SAUER DANFOSS

Genuine Parts

LPV Closed Circuit Axial Piston Pumps

Service Manual

HISTORY OF REVISIONS

Table of Revisions

Date	Page	Changed	Rev.
January 2007	All	First printing	AA

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LPV Closed Circuit Axial Piston Pumps Service Manual

Contents

OVERVIEW

This manual includes information for the installation, maintenance, and minor repair of the LPV pump. It includes a description of the unit and its individual components, troubleshooting information, and minor repair procedures.

Performing minor repairs requires the unit to be removed from the vehicle/machine. Thoroughly clean the unit before beginning maintenance or repair activities. Since dirt and contamination are the greatest enemies of any type of hydraulic equipment, follow cleanliness requirements strictly. This is especially important when changing the system filter and when removing hoses or plumbing.

A worldwide network of Sauer-Danfoss Global Service Partners is available for major repairs. Sauer-Danfoss trains Global Service Partners and certifies them on a regular basis. You can locate your nearest Global Service Partner using the distributor locator at www.sauer-danfoss.com. Click on the *Sales and Service* link.

WARRANTY

Performing installation, maintenance, and minor repairs according to the procedures in this manual will not affect your warranty. Major repairs requiring the removal of a unit's rear cover or front flange voids the warranty unless done by a Sauer-Danfoss Global Service Partner.

GENERAL INSTRUCTIONS

Follow these general procedures when repairing Series LPV variable displacement closed circuit pumps.

Remove the unit

Prior to performing major repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and / or hot. Inspect the outside of the pump and fittings for damage. Cap hoses after removal to prevent contamination.

Keep it clean

Cleanliness is a primary means of assuring satisfactory pump life, on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts by using a clean solvent wash and air drying is usually adequate.

As with any precision equipment, you must keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

Lubricate moving parts

During assembly, coat all moving parts with a film of clean hydraulic oil. This assures that these parts will be lubricated during start-up.

Replace all O-rings and gaskets

We recommend you replace all O-rings, seals, and gaskets during repair. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.

Secure the unit

For major repair, place the unit in a stable position with the shaft pointing downward. It will be necessary to secure the pump while removing and torquing the endcap bolts.

SAFETY PRECAUTIONS

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended machine movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

SYMBOLS USED IN SAUER-DANFOSS LITERATURE

- WARNING may result in injury
- CAUTION may result in damage to product or property
- Reusable part
- Non-reusable part, use a new part
- Non-removable item
- Option – either part may exist
- Superseded – parts are not interchangeable
- Measurement required
- Flatness specification
- Parallelism specification
- External hex head
- Internal hex head
- Torx head
- O-ring boss port
- Tip, helpful suggestion
- Lubricate with hydraulic fluid
- Apply grease / petroleum jelly
- Apply locking compound
- Inspect for wear or damage
- Clean area or part
- Be careful not to scratch or damage
- Note correct orientation
- Mark orientation for reinstallation
- Torque specification
- Press in – press fit
- Pull out with tool – press fit
- Cover splines with installation sleeve
- Pressure measurement / gauge location or specification

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

DESIGN

Series LPV is a family of hydrostatic pumps for low to medium power applications with maximum pressures up to 345 bar [5000 psi]. You can apply these pumps with other products in a system to transfer and control hydraulic power.

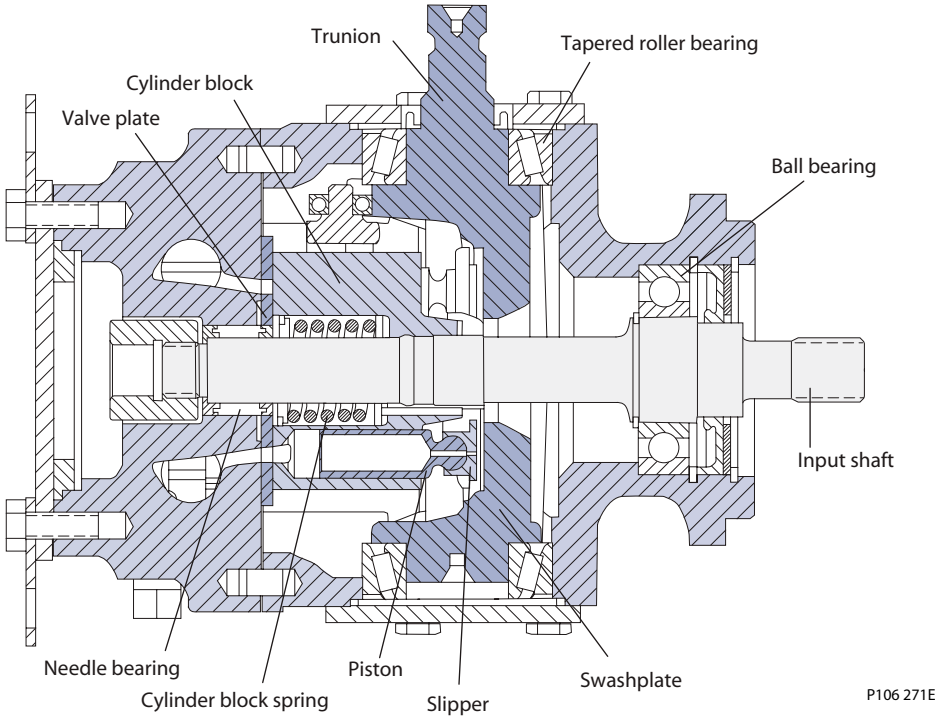
LPV pumps provide an infinitely variable speed range between zero and maximum in both forward and reverse. LPV pumps come in three displacements (25 cm^3 [1.53 in^3], 30 cm^3 [1.83 in^3], and 35 cm^3 [2.32 in^3]).

LPV pumps are compact, high power density units. All models use the parallel axial piston/slipper concept in conjunction with a tiltable swashplate to vary the pump's displacement. Reversing the angle of the swashplate reverses the flow of fluid from the pump, reversing the direction of rotation of the motor output.

LPV pumps have an internal neutral return mechanism and are available with optional loop flushing. LPV pumps receive charge flow from an auxiliary circuit or from a gear pump mounted on the auxiliary pad. LPV pumps feature an SAE-A auxiliary mounting pad to accept a pump(s) for system charge or complementary systems.

LPV pumps use a trunnion style direct displacement control.

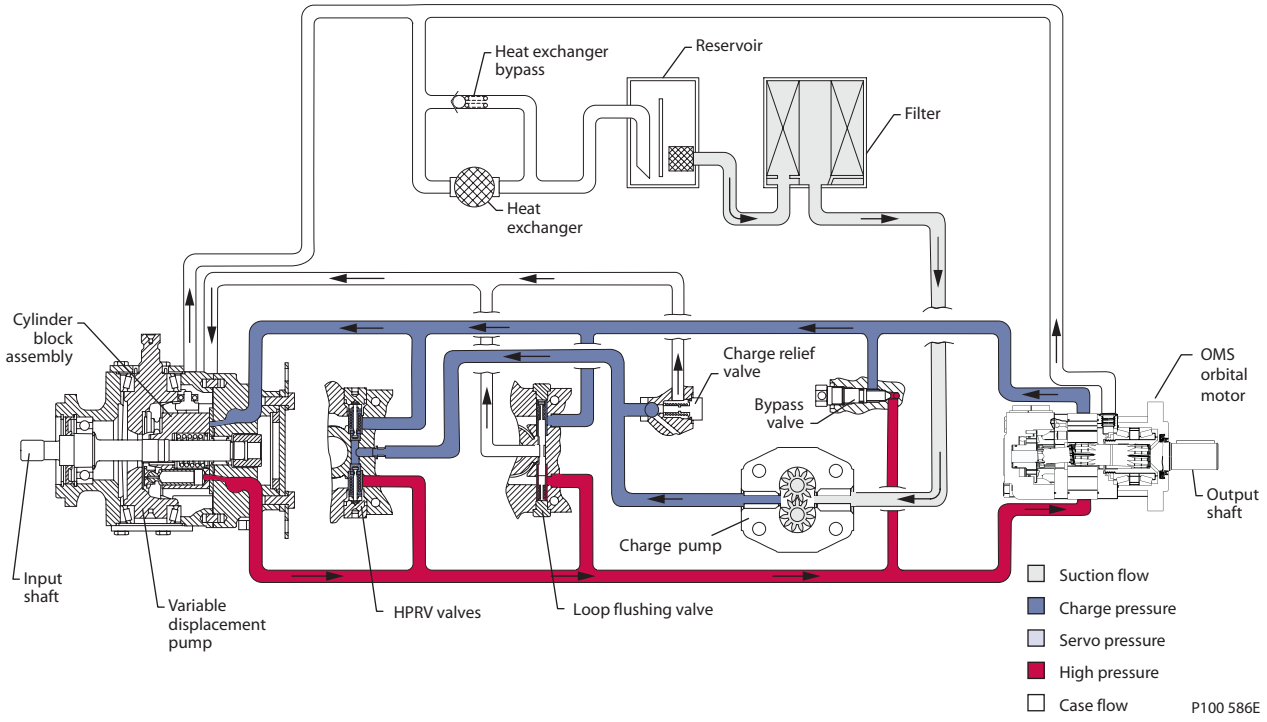
LPV cross section



DIRECT DISPLACEMENT DRIVE SYSTEM

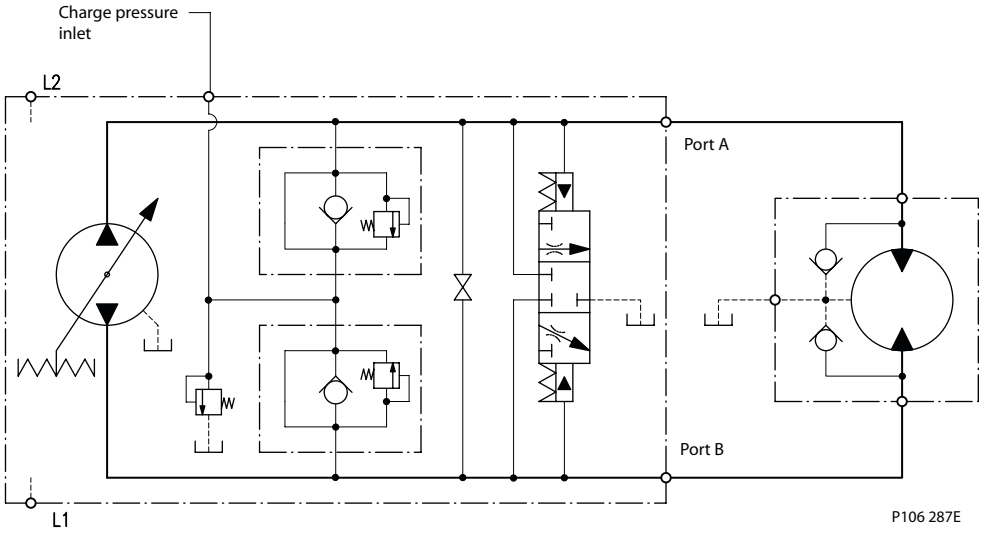
The direct displacement control varies the swashplate angle. Swashplate angle determines pump flow and motor speed.

Pictorial circuit diagram



The diagram shows an LPV pump driving an OMS motor. The system shown uses an external charge pump and external filter. Charge pressure relief valves, high pressure relief valves, and loop flushing valves are shown separated from the pump to provide clarity to the diagram.

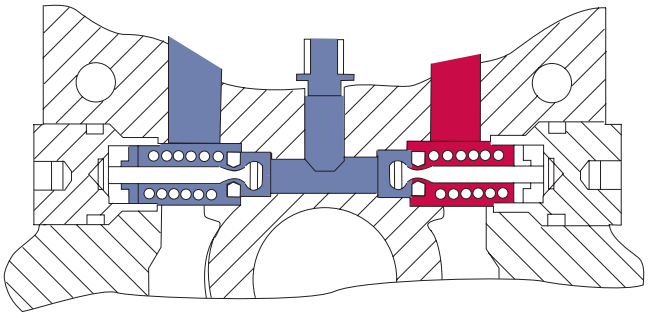
LPV PUMP SCHEMATIC DIAGRAM



HPRV (HIGH PRESSURE RELIEF VALVE)

LPV pumps have a combination high pressure relief and charge check valve. The high-pressure relief function is a dissipative (with heat generation) pressure control valve for the purpose of limiting excessive system pressures. The charge check function replenishes the low-pressure side of the working loop with charge oil. Each side of the transmission loop has a dedicated HPRV valve that is non-adjustable with a factory set pressure. When system pressure exceeds the factory setting of the valve, oil is passed from the high pressure system loop, into the charge gallery, and into the low pressure system loop via the charge check.

HPRV valves



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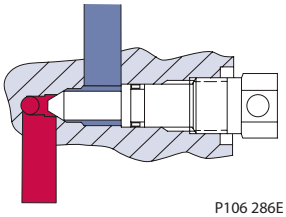
BYPASS FUNCTION

The LPV contains a dedicated bypass valve. To activate the bypass valve, back out 3 full turns (maximum). The bypass function allows you to move a machine or load without rotating the pump shaft or prime mover.

Bypass valve



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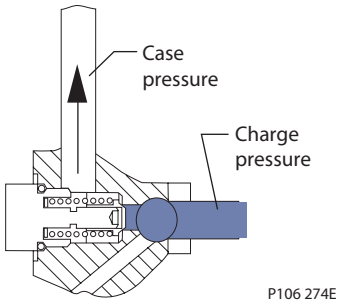
Caution

Excessive speed or extended movement will damage the pump and motor(s) Avoid excessive speeds and extended load/vehicle movement. Do not move the load or vehicle more than 20% of maximum speed or for longer than 3 minutes. When the bypass function is no longer needed, reseat the bypass valve to the normal operating position.

CPRV (CHARGE PRESSURE RELIEF VALVE)

An external pump provides charge pressure to maintain a minimum pressure in the low side of the transmission loop. The CPRV regulates charge pressure.

CPRV



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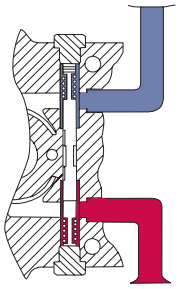
LOOP FLUSHING VALVE

LPV pumps incorporate an optional integral loop flushing valve to remove heat and contaminants from the transmission loop. The loop flushing valve resolves low loop pressure and flushes the low side to pump case. Internal orificing prevents charge pressure drop.

Loop flushing valve



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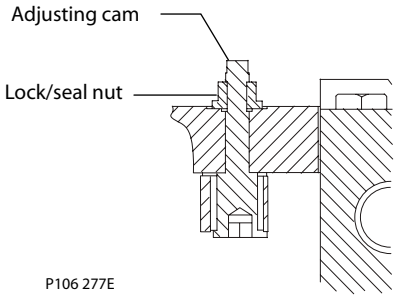
NEUTRAL RETURN MECHANISM

The neutral return mechanism uses a spring to mechanically return the pump to zero displacement. A cam allows precise zero displacement adjustment. Control linkage may also include a redundant neutral return mechanism.

Neutral return adjusting cam



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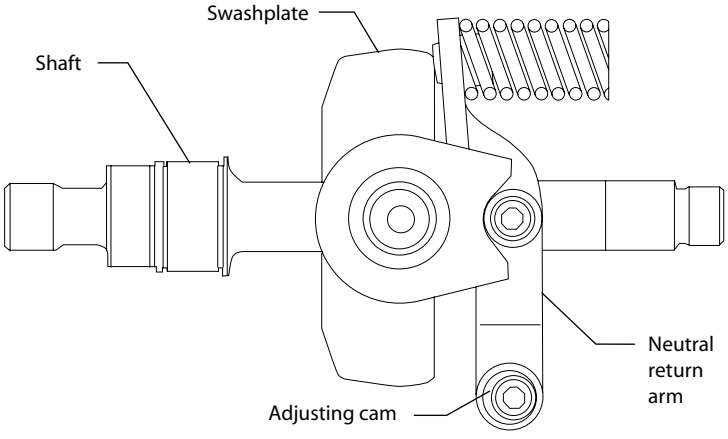
Neutral return mechanism



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SPECIFICATIONS

General specifications

Design	Axial piston pump of trunnion swashplate design with variable displacement
Direction of rotation	Clockwise, counter clockwise
pipe connections	Main pressure ports: SAE straight thread O-ring boss
Recommended installation position	Pump installation recommended with control position on the top or side. Consult Sauer-Danfoss for non conformance to these guidelines. The housing must always be filled with hydraulic fluid.

Physical properties

		Displacement		
Feature	**Unit**	**25**	**30**	**35**
Maximum Displacement	cm^3 [in^3]	25 [1.53]	30 [1.83]	35 [2.14]
Flow at rated speed (theoretical)	l/min [US gal/min]	85.2 [22.5]	104.9 [27.7]	137.0 [36.2]
Input torque at maximum displacement (theoretical)	N•m/ bar [lbf•in/1000 psi]	0.4 [244]	0.5 [291]	0.6 [340]
Mass moment of inertia of internal rotating components	kg•m^2 [slug•ft^2]	0.001670 [0.0012]	0.001580 [0.00120]	0.001530 [0.00113]
Weight	kg [lb]	23 [51]		
Rotation		Clockwise, Counter clockwise		
Mounting		SAE B 2 bolt		
Auxiliary mounting		SAE J744 A 9T, SPCL 11T		
System ports (type)		1 1/16-12 UNF-2B ORB		
System ports (location)		Twin radial		
Control types		Direct displacement control		
Shafts	Splined	Splined SAE 13 tooth, 15 tooth		
Case drain ports		1-1/16-12 SAE ORB		

Operating parameters

			Displacement		
Rating		**Units**	**25**	**30**	**35**
Input speed	minimum	min^{-1} (rpm)	500	500	500
	continuous		3400	3500	3600
	maximum		3950	4150	4300
Working pressure	continuous	bar [psi]	210 [3045]	175 [2540]	140 [2030]
	maximum		345 [5000]		
External shaft loads	External moment (M_e)	N•m [lbf•in]	7.7 [68]		
	Thrust in (T_{in}), out (T_{out})	N [lbf]	750 [169]		
Bearing life (max. swashplate angle and max. continuous speed)	at 210 bar [3045 psi]	B_{10} hours	120,000	63,000	37,000
Charge pressure	minimum	bar [psi]	6 [87]		
	maximum		20 [300]		
Case pressure	rated	bar [psi]	2 [29]		
	maximum		6 [87]		

SPECIFICATIONS (continued)

Sound levels[1]

dB(A)	100 bar [1450 psi]	200 bar [2900 psi]	300 bar [3451 psi]
Displ. cm³ [in³]	**1000 min⁻¹(rpm)**	**1000 min⁻¹(rpm)**	**1000 min⁻¹(rpm)**
25 [1.53]	62	66	68
35 [2.14]	61	66	69
dB(A)	**100 bar [1450 psi]**	**200 bar [2900 psi]**	**300 bar [3451 psi]**
Displ. cm³ [in³]	**3000 min⁻¹(rpm)**	**3000 min⁻¹(rpm)**	**3000 min⁻¹(rpm)**
25 [1.53]	70	74	76
35 [2.14]	71	75	80

1. Sound data was collected in a *semi-anechoic* chamber. Values have been adjusted (-3 dB) to reflect *anechoic* levels.

Fluid specifications

Feature		Unit	Displacement cm³ [in³] 25 [1.53], 30 [1.83], 35 [2.14]
Viscosity	Minimum	mm²/s [SUS]	7 [47]
	Recommended range		12-60 [66-278]
	Maximum		1600 [7500]
Temperature Range [2]	Minimum	C° [F°]	-40 [-40]
	Rated		82 [180]
	Maximum intermittent		100 [212]
Filtration	Cleanliness per ISO 4406		22/18/13
	Efficiency (charge pressure filtration)	β-ratio	$\beta_{15\text{-}20}$= 75 ($\beta_{10}\geq$ 10)
	Efficiency (suction filtration)		$\beta_{35\text{-}45}$= 75 ($\beta_{10}\geq$ 2)
	Recommended inlet screen mesh size	µ m	100 - 125

2. At the hottest point, normally case drain port.

Mounting flange allowable overhung parameters

Continuous load moment (M_c)		Shock load moment (M_s)	
N•m	[lbf•in]	N•m	[lbf•in]
361	[3200]	617	[5470]

Applications experiencing extreme resonant vibrations may require additional pump support. Refer to **520L0954** *LPV Technical Information* for information concerning mounting flange loads.

Mounting flange G-factors for sample applications

Application	Continuous (vibratory) acceleration (G_c)	Maximum (shock) acceleration (G_s)
Skid steer loader	6	10
Trencher (rubber tires)	6	8
Asphalt paver	6	6
Windrower	6	5
Aerial lift	6	4
Turf care vehicle	6	4
Vibratory roller	6	10

FLUID AND FILTER RECOMMENDATIONS

To ensure optimum life, perform regular maintenance of the fluid and filter. Contaminated fluid is the main cause of unit failure. Take care to maintain fluid cleanliness when servicing.

Check the reservoir daily for proper fluid level, the presence of water, and rancid fluid odor. Fluid contaminated by water may appear cloudy or milky or free water may settle in the bottom of the reservoir. Rancid odor indicates the fluid has been exposed to excessive heat. Change the fluid immediately if these conditions occur. Correct the problem immediately.

Inspect vehicle for leaks daily.

Change the fluid and filter per the vehicle/machine manufacturer's recommendations or at these intervals: We recommend first fluid change at 500 hours.

Fluid and filter change interval

Reservoir type	Max oil change interval
Sealed	2000 hours
Breather	500 hours

Caution

High temperatures and pressures result in accelerated fluid aging. More frequent fluid changes may be required.

Change the fluid more frequently if it becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid is subjected to temperature levels greater than the recommended maximum. Dispose of used hydraulic fluid properly. Never reuse hydraulic fluid.

Change filters whenever the fluid is changed or when the filter indicator shows that it is necessary to change the filter. Replace all fluid lost during filter change.

Hazardous material

Warning

Hydraulic fluid is hazardous material. Avoid contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state, and federal environmental regulations.

GENERAL

Follow this procedure when starting-up a new pump installation or when restarting an installation in which you have removed and re-installed the pump. Ensure pump has been thoroughly tested on a test stand before installing on a machine.

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Prior to installing the pump, inspect for damage that may have occurred during shipping.

START-UP PROCEDURE

1. Ensure the machine, hydraulic oil, and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.

2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and free of air leaks.

3. Install the pump. Install a 50 bar [1000 psi] gauge in the charge pressure gauge port M3.

4. Fill the housing by adding filtered oil to the upper case drain port.

5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron filler filter. Ensure inlet line from reservoir to pump is filled.

After start-up the oil level in the reservoir may drop due to filling of the system components. Check the level in the reservoir to maintain a full oil level throughout the start-up.

⚠ Warning

Damage to hydraulic components may occur if the oil supply is not maintained.

6. Disconnect the pump from control linkage.

7. Use a common method to disable the engine to prevent the engine from starting. Crank the starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.

8. When charge pressure begins to appear, enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.

❗ Caution

Air entrapment in oil under high pressure may damage hydraulic components. Do not run at maximum pressure until system is free of air and fluid has been thoroughly filtered.

STARTUP PROCEDURE (continued)

9. When adequate charge pressure is established, increase engine speed to normal operating rpm to further purge residual air from the system.

10. Shut off engine. Connect pump control.
    Start engine, checking to be certain pump remains in neutral. Run engine at normal operating speed and carefully check for forward and reverse control operation.

11. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of loop.

Normal charge pressure fluctuation may occur during forward and reverse operation.

12. Check that the reservoir is full. Remove charge pressure gauge. The pump is now ready for operation.

REQUIRED TOOLS

The service procedures described in this manual can be performed using common mechanic's hand tools. Special tools, if required, are shown. When testing system pressures, calibrate pressure gauges frequently to ensure accuracy.

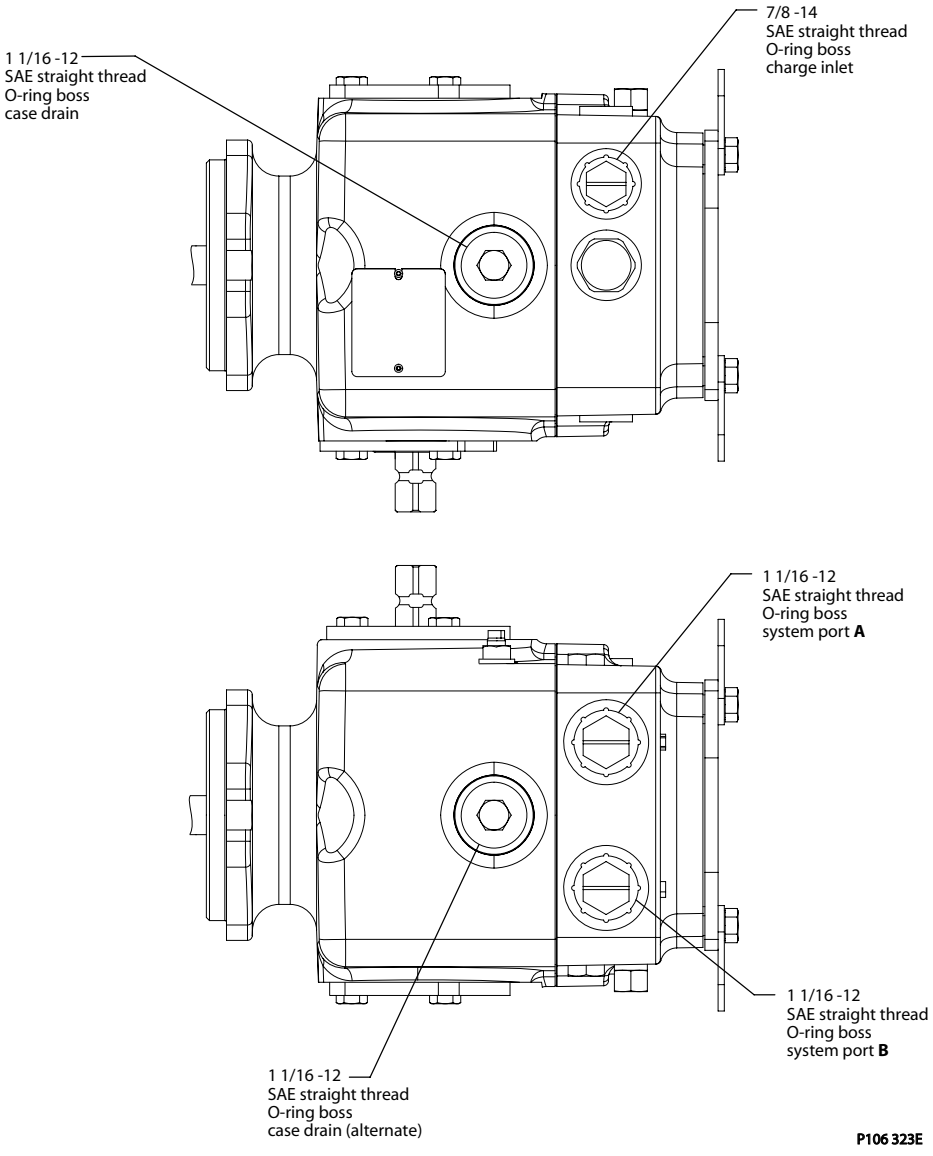
PORT LOCATIONS AND GAUGE INSTALLATION

The following table and drawing show the port locations and gauge sizes needed. Use snubbers to protect gauges.

Port information

Port identifier	Port size	Wrench size	Pressure obtained	Gauge size, bar [psi]
Case drain	1 1/16-12 UNF 2B	15 mm internal hex	Case drain	10 [100]
Port A, Port B	1 1/16-12 UNF 2B	N/A	System pressure	600 [10,000]
Charge inlet	7/8-14 UNF 2B	N/A	Charge pressure	50 [1000]

Port locations



OVERVIEW

This section provides general steps to follow if you observe undesirable system conditions. Follow these steps until you solve the problem. Some of the items are system specific. For areas this manual covers, we reference the section. Always observe the safety precautions listed in the *Introduction* section, page 5, and precautions related to your specific equipment.

SYSTEM OPERATING HOT

Item	Description	Action
Oil level in reservoir.	Insufficient hydraulic fluid will not meet cooling demands of system.	Fill reservoir to proper level.
Heat exchanger.	Heat exchanger not sufficiently cooling the system.	Check air flow and input air temperature for heat exchanger. Clean, repair or replace heat exchanger.
Charge pressure.	Low charge pressure will overwork system.	Measure charge pressure. Inspect and adjust or replace charge relief valve. Inspect charge pump. Repair or replace charge pump.
Charge pump inlet vacuum.	High inlet vacuum will overwork system. A dirty filter will increase the inlet vacuum. Inadequate line size will restrict flow.	Check charge inlet vacuum. If high, inspect inlet filter and replace as necessary. Check for adequate line size, length or other restrictions
System relief pressure settings.	If the system relief valves are worn, contaminated, or valve settings are too low, the relief valves will be overworked.	Verify settings of high pressure relief valves and replace valves as necessary.
System pressure.	Frequent or long term operation over system relief setting will create heat in system	Measure system pressure. If pressure is too high, reduce loads.

TRANSMISSION OPERATES NORMALLY IN ONE DIRECTION ONLY

Item	Description	Action
Control linkage	Control linkage operating improperly	Repair/replace control linkage
Malfunctioning high pressure relief valve	Exchange the high pressure relief valves..	If the problem changes direction, replace the valve that does not operate correctly.
Bypass valve open.	Open bypass will cause either direction to be inoperative.	Close/repair bypass function.

SYSTEM NOISE OR VIBRATION

Item	Description	Action
Reservoir oil level	Low oil level leads to cavitation.	Fill reservoir.
Aeration of the oil/pump inlet vacuum	Air in system decreases efficiency of units and controls. Air in system is indicated by excessive noise in pump, foaming in oil, and hot oil.	Find location where air is entering into the system and fix. Check that inlet line is not restricted and is proper size.
Cold oil	If oil is cold, it may be too viscous for proper function and cause cavitation	Allow the oil to warm up to its normal operating temperature with engine at idle speed.
Pump inlet vacuum	High inlet vacuum causes noise/cavitation.	Check that inlet line is not restricted and is proper size. Check filter and bypass valves (if present).
Shaft couplings	A loose shaft coupling will cause excessive noise.	Replace loose shaft coupling. Replace pump or motor.
Shaft alignment	Misaligned shafts creates noise	Align shafts.
Charge/system relief valves	Unusual noise may indicate sticking valves. Possible contamination.	Clean/replace valves and test pump. May be a normal condition.

SYSTEM WILL NOT OPERATE IN EITHER DIRECTION

Item	Description	Action
Open bypass valve	If bypass valve is open, the system loop will be depressurized.	Close bypass valve.
Low charge pressure with pump in neutral	Low charge pressure insufficient to recharge system loop	Measure charge pressure with the pump in neutral. If pressure is low, go to Pump charge relief valve
Low charge pressure with pump in stroke	Low charge pressure resulting from elevated loop leakage.	Isolate pump from motor by blocking system ports. With pump in partial stroke and engaged for only a few seconds, check pump charge pressure. Low charge pressure indicates a malfunctioning pump. Continue to next step. Good charge pressure indicates a malfunctioning motor or other system component. Check motor charge relief operation (if present).
Pump charge relief valve.	A pump charge relief valve that is leaky, or contaminated, or set too low will depressurize the system.	Adjust or replace pump charge relief valve as necessary
Charge pump inlet filter.	A clogged filter will under supply system loop.	Inspect filter and replace if necessary.
Charge pump.	A malfunctioning charge pump will provide insufficient charge flow.	Repair or replace the charge pump.
System pressure	Low system pressure does not provide enough power to move load	Measure system pressure. Continue to next step.
System relief valves	Defective high pressure relief valves cause system pressure to be low	Repair or replace high pressure relief valves.

SLUGGISH SYSTEM RESPONSE

Item	Description	Action
Oil level in reservoir	Low oil level causes sluggish response	Fill reservoir
High pressure relief valves	Incorrect pressure settings will affect system reaction time	Adjust or replace high pressure relief valves
Low prime mover speed	Low engine speed will reduce system performance	Adjust engine speed
Air in system	Air in system will produce sluggish system response	Fill tank to proper level. Cycle system slowly for several minutes to remove air from system
Pump inlet vacuum	Inlet vacuum is too high resulting in reduced system pressure.	Measure charge inlet vacuum. Inspect line for proper sizing. Replace filter. Confirm proper bypass operation.

PUMP ADJUSTMENT

This section offers instruction on adjustment of pump components. Read through the entire topic before beginning a service activity. Refer to *Pressure measurements*, page 17, for location of gauge ports and suggested gauge size.

STANDARD PROCEDURES

Caution

Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines

1. With the prime mover off, thoroughly clean the outside of the pump.
2. If removing the pump, tag each hydraulic line connected to the pump. If hydraulic lines are disconnected, plug each open port, to ensure that dirt and contamination do not get into the pump.
3. Ensure the surrounding areas are clean and free of contaminants such as dirt and grime.
4. Inspect the system for contamination.
5. Look at the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or small metal particles.
6. If there are signs of contamination in the hydraulic fluid, replace all filters, drain the hydraulic system, and fill with the correct hydraulic fluid.
7. Flush the lines before replacing the hydraulic fluid.

CHARGE PRESSURE RELIEF VALVE ADJUSTMENTS

The following procedure explains how to check proper operation of the charge pressure relief valve. Charge pressure is the measured pressure minus case drain pressure.

1. Validate that external charge pump is operating properly.

2. Install a 50 bar [1000 psi] pressure gauge (tee-in) at the charge pressure inlet port. Install a 10 bar [100 psi] gauge at one of the case pressure ports. Operate the system with the pump in neutral (zero displacement) when measuring charge pressure.

3. Verify correct charge pressure per model code. Pressure measurements assume: 19 l/min [5 US gal/min] charge flow, reservoir temperature of 50°C [120°F], and are referenced to case pressure.

Pressure listed in model code assumes a charge flow of 19 l/min [5 US gal/min]. At higher charge flows, the charge pressure will rise over the rated setting.

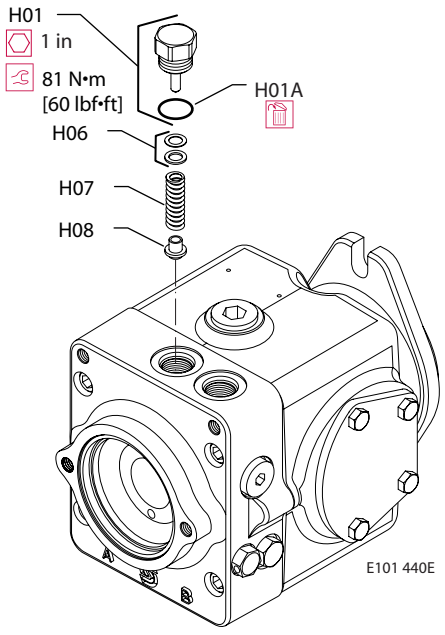
4. If measured pressure is not correct, disassemble valve and look for signs of wear or contamination. Refer to *Minor repair* page 29, for wrench sizes and torque settings.

5. If valve is worn, replace entire valve.

6. If necessary, adjust valve by adding or removing shims (H06). Kit is available, refer to service parts manual.

7. When the desired charge pressure setting is achieved, remove the gauges.

Charge pressure relief valve



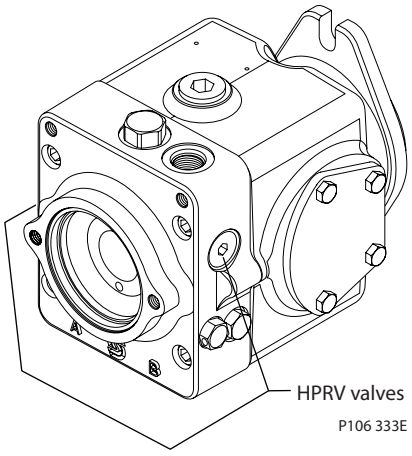
SYSTEM CHECK AND HPRV

Whenever an HPRV valve has been replaced or opened, operate the pump in its full range of functions to ensure proper machine operation. The HPRV valves are pre-set at the factory, no adjustment is possible.

Checking for proper HPRV valve operation

For suspected HPRV valve malfunction, replace valve with identical relief setting and test operation of pump.

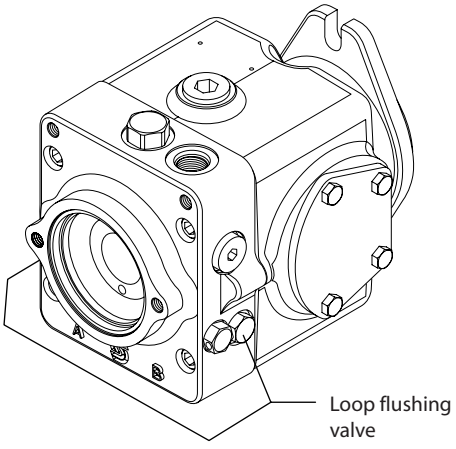
HPRV valves



LOOP FLUSHING VALVE

The loop flushing valve is not adjustable. If loop flushing malfunction is suspected, disassemble valve and check for worn, damaged or scored components. Replace parts if necessary. Refer to *Minor repair*, page 30 for disassembly procedures.

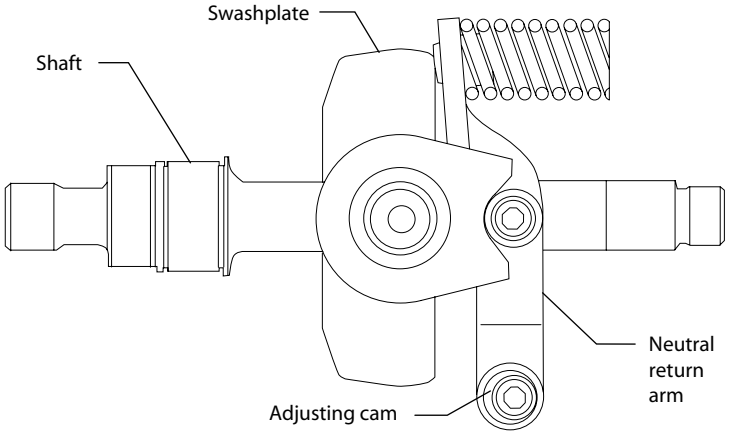
Loop flushing valve



NEUTRAL RETURN MECHANISM

The neutral return mechanism returns the pump to zero displacement in the absence of control input. If machine does not return to neutral, first disconnect control linkage and check for creep. If creep is not present with control linkage disconnected, refer to machine adjustment/service procedures for control linkage adjustment. If creep is still present with control linkage disconnected, follow this procedure for pump neutral adjustment.

Neutral return mechanism



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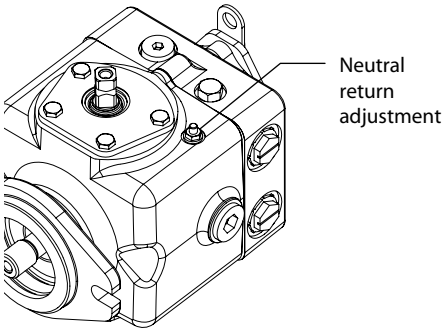
1. For propel applications, raise the wheels off the ground and secure the vehicle so you can operate it safely. Other applications: take necessary steps to ensure you can operate the machine safely during this procedure.

2. Remove the control linkage and check for creep. If the wheels/ mechanism move while the control linkage is disconnected, loosen the locknut and turn the adjusting screw clockwise or counterclockwise. You will achieve maximum adjustment with only 1/4 turn in either direction.

3. If creep is eliminated by adjustment, torque the locknut to 22 N•m [16 lbf•ft] while holding the adjustment screw secure. If creep cannot be eliminated, then the pump requires major repair. Remove the unit and refer to Sauer-Danfoss Global Service Partner for repairs.

Neutral return adjustment



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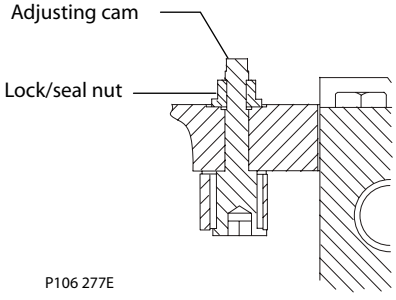
Neutral return adjusting screw



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INPUT SHAFT AND SEAL

Shaft seal removal

1. Orient pump with the shaft pointing up.
2. Remove retaining ring (D03) using retaining ring pliers to release the shaft seal components.
3. Remove the seal support washer (D02). Use a packing hook if necessary.
4. Remove the shaft seal and discard. Carefully drive a small sheet-metal screw into the shaft seal (D01) to facilitate removal. Be careful not to damage the bearing below the seal. Attach a slide hammer or appropriate puller to the screw head and pull to remove the seal.

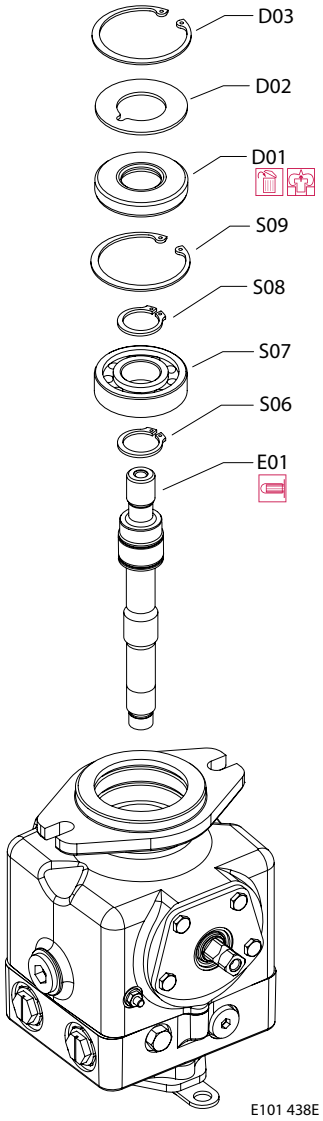
Caution
Do not damage the housing bore, shaft or bearing when removing the shaft and shaft seal.

Shaft removal

1. Remove retaining ring (S09) using retaining ring pliers.
2. Pull shaft (E01) with bearing (S07) out of the pump. If necessary, tap lightly on the shaft to dislodge it from the internal pump components.
3. Remove retaining rings (S06, 8) using retaining ring pliers.
4. Press on the inner race to remove bearing from shaft.

Caution
Moving the pump with the shaft removed may dislodge the rotating group making reassembly impossible without removing the endcap. Use extreme caution removing the shaft and replace it immediately. Do not allow the pump to move while the shaft is out.

Remove shaft /seal/bearing

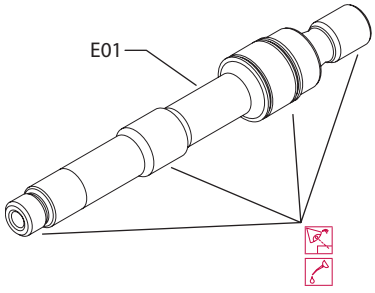


INPUT SHAFT AND SEAL (continued)

Shaft inspection

Ensure the shaft (E01) and its splines are straight and free of damage or heavy wear. Inspect the shaft surface where it meets the shaft seal. Replace the shaft if a groove exists at the sealing land surface that may let dirt into or hydraulic fluid out of the unit. Clean the sealing area with a nonabrasive material if necessary. Lubricate the shaft with a light coat of hydraulic fluid before re-assembly.

Inspect shaft



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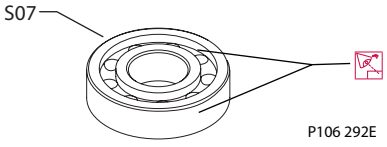
Bearing inspection

Clean bearing with a solvent and lubricate with hydraulic fluid. Inspect for wear, or pitting. The bearing should rotate smoothly. Any roughness you can feel while rotating is cause for replacement.

Inspect shaft bearing



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INPUT SHAFT AND SEAL (continued)

Reassembly

1. Install first bearing retaining ring (S06) using retaining ring pliers.
2. Lubricate bearing (S07) with hydraulic fluid. Press bearing onto shaft by applying force to inner race.
3. Install second bearing retaining ring (S08) using retaining ring pliers.
4. For protection, cover end of shaft with installation sleeve or packaging tape.

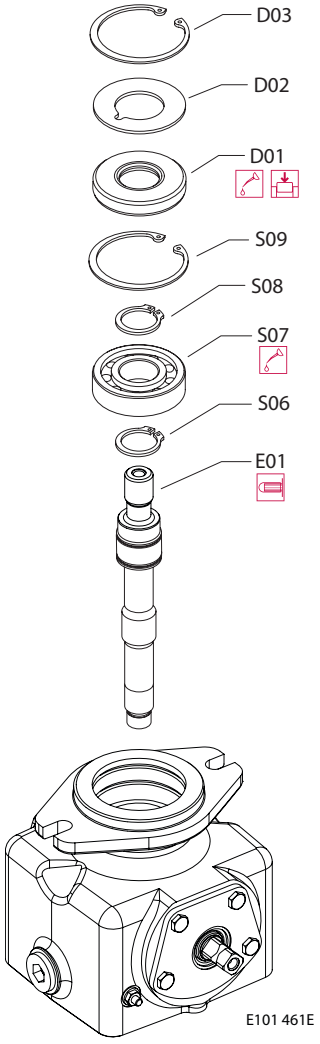
Caution
Do not damage the housing bore, shaft or rear bearing when installing the shaft and shaft seal. All components should fit together smoothly.

5. Install shaft (S01) with bearing into housing. Ensure the shaft splines engage the block splines and the shaft end slides smoothly into the rear bearing. ! It may be necessary to tap the shaft to seat the bearing. Do not force the shaft through the block or into the rear bearing.

If the shaft does not go into the pump, refer to a Sauer-Danfoss Global Service Partner for major repair.

6. Using retaining ring pliers, install shaft/bearing retaining ring (S09).
7. Lubricate the seal (D01) using hydraulic fluid. Press seal into housing until it bottoms out. Press evenly to avoid binding and damaging the seal.
8. Install the seal support washer (D02).
9. Install the seal retaining ring (D03) using retaining ring pliers.

Install shaft /seal/bearing



TRUNNION SEAL

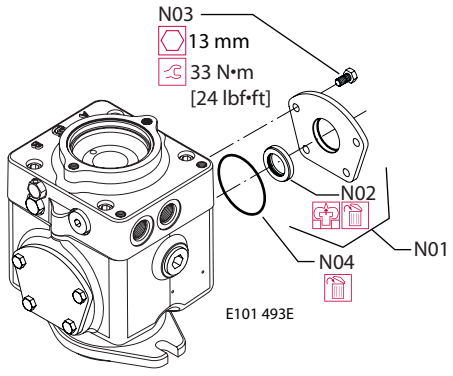
Removal

1. Remove four trunnion cover bolts (N03) using a 13 mm hex wrench.
2. Remove trunnion cover (N01). Remove and discard O-ring (N04).
3. Press the lip seal (N02) out of the trunnion cover (N01); discard.

Inspection

Inspect seal land on trunnion shaft and trunnion cover for rust, wear, or contamination. Polish seal land on trunnion shaft if necessary.

Remove trunnion cover and seal



Reassembly

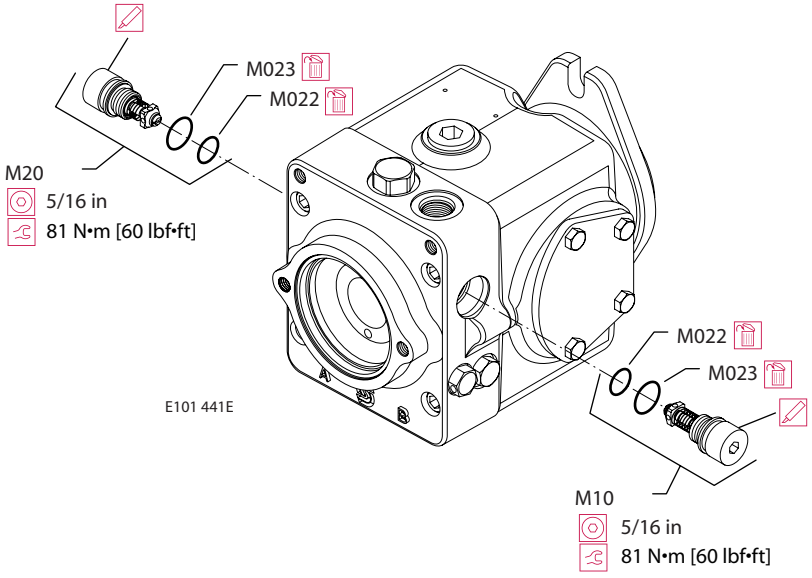
1. Press new trunnion seal (N02) into cover (N03).
2. Install new O-ring (N04). Retain with petroleum jelly.
3. Cover the trunnion shaft with an installation sleeve or wrap with packaging tape to prevent damage to seal.
4. Install trunnion cover and seal assembly (N01) to housing.
5. Install four trunnion cover bolts using a 13mm hex wrench. Torque to 33 N•m [24 lbf•ft]

HIGH PRESSURE RELIEF VALVES

Removal

1. Mark the location of each valve for proper reassembly.
2. Using a 5/16 internal hex wrench, remove the valves (M10) and (M20).
3. Remove and discard O-rings (M022) and (M023).

Disassemble system check relief valves



Inspection

Inspect plug and internal parts of cartridge. If parts are worn or damaged, replace entire cartridge.

Reassembly

1. Lubricate and install new O-rings (M022) and (M023) onto each valve (M10) and (M20).
2. Install the valves in their original location as noted during disassembly.
3. Use a 5/16 in internal hex wrench to torque valves to 81 N•m [60 lbf•ft].

CHARGE PRESSURE RELIEF VALVE

Removal

1. Using a 1 in hex wrench, remove the charge pressure relief valve plug (H01). Discard O-ring (H01A).
2. Charge relief valve shims (H06) may remain in plug (H01). Remove shims by tapping plug on the workbench.
3. Use a magnet to remove the spring (H07).
4. Use a magnet to remove the charge relief poppet (H08).

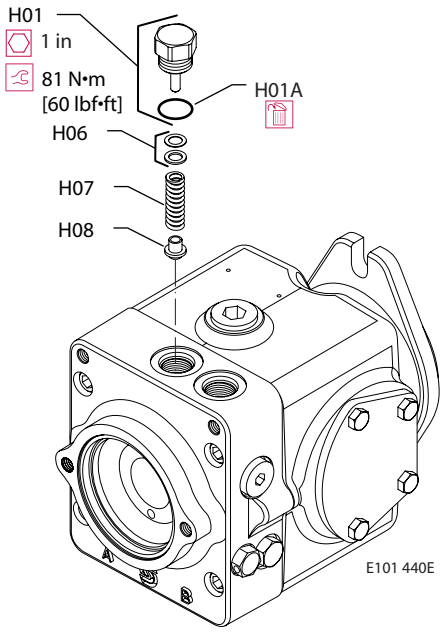
Inspection

Inspect charge relief valve plug, shims, spring, and poppet for wear or damage. Replace spring if it is warped or bent.

Reassembly

1. Insert charge relief valve poppet (H08) and spring (H07) into endcap.
2. Install shims (H06) into charge relief valve plug (H01).
3. Lubricate and install a new O-ring (H01A) onto the charge relief valve plug.
4. Install charge relief valve plug using a 1 in. hex wrench. Torque to 81-203 N•m [60-150 lbf•ft].

Charge pressure relief valve



LOOP FLUSHING VALVE

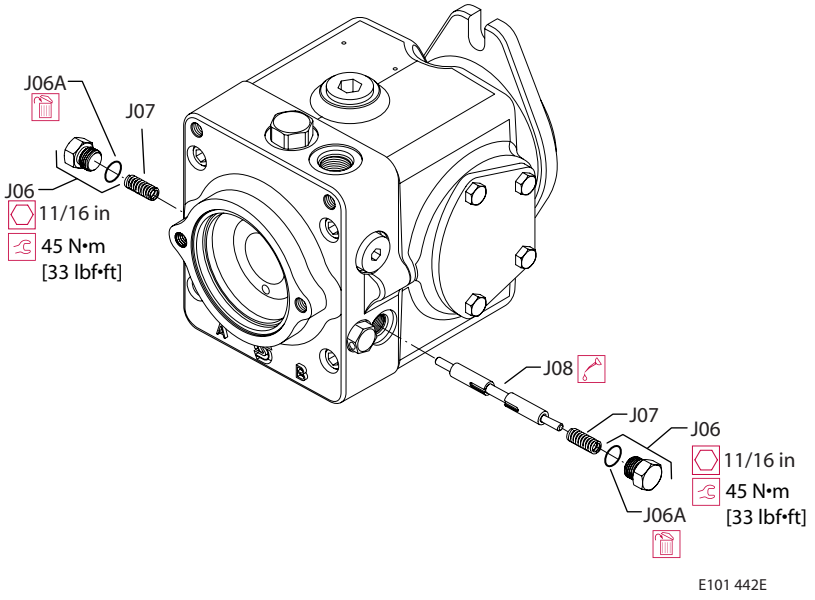
Removal

1. Using an 11/16 in hex wrench, remove the loop flushing valve plugs (J06). Discard O-ring (J06A).

2. Use a magnet to remove springs (J07).

3. Use a magnet to remove loop flushing spool (J08).

Disassemble loop flushing valve



Inspection

Inspect loop flushing valve spool and springs for damage or wear. Replace parts as necessary.

Reassembly

1. Lubricate and insert loop flush spool (J08) into endcap.

2. Install springs (J07).

3. Lubricate and install new O-rings (J06A) onto loop flushing valve plug (J06).

4. Thread the loop flushing valve plugs into the housing and torque to 45 N•m [33 lbf•ft] using an 11/16 in hex wrench.

BYPASS VALVE

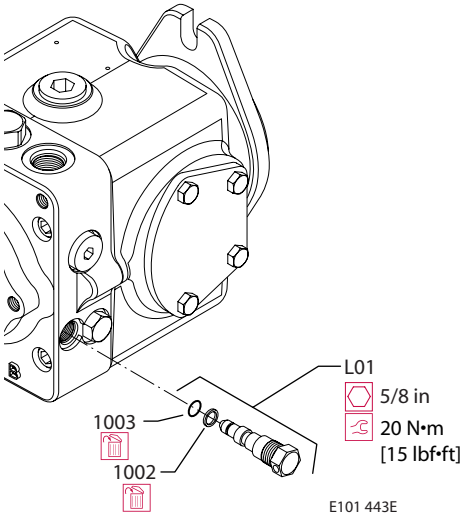
Removal
Using a 5/8 in hex wrench, remove the bypass valve cartridge (L01). Discard O-ring (1003) and backup ring (1002).

Inspection
Inspect cartridge. Replace as necessary.

Reassembly
1. Lubricate and install new O-ring (1003) and backup ring (1002) onto cartridge.

2. Install the bypass valve cartridge (L01) using a 5/8 in hex wrench. Torque to 20 N•m [15 lbf•ft].

Bypass valve



COUPLING

Removal
1. Position pump so endcap is on top.

2. Remove auxiliary pump or cover (not shown).

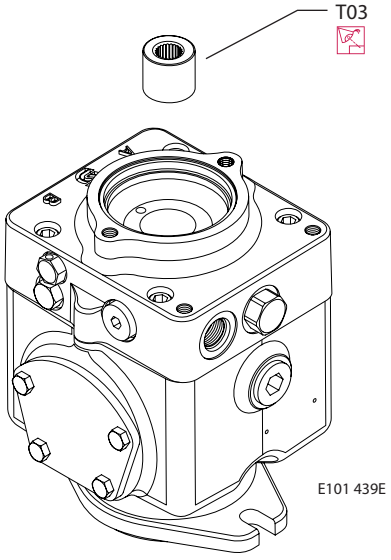
3. Remove coupling (T03). Use a small hook if necessary.

Inspection
Check coupling splines for fretting or abnormal/excessive wear. Look for cracks that indicate coupling fatigue. If wear or damage is found, replace coupling.

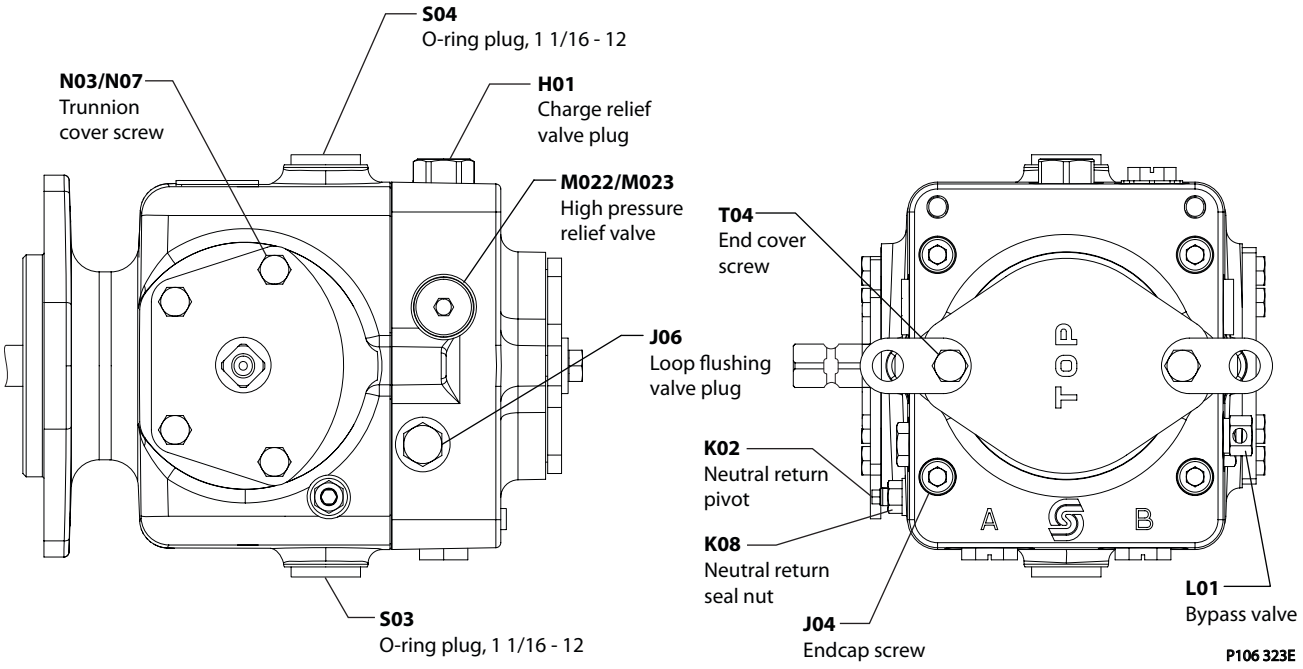
Reassembly
1. Lubricate and install coupling (T03).

2. Replace auxiliary pump or cover.

Remove end cover



FASTENERS AND PLUGS



FASTENER SIZE AND TORQUE CHART

Item	Fastener	Wrench size	Torque
H01	Charge relief valve plug	1 in	81-203 N•m [60-150 lbf•ft]
J04	Endcap screw	8 mm internal hex	54 N•m [40 lbf•ft]
J06	Loop flushing valve plug	11/16 in	45 N•m [33 lbf•ft]
K02	Neutral return pivot	1/4 in	N/A
K08	Neutral return seal nut	13 mm	22 N•m [16 lbf•ft]
L01	Bypass valve	11/16 in	20 N•m [15 lbf•ft]
M022/M023	High pressure relief valve	5/16 in internal hex	81 N•m [60 lbf•ft]
N03/N07	Trunnion cover screw	13 mm	33 N•m [24 lbf•ft]
T04	End cover screw	9/16 in	44 N•m [32 lbf•ft]

PLUG SIZE AND TORQUE CHART

Item	O-ring plug	Wrench size	Torque
S03, S04	1 1/16 - 12	15 mm internal hex	69 N•m [51 lbf•ft]

Notes

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