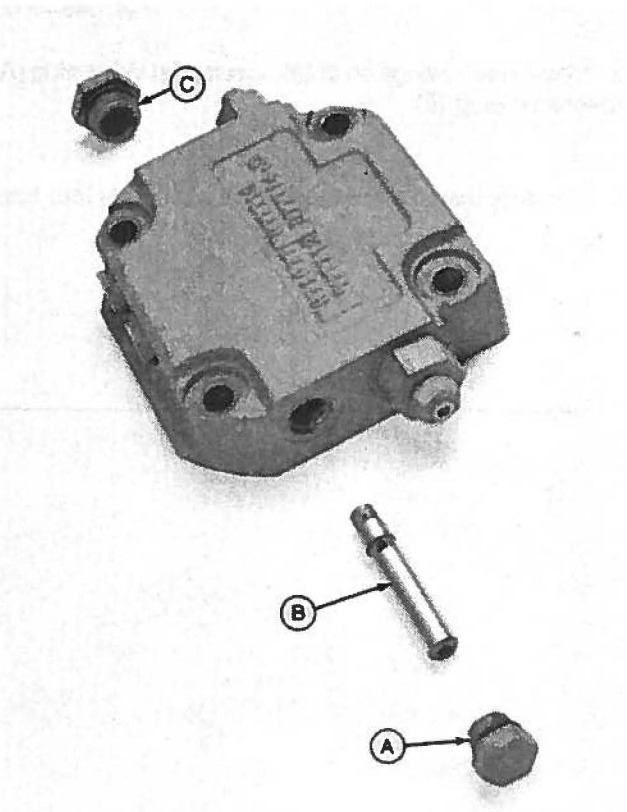
AW1;R39791 R70;070300 1119 090288

REMOVE, INSPECT AND ASSEMBLE FIXED ORIFICE— *SERIALIZED PUMPS*

1. Remove plugs (A and C).

2. Remove and inspect fixed orifice sleeve (B).

3. Install new O-rings on plugs and reassemble fixed orifice.



AW1;R39790 R70;070300 1121 090288

ESSENTIAL TOOLS

NOTE: Order tools from your SERVICE-GARD™ Catalog. Some tools may be available from a local supplier.

053;TOOLS 160187

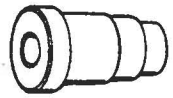
Spline Protector JDG494

Install pump shaft

AB6;R40151 R53;JDG494 250489

Hydraulic Pump Seat Installation and Removal Tool JDG539

Install and remove discharge valve seats



AB6;R40153 R53;JDG539 100588

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools from your SERVICE-GARD™ Catalog. Some tools may be available from a local supplier.

Name	Use
Pump Holding Fixture	Hold pump during repair
Bushing, Bearing and Seal Driver Set	Aid in the installation of bearings and seals
O-Ring Seal Tool Kit	Remove and Install O-rings and sealing rings
Shaft Seal Sizer	Aid shaft sealing ring installation
O-Ring Seal Hook	Aid removal and installation of O-rings and backup rings in control valve housing
Hydraulic Pump Parts Tray	Organize, identify and protect pump parts during repair
*DFRW52 Pressure Compensator Valve Installation and Removal Tool	Remove and install pressure compensator valve and sleeve in non-unitized inlet housing

* Fabricated Tool—See Group 99

R70;070300 1064 150589

HYDRAULIC PUMP SPECIFICATIONS—3000 SERIES

Item	Measurement	Specification
Pump Shaft	End Play	0.025—0.100 mm (0.001—0.004 in.)
Shaft Journal	OD	44.302—44.318 mm (1.7442—1.7448 in.)
Shaft Bearing Race	OD	71.475—71.525 mm (2.8140—2.8159 in.)
Shaft Bearing Race	ID	57.041—57.061 mm (2.2457—2.2465 in.)
Shaft Needle Rollers	OD	6.35 mm (0.250 in.)
Piston	OD	25.363—25.373 mm (0.9985—0.9989 in.)
Piston Bore	ID	25.395—25.405 mm (0.9998—1.0001 in.)
Piston Spring	Free Length	77 mm (3.0 in.) (approx.)
	Test Length	54.4 mm at 240—295 N (2.1 in. at 54—66 lb force)
Discharge Valve Spring	Free Length	12.7 mm (0.5 in.) (approx.)
	Test Length	9.3 mm at 17—24 N (0.4 in. at 4—5 lb force)
Inlet Valve	Lift	2.7—3.7 mm (0.11—0.15 in.)
Discharge Valve Plug	Torque	140 N·m (100 lb-ft)
Piston Plug	Torque	200 N·m (150 lb-ft)
Manifold-to-Pump (Double Bank with "B" Drive)	Torque	90 N·m (65 lb-ft)

R70;070300 1039 170589

NON-UNITIZED DESIGN CONTROL VALVE SPECIFICATIONS—3000 SERIES

Item	Measurement	Specification
Pressure Compensator Valve Dampening Spring ...	Free Length	20.6 mm (0.8 in.) (approx.)
	Test Length	13.7 mm at 200—247 N (0.5 in. at 45—55 lb force)
Shuttle Valve Spring	Free Length	45 mm (1.8 in.) (approx.)
	Test Length	26.5 mm 175—218 N (1.0 in. at 40—49 lb force)
WITHOUT SPRING SLEEVE		
Pressure Compensator Valve Spring		
Green	Free Length	93.6 mm (3.67 in.) (approx.)
	Test Length	80 mm at 706—864 N (3.2 in. at 159—194 lb force)
Red	Free Length	95.5 mm (3.76 in.) (approx.)
	Test Length	80 mm at 1131—1383 N (3.2 in. at 254—311 lb force)
Blue	Free Length	91.3 mm (3.59 in.) (approx.)
	Test Length	79.4 mm at 1152—1408 N (3.1 in. at 259—317 lb force)
No Color	Free Length	97.5 mm (3.84 in.) (approx.)
	Test Length	80 mm at 1620—1980 N (3.2 in. at 364—445 lb force)
WITH SPRING SLEEVE		
*Pressure Compensator Valve Spring		
Outer Spring		
No Color	Free Length	97 mm (3.8 in.) (approx.)
	Test Length	78 mm at 1340—1640 N (3.1 in. at 300—370 lb force)
Green	Free Length	96 mm (3.7 in.) (approx.)
	Test Length	82 mm at 780 N (3.2 in. at 175 lb force)
Inner Spring (if used)	Free Length	92 mm (3.6 in.) (approx.)
	Test Length	79 mm at 495—605 N (3.1 in. at 110—135 lb force)

*Spring and sleeve assemblies with one row of holes in the end of sleeve are not serviceable or interchangeable with design that has two rows of holes in sleeve. These should be updated to the latest design if service is required.

Continued on next page

R70;070300 1055 150589

UNITIZED DESIGN CONTROL VALVE SPECIFICATIONS—3000 SERIES

PRESSURE COMPENSATOR VALVE HOUSING

Item	Measurement	Specification
Pressure Compensator Valve Spring		
Outer Spring		
Red	Free Length	71 mm (2.8 in.) (approx.)
	Test Length	60 mm at 580—700 N (2.4 in. at 130—158 lb force)
Blue	Free Length	71 mm (2.8 in.) (approx.)
	Test Length	60 mm at 930—1130 N (2.4 in. at 210—254 lb force)
Inner Spring (if used)	Free Length	68 mm (2.7 in.) (approx.)
	Test Length	58 mm at 270—330 N (2.3 in. at 60—74 lb force)
Crankcase Relief Valve Spring	Free Length	51 mm (2.0 in.) (approx.)
	Test Length	37 mm at 200—245 N (1.5 in. at 45—55 lb force)
Shuttle Valve Spring	Free Length	44 mm (1.7 in.) (approx.)
	Test Length	22 mm at 18—22 N (0.9 in. at 4—5 lb force)

LOAD SENSE VALVE HOUSING

Item	Measurement	Specification
Pressure Compensator Valve Spring		
Outer Spring		
Red	Free Length	71 mm (2.8 in.) (approx.)
	Test Length	60 mm at 580—700 N (2.4 in. at 130—158 lb force)
Blue	Free Length	71 mm (2.8 in.) (approx.)
	Test Length	60 mm at 930—1130 N (2.4 in. at 210—254 lb force)
Inner Spring (if used)	Free Length	68 mm (2.7 in.) (approx.)
	Test Length	58 mm at 270—330 N (2.3 in. at 60—74 lb force)
Load Sense Spring		
Orange	Free Length	73 mm (2.9 in.) (approx.)
	Test Length	64 mm at 58—70 N (2.5 in. at 13—16 lb force)
Violet	Free Length	73 mm (2.9 in.) (approx.)
	Test Length	63 mm at 115—139 N (2.4 in. at 26—31 lb force)
Pink	Free Length	75 mm (3.0 in.) (approx.)
	Test Length	63 mm at 169—205 N (2.4 in. at 38—46 lb force)
Crankcase Relief Valve Spring	Free Length	64 mm (2.5 in.) (approx.)
	Test Length	59 mm at 180—220 N (2.3 in. at 40—49 lb force)

Continued on next page

R70;070300 1065 150589

CONTROL VALVE SPECIFICATIONS—3000 SERIES - Continued

Item	Measurement	Specification
Inlet Housing-to-Pump	Torque	200 N·m (150 lb-ft)
Valve Housing-to-Inlet Housing (Unitized Design)	Torque	15 N·m (11 lb-ft)
Test Port Plug	Torque	34 N·m (25 lb-ft)
Destroke Plug or Manual Destroke (if used)	Torque	61 N·m (45 lb-ft)
Destroke Solenoid Valve (if used)	Torque	34 N·m (25 lb-ft)

R70;070300 1056 150589

DIAGNOSING MALFUNCTIONS

No Pump Output
- Broken pump drive shaft
- Pressure compensator valve malfunction
- Improper compensator valve adjustment
- Excessive charge circuit leakage
- No oil to pump inlet

Low Pump Output
- Low deadhead pressure
- Compensator valve, seat, spring, or packing failure
- Worn or scored pistons and bores
- Broken discharge valve or spring
- Restricted inlet
- Insufficient inlet oil

Hydraulic Functions Slow
- Low deadhead pressure
- Plugged hydraulic filter or return filter
- Compensator valve, seat, spring, or packing failure

Slow Pump Response
- Failure of charge pump or charge leak
- Plugged return oil filter

Excessive Pump Pressure
- Improper compensator valve adjustment

Function Chatter
- Insufficient inlet oil (cavitation)
- Sticking pump pistons
- Broken discharge valve or spring
- Broken inlet valve
- Charge system leakage
- Charge pump suction air leak

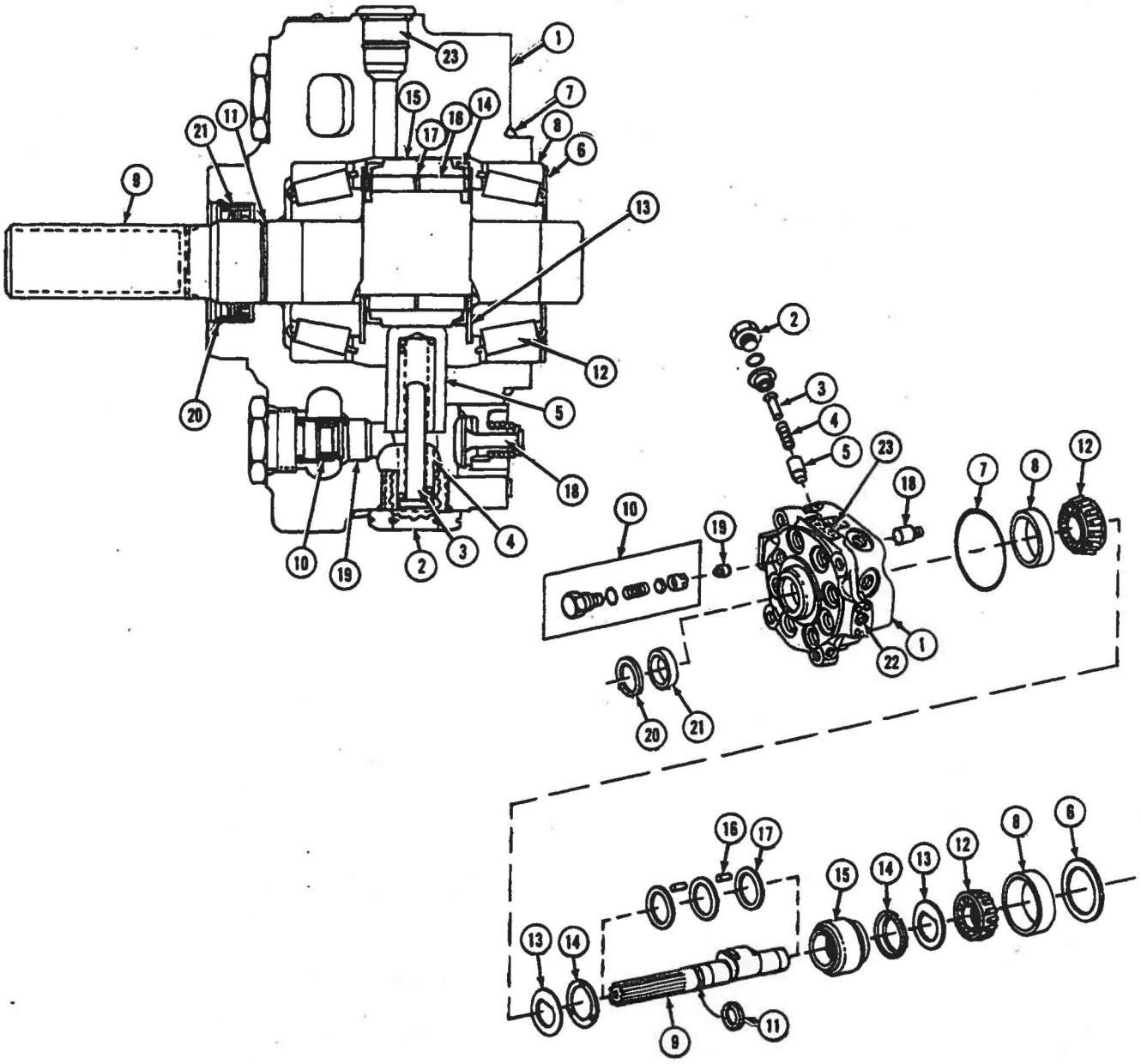
Pump and Oil Line Vibration
- Broken discharge valve or spring
- Leaking inlet valve
- Broken inlet valve

Pump Shaft Seal Failure
- Overpressurized seal drain line
- Broken discharge valve

Pump Noise or Squeal
- Low deadhead pressure
- Compensator valve, seat, spring, or packing failure
- Leaking inlet valve
- Air leak at inlet connections (inspect)
- Insufficient inlet oil (cavitation)

R70;070300 1147 090288

CROSS-SECTION AND EXPLODED VIEW—SINGLE BANK PUMP—3000 SERIES

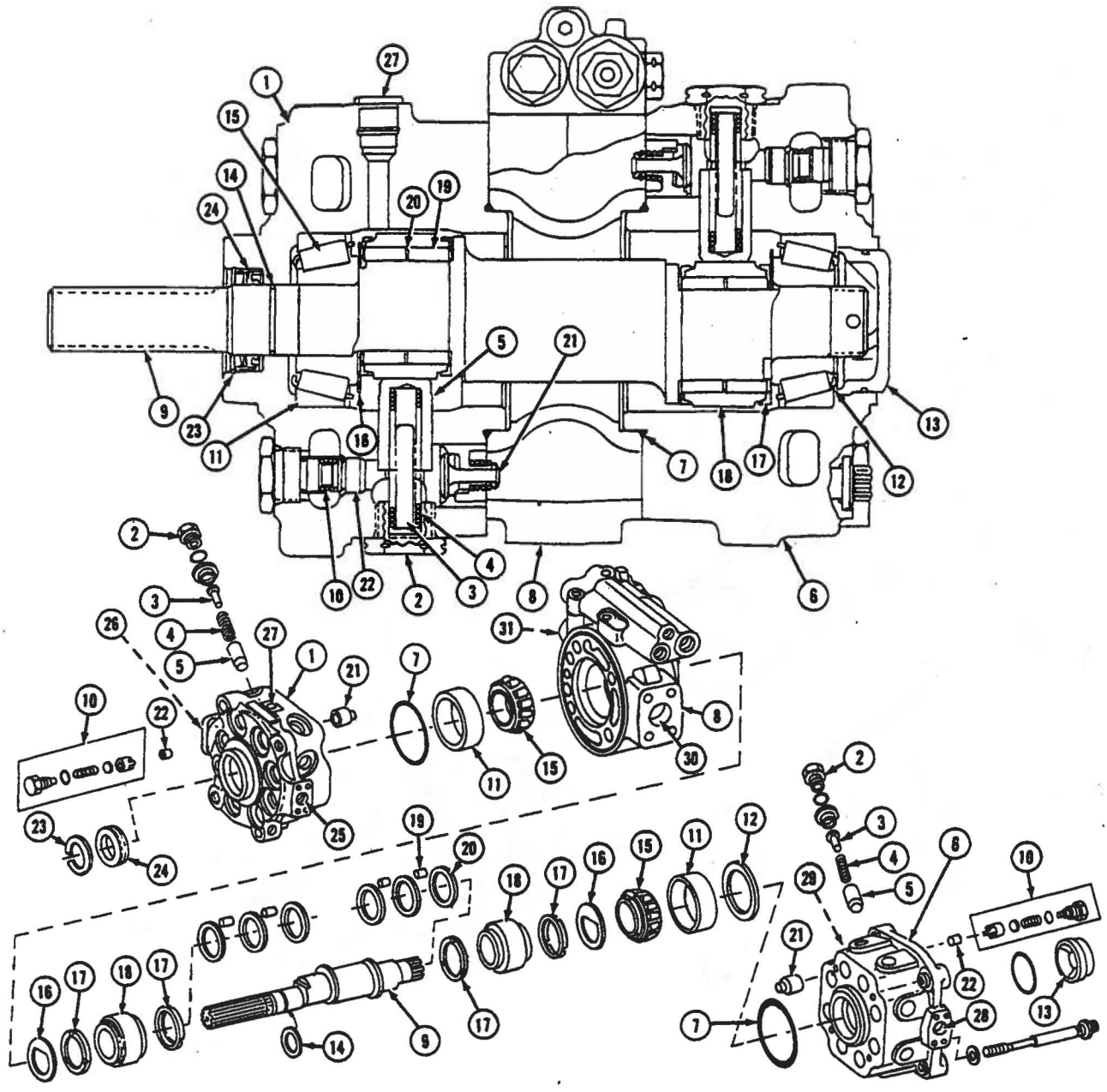


(Standard Drive Pump Shown)

1—Pump Housing
2—Piston Plug (8 used)
3—Cooling Pin (8 used)
4—Piston Spring (8 used)
5—Piston (8 used)
6—Shims (as required)
7—O-Ring
8—Bearing Cup (2 used)
9—Shaft
10—Discharge Valve (8 used)
11—Sealing Ring
12—Bearing Cone (2 used)
13—Spacer (2 used)
14—Thrust Washer (2 used)
15—Bearing Race
16—Needle Rollers (50 used)
17—Spacers (3 used)
18—Inlet Valve (8 used)
19—Discharge Valve Seat (8 used)
20—Snap Ring
21—Oil Seal
22—Discharge Port (S1)
23—Crankcase Port (C1)

AW1;R40179 R70;070300 1067 040288

CROSS-SECTION AND EXPLODED VIEW—DOUBLE BANK PUMP—3000 SERIES

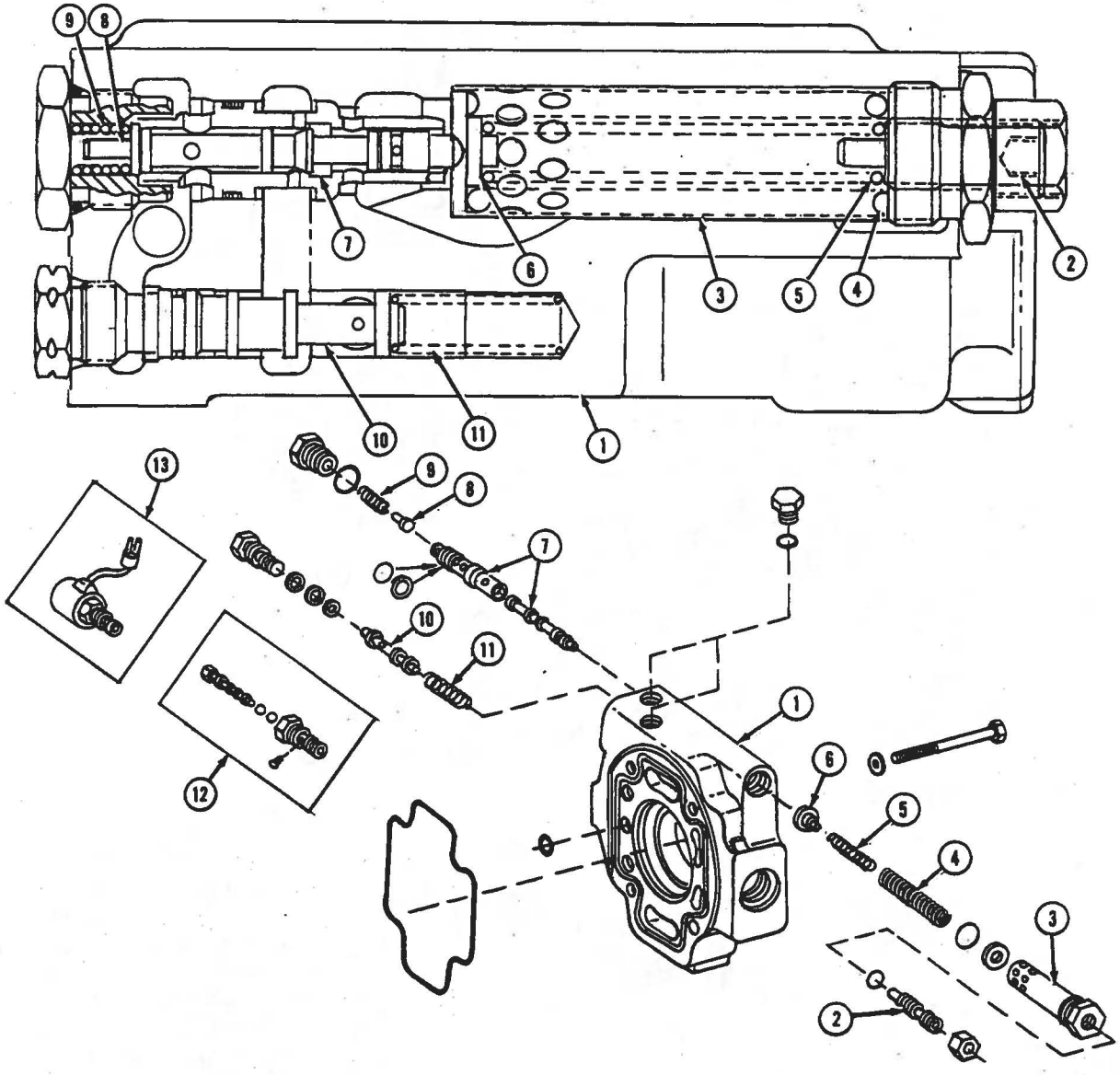


(Standard Drive Pump Shown)

1—Primary Housing
2—Piston Plug (16 used)
3—Cooling Pin (16 used)
4—Piston Spring (16 used)
5—Piston (16 used)
6—Secondary Housing
7—O-Ring (2 used)
8—Inlet Housing
9—Shaft
10—Discharge Valve (16 used)
11—Bearing Cup (2 used)
12—Shims (as required)
13—End Plug
14—Sealing Ring
15—Bearing Cone (2 used)
16—Spacer (2 used)
17—Thrust Washer (4 used)
18—Bearing Race (2 used)
19—Needle Rollers (100 used)
20—Spacer (6 used)
21—Inlet Valve (16 used)
22—Discharge Valve Seat (8 used)
23—Snap Ring
24—Oil Seal
25—Discharge Port (S1)
26—Discharge Port (S2)
27—Crankcase Access Port (C1)
28—Discharge Port (S3)
29—Discharge Port (S4)
30—Inlet Port (I1)
31—Inlet Port (I2)

AW1;R40180 R70;070300 1068 050288

CROSS-SECTION AND EXPLODED VIEW—CONTROL VALVE—3000 SERIES *(NON-UNITIZED DESIGN)*

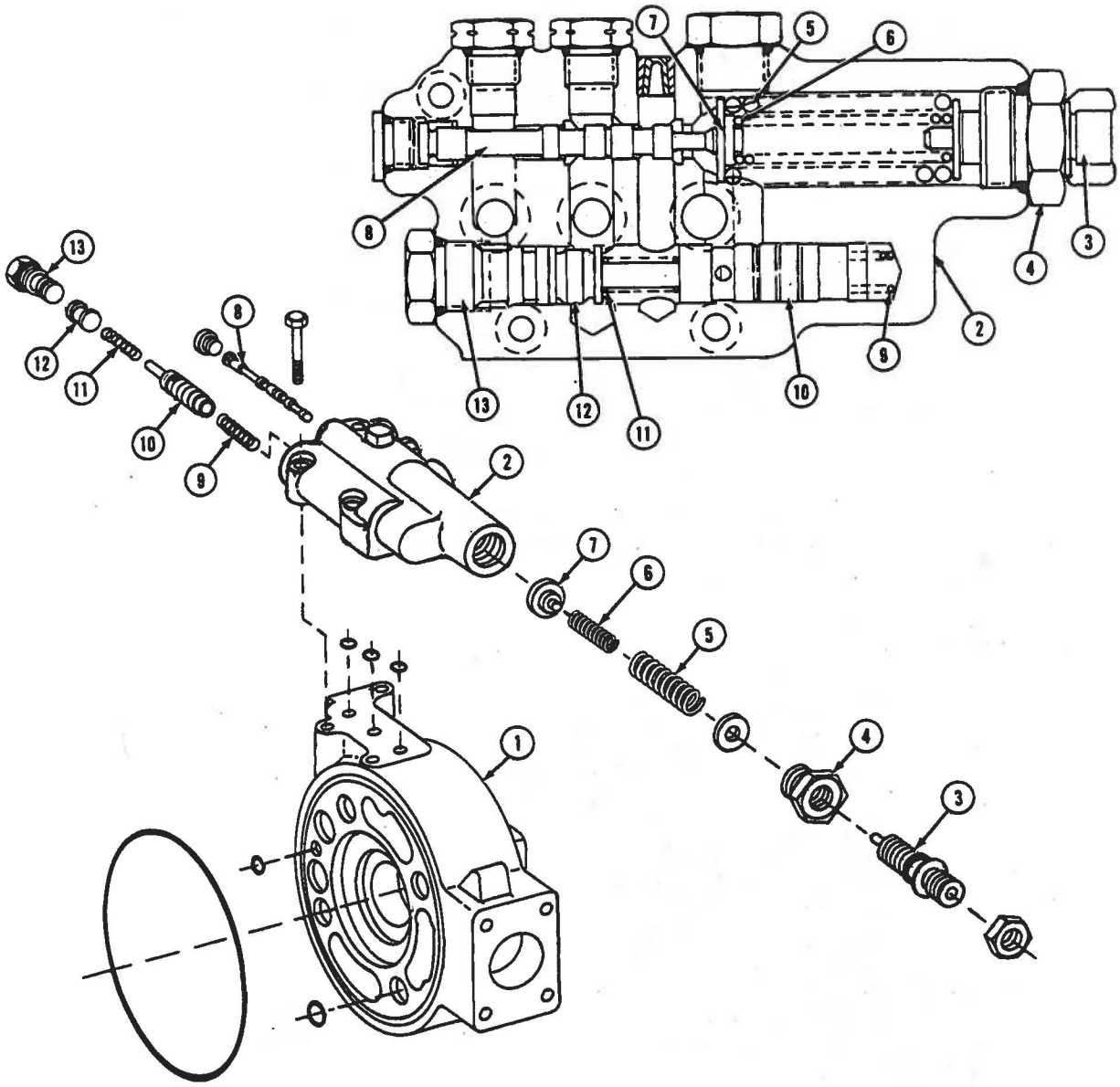


(Standard Drive Single Bank Shown)

1—Inlet Housing
2—Pressure Compensator Adjusting Screw
3—Bushing With Sleeve
4—Pressure Compensator Outer Spring
5—Pressure Compensator Inner Spring (if used)
6—Spring Guide
7—Pressure Compensator Control Valve
8—Dampening Valve
9—Dampening Valve Spring
10—Shuttle Valve
11—Shuttle Valve Spring
12—Manual Destroke (Option)
13—Electric Destroke (Option)

AW1;R40184 R70;070300 1069 040288

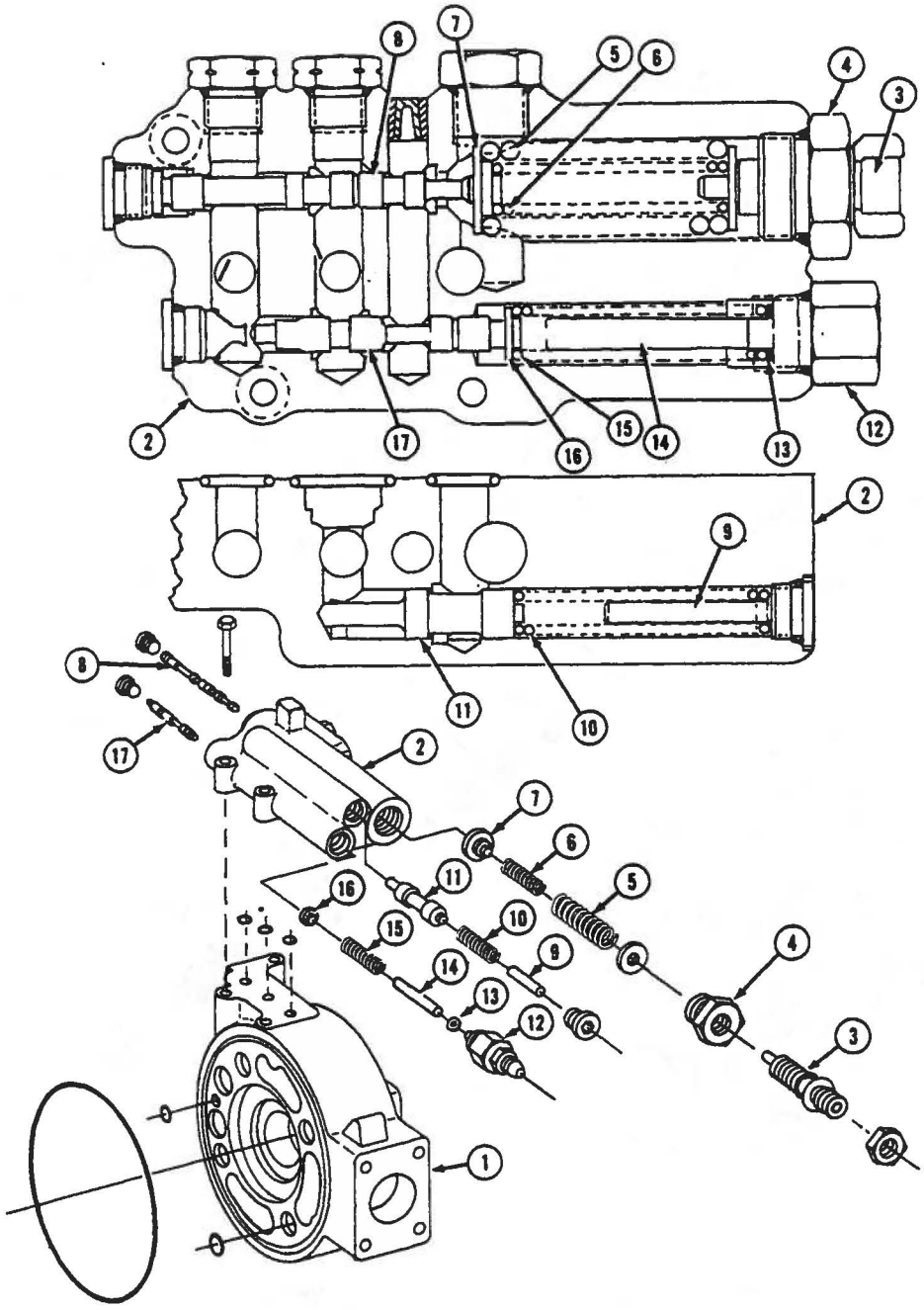
CROSS-SECTION AND EXPLODED VIEW—CONTROL VALVE—3000 SERIES *(UNITIZED DESIGN—PRESSURE COMPENSATED)*



1—Inlet Housing
2—Pressure Compensator Housing
3—Pressure Compensator Adjusting Screw
4—Special Plug
5—Pressure Compensator Outer Spring
6—Pressure Compensator Inner Spring (if used)
7—Spring Guide
8—Pressure Compensator Valve
9—Spring
10—Crankcase Relief Valve
11—Spring
12—Shuttle Valve
13—Destroke Port Plug

AW1;R40185 R70;070300 1070 090288

CROSS-SECTION AND EXPLODED VIEW—CONTROL VALVE—3000 SERIES *(UNITIZED DESIGN—LOAD SENSING)*



1—Inlet Housing
2—Load Sense Housing
3—Pressure Compensator Adjusting Screw
4—Special Plug
5—Pressure Compensator Outer Spring
6—Pressure Compensator Inner Spring (If used)
7—Spring Guide
8—Pressure Compensator Valve
9—Pin
10—Spring
11—Crankcase Relief Valve
12—Special Plug
13—Shims (as required)
14—Pin
15—Spring
16—Spring Guide
17—Load Sense Valve

AW1;R40186 R70;070300 1073 090288

REMOVE AND INSPECT PISTON ASSEMBLIES

IMPORTANT: Pistons must be installed in their original bores if they are reused. Write numbers on piston plugs and discharge valve plugs for identification.

1. Remove piston assemblies and put them in a parts tray to insure installation into the same bores from which they were removed.

2. Inspect piston plugs (A) for thread damage.

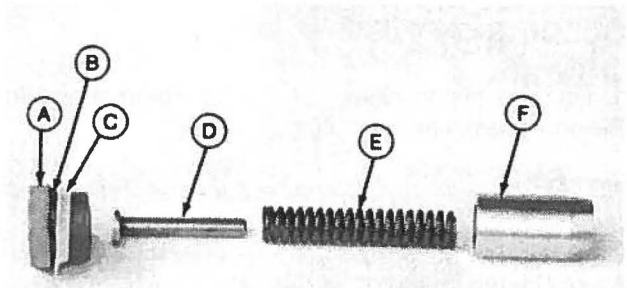
3. Inspect face and skirt of pistons (F). Replace all pistons and pump housing(s) if metal transfer, galling, or scoring exists.

IMPORTANT: All springs must be the same color code.

4. Inspect springs (E) for excessive wear or damage to coils. Replace ALL piston springs as a set if springs are questionable.

NEW SPRING SPECIFICATION

Free Length	77 mm (3.0 in.) (approximate)
Test Length	54.4 mm at 241—295 N (2.1 in. at 54—66 lb force)



A—Piston Plug
B—O-Ring
C—Shield
D—Cooling Pin
E—Spring
F—Piston

AW1;R39493 R70;070300 955 110588

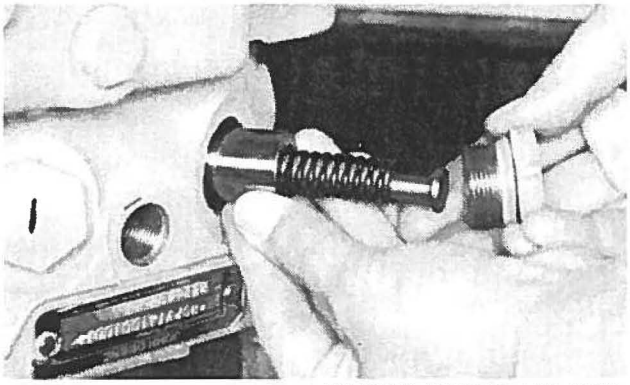
INSTALL PISTON ASSEMBLIES

1. Install new O-rings and plastic shields on piston plugs.

IMPORTANT: To prevent damage to O-rings and shields, DO NOT use an air-operated wrench to tighten piston plugs; use a torque wrench.

2. Install piston assemblies. For easier assembly, turn pump shaft so piston installed is on the low side of cam.

3. Tighten piston plugs to 200 N·m (150 lb-ft).



AW1;R39490 R70;070300 1003 050288

CHECK SHAFT END PLAY

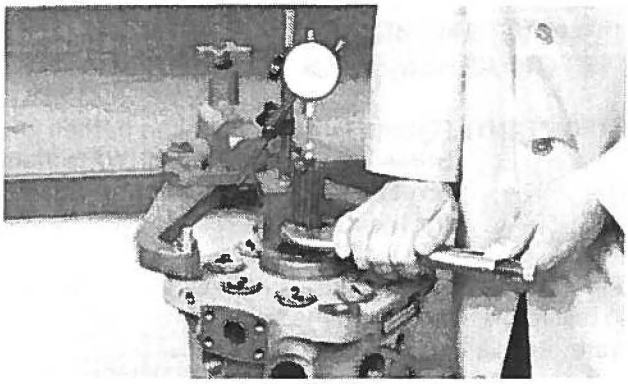
1. Remove piston assemblies. (See Remove and Inspect Piston Assemblies in this group.)

NOTE: Use vice grip with curved jaw for better clamping.

2. Install vice grips as tightly as possible on pump shaft approximately 5/8 in. from housing hub.

3. Put a dial indicator base on pump housing and indicator contact point on steel ball placed in center of pump shaft.

4. Turn shaft back and forth while pushing down to align the tapered roller bearings inside pump housing.



AW1;R39491 R70;070300 953 020288

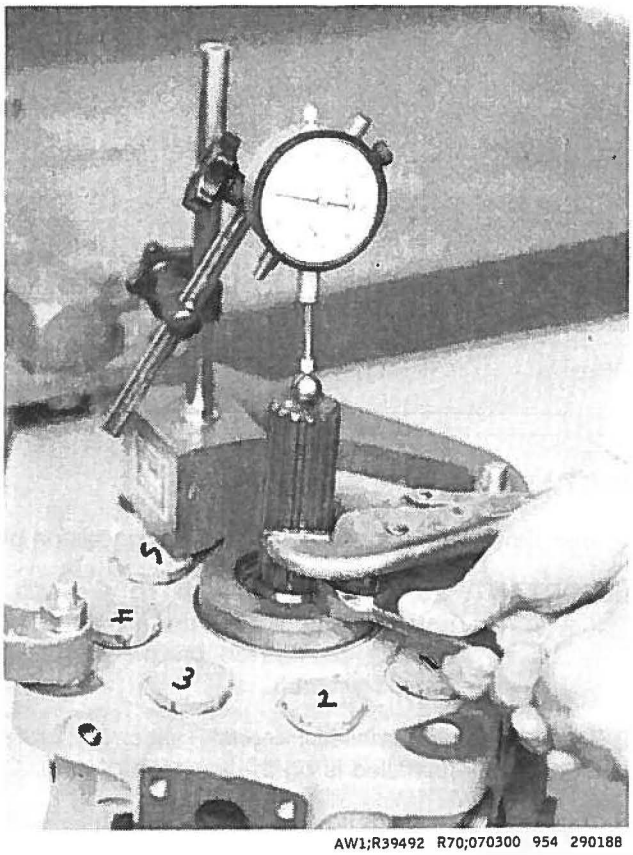
5. Zero the indicator.

6. Pry upward on vice grips using a long (3/4 in. minimum) box-end wrench noting indicator reading. If end play is more than specification, check bearings for wear.

END PLAY SPECIFICATION

Acceptable	0.025—0.100 mm (0.001—0.004 in.)

7. Increase number or size of shims in inlet housing on single bank pump to obtain correct specification.

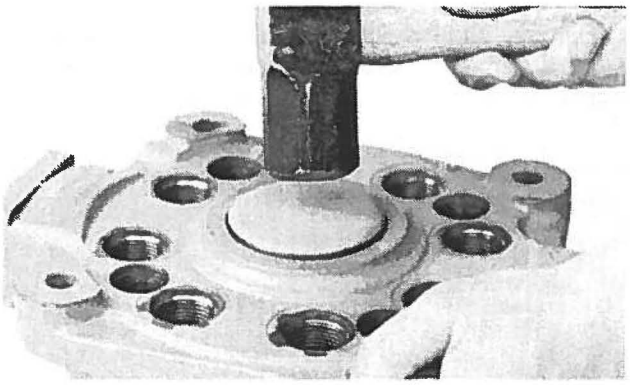


AW1;R39492 R70;070300 954 290188

For DOUBLE BANK pump, perform Steps 7a and 7b.

IMPORTANT: Double bank pump bearing cup removal in secondary housing will damage shims. DO NOT remove bearing cup if end play is within specification and cup does not appear to be worn or damaged.

NOTE: On double bank pump with "B" drive, remove bearing cup and shims using a bearing cup puller.



7a. Drive end plug through secondary housing on double bank pump to remove bearing cup and shims.

7b. Increase number or size of shims in secondary housing to obtain correct specification.

AW1;R39502 R70;070300 967 020288

REMOVE AND INSTALL PUMP SHAFT

IMPORTANT: Pistons must be installed in their original bores if they are reused.

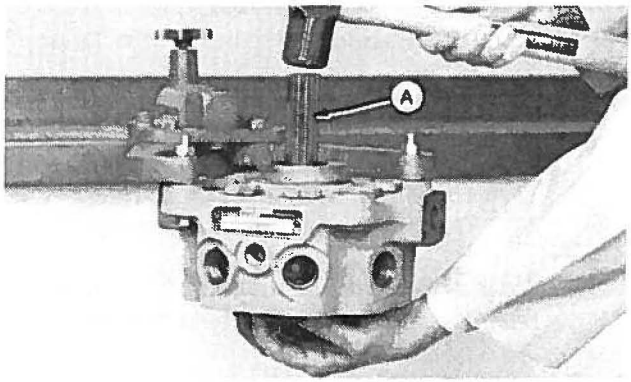
1. Remove piston assemblies. (See Remove and Inspect Piston Assemblies in this group.)

2. Remove secondary pump housing on double bank pump.

3. Remove inlet housing from primary pump housing. (See Remove and Install Inlet Housing in this group.)

R70;070300 959 290188

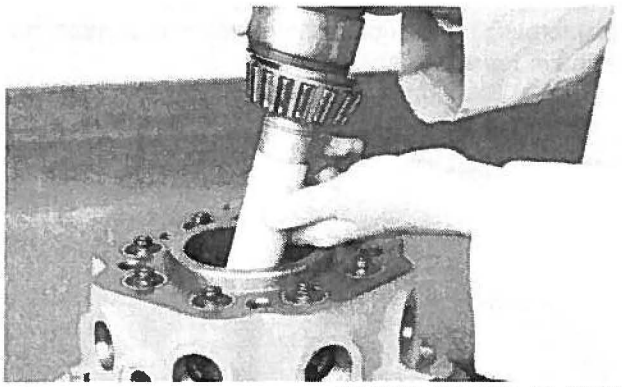
4. Remove pump shaft assembly (A) on single bank pump using a hammer to remove bearing cup. Lift shaft from primary housing on double bank pump.



AW1;R39495 R70;070300 964 290188

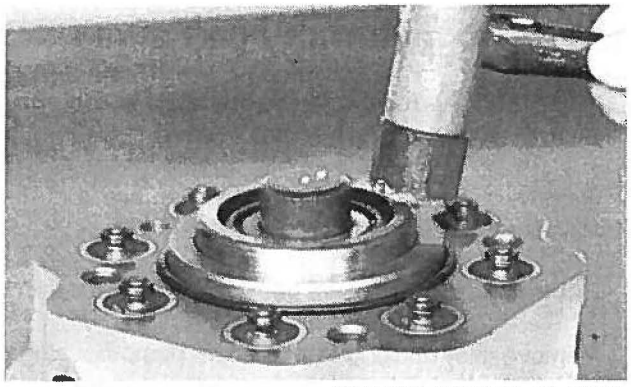
5. Replace oil seal in primary pump housing before installing pump shaft. (See Remove and Install Oil Seal in this group.)

6. Install pump shaft in primary pump housing using JDG494 Spline Protector to prevent seal damage.



AW1;R39605 R70;070300 995 020288

7. Install bearing cup on single bank pump leaving cup partially away from bearing cone. Installation of shims and inlet housing will properly align bearing cup and cone.



AW1;R39606 R70;070300 996 290188

DISASSEMBLE AND INSPECT PUMP SHAFT

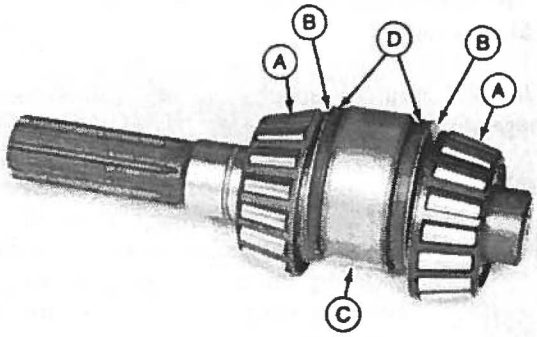
NOTE: Single bank pump shaft is shown.

1. Visually inspect taper bearing cones (A) for damaged cage or rollers.

2. Visually inspect fixed spacers (B) and thrust washers (D) for wear or damage.

3. Inspect race (C) for nicks, scratches, pitting or metal discoloration. Replace race and pistons if external damage exists.

4. Hold pump shaft and slowly turn race (C). If assembly is sticking or noisy, replace ALL needle rollers between race and pump journal.

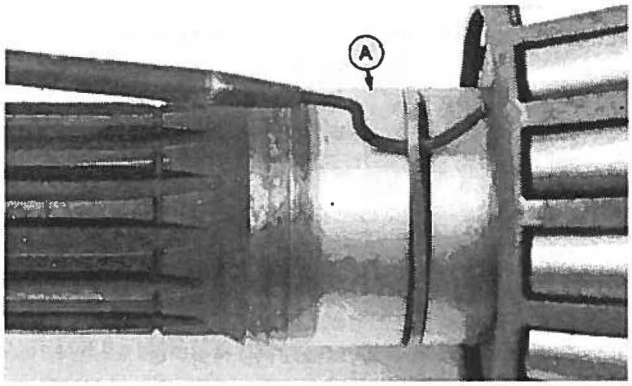


A—Bearing Cones
B—Fixed Spacers
C—Race
D—Thrust Washers

AW1;R39499 R70;070300 965 290188

IMPORTANT: Be careful not to scratch or damage machined shaft surface (A). This could cause seal leakage.

5. Remove sealing ring(s) from shaft using an O-ring Seal Tool Set.



AW1;R39945 R70;070300 969 150589

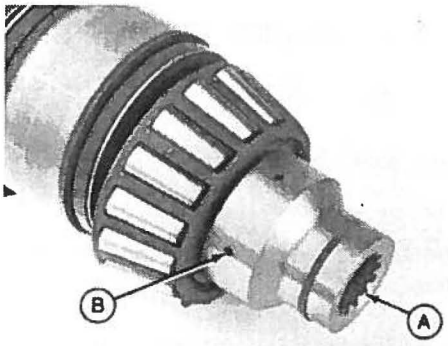
For "B" DRIVE COUPLER, perform Steps 5a, 5b, 5c, 5d, 5e, 5f, and 5g.

5a. Inspect coupler splines (A) for excessive wear or damage.

IMPORTANT: Do not remove coupler from shaft unless absolutely necessary. Coupler will have to be removed in order to remove rear bearing cone on pump shaft and rear bearing race assembly on double bank pump shaft.

NOTE: Machine screws should be ground on the ends so shaft length of screws are 7.9 mm (5/16 in.) long. This is important when compressing snap ring during coupler removal.

5b. Insert a No. 2 or No. 3 machine screw 3/8 in. long into each of the five holes (B) in coupler. Check for snap ring spring-back by pushing on screw while pushing coupler toward bearing. Snap ring must be under all five holes before coupler can be removed. Skip Step 5c and 5d if snap ring is under all five holes.



AW1;RW1673 6 R70;070300 1199 170589

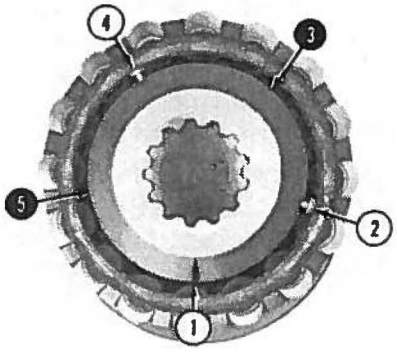
5c. Mark hole (1) where snap is not present.

5d. Put screws in holes (2) and (4) and use the following push-release sequence to make snap ring "walk around" internal groove:

A—Push 2 Push 4

B—Release 2 Release 4

Continue sequence until snap ring is under all five holes in coupler.

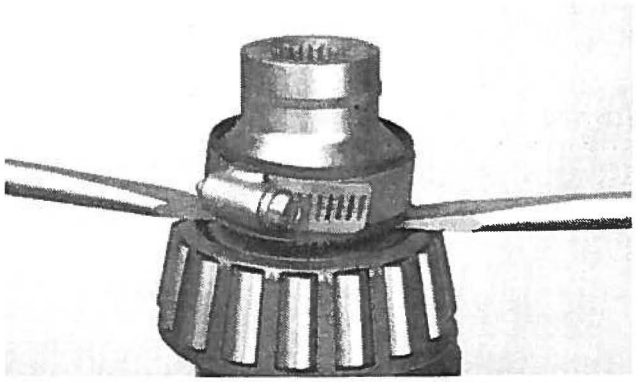


AW1;RW1673 7 R70;070300 1200 150589

5e. Compress snap ring in coupler by installing No. 2 or No.3 machine screws in each of the five holes in coupler. Use a piece of metal strapping material and a hose clamp to compress snap ring.

5f. Pry coupler off end of shaft while snap ring is compressed.

5g. Inspect internal splines of coupler for excessive wear or damage. Replace snap ring as required.



AW1;RW1673 8 R70;070300 1201 170589

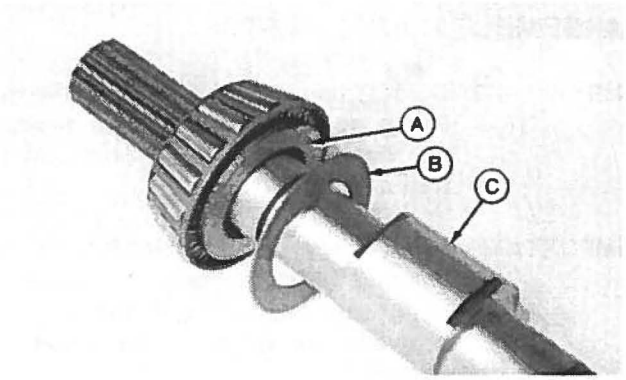
6. Remove bearing cones using a bearing puller.

7. Disassemble pump shaft assembly.

8. Inspect shoulder surface (A) of taper roller bearings. Replace if spacer wear exists.

9. Inspect fixed spacers (B). Replace if scored or discolored.

10. Inspect pump shaft journal (C). Replace if pitted, scored, or discolored.



NEW PART SPECIFICATION

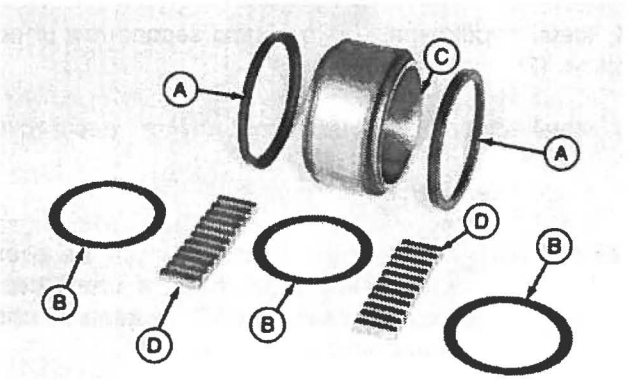
Pump Shaft Journal OD	44.302—44.318 mm (1.7442—1.7448 in.)

AW1;R39504 R70;070300 971 110589

11. Inspect thrust washers (A) for cracking or chipping. Inspection may require magnification.

12. Inspect spacers (B). Replace if scored or discolored.

13. Inspect race (C). Replace if scored or discolored.



NEW PART SPECIFICATION

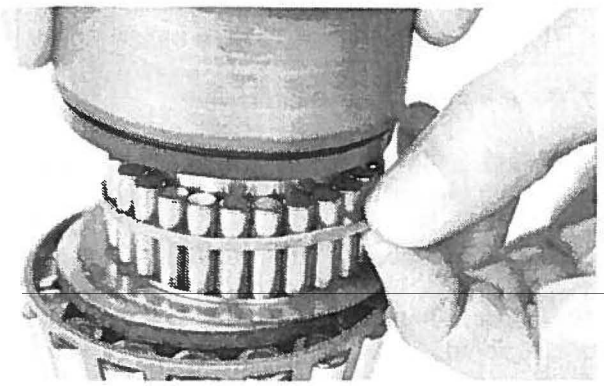
Race ID	57.041—57.061 mm (2.2457—2.2465 in.)
Race OD	71.475—71.525 mm (2.8140—2.8159 in.)

14. Inspect needle rollers (D). Replace ALL needle rollers if any are scratched, pitted or discolored.

A—Thrust Washers
B—Spacers
C—Race
D—Needle Rollers

AW1;R39505 R70;070300 972 290188

ASSEMBLE PUMP SHAFT



IMPORTANT: DO NOT use grease to hold needle rollers. Doing so can restrain roller movement and cause pump failure. Use only clean hydraulic oil.

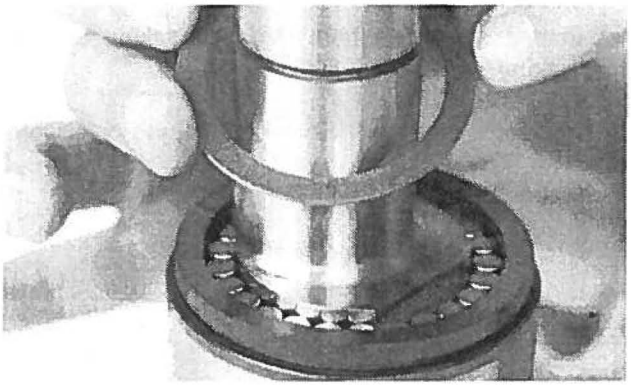
IMPORTANT: Fixed spacers on double bank pump are installed only after races are installed on pump shaft. One fixed spacer is used between each race and taper roller bearing.

1. Put spacer on pump shaft.

2. Install first row needle rollers (25 used) on shaft journal using a rubber band to aid installation.

3. Install race with thrust washers onto pump shaft sliding race over first row needle rollers. Pull rubber band over race as race slides over needle rollers.

AW1;R39600 R70;070300 989 290188



4. Install middle spacer in race and second row of needle rollers (25 used).

5. Install third spacer over second row of needle rollers.

6. Install fixed spacer on pump shaft.

IMPORTANT: Taper roller bearings must be pressed onto pump shaft even if shaft has not been disassembled. This assures correct pump shaft end play.

7. Press bearing cones against pump shaft journal making sure fixed spacer aligns properly with slot in shaft journal.

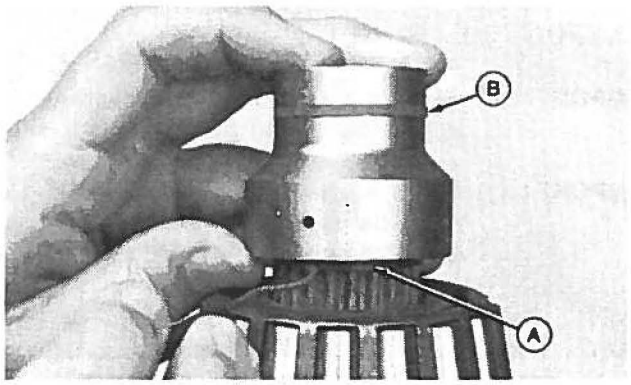
AW1;R39601 R70;070300 990 290188

For "B" DRIVE COUPLER, perform Steps 7a, 7b, and 7c.

7a. Install snap ring on pump shaft groove.

7b. Install coupler on end of shaft using an O-ring Seal Tool Set to compress snap ring (A) while pushing on coupler.

7c. Install new sealing ring (B) on coupler using procedure in Steps 8, 9, and 10.



AW1;RW1673 9 R70;070300 1202 150589

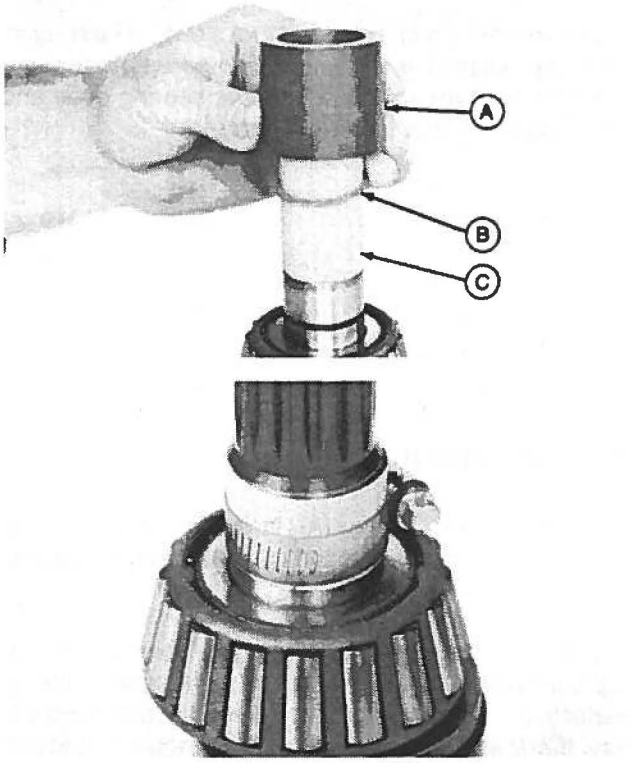
NOTE: Use optional JDG493 Shaft Seal Sizer Tool (A) to aid sealing ring installation.

8. Install JDG494 Spline Protector Tool (C) on pump shaft.

9. Carefully slide new sealing ring (B) over spline protector and down into groove on pump shaft making sure sealing ring does not twist. Use optional JDG493 Sizing Tool (A) to aid installation.

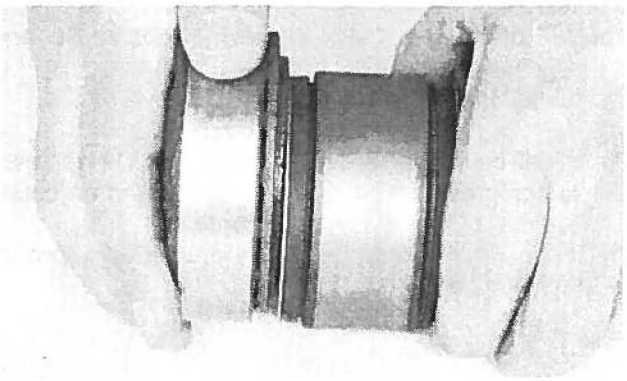
NOTE: Optional JDG493 Sizing Tool may be used in place of hose clamp.

10. Clamp sealing ring in groove using a hose clamp. Put shim stock between clamp and sealing ring to prevent sealing ring damage. Leave hose clamp in place approximately five minutes to allow sealing ring to set.



AW1;R37912,R39604 R70;070300 993 110589

INSPECT BEARING CUPS



IMPORTANT: Bearing cups must be used with the same cone from which they were removed.

IMPORTANT: Pump housing, bearing cones and cups must be replaced if bearing cups show signs of spinning.

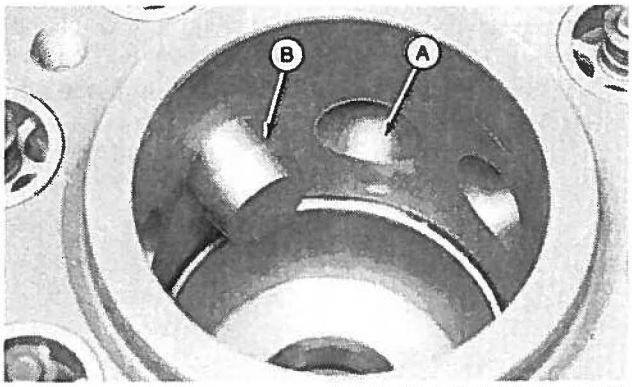
NOTE: Bearing cup removal from secondary housing on double bank pump will damage shims. New shims must be used if bearing cup is removed.

1. Inspect bearing cups for damage.

2. Put bearing cup on cone and turn slowly. If bearing makes a clicking noise or is sticking, clean and dip cone in clean hydraulic oil. Turn again and replace bearing cone and cup if bearing continues to click or stick.

AW1;R39503 R70;070300 968 020288

INSPECT PUMP HOUSING

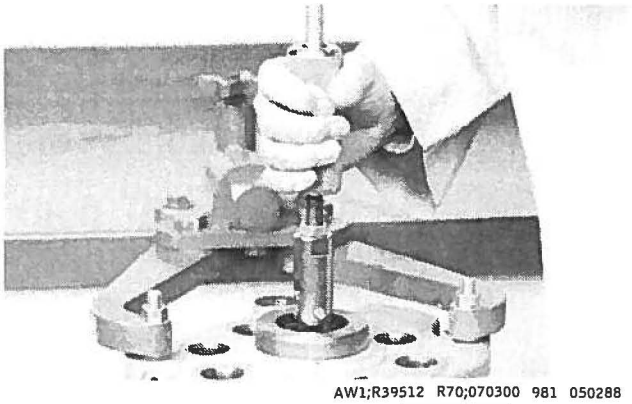


1. Inspect piston bores (A) in pump housing. Replace housing and pistons if scoring, galling or metal transfer exists.

2. Install each piston (B) into its bore so it extends approximately 13 mm (0.5 in.) into crankcase after visual inspection. . Pistons must slide smoothly and have no side play. If any side play is found, replace housing and pistons.

AW1;R39506 R70;070300 973 110589

REMOVE AND INSTALL OIL SEAL



NOTE: Through drive shaft has an oil seal on both ends of pump.

1. Remove oil seal retaining snap ring(s).

2. Remove oil seal(s) using a puller and slide hammer.

AW1;R39512 R70;070300 981 050288

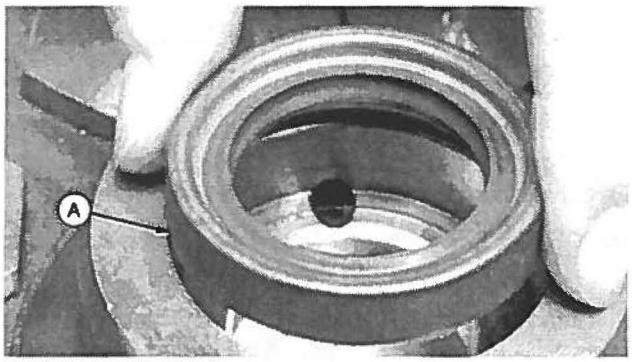
IMPORTANT: DO NOT push oil seal beyond inner edge of snap ring groove. Doing so can close drain passage and cause an oil seal failure.

NOTE: Use a 1-15/16 in. disk to aid installation.

3. Install oil seal (A) with lip (spring side) toward inside of pump housing making sure drain passage is not blocked.

4. Apply petroleum jelly to lips of oil seal(s) for lubrication when shaft is installed.

5. Install retaining snap ring(s).



AW1;T85279 R70;070300 982 110589

REMOVE, INSPECT AND INSTALL DISCHARGE VALVES

1. Remove inlet housing on single bank pump or secondary housing and inlet housing on double bank pump. (See Remove and Install Inlet Housing in this group.)

IMPORTANT: Discharge valve assemblies must be installed in their original bores.

2. Remove discharge valve assemblies and put them in a parts tray to insure installation into the same bores from which they were removed.

3. Inspect valve guide (A) for fatigue cracks at tabs and radius of legs.

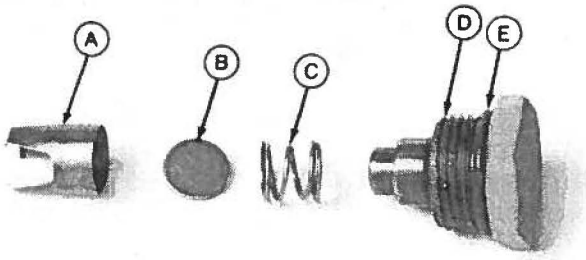
4. Inspect discharge valve plug (D) for thread damage or wear on stop.

5. Inspect springs (C) for excessive wear to coils and end surface of coils. Replace spring if wear is questionable.

NEW SPRING SPECIFICATION

Free Length	12.7 mm (0.5 in.) (approximate)
Test Length	9.3 mm at 17—24 N (0.4 in. at 4—5 lb force)

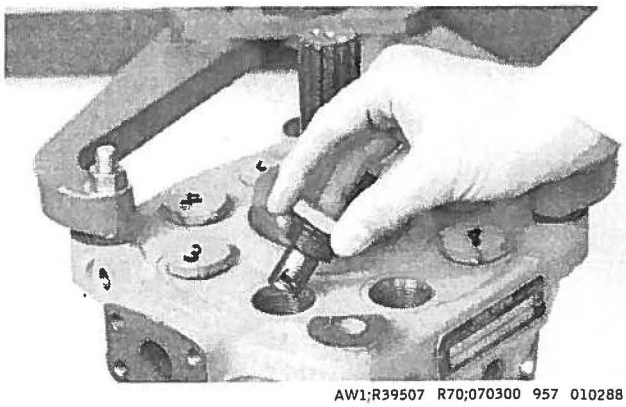
6. Inspect valve (B) for erosion, pitting or excessive wear. Replace valve if wear is excessive. Discharge valve seat should also be checked for wear. (See Inspect, Remove and Install Discharge Valve Seats in this group.)



A—Valve Guide
B—Discharge Valve
C—Spring
D—Discharge Valve Plug
E—O-Ring

AW1;R39508 R70;070300 958 040288

7. Install discharge valve assemblies with new O-rings. Tighten discharge valve plugs to 140 N·m (100 lb-ft).



AW1;R39507 R70;070300 957 010288

INSPECT, REMOVE AND INSTALL DISCHARGE VALVE SEATS

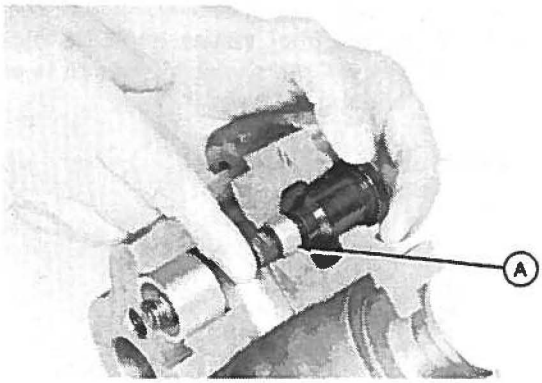
1. Wipe discharge valve seats (A) with your finger accessing seat through the discharge valve bores. This should be done before inspection since oil on valve seat may give impression of seat damage.

2. Visually inspect discharge valve seats (A) for peening or damage.

IMPORTANT: Press fit is critical for sealing, DO NOT remove discharge valve seats unless replacement is absolutely necessary.

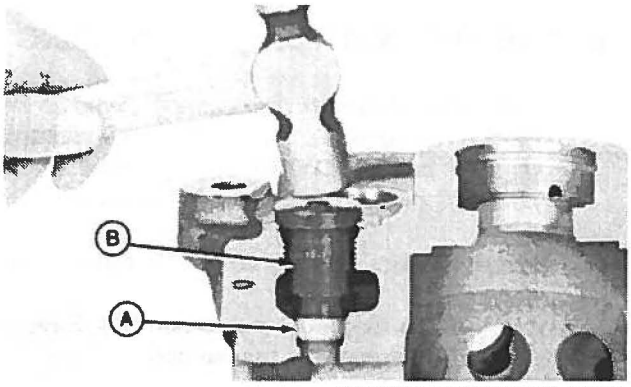
3. Install special screw into seat through piston bore and JDG539 Installer and Removal Tool through discharge valve bore.

4. Install a slide hammer and adapter into the tool and remove seat.



AW1;R39509 R70;070300 974 020288

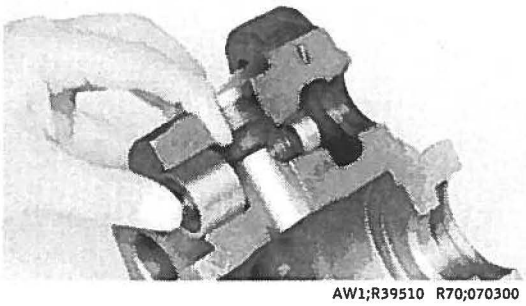
5. Install new discharge valve seat (A) using JDG539 Installer and Removal Tool (B). Drive seat into housing until flange of tool is against face of housing.



AW1;R39597 R70;070300 986 010288

INSPECT, REMOVE AND INSTALL INLET VALVES

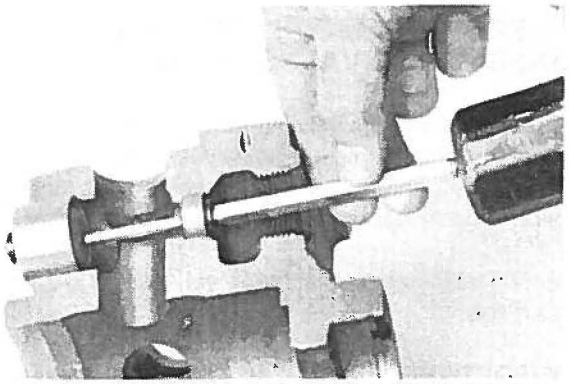
1. Check inlet valves for free valve movement and valve lift. Valve should move until retainer contacts valve body. If valves are not broken and move freely, do not remove.



AW1;R39510 R70;070300 979 020288

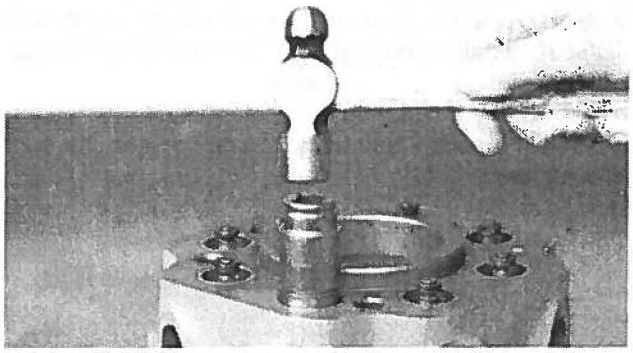
IMPORTANT: Removed inlet valves must be replaced with new valves, since press fit is critical for sealing.

2. Remove inlet valves and discard.



AW1;R39511 R70;070300 980 090288

3. Install new inlet valve assemblies using a socket. Drive valves into pump housing until they are flush with housing surface.



AW1;R39598 R70;070300 987 090288

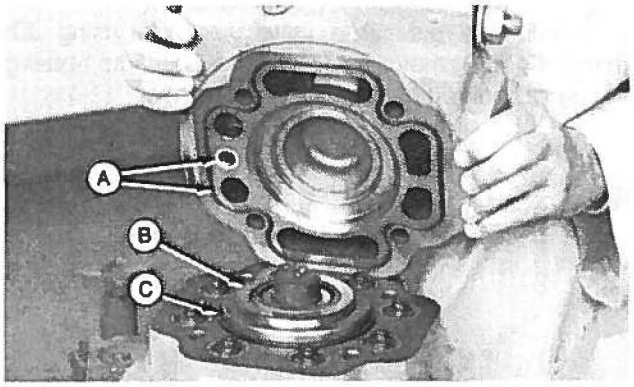
REMOVE AND INSTALL INLET HOUSING

NOTE: Non-unitized design single bank pump is shown. Packing designs are different for non-unitized versus unitized pumps. Double bank pump has special packings on both sides of inlet housing.

1. Remove secondary housing on double bank pump.

2. Remove inlet housing from pump housing. Save shims (B) on single bank pumps for reassembly.

3. Discard special packings (A) and O-ring (C).



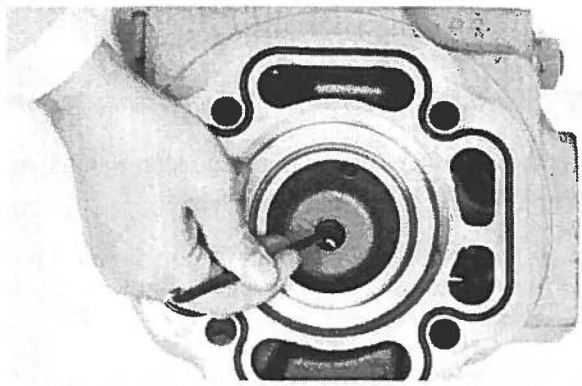
AW1;R39494 R70;070300 961 150589

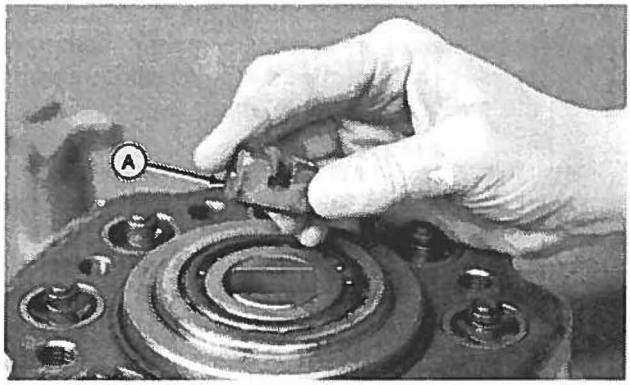
For pump with AUXILIARY GEAR-DRIVEN CHARGE PUMP, perform Steps 3a and 3b.

3a. Install new charge pump drive seal in inlet housing.

IMPORTANT: DO NOT move pump until inlet housing and charge pump have been installed. Doing so may cause drive key in end of pump shaft to become dislodged.

3b. Inspect special key (A) for excessive wear or damage and install into end of pump shaft.





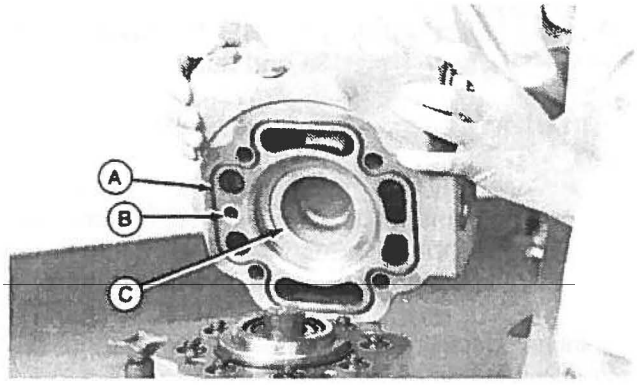
AW1;R39608,R39610 R70;070300 997 110589

For SINGLE BANK pump, perform Step 3c.

NOTE: Non-unitized design single bank pump is shown.

3c. Install shims (C) in inlet housing using a small amount of petroleum jelly to hold shims in place.

4. Install special packings (A and B) and O-ring on center hub of pump housing, using small amount of petroleum jelly to hold packings in place.



CAUTION: Failure to align the high-pressure passages will keep the pump in full stroke. This could result in hydraulic system damage and possibly a high-pressure leak which could create a risk of personal injury.

5. Install inlet housing making sure high-pressure passage (B) in inlet housing and primary pump housing are aligned.

6. Install secondary housing on double bank pump making sure high-pressure passages align.

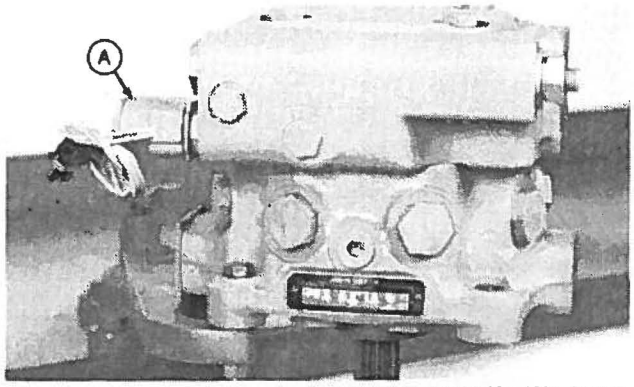
7. Install cap screws and tighten cap screws alternately to 200 N·m (150 lb-ft).

AW1;R39607 R70;070300 998 150288

DISASSEMBLE, INSPECT AND ASSEMBLE PRESSURE COMPENSATOR VALVE— *(NON-UNITIZED DESIGN)*

NOTE: Inlet housing does not have to be removed from pump for servicing pressure compensator.

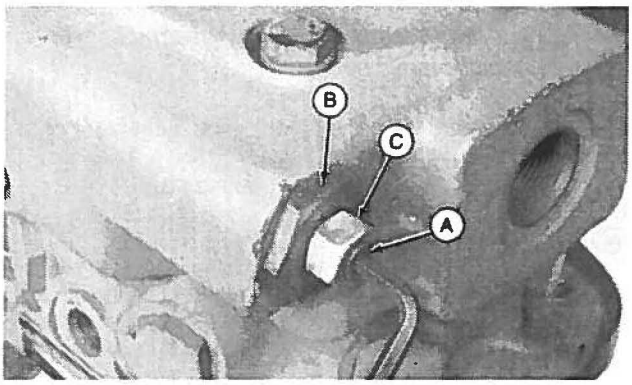
1. Remove electric destroke solenoid (A) from inlet housing, if so equipped, to prevent damage to solenoid during pressure compensator valve repair.



AW1;R39611 R70;070300 1006 040288

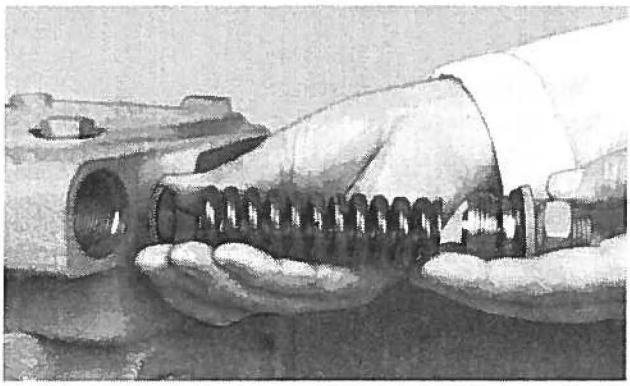
2. Remove adjusting screw (A) and sleeve assembly (B) by first loosening nut (C).

NOTE: Several adjusting screw assemblies exist.

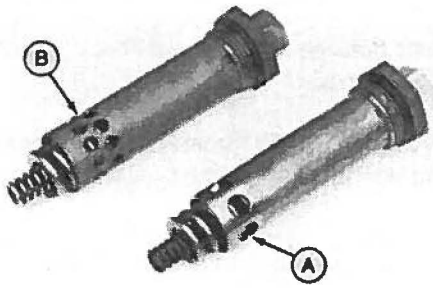


AW1;RW1671 6 R70;070300 1007 110589

IMPORTANT: Pump pressure adjusting screw assembly WITHOUT spring sleeve is not serviceable. Pressure compensator should be updated to design with spring sleeve. Kits are available.



Two spring sleeve designs exist. Spring and sleeve assemblies with a single row of holes (A) are NOT serviceable and should be updated to the design with two rows of holes (B). Kits are available.



AW1;RW1671 7,RW1671 8 R70;070300 1051 150589

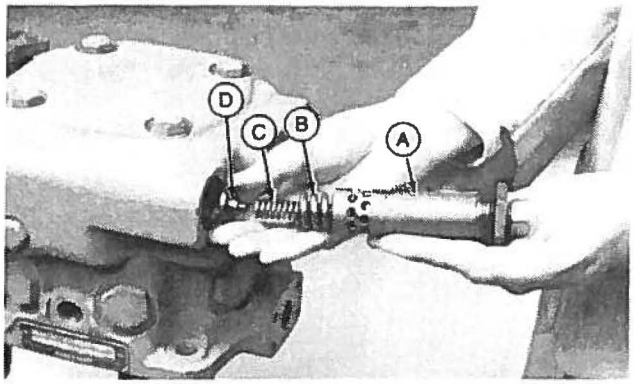
NOTE: Not all pressure adjusting assemblies will use the smaller inner spring (C).

3. Inspect springs (B) and (C) for excessive wear or damage.

NEW SPRING SPECIFICATION

Outer Spring		
No Color	Free Length	97mm (3.8 in.) (approx.)
	Test Length	78 mm at 1340—1640 N (3.1 in. at 300—370 lb force)
Green	Free Length	96 mm (3.7 in.) (approx.)
	Test Length	82 mm at 780 N (3.2) in. at 175 lb force)
Inner spring	Free Length	92 mm (3.6 in.) (approx.)
(if used)	Test Length	79 mm at 495—605 N (3.1 in. at 110—135 lb force)

4. Inspect guide (D) for wear.



A—Sleeve Assembly
B—Outer Spring
C—Inner Spring
D—Spring Guide

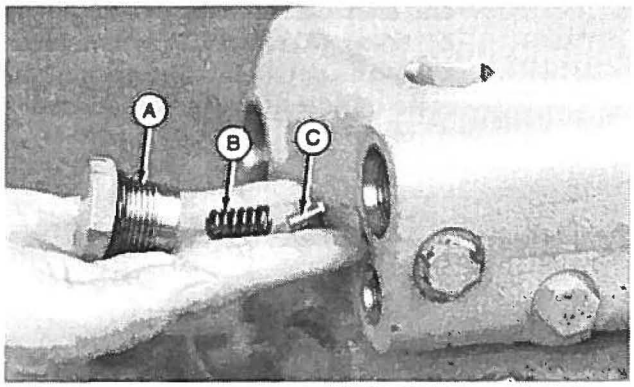
AW1;RW1671 9 R70;070300 1203 150589

NOTE: Inlet housing is shown with electric destroke solenoid removed.

5. Remove and inspect pressure compensator plug (A), dampening spring (B) and valve (C) for excessive wear or damage.

NEW SPRING SPECIFICATION

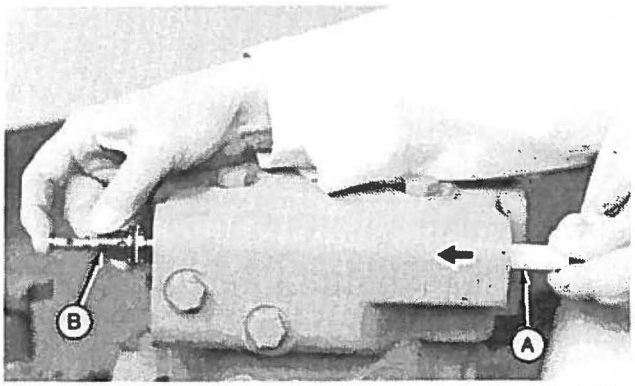
Free Length	20.6 mm (0.8 in.) (approximate)
Test Length	13.7 mm at 200—247 N (0.5 in. at 45—55 lb force)



AW1;R39614 R70;070300 1008 110589

6. Install small end of DFRW52 Pressure Compensator Valve Installation and Removal Tool (A) in center of valve assembly inside inlet housing. (See Dealer Fabricated Tools, Group 99.)

7. Carefully push on tool removing pressure compensator valve assembly (B).



AW1;R39615 R70;070300 1009 110589

8. Inspect pressure compensator valve assembly. Valve (A) must slide freely in sleeve (B). Replace assembly if valve sticks or hangs up in sleeve.

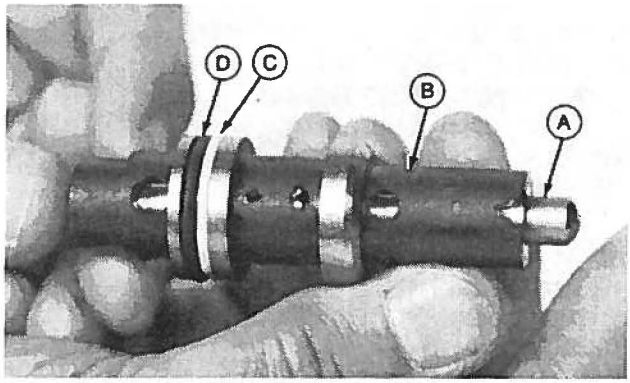
IMPORTANT: All pressure compensator parts must be thoroughly cleaned. All passage holes in parts must be open and clean.

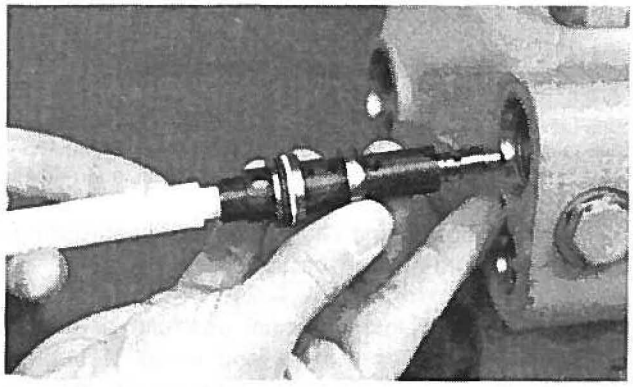
IMPORTANT: Valve (A) and sleeve (B) must be assembled correctly. Misassembly will cause pump malfunction.

9. Install new back-up (C) and O-ring (D) with back-up ring towards center of valve sleeve.

10. Carefully install valve assembly into housing using DFRW52 Pressure Compensator Valve Installation and Removal Tool. Push until valve bottoms out in housing. Scribe line on tool should be approximately even with opening in inlet housing.

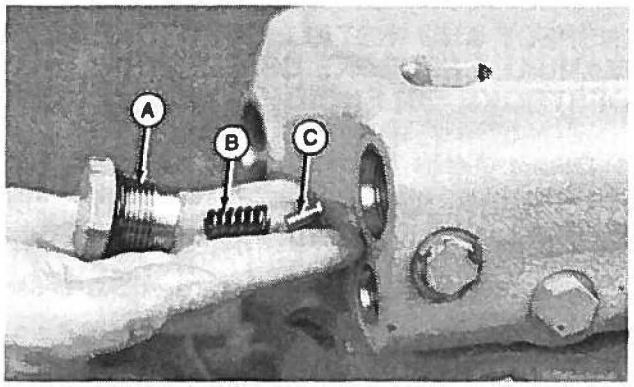
A—Valve
B—Sleeve
C—Back-Up Ring
D—O-Ring





AW1;R39616,R39620 R70;070300 1015 150589

11. Install retaining plug (A) with new O-ring, spring (B) and valve (C) into inlet housing tightening retaining plug to 140 N·m (100 lb-ft).

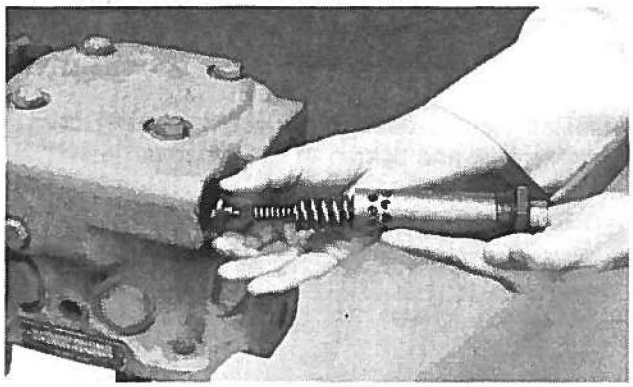


AW1;R39614 R70;070300 1016 110589

12. Install pressure adjusting assembly into inlet housing making sure spring guide protrusion is toward spring(s).

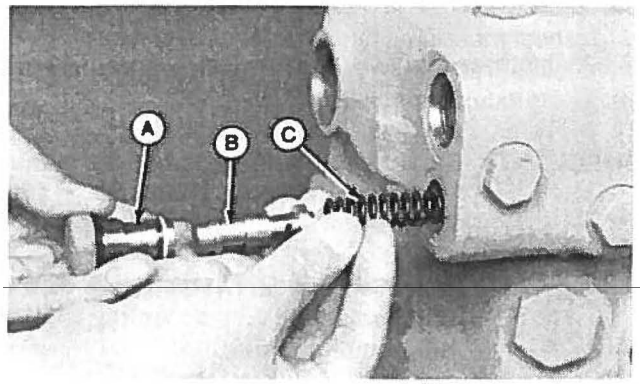
IMPORTANT: Adjusting screw should be set to a minimum depth to prevent excessive deadhead pressure at start up.

13. Check pump deadhead pressure setting. (See 3000 Series Operation and Tests, Group 115.)



AW1;R39698 R70;070300 1054 110589

DISASSEMBLE, INSPECT AND ASSEMBLE SHUTTLE VALVE— *(NON-UNITIZED DESIGN)*



NOTE: Some pumps may be equipped with an optional manual destroke or optional electric destroke solenoid in place of the destroke plug.

1. Remove destroke plug (A) or optional manual destroke or electric destroke solenoid.

2. Remove and inspect shuttle valve (B) and spring (C) for excessive wear or damage.

NEW SPRING SPECIFICATION

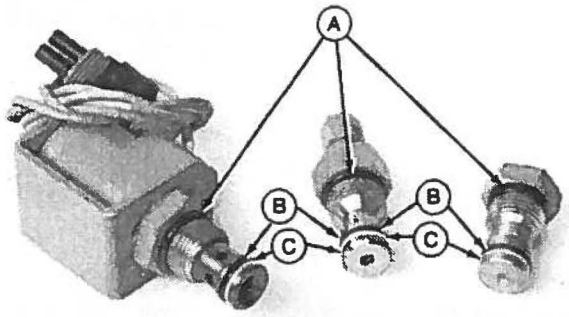
Free Length	45 mm (1.8 in.) (approximate)
Test Length	26.5 mm at 175—218 N (1.0 in. at 40—49 lb force)

3. Install spring (C) and shuttle valve (B) depressing valve against spring to insure free travel.

4. Install destroke plug, manual destroke or electric destroke solenoid. (See Inspect and Install Destroke Plug, Manual Destroke or Electric Destroke Solenoid in this group.)

AW1;R39617 R70;070300 1011 110589

INSPECT AND INSTALL DESTROKE PLUG, MANUAL DESTROKE OR ELECTRIC DESTROKE SOLENOID



1. Discard O-rings (A and B) and back-up ring (C) from destroke plug, manual destroke or electric destroke solenoid.

2. Inspect manual destroke or electric destroke for damage. Small hole(s) should be open.

IMPORTANT: Torque specification for electric destroke solenoid is different than destroke plug or manual destroke. Over torquing electric destroke solenoid may cause pump to malfunction.

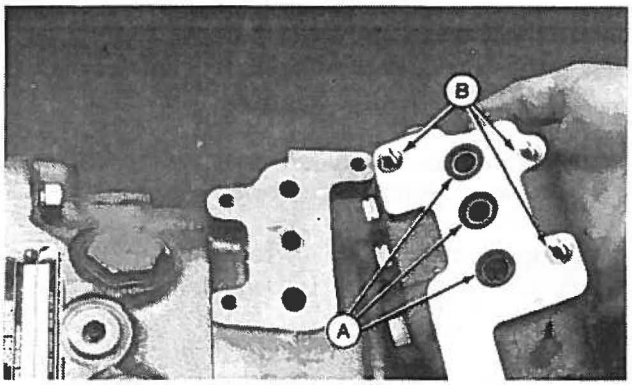
3. Install electric destroke solenoid, manual destroke or destroke plug and tighten to specification.

TORQUE SPECIFICATION

Manual Destroke Screw or Destroke Plug	61 N·m (45 lb-ft)
Electric Destroke Solenoid	34 N·m (25 lb-ft)

AW1;R39618 R70;070300 1012 110589

REMOVE AND INSTALL VALVE HOUSING— *(UNITIZED DESIGN)*



1. Remove valve housing from inlet housing.

2. Inspect valve housing and inlet housing surfaces for damage. Surfaces must be clean.

3. Replace all pressure packings (A).

IMPORTANT: Valve housing must be installed with shims on each cap screw. Cap screws must not be over-torqued.

4. Install valve housing with shims (B). Tighten cap screws to 15 N·m (11 lb-ft).

AW1;RW1673 3 R70;070300 1052 110589

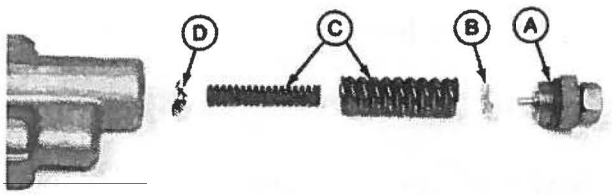
DISASSEMBLE, INSPECT AND ASSEMBLE PRESSURE COMPENSATOR VALVE— *(UNITIZED DESIGN)*

NOTE: Valve housing does not have to be removed from inlet housing for servicing.

1. Remove electric destroke solenoid from valve housing, if so equipped, to prevent damage to solenoid during valve repair.

2. Slowly loosen and remove pressure adjusting screw (A), also removing washer (B), spring(s) (C) and spring guide (D).

3. Inspect parts (A—D) for excessive wear or damage.



A—Pressure Adjusting Screw
B—Washer
C—Spring(s)
D—Spring Guide

NEW SPRING SPECIFICATION

Outer Spring		
Red	Free Length	71 mm (2.8 in.) (approx.)
	Test Length	60 mm at 580—700 N (2.4 in. at 130—158 lb force)
Blue	Free Length	71 mm (2.8 in.) (approx.)
	Test Length	60 mm at 930—1130 N (2.4 in. at 210—254 lb force)
Inner Spring .... (if used)	Free Length	68 mm (2.7 in.) (approx.)
	Test Length	58 mm at 270—330 N (2.3 in. at 60—74 lb force)

AW1;R40195 R70;070300 966 170589

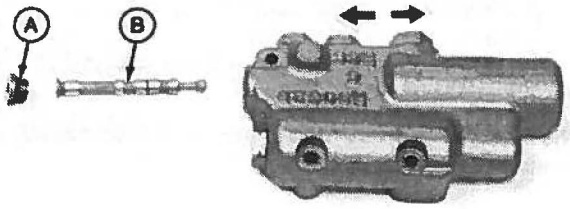
NOTE: Insert a brass dowel through the adjusting spring end of housing to aid in checking valve movement.

4. Remove plug (A) from housing and check for free back and forth movement of pressure compensator valve (B). If valve sticks, thoroughly clean valve and internal valve passage in housing. Dip valve in clean hydraulic oil and recheck for free movement. If valve continues to stick, valve housing assembly must be replaced.

IMPORTANT: Adjusting screw should be set to a minimum depth to prevent excessive deadhead pressure at start up.

5. Install pressure compensator valve and pressure adjusting assembly using new O-rings on adjusting plug and valve plug.

6. Check pump deadhead pressure setting. (See 3000 Series Operation and Tests, Group 115.)



AW1;R40196 R70;070300 1053 040288

DISASSEMBLE, INSPECT AND ASSEMBLE CRANKCASE RELIEF VALVE— *(UNITIZED DESIGN)*

NOTE: Pressure Compensator Housing and Load Sense Housing use two different crankcase relief valve designs. Valve function is the same.

For pumps equipped with Pressure Compensator Housing perform Steps 1, 2, 3, and 4.

1. Remove parts (A), (B), (C), (D), and (E) for standard crankcase relief valve assembly or parts (A), (E), and (F) for external control valve assembly.

2. Inspect parts for excessive wear or damage.

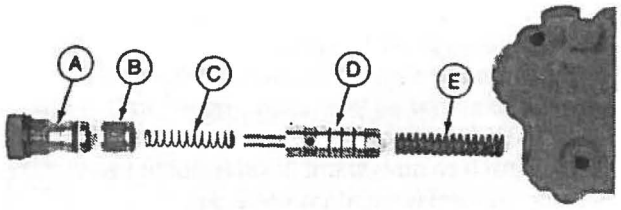
NEW SPRING SPECIFICATION

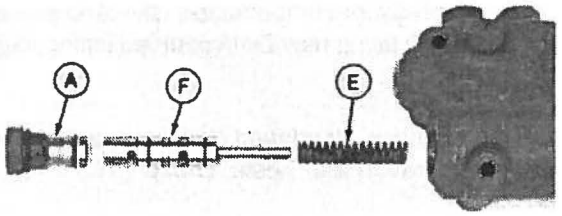
Shuttle Valve Spring (C)	Free Length ...	44 mm (1.7 in.) (approx.)
	Test Length ...	22 mm at 18—22 N (0.9 in. at 4—5 lb force)
Relief or Control Valve Spring (E) ...	Free Length ...	51 mm (2.0 in.) (approx.)
	Test Length ...	37 mm at 200—245 N (1.5 in. at 45—55 lb force)

3. Install spring (E) and crankcase relief valve (D) or external control valve (F) in housing and check for free valve movement. If valve sticks, thoroughly clean valve and valve bore in housing. Dip valve in clean hydraulic oil and recheck for free valve movement. If valve continues to stick, replace valve.

NOTE: New O-rings and backup rings should be installed on destroke plug, manual destroke or destroke solenoid. Torque specification for destroke solenoid is different than plug or manual destroke. (See Inspect and Install Destroke Plug, Manual Destroke or Electric Destroke Solenoid in this group.)

4. Reassemble valve assembly.





A—Destroke Plug
B—Shuttle Valve
C—Spring
D—Crankcase Relief Valve
E—Spring
F—External Control Valve

AW1;R40197, RW1673 5 R70;070300 1017 170589

For pumps equipped with Load Sense Housing perform Steps 1a, 2a, 3a and 4a.

1a. Remove plug (A), pin (B), spring (C) and crankcase relief valve (D).

2a. Inspect parts (A—D) for excessive wear or damage.

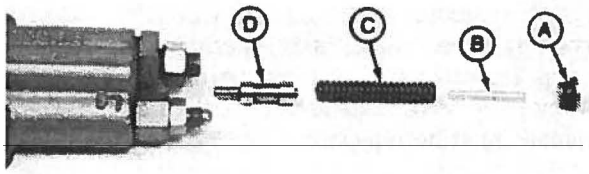
NEW SPRING SPECIFICATION

Free Length ..... 64 mm (2.5 in.) (approximate)
Test Length ..... 59 mm at 180—220 N
(2.3 in. at 40—49 lb force)

NOTE: Checking free valve movement can be accomplished by manipulating valve via ports on bottom of housing.

3a. Install crankcase relief valve in housing and check for free valve movement. If valve sticks, thoroughly clean valve and crankcase relief passage in housing. Dip valve in clean hydraulic oil and recheck for free valve movement. If valve continues to stick, replace valve.

4a. Reassemble crankcase relief valve assembly.



A—Plug
B—Pin
C—Spring
D—Crankcase Relief Valve

AW1;R40198 R70;070300 1018 110589

DISASSEMBLE, INSPECT AND ASSEMBLE LOAD SENSE VALVE— *(UNITIZED DESIGN)*

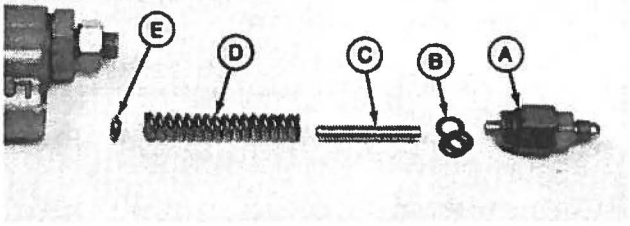
NOTE: Load sense valve is not used on all unitized valve assemblies.

1. Remove special load sense plug (A), shims (B), pin (C), spring (D) and spring guide (E).

2. Inspect parts (A—E) for excessive wear or damage.

NEW SPRING SPECIFICATION

Load Sense Spring		
Orange	Free Length	73 mm (2.9 in.) (approx.)
	Test Length	64 mm at 58—70 N (2.5 in. at 13—16 lb force)
Violet	Free Length	73 mm (2.9 in.) (approx.)
	Test Length	63 mm at 115—139 N (2.4 in. at 26—31 lb force)
Pink	Free Length	75 mm (3.0 in.) (approx.)
	Test Length	63 mm at 169—205 N (2.4 in. at 38—46 lb force)



A—Load Sense Plug
B—Shims
C—Pin
D—Spring
E—Spring Guide

AW1;R40199 R70;070300 1019 150589

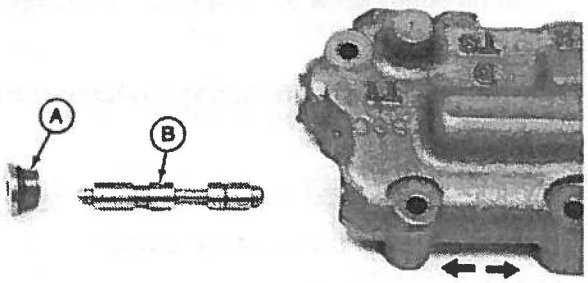
NOTE: Insert a brass dowel through spring end of housing to aid in checking valve movement.

3. Remove plug (A) from housing and check for free back and forth movement of load sense valve (B). If valve sticks, thoroughly clean valve and internal valve passage in housing. Dip valve in clean hydraulic oil and recheck for free movement. If valve continues to stick, load sense housing assembly must be replaced.

NOTE: A small amount of petroleum jelly on spring and spring guide will aid in assembling load sense valve assembly.

4. Install load sense valve, spring guide, spring, pin and the correct number of shims.

5. Install plugs with new O-rings.



AW1;R40200 R70;070300 1020 090288

SERVICE EQUIPMENT AND TOOLS

NOTE: Order tools from your Service-Gard™ Catalog. Some tools may be available from a local supplier.

Name	Use
O-Ring Seal Hook	Remove and install sealing ring

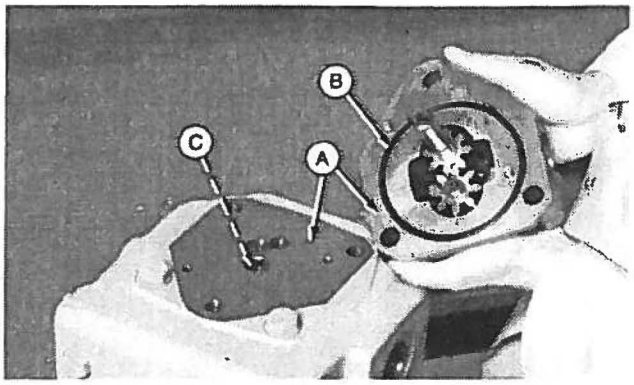
R70;070300 1140 110589

AUXILIARY CHARGE PUMP SPECIFICATIONS

Item	Measurement	Specification
Drive Gear Shaft	OD	16.023—16.033 mm (0.6308—0.6312 in.)
Driven Gear Bushing	ID	12.385—12.411 mm (0.4876—0.4886 in.)
Housing Idler Shaft	OD	12.319—12.335 mm (0.4850—0.4856 in.)
Housing Bushing	ID	16.129—16.179 mm (0.6350—0.6370 in.)
Gear	OD (allowable)	43.231 mm (1.7020 in.)
Gear	Length (allowable)	44.805 mm (1.7639 in.)
Gear	Side Clearance (allowable)	0.15 mm (0.006 in.)
Gear	End Clearance (allowable)	0.25 mm (0.010 in.)
Charge Pump-to-Pressure Compensator Housing—(2000 Series)	Torque	115 N·m (85 lb-ft)
Charge Pump-to-Inlet Housing—(3000 Series)		
Long Cap Screws	Torque	200 N·m (150 lb-ft)
Short Cap Screw	Torque	115 N·m (85 lb-ft)

R70;070300 1057 150589

DISASSEMBLE AND INSPECT AUXILIARY CHARGE PUMP



NOTE: 3000 Series auxiliary charge pump is shown. Drive gear shaft length is different for 2000 Series auxiliary charge pump.

IMPORTANT: DO NOT move 3000 Series hydraulic pump and inlet housing assembly with auxiliary charge pump removed. Doing so could dislodge key in end of pump shaft inside inlet housing causing hydraulic pump failure.

1. Carefully remove auxiliary charge pump from control valve housing.

2. Inspect surfaces (A) for damage that could cause oil leakage.

NOTE: O-ring packing extrusion may be caused by a loosened pressure compensator housing cap screw.

3. Discard O-ring packing (B) and seal (C) inside control valve housing.

AW1;R39640 R70;070300 1025 080288

4. Inspect drive gear shaft bearing area (A) for wear.

NEW PART SPECIFICATION

Drive Shaft OD	16.023—16.033 mm (0.6308—0.6312 in.)

5. Inspect bushing (B) for excessive wear, pitting or flaking. Install new gear if bushing requires replacement.

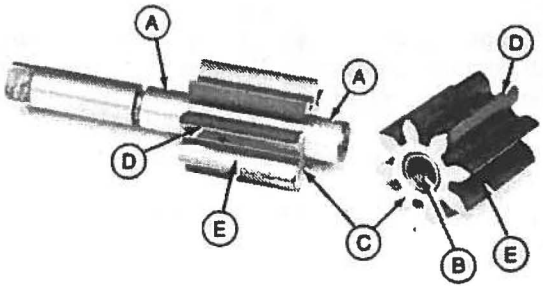
NEW PART SPECIFICATION

Bushing ID	12.385—12.411 mm (0.4876—0.4886 in.)

6. Inspect gear face (C) for radial scoring and wear.

7. Inspect gear tooth tip (D) for knife edge and rolled tip. Replace gears as a set if this condition is found.

8. Inspect gear tooth contact area (E) for pitting, scoring or metal transfer. Replace gears as a set if this condition is found.



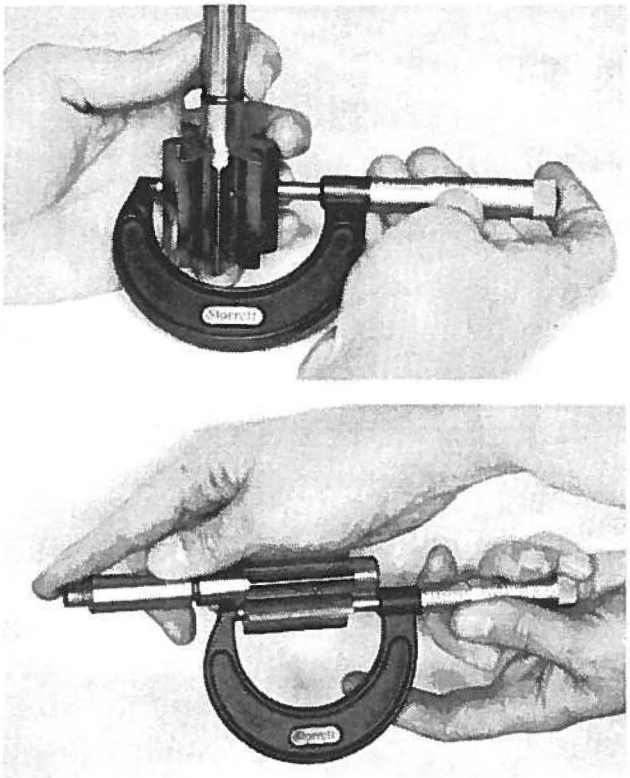
A—Bearing Area
B—Bushing
C—Gear Face
D—Gear Tooth Tip
E—Tooth Contact Area

AW1;R39628 R70;070300 1026 110589

9. Measure gear length and OD for excessive wear. Replace gears as a set if gears do not meet minimum specification.

MINIMUM ALLOWABLE GEAR SIZE

Gear OD	43.231 mm (1.7020 in.)
Gear Length	44.805 mm (1.7639 in.)



AW1;R39629, R39630 R70;070300 1027 060188

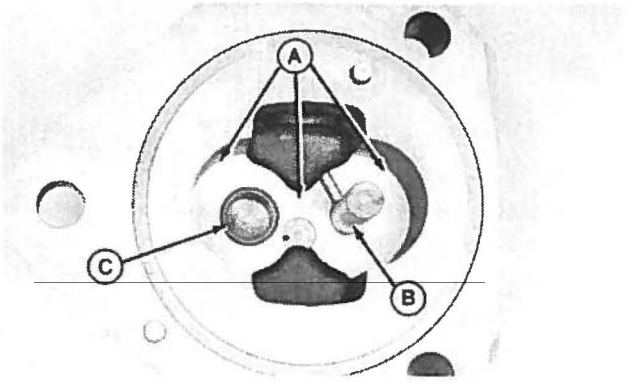
NOTE: A measurable gear track area indicates over pressurization or worn bushings.

10. Inspect gear track and sealing areas (A) for pit marks and circular scratches. Replace housing if marks or scratches are excessive.

11. Inspect idler shaft (B) and bushing (C) for wear.

NEW PART SPECIFICATION

Idler Shaft OD	12.319—12.335 mm (0.4850—0.4856 in.)
Bushing ID	16.129—16.179 mm (0.6350—0.6370 in.)

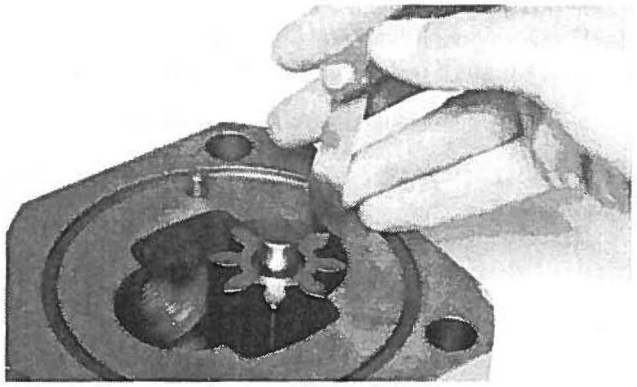


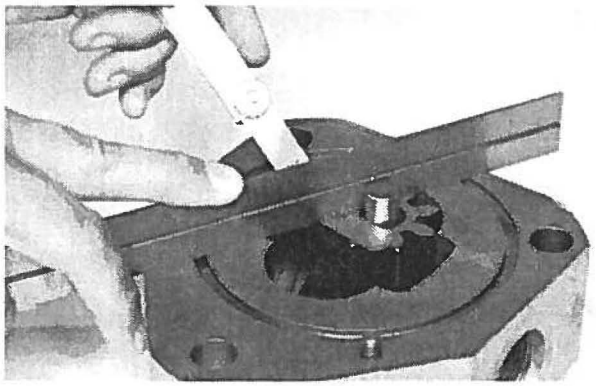
AW1;R39631 R70;070300 1028 060188

12. Measure end and side clearance between gear and housing.

MAXIMUM ALLOWABLE CLEARANCE

Side Clearance	0.15 mm (0.006 in.)
End Clearance	0.25 mm (0.010 in.)





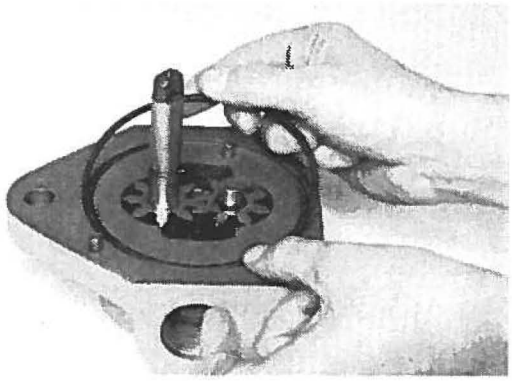
AW1;R39632, R39633 R70;070300 1029 060188

ASSEMBLE AUXILIARY CHARGE PUMP

IMPORTANT: DO NOT move 3000 Series hydraulic pump and inlet housing assembly with auxiliary charge pump removed. Doing so could dislodge key in end of pump shaft inside inlet housing causing hydraulic pump failure.

1. Coat gears with clean hydraulic oil and install gear set into charge pump housing.

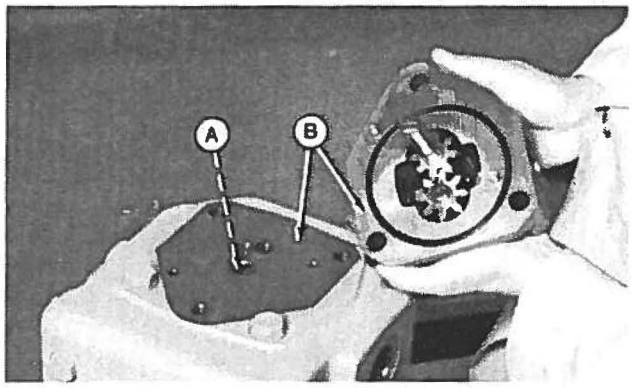
2. Install new O-ring packing with a light coating of clean hydraulic oil.



AW1;R39634 R70;070300 1030 270188

3. Install new seal (A) inside control valve housing.

4. Remove excess oil film from surfaces (B) and carefully install auxiliary charge pump on control valve housing.



AW1;R39635 R70;070300 1031 060188

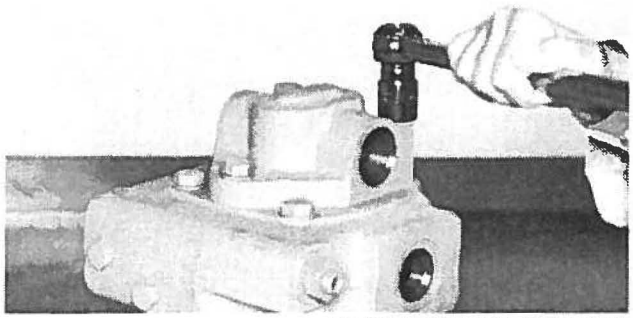
5. Tighten cap screws alternately to obtain a final torque:

2000 Series

Long Cap Screws	115 N·m (85 lb-ft)
Short Cap Screws	115 N·m (85 lb-ft)

3000 Series

Long Cap Screws	200 N·m (150 lb-ft)
Short Cap Screws	115 N·m (85 lb-ft)



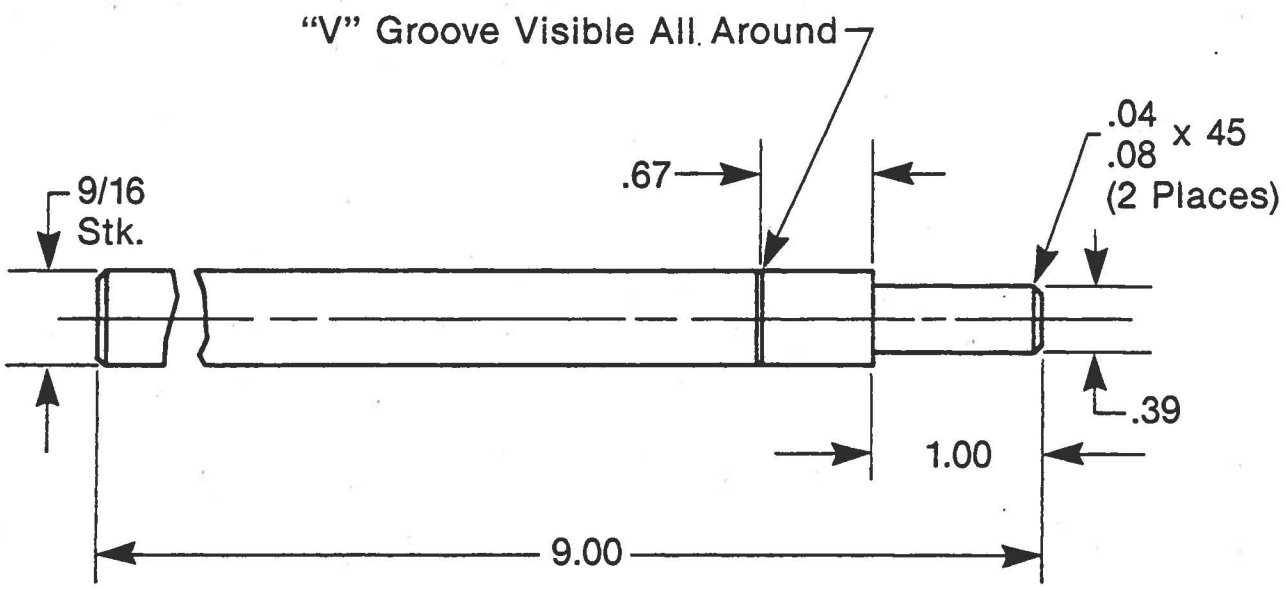
AW1;R39496 R70;070300 1032 260188

DEALER FABRICATED TOOLS

NOTE: These tools can be made in a service shop using common tools and locally obtained materials.

R70;070300 1033 110589

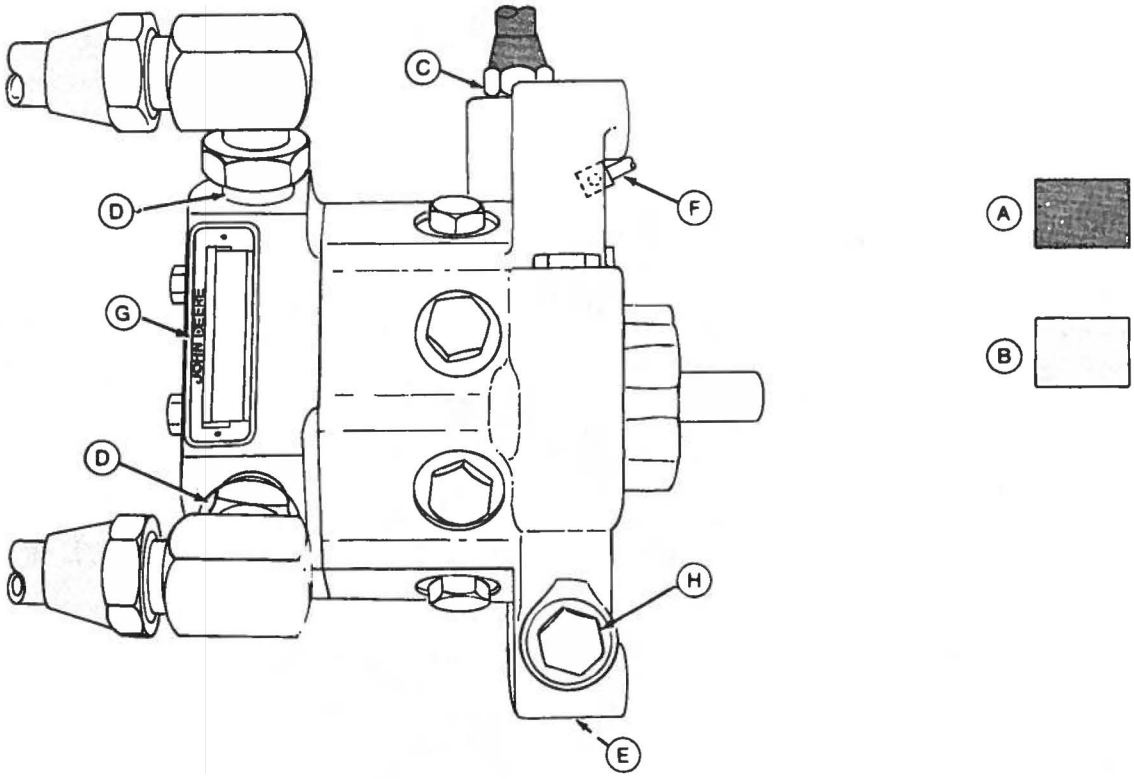
DFRW52—PRESSURE COMPENSATOR VALVE INSTALLATION AND REMOVAL TOOL



Tool should be made from 9/16 in. nylon rod or other suitable material that will not splitter or flake causing damage to internal machined surfaces.

AW1;R39641 U99;DFRW52 110589

HOW HYDRAULIC LINES ARE ROUTED



A—Discharge Oil
B—Inlet Oil
C—Discharge Port
D—Inlet Ports
E—Crankcase Pressure Port
F—Drain Port
G—Serial Plate
H—Destroke Port Plug (or Optional Manual Destroke)

NOTE: Applications vary. Some ports may not be used.

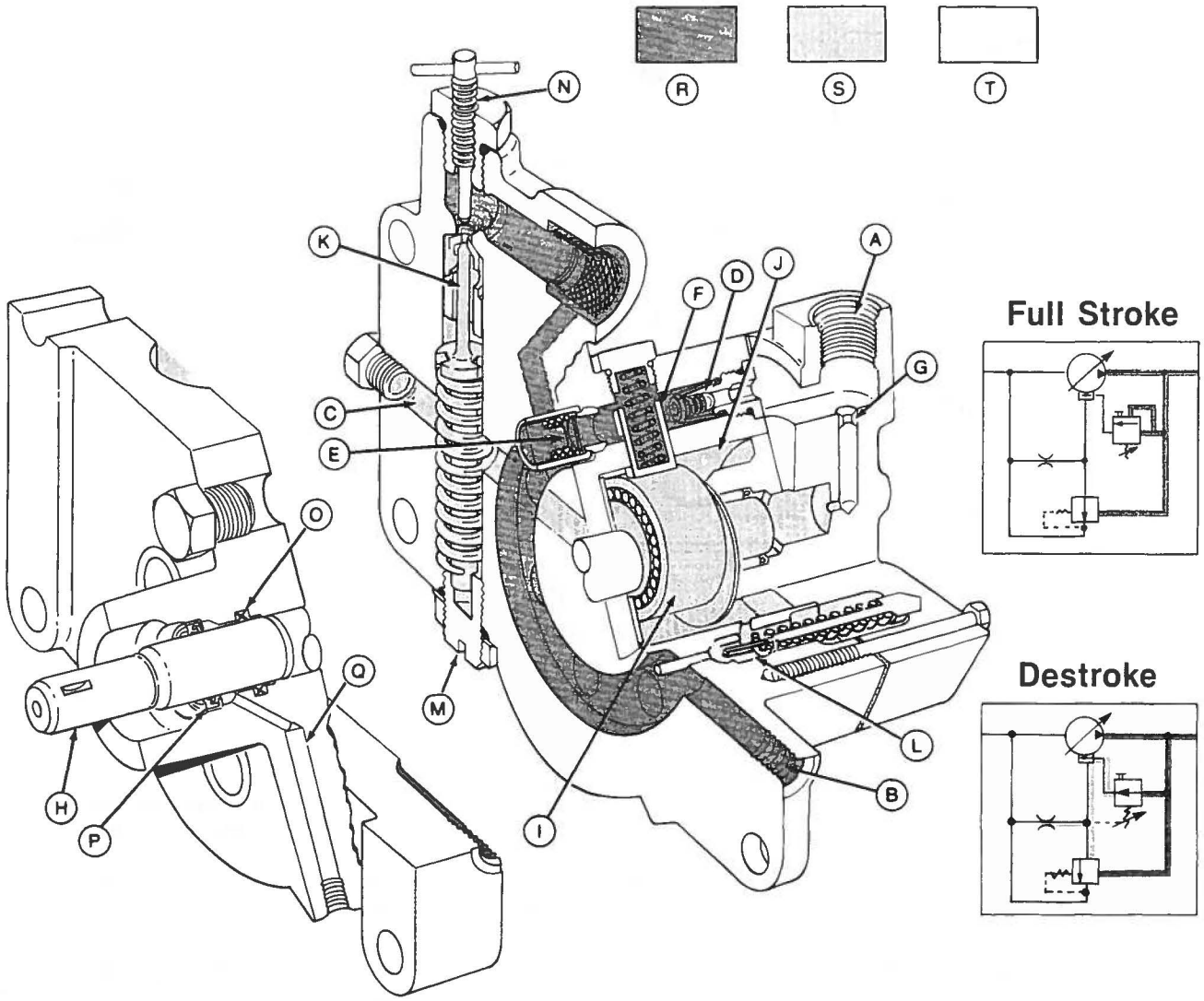
Charge pressure oil flows from hydraulic filter to inlet(s) (D).

System pressure oil flows into hydraulic system from pump discharge port (C).

Drain line (F) carries any oil which passes by pump shaft seal to sump.

RWH167 26 R70;070300 1187 110589

HYDRAULIC PUMP OPERATION



A—Inlet Source
B—High Pressure Outlet
C—Crankcase Pressure Port
D—Inlet Valve
E—Discharge Valve
F—Piston
G—Orifice
H—Shaft
I—Bearing Race
J—Crankcase
K—Pressure Compensator Valve
L—Crankcase Outlet Valve
M—Pressure Compensator Adjusting Screw
N—Manual Destroke Screw
O—Sealing Ring
P—Oil Seal
Q—Drain Passage
R—Discharge Pressure Oil
S—Crankcase Pressure Oil
T—Inlet Pressure Oil

RWH167 27 R70;070300 1188 110589

The 1000 Series radial piston pump is a variable displacement pump. Inlet pressure oil (T) is supplied through inlets (A). The pump works with pressure compensator valve (K) to supply oil on demand to the components of the hydraulic system. When there is demand for oil in the system, the inlet pressure oil flows through the inlet valve (D) on the downward stroke of piston (F). As the piston moves outward, the inlet valve closes and the discharge valve (E) is forced open allowing the oil to flow out of the piston bore into the outlet gallery.

As the demand for oil in the system decreases, the pressure in the outlet gallery increases. The increasing pressure first closes the crankcase outlet valve (L). When the oil pressure reaches deadhead pressure, the pressure compensator valve (K) opens allowing high pressure oil to enter the crankcase (J). The high pressure oil holds the pistons away from race and reducing pump displacement (output). Enough stroke on the pistons will remain in order to maintain deadhead pressure.

When a hydraulic function is actuated, the pressure in the outlet gallery is decreased. Once the pressure decreases below deadhead pressure, the pressure compensator valve will close stopping the flow of oil into the crankcase. As the pressure drops lower, the crankcase outlet valve opens, dumps the high pressure oil, and allows the pump to go back into stroke.

The pump is also designed to allow oil to leak past the sealing ring (O) for lubrication purposes. The oil then flows through a drain passage (Q) back to sump.

The crankcase also contains a crankcase orifice (G). The orifice allows oil to flow from the crankcase back to the inlet gallery at all times. Fresh oil then enters the crankcase for lubrication and cooling also allowing the pump to go back into stroke more gradually.

R70;070300 1189 080288

ADJUST DEADHEAD (STANDBY) PRESSURE

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

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

NOTE: When operating or testing any hydraulic pump, it is good hydraulic systems practice to include a system relief valve set at 2070 kPa (20.7 bar) (300 psi) above deadhead pressure.

IMPORTANT: Adjusting screw should be set to a minimum depth to prevent excessive deadhead pressure at start up.

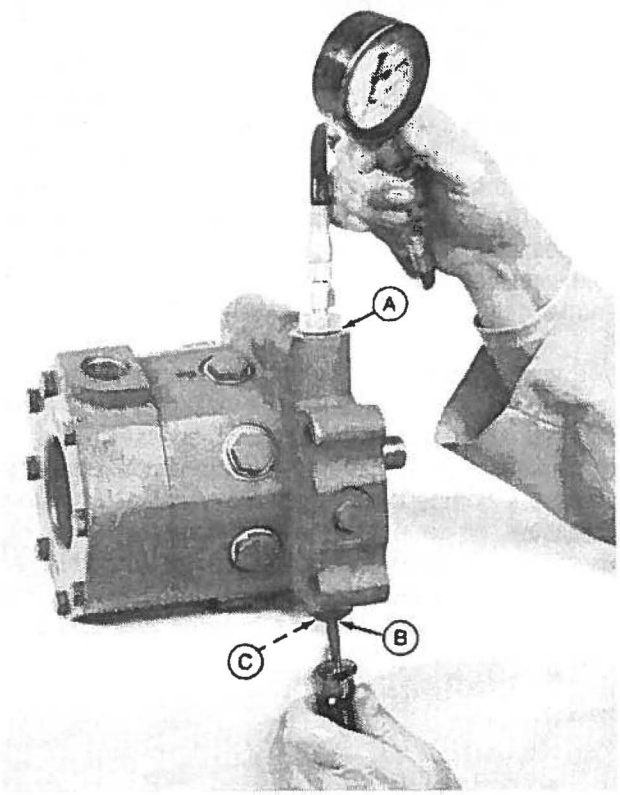
1. Install an adapter to port (A).

2. Connect a 0—34 500 kPa (0—345 bar) (0—5000 psi) gauge.

NOTE: System pressures vary. Check applications or machine manual for proper deadhead pressure setting.

3. Turn adjusting screw (B) in to increase deadhead pressure.

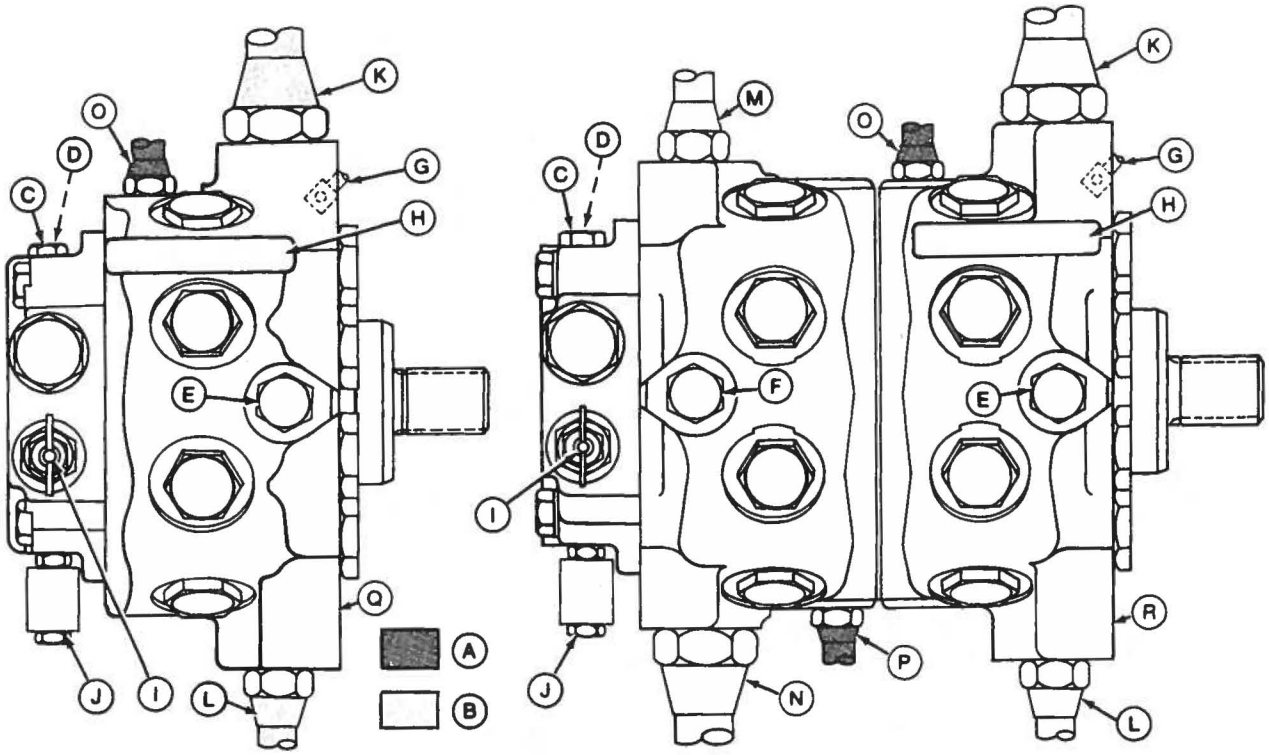
4. Tighten lock nut (C) once deadhead pressure is set.



A—Test Port (E1)
B—Pressure Compensator Adjusting Screw
C—Lock Nut

AW1;R40190 R70;070300 1196 090288

HOW HYDRAULIC LINES ARE ROUTED



A—Discharge Oil
B—Inlet Oil
C—High Pressure Test Port (Top) (T1)
D—Inlet Pressure Test Port (Bottom) (T2)
E—Inlet Pressure Sensing (V1)
F—Inlet Pressure Sensing (V2)
G—Drain Line (D1)
H—Serial Plate (Current Design)
I—Manual Destroke Screw
J—Electric Destroke Solenoid (Optional (C1-C2)
K—Inlet Port (I1)
L—Inlet Port (I2)
M—Inlet Port (I3)
N—Inlet Port (I4)
O—Discharge Port (S1)
P—Discharge Port (S2)
Q—Single Bank Pump
R—Double Bank Pump

NOTE: Applications vary. Some ports may not be used.

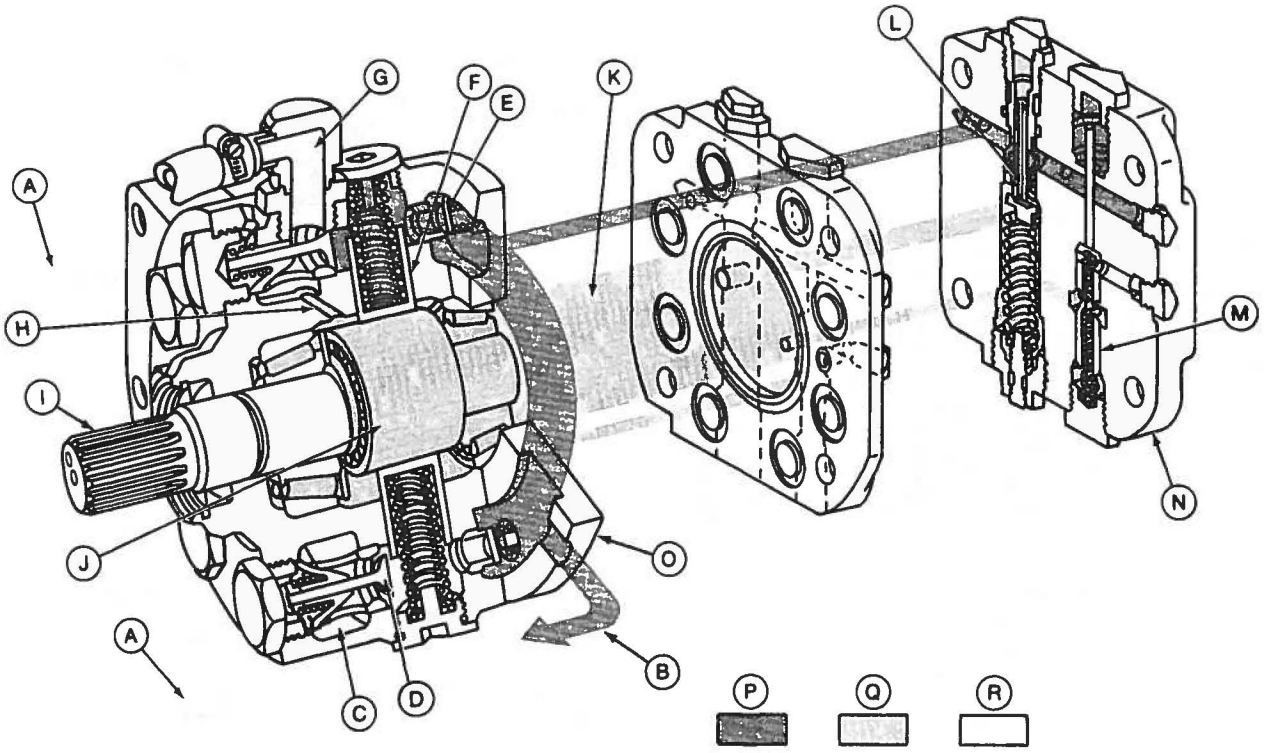
Inlet pressure oil (B) flows from hydraulic filter to inlet(s) (K-N). Double bank pump may use a crossover pipe between primary and secondary housing inlet galleries (E and F) to equalize inlet gallery pressure. Inlet pressure may flow from pump primary housing at (E) to provide sensing for hydraulic charge pump control valve.

Discharge pressure oil (A) flows into hydraulic system from pump discharge ports (O and P).

Drain line (G) carries any oil which passes by pump shaft seal to sump.

RWH16725 R70;070300 1044 250489

HYDRAULIC PUMP OPERATION

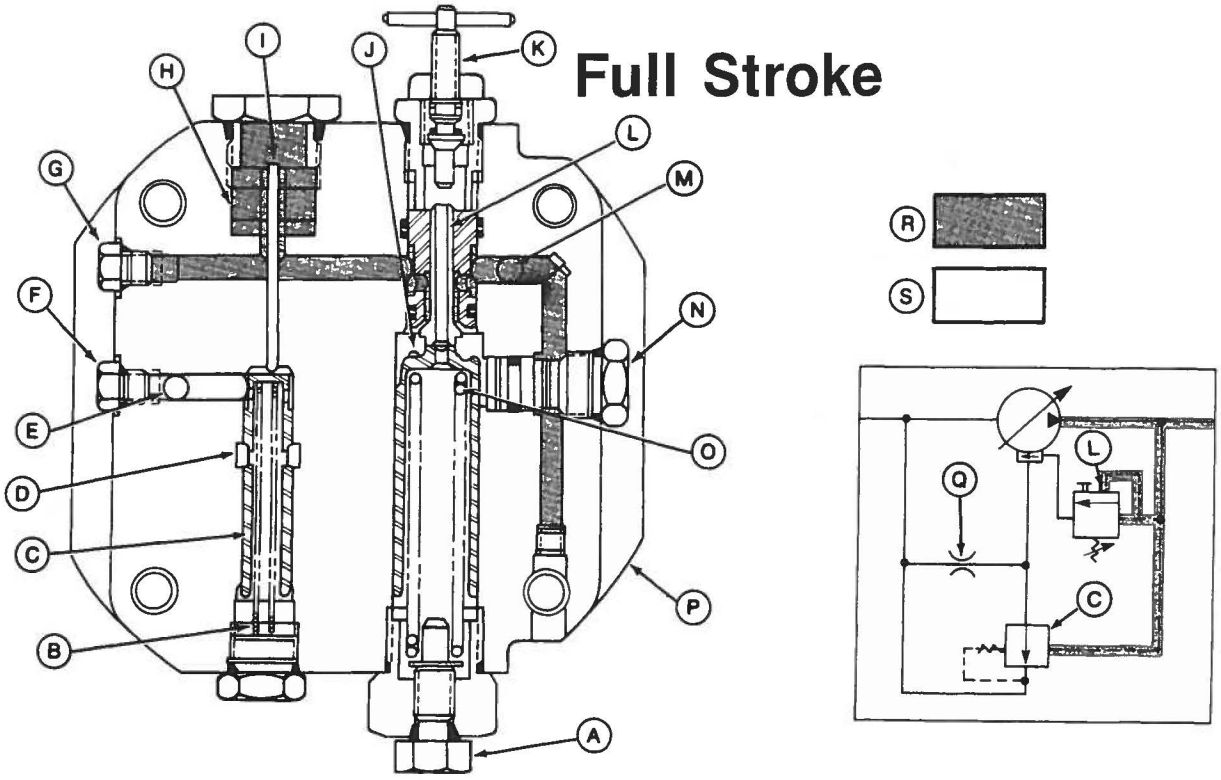


A—Inlet Source
B—High Pressure Outlet
C—Inlet Gallery
D—Inlet Valve
E—Discharge Valve
F—Piston
G—Inlet Source
H—Orifice
I—Shaft
J—Bearing Race
K—Crankcase
L—Pressure Compensator Valve
M—Crankcase Outlet Valve
N—Pressure Compensator Housing
O—Pump Housing
P—Discharge Pressure Oil
Q—Crankcase Pressure Oil
R—Inlet Pressure Oil

The 2000 Series radial piston pump is a variable displacement pump. Double banks are essentially two single bank pumps sharing a common shaft and pressure compensator. Designs vary slightly between serialized and non-serialized versions. Inlet oil (A) enters through inlet ports in the pump housing (O). A common inlet gallery (C) in the pump housing provides oil to eight inlet valves (D). Pistons (F) radially surround an eccentric cam. The cam uses a bearing race (J) upon which the pistons ride. Behind each piston is a spring (some models have double springs) which pushes in and holds pistons against bearing race (J). As pump shaft (I) rotates, a low pressure cavity develops in the piston spring area during the downward stroke of piston. This low pressure allows inlet valve (D) to open, filling the piston cavity with oil. Inlet valves close at the end of inlet stroke of pistons. High pressure oil is developed as race pushes pistons outward. As pressure increases, discharge valve (E) opens allowing discharge pressure oil (P) to pass into the outlet gallery. At the end of stroke, discharge pressure oil in outlet gallery closes discharge valve (E). All discharge valves share a common outlet gallery in each pump housing. An orifice (H) is located between the crankcase and the inlet gallery. Any oil leakage past pistons is routed through orifice (H) to the inlet gallery. This flow allows for cooling and lubrication. The pump is designed to provide "on demand" discharge pressure oil (P) regardless of flow requirements. As demand for oil decreases system pressure increases. This increased pressure closes crankcase outlet valve (M) and then opens pressure compensator valve (L) allowing high pressure oil to dump into crankcase (K) as deadhead pressure is reached. Increased pressure in the crankcase overcomes piston spring pressure and holds pistons (F) away from race (J), thereby destroking the pump.

RWH167 22 R70;070300 1040 110589

PRESSURE COMPENSATOR VALVE OPERATION



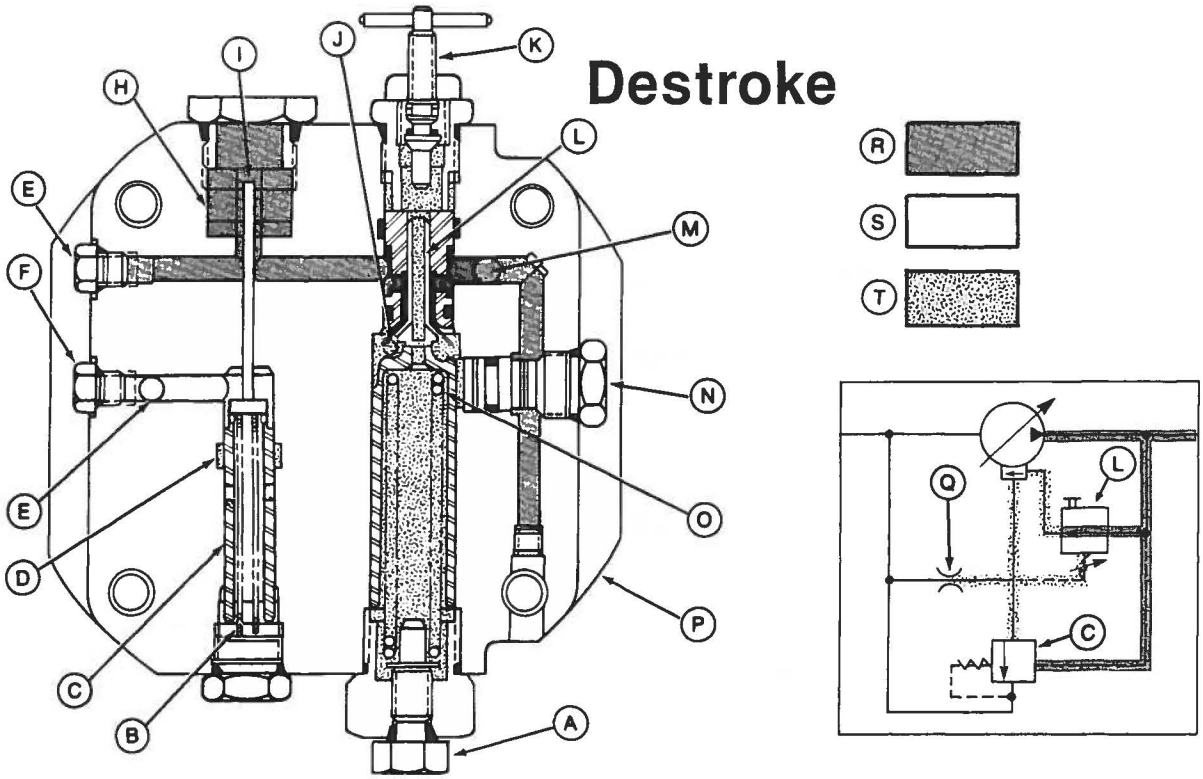
A—Pressure Compensator Adjusting Screw
B—Spring
C—Crankcase Outlet Valve
D—From Pump Crankcase
E—From Pump Inlet Gallery
F—Inlet Pressure Test Port
G—Discharge Pressure Test Port
H—Helmholz Resonator (Serialized Pumps)
I—Pressure Sensing Pin (Serialized Pumps)
J—To Pump Crankcase
K—Manual Destroke Screw
L—Pressure Compensator Valve
M—From Pump Outlet Gallery
N—Destroke Plug or Optional Electric Destroke Solenoid
O—Spring
P—Pressure Compensator Housing
Q—Orifice
R—Discharge Pressure
S—Inlet Pressure

The 2000 Series pump contains a pressure compensator housing (P). There are two basic designs. The one shown above is for serialized pumps. Crankcase outlet valve (C) for serialized pumps uses a single spool valve design. Non-serialized pumps have a crankcase valve operating within a fixed sleeve. Both designs function the same. A crankcase design variation within both serialized and non-serialized pumps is provided in some pump models where improved performance under high load conditions is required. In non-serialized pumps crankcase valve and outlet valve sleeve are replaced with a sleeve designed with a secondary orifice. Crankcase outlet valve (C) in serialized pumps is replaced with a fixed valve also with a secondary orifice. These variations in design allow a continuous flow of oil between pump crankcase and inlet gallery. They also require slightly more horsepower at deadhead pressure.

Pressure compensator housing (P) is connected to pump inlet gallery (E), outlet gallery (M), and pump crankcase (D and J). Pressure compensator valve (L) working with the crankcase outlet valve (C) maintain discharge pressure under varying flow demands. Discharge pressure oil enters at point (M) and flows to center section of pressure compensator valve. At full pump stroke, as shown above, crankcase pressure is at inlet pressure. As demand for system oil decreases, discharge pressure will begin to increase, causing crankcase outlet valve (C) to close (move downward). This blocks the pump crankcase oil (D) from the inlet gallery (E) except for any oil which passes through the crankcase orifice (Q). As system pressure approaches deadhead, pressure compensator valve (L) opens (moves downward) allowing discharge pressure oil into the crankcase.

RWH167 23 R70;070300 1042 150589

PRESSURE COMPENSATOR VALVE OPERATION -Continued



A—Pressure Compensator Adjusting Screw
B—Spring
C—Crankcase Outlet Valve
D—From Pump Crankcase
E—From Pump Inlet Gallery
F—Inlet Pressure Test Port
G—Discharge Pressure Test Port
H—Helmholz Resonator (Serialized Pumps)
I—Pressure Sensing Pin (Serialized Pumps)
J—To Pump Crankcase
K—Manual Destroke Screw
L—Pressure Compensator Valve
M—From Pump Outlet Gallery
N—Destroke Plug or Optional Electric Destroke Solenoid
O—Spring
P—Pressure Compensator Housing
Q—Orifice
R—Discharge Pressure
S—Inlet Pressure
T—Low Pressure

As discharge pressure rises further, more oil enters the crankcase than can flow through orifice (Q). Crankcase pressure increases to slightly higher than inlet pressure overcoming combined spring force on pump pistons. Pistons are then held away from pump shaft bearing race destroking pump. Pump shaft continues to rotate, but pistons do not move.

As demand for system oil increases, discharge pressure will decrease closing pressure compensator valve (L). Discharge oil will no longer be routed to crankcase. Crankcase pressure begins to decrease as oil flows through crankcase orifice (Q). When discharge pressure decreases sufficiently, crankcase outlet valve (C) opens (moves upward) rapidly dumping pump crankcase.

Pump piston springs overcome decreased crankcase pressure and pistons again come in contact with shaft bearing race putting pump into stroke.

Helmholz resonator (I) on serialized pumps is a volume chamber that acts as a small attenuator. It reduces pressure spikes and dampens pressure compensator valve action. A manual destroke screw (K) is used to destroke pump without building deadhead pressure in hydraulic system. This reduces the load on the starting motor during cold weather starting and is also used in testing for hydraulic leaks. Some pump models have a destroke plug (N). Using an optional electric destroke solenoid in place of plug (N) performs the same function as manual destroke screw (K).

RWH167 24 R70;070300 1043 110589

ADJUST DEADHEAD (STANDBY) PRESSURE

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

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

NOTE: When operating or testing any hydraulic pump, it is good hydraulic systems practice to include a system relief valve set at 2070 kPa (20.7 bar) (300 psi) above deadhead pressure.

IMPORTANT: Adjusting screw should be set to a minimum depth to prevent excessive deadhead pressure at start up.

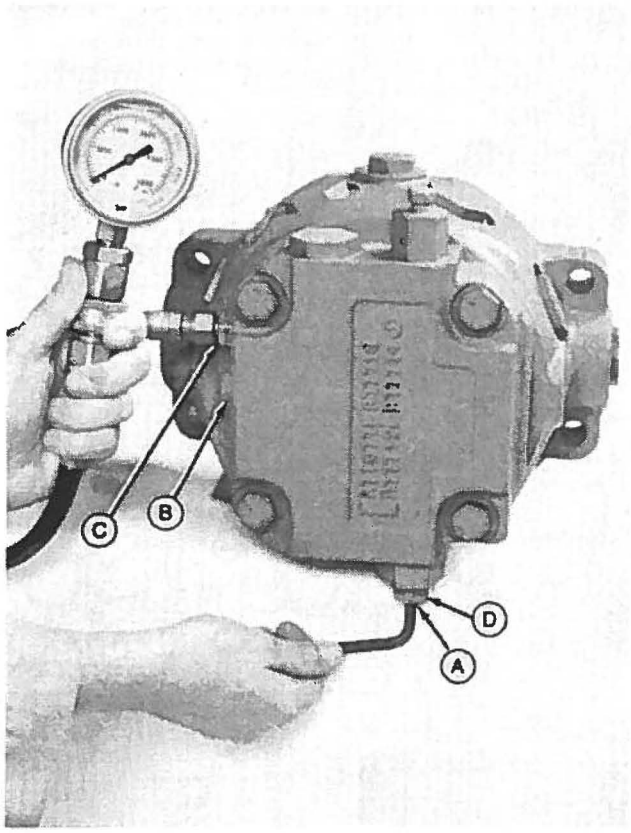
1. Install an adapter to high pressure test port (C).

2. Connect a 0—34 500 kPa (0—345 bar) (0—5000 psi) gauge.

NOTE: System pressures vary. Check applications or machine manual for proper deadhead pressure setting.

3. Turn adjusting screw (A) in to increase deadhead pressure.

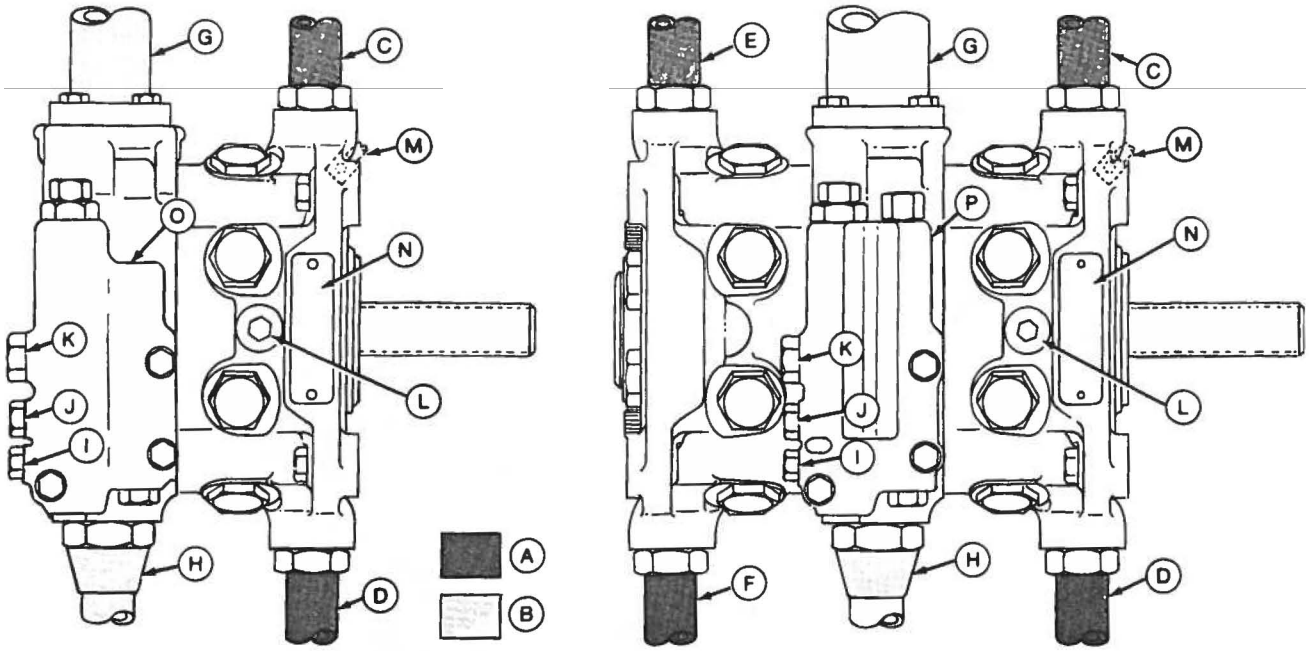
4. Tighten lock nut (D) once deadhead pressure is set.



A—Pressure Compensator Adjusting Screw
B—Inlet Pressure Test Port (T2)
C—High Pressure Test Port (T1)
D—Lock Nut

AW1;R39783 R70;070300 1148 050288

HOW HYDRAULIC LINES ARE ROUTED



A—Discharge Oil
B—Inlet Oil
C—Outlet Port (S1)
D—Outlet Port (S2)
E—Outlet Port (S3)
F—Outlet Port (S4)
G—Inlet Port (I1)
H—Inlet Port (I2)
I—High Pressure Test Port (T1)
J—Crankcase Pressure Test Port (T3)
K—Inlet Pressure Test Port (T2)
L—Crankcase Access Port (C1)
M—Drain Line (D1)
N—Serial Plate
O—Pressure Compensator Valve Housing
P—Load Sense Valve Housing

NOTE: Applications vary. Some ports may not be used.

Inlet oil (B) flow from hydraulic filter to inlet(s) (G and H).

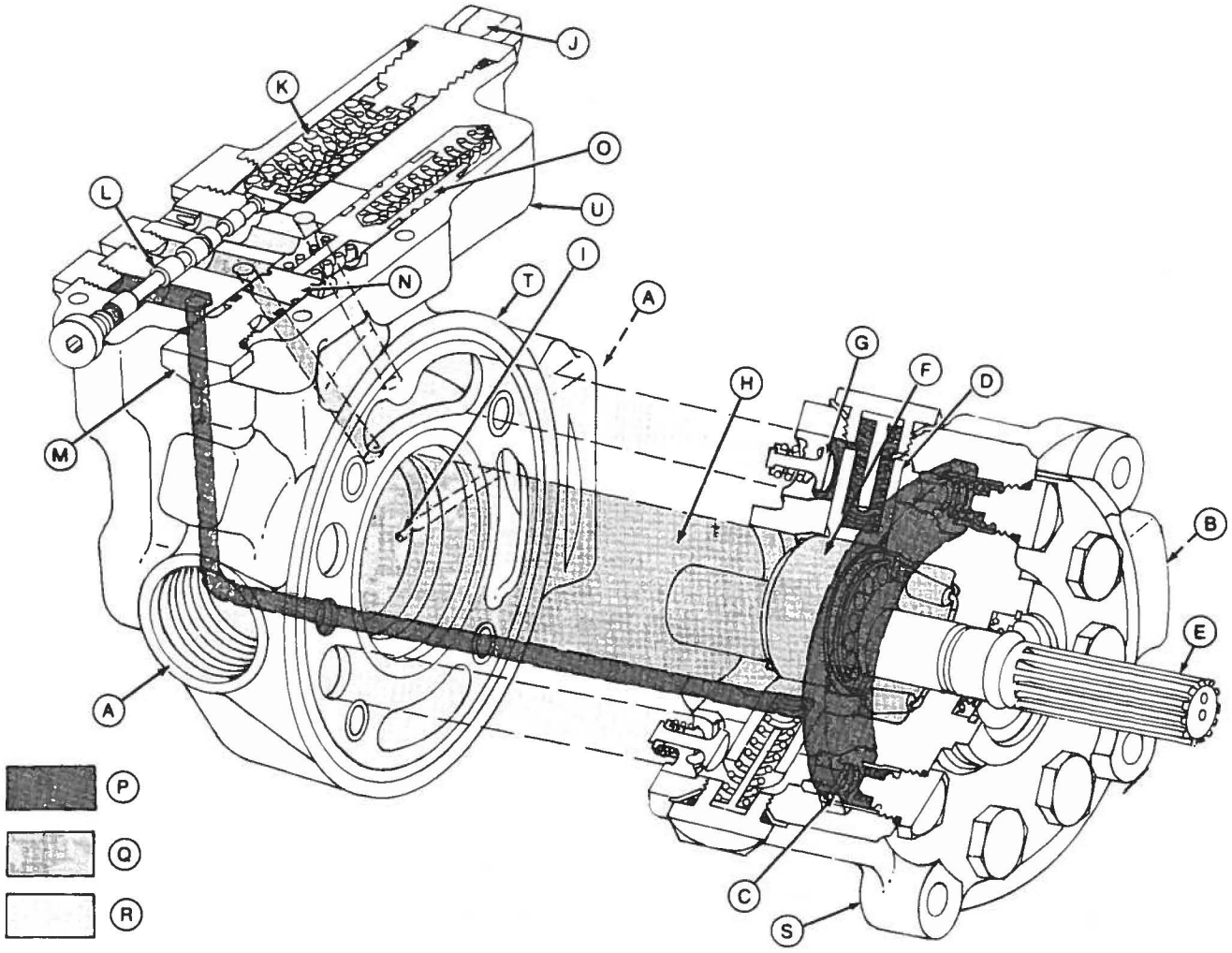
Discharge oil (A) flows into hydraulic system from pump outlet ports (C—F).

Crankcase pressure may be sensed through port (L) for system applications.

Drain line (M) carries any oil which passes by pump shaft seal to sump.

RWH167 28 R70;070300 1045 170589

HYDRAULIC PUMP OPERATION



(Unitized Design Single Bank Pump Shown)

A—Inlet Source
B—High Pressure Outlet
C—Discharge Valve
D—Piston
E—Shaft
F—Bearing Race
G—Inlet Valve
H—Crankcase
I—Orifice
J—Pressure Compensator Adjusting Screw
K—Spring
L—Pressure Compensator Valve
M—Destroke Plug (Optional Manual Destroke or Electric Destroke Solenoid)
N—Shuttle Valve
O—Crankcase Relief Valve
P—Discharge Pressure Oil
Q—Crankcase Pressure Oil
R—Inlet Pressure Oil
S—Pump Housing
T—Inlet Housing
U—Valve Housing

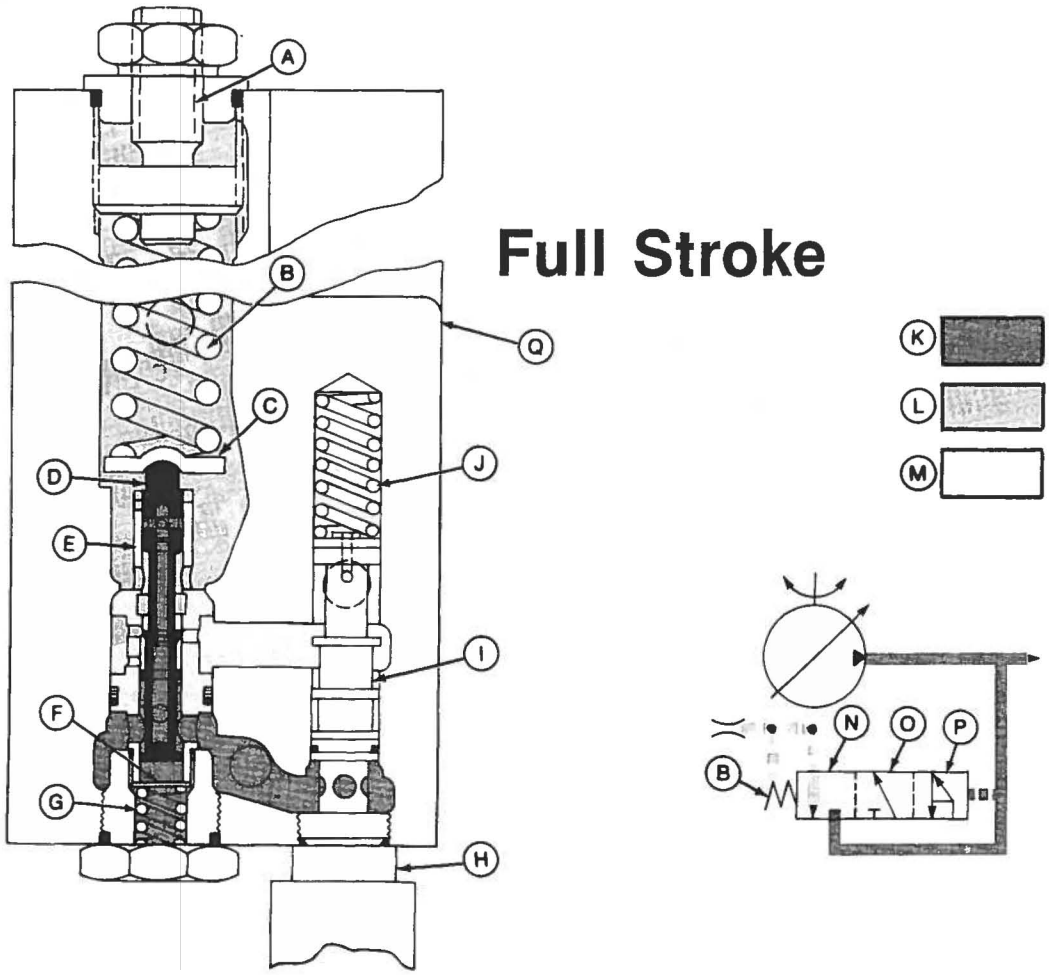
RWH167 29 R70;070300 1022 110589

The 3000 Series radial piston pump is a variable displacement pump. Single and double bank versions operate the same to provide high pressure oil flow. Double banks are essentially two single bank pumps sharing a common drive shaft and control valve.

Inlet oil (R) enters through inlet ports (A) in the inlet housing (T). A common inlet gallery in the housing provides oil to eight inlet valves (G) in pump housing (S). Pistons (D) radially surround an eccentric cam. The cam uses a bearing race (F) upon which the pistons ride. Behind each piston is a spring which pushes in and holds pistons against the bearing race (F). As pump shaft (E) rotates a low pressure cavity develops in the piston spring area during downward stroke of piston. This low pressure allows inlet valve (G) to open filling the piston cavity with oil. Inlet valves close at the end of intake stroke of pistons. High pressure oil is developed as race pushes pistons outward. As pressure increases discharge valve (C) opens allowing discharge pressure oil (P) to pass into outlet gallery. At the end of stroke, discharge pressure oil in outlet gallery closes discharge valve (C). All discharge valves share a common outlet gallery in pump housing (S). An orifice (I) is located between the crankcase and the inlet gallery. Any oil leakage past the pistons is routed through orifice (I) to the inlet gallery. This flow allows for cooling and lubrication. Pressure compensated pumps (both older style non-unitized and newer style unitized designs) are designed to provide "on demand" discharge pressure oil (P) regardless of flow requirements. As demand for oil decreases, system pressure increases. Pressure compensator valve (L) then routes system oil into crankcase (H). Increased pressure in the crankcase overcomes piston spring pressure and hold pistons (D) away from race (F), thereby destroking the pump.

R70;070300 951 080288

PRESSURE COMPENSATOR OPERATION— *(NON-UNITIZED DESIGN)*



(Early Design Shown)

A—Pressure Compensator Adjusting Screw
B—Spring
C—Spring Guide
D—Pressure Compensator Valve
E—Sleeve
F—Valve
G—Spring
H—Optional Manual Destroke or Electric Destroke Solenoid
I—Shuttle Valve
J—Spring
K—Discharge Pressure Oil
L—Crankcase Pressure Oil
M—Inlet Pressure Oil
N—Pressure Compensator Valve In 1st Position
O—Pressure Compensator Valve In 2nd Position
P—Pressure Compensator Valve In 3rd Position
Q—Inlet Housing

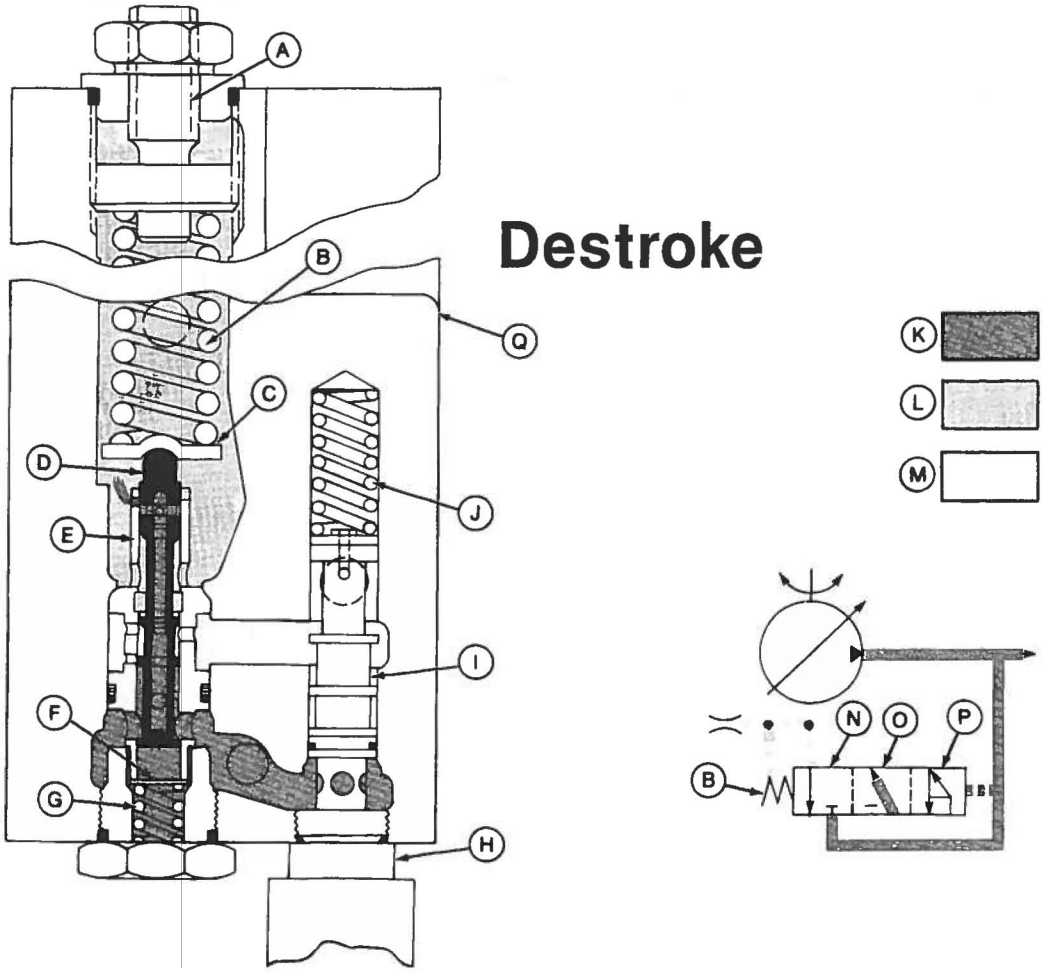
RWH167 20 R70;070300 1023 110589

The 3000 Series non-unitized designed inlet housing (Q) contains a pressure compensator valve as shown in this cross-section view. The pressure compensator valve (D) working within a fixed sleeve (E) maintains system pressure under varying flow demands. Valve movement is controlled on one end by outlet pressure (K) and on the other by force from spring (B) and crankcase pressure (L). Discharge pressure can be increased or decreased by changing the force on spring (B) using the pressure compensator adjusting screw (A). The pump may be manually destroked if equipped with an optional manual destroke screw or electric destroke solenoid (H). Shuttle valve (I) moves against spring (J) when manual destroke screw or electric solenoid are engaged. This allows discharge pressure oil (K) to flow into inlet pressure oil (M), flow around the pressure compensator valve (D) and into the crankcase putting the pump into destroke. Shuttle valve (I) is only used to destroke the pump in conjunction with manual destroke or electric destroke solenoid.

The first pressure compensator valve position (N) is seen when pump is in FULL STROKE. In this position oil flowing through small orifice in crankcase is equal to the amount of oil flowing into crankcase via the pressure compensator valve (D). As demand for system oil decreases, system pressure will begin to increase. System pressure increase will move pressure compensator valve (D) toward spring (B).

R70;070300 952 050288

PRESSURE COMPENSATOR OPERATION—Continued
(NON-UNITIZED DESIGN)



(Early Design Shown)

A—Pressure Compensator Adjusting Screw
B—Spring
C—Spring Guide
D—Pressure Compensator Valve
E—Sleeve
F—Valve
G—Spring
H—Optional Manual Destroke or Electric Destroke Solenoid
I—Shuttle Valve
J—Spring
K—Discharge Pressure Oil
L—Crankcase Pressure Oil
M—Inlet Pressure Oil
N—Pressure Compensator Valve In 1st Position
O—Pressure Compensator Valve In 2nd Position
P—Pressure Compensator Valve In 3rd Position
Q—Inlet Housing

RWH167 21 R70;070300 1024 110589

When system pressure is reached, the pump DESTROKES. The pressure compensator valve will be in the second position (O). Discharge pressure oil is routed through valve (D) into crankcase cavity. Crankcase pressure increases overcoming the combined spring force on the pump pistons. Pump pistons then are held away from pump shaft bearing race by increased crankcase pressure. The pump shaft continues to rotate, but pistons do not move.

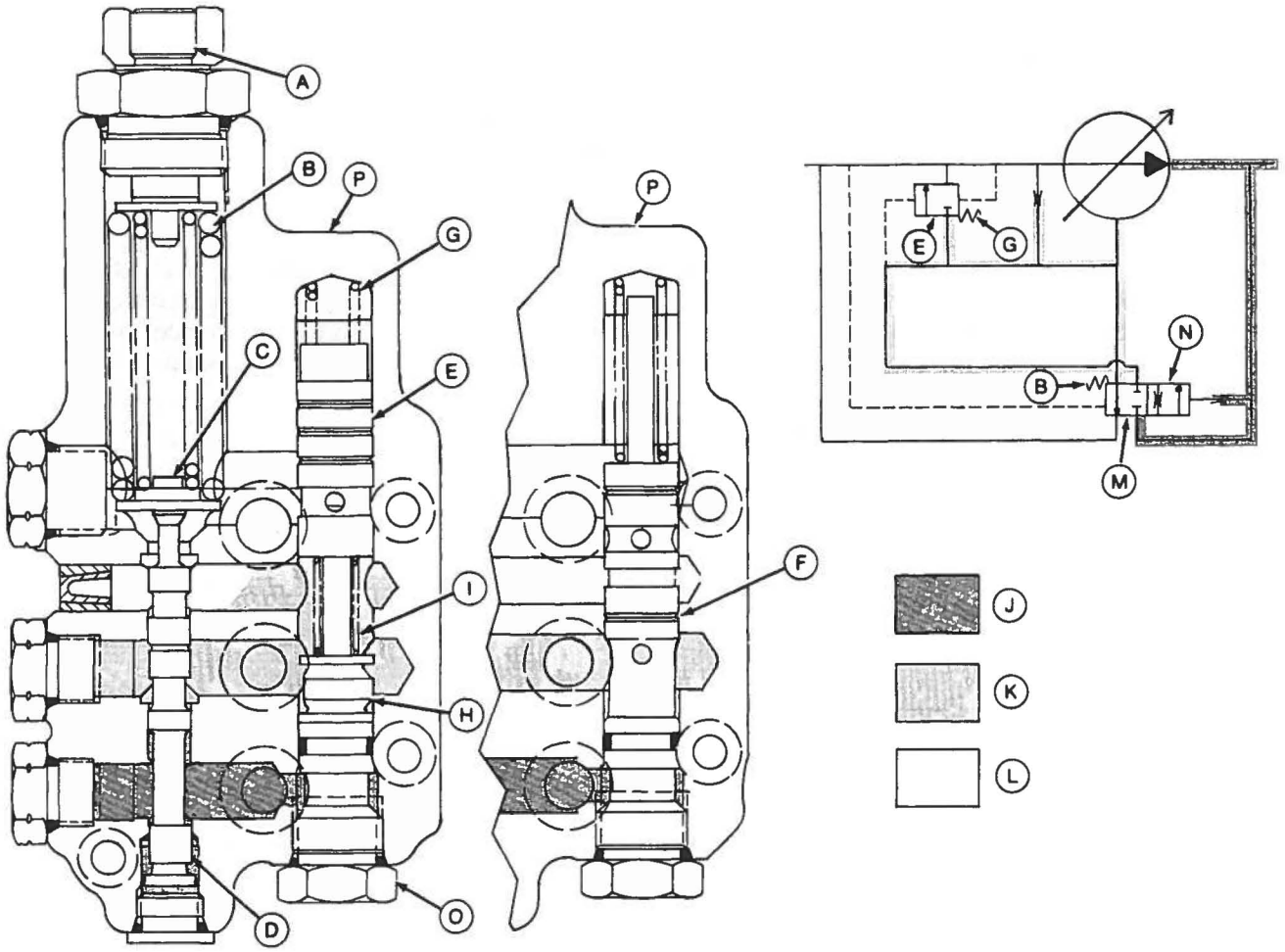
QUICK DESTROKE OVERSHOOT is shown when the pressure compensator valve is in third position (P). During quick destroke, the pressure compensator valve moves far enough allowing discharge pressure oil to be routed to both crankcase and inlet oil and also allowing crankcase oil to feed into inlet oil. This limits high pressure spikes caused by discharge pressure oil being routed too rapidly into crankcase cavity.

As demand for system oil increases, discharge pressure will decrease moving pressure compensator valve (D) away from spring (B). System oil will no longer be routed to the crankcase. This will decrease crankcase pressure (L) as crankcase oil passes through the small orifice into inlet oil (M). Pump piston springs will overcome the decreased pressure in the crankcase and pistons will again come in contact with pump shaft bearing race.

A sudden demand for system oil will cause pressure compensator valve (D) to move rapidly downward. Valve (F) and spring (G) acts like a shock absorber dampening the movement of the pressure compensator valve. Therefore, valve movement will not be influenced by periodic pressure spikes.

R70;070300 956 050288

PRESSURE COMPENSATOR OPERATION— *(UNITIZED DESIGN)*



A—Pressure Compensator Adjusting Screw
B—Pressure Compensator Spring(s)
C—Spring Guide
D—Pressure Compensator Valve
E—Crankcase Relief Valve
F—External Control Valve
G—Spring
H—Shuttle Valve
I—Spring
J—Discharge Pressure Oil
K—Crankcase Pressure Oil
L—Inlet Pressure Oil
M—Pressure Compensator Valve In 1st Position
N—Pressure Compensator Valve In 2nd Position
O—Plug (or Optional Manual Destroke or Electric Solenoid)
P—Valve Housing

RWH167 30 R70;070300 1013 110589

The 3000 Series unitized designed pump provides a bolt-on control valve. The pressure compensator valve (D) controls the flow of the pump. Valve movement is controlled by discharge pressure oil (J) on one end of the valve and by inlet pressure oil (L) and force from spring (B) on the other end. Discharge pressure can be increased or decreased by changing the force on spring (B) using the pressure compensator adjusting screw (A). Shuttle valve (H) is used in conjunction with either a manual destroke screw or an electric destroke solenoid in place of plug (O). Valve (H) moves against crankcase relief valve (E) and spring (G) allowing discharge pressure oil to be dumped into crankcase thereby destroking the pump.

Pump is in FULL STROKE when pressure compensator valve (D) is in position (M) shown above. As demand for oil decreases, discharge pressure increases moving pressure compensator valve (D) toward spring (B). Valve continues to move to position (N) dumping discharge pressure oil (J) into the crankcase, thereby increasing crankcase pressure. Crankcase pressure overcomes the combined spring force on the pump pistons. Pistons are then held away from the pump shaft bearing race and the pump is DESTROKED.

The pump goes into QUICK DESTROKE when there is a sudden drop in demand for oil flow, creating a sudden increase in discharge pressure oil. Discharge pressure oil increases greatly allowing crankcase relief valve (E) to move against spring (G). This allows crankcase pressure oil (K) to dump into inlet pressure oil (L). This limits high pressure spikes caused by discharge pressure oil being too rapidly routed into crankcase cavity. An optional external control valve (F) is sometimes used in place of the crankcase relief valve (E). This provides for external load sensing control. This valve restricts the crankcase oil dumping into inlet.

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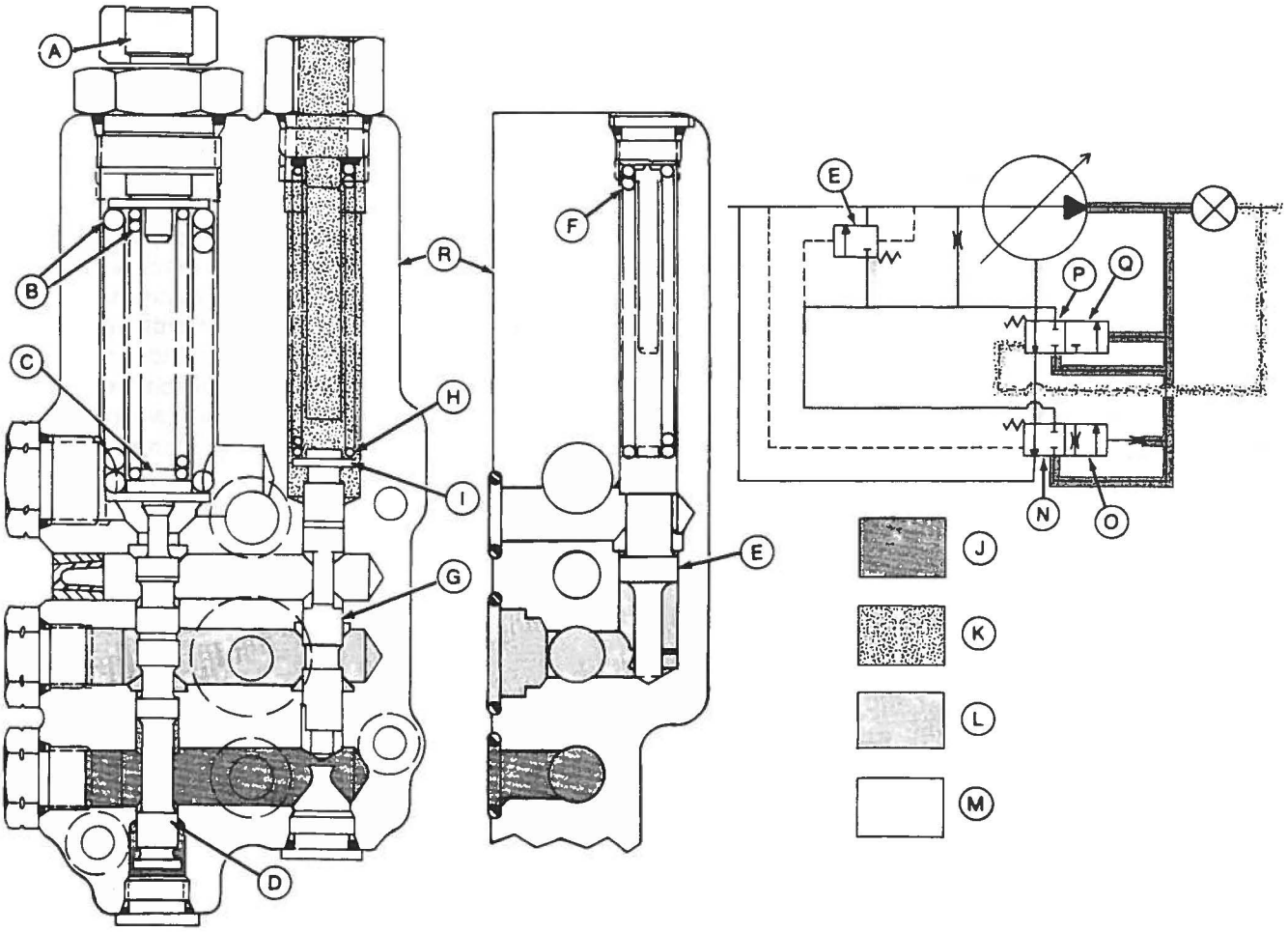
LOAD SENSE OPERATION— *(UNITIZED DESIGN)*



A—Pressure Compensator Adjusting Screw
B—Pressure Compensator Spring(s)
C—Spring Guide
D—Pressure Compensator Valve
E—Crankcase Relief Valve
F—Spring
G—Load Sense Valve
H—Spring
I—Spring Guide
J—Discharge Pressure Oil
K—Load Pressure Oil
L—Crankcase Pressure Oil
M—Inlet Pressure Oil
N—Pressure Compensator Valve in 1st Position
O—Pressure Compensator Valve in 2nd Position
P—Load Sense Valve in 1st Position
Q—Load Sense Valve in 2nd Position
R—Valve Housing

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The load sense unitized designed control valve provides a pressure compensator valve (D) and an additional load sense valve (G) each having the capability of decreasing or increasing the flow of the pump. Pump is in FULL STROKE when pressure compensator valve (D) and load sense valve (G) are in positions (N and P) shown above. As demand for oil flow decreases, discharge pressure oil increases moving both valves (D and G) towards springs (B and H). With both valves in position (O and Q) discharge pressure oil is routed into the crankcase increasing the crankcase pressure and limiting the movement of the pump pistons. Both the pressure compensator valve (D) and the load sense valve (G) are ported so they can decrease pump flow independently, but either valve can increase pump flow only if the other valve is in a position to permit the stroking function. This interaction allows the load sense valve to control the pump within the pressure compensator valve's pressure limit. The load sense valve maintains the pump discharge pressure (J) above the load sense pressure (K) by an amount proportional to the load sense spring (H) preload.

The crankcase relief valve (E) operates under two conditions. First, the valve moves against spring (F) when there is a sudden drop in demand for discharge oil flow. The pressure compensator valve dumps excess oil from the pump discharge into the crankcase. The crankcase relief valve in turn passes the oil back to the inlet. The second condition is when a directional valve is returned to neutral, allowing the load sense pressure (K) to drop. The load sense valve shifts to (Q) and decompresses the system into the crankcase. The relief valve quickly passes the oil into the inlet, allowing the pump discharge pressure to rapidly drop to the low standby pressure level.

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ADJUST DEADHEAD (STANDBY) PRESSURE

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

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

CAUTION: When operating or testing a non-unitized designed pump without a pressure compensator spring sleeve, a relief valve, set 2070 kPa (20.7 bar) (300 psi) above deadhead pressure, MUST BE used between pump discharge and nearest valve (or variable restriction) in system. Failure to do so can result in hydraulic component or line failure which may cause personal injury.

NOTE: When operating or testing any hydraulic pump, it is good hydraulic systems practice to include a system relief valve set at 2070 kPa (20.7 bar) (300 psi) above deadhead pressure.

IMPORTANT: Adjusting screw should be set to a minimum depth to prevent excessive deadhead pressure at start up.

1. Install a 14 mm adapter to high pressure test port (A).

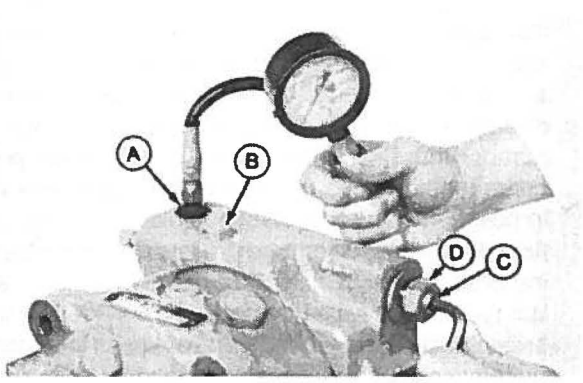
2. Connect a 0—34 500 kPa (0—345 bar) (0—5000 psi) gauge.

NOTE: System pressures vary. Check applications or machine manual for proper deadhead pressure setting.

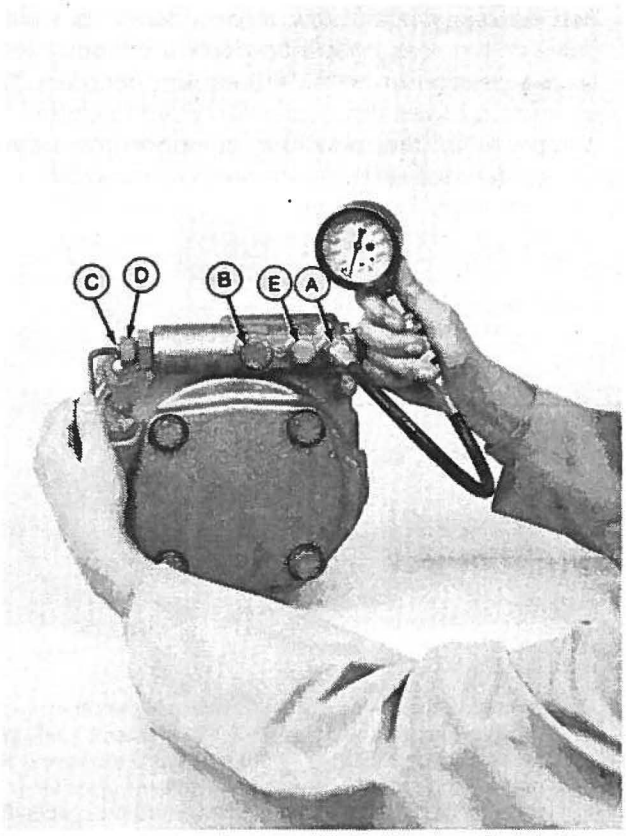
3. Turn adjusting screw (C) in to increase deadhead pressure.

4. Tighten lock nut (D) once deadhead pressure is set.

A—High Pressure Test Port (T1)
B—Inlet Pressure Test Port (T2)
C—Pressure Compensator Adjusting Screw
D—Lock Nut
E—Crankcase Pressure Test Port (T3)



Non-Unitized Design



Unitized Design

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