Service Manual
danfoss.com

Axial Piston Open Circuit Pumps

X1P



Revision history

Table of revisions

Date	Changed	Rev
October 2026	Initial Release	0101

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Introduction

Using this manual

This manual includes information for the normal operation, maintenance, and service of the X1P open circuit pumps. The manual includes a description of the units and their individual components, troubleshooting information, adjustment instructions and minor repair procedures. Unit warranty obligations should not be affected if maintenance, adjustment and minor repairs are performed according to the procedures described in this manual.

Many service and adjustment activities can be performed without removing the unit from the vehicle or machine. However, adequate access to the unit must be available, and the unit must be thoroughly cleaned before beginning maintenance, adjustment, 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 Danfoss Authorized Service Centers (ASCs) is available should major repairs be needed. Contact any Danfoss ASC for details. A list of all ASCs can be found in bulletin BLN-2-40527, or in brochure SAW (Ident. No. 698266), or you can locate your nearest ASC using the distributor locator at http://www.powersolutions.danfoss.com

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 diable/disconnect the mechanism while servicing.

Flammable cleaning solvents

Fluid under pressure

⚠ 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.

⚠ 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.

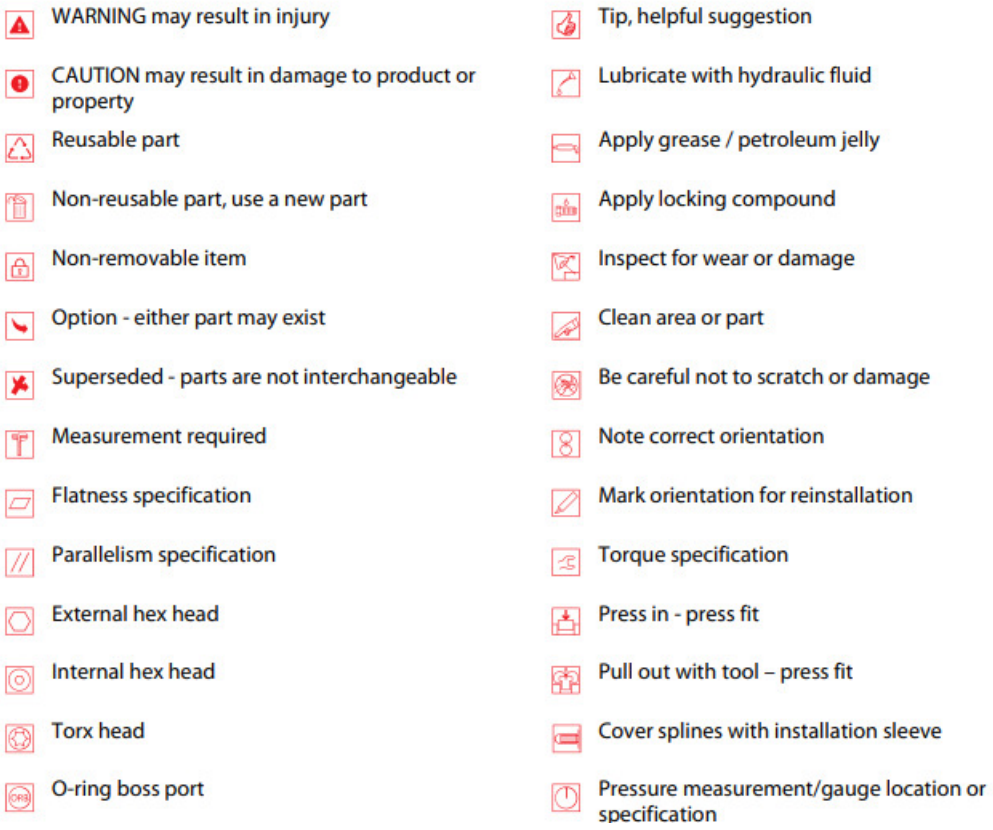
Personal safety

⚠ Warning

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

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Symbols used in Danfoss literature



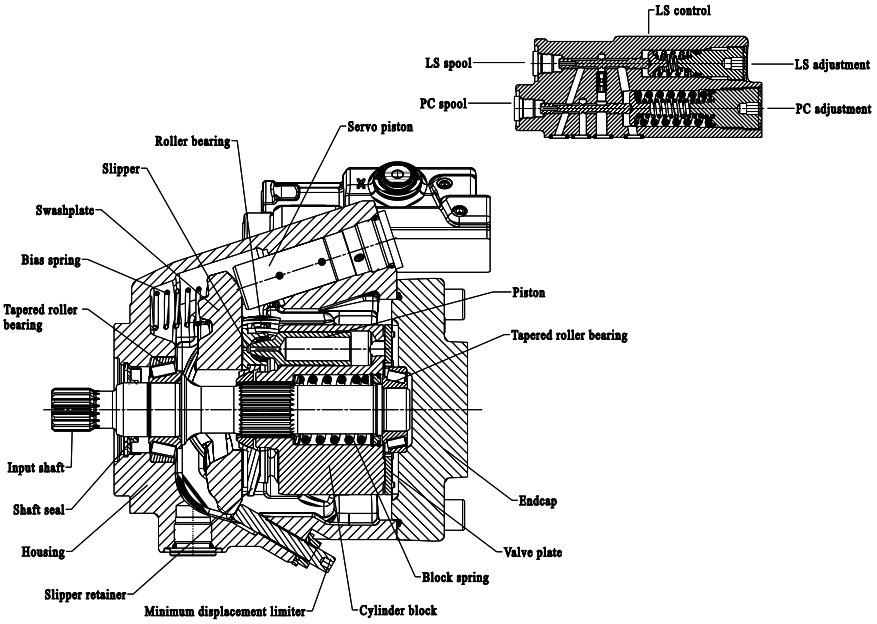
The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains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

General Description

Danfoss X1P open circuit piston pumps convert input torque into hydraulic power. Rotational force is transmitted through the input shaft to the cylinder block. The input shaft is supported by tapered roller bearings at the front and rear of the pump and is splined into the cylinder block. A lipseal at the front end of the pump prevents leakage where the shaft exits the pump housing. The spinning cylinder block contains nine reciprocating pistons. Each piston has a brass slipper connected at one end by a ball joint. The slippers are held to the swashplate by the spring retainer and block spring. The block spring also holds the cylinder block to the valve plate. The reciprocating movement of the pistons occurs as the slippers slide against the inclined swashplate during rotation. Via the valve plate, one half of the cylinder block is connected to pump inlet and the other half to pump outlet. As each piston cycles in and out of its bore, fluid is drawn from the inlet and displaced to the outlet thereby imparting power into the system circuit. A small amount of fluid is allowed to leak from the cylinder block / valve plate and slipper / swashplate interfaces for lubrication and cooling. Case drain ports are provided to return this fluid to the reservoir.

The volume of fluid displaced into the system circuit is controlled by the angle of the swashplate. The swashplate is forced into an inclined position (into stroke) by the bias spring. The servo piston opposes the action of the bias spring forcing the swashplate out of stroke when hydraulic pressure in the control circuit rises above the spring force.

The pump control, by varying the pressure at the servo piston, controls the displacement of fluid in the system circuit. Controls designed for Pressure Compensation (PC) or Load Sensing (LS) are available. For a detailed description of control operation, refer to Control options.



General Specifications

- Type of mounting: SAE-B and SAE-C mounting flanges
- Auxiliary mounting pad options: Running Cover, SAE-A, Integral A, SAE-B, or SAE-C
- Control options:
  - PC: Pressure Compensator
  - PC: Pressure Compensator LS: Load Sensing (with PC)
  - PC: Pressure Compensator LS: Load Sensing (with PC) With Bleed
  - Fan Drive Control
- Port options
  - Inlet and system ports
  - Code 61
  - Radial (side) ports
- Direction of rotation: Clockwise and Counter Clockwise
- Intallation position: Installation position is discretionary. To satisfy inlet pressure conditions, it is recommended that the pump always be located below the lowest level of hydraulic fluid in the reservoir. The housing must always be filled with hydraulic fluid.

Technical specifications

Pump Model		Frame C	
Maximum displacement cm^3 [in^3]		60 [3.66]	75 [4.58]
System Pressure Bar [PSI]	Cont. working pressure	310 [4495]	280 [4060]
	Max working pressure	400 [5800]	350 [5075]
Continuous input speed [rpm]		2600	2500
Theoretical flow l/min [US gal/min]		156 [41.2]	187.5 [49.5]
Weight kg [lbs]	Radial	28.5 [62.8]	

Hydraulic parameters

Inlet pressure

Minimum pressure, continuous = 0.8 bar absolute [6.7 in Hg] (at reduced maximum pump speed)

Minimum pressure, cold start = 0.5 bar absolute [15.1 in Hg]

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Pressure compensator valve setting

Minimum: 100 bar [1450 psi]

Maximum (75cc): 280 bar [4060 psi]

Maximum (60cc): 310 bar [4495 psi]

Case pressure

Maximum continuous: 0.5 bar [7 psi] Above inlet

Intermittent: 2 bar [29 psi] Cold start

Hydraulic fluid

Please provide Danfoss's fluids technical information manual (BC152886484524en) and details of your application to your fluid supplier to ensure the suitability of the fluid for your purpose. See Fluid and filter maintenance for recommended fluid and filter change intervals.

Temperature range

Intermittent (cold start): -40°C [-40°F]

Continuous: 104°C [220°F]

Maximum*: 115°C [240°F]

Note

Hydraulic fluid viscosity must be maintained within the prescribed limits.

Fluid viscosity

Viscosity limits

Rating		mm^2/s (cSt) [SUS]
v continuous	minimum	9[58]
	maximum	110 [500]
v intermittent	minimum	6.4 [47]
	maximum [cold start]	1000 [4700]

Filtration

Required cleanliness level: ISO 4406 Class 18/13 or better. Refer to Danfoss' fluids technical information manual (BC152886484524en). See Fluid and filter maintenance for recommended fluid and filter change intervals.

Features

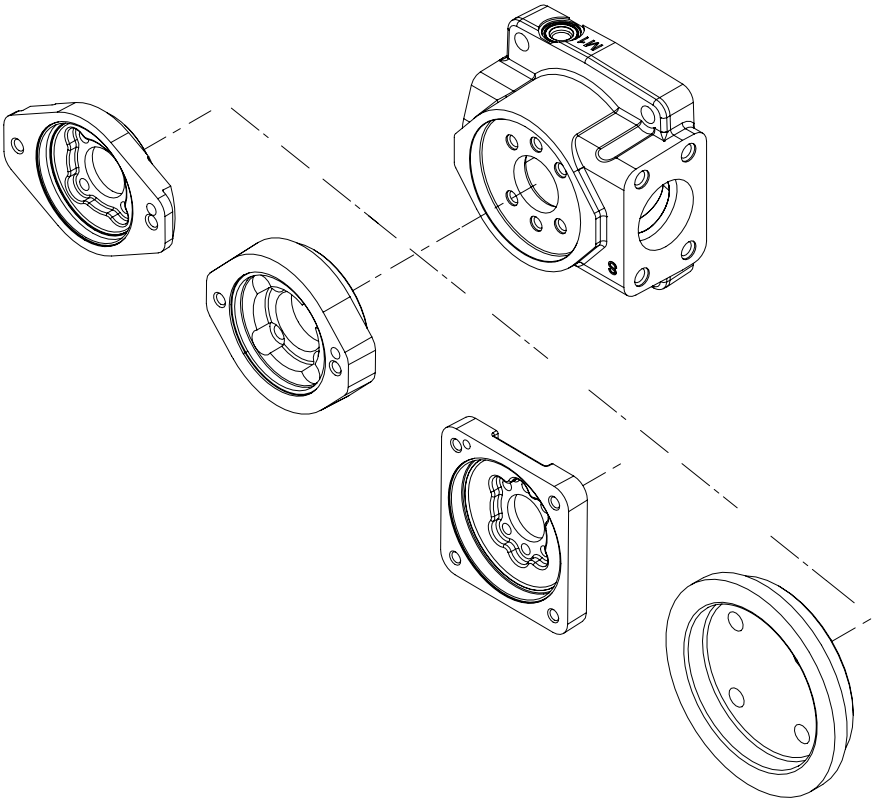
Displacement limiter

X1P pumps are available with an optional maximum or minimum displacement limiter. If installed, this allows for displacement to be limited and adjustable. For more information refer to the X1P technical information manual.

Auxiliary mounting pads

Auxiliary mounting pads are available for all radial ported X1P pumps. These pads are typically used for mounting auxiliary hydraulic pumps.

Since the auxiliary pad operates under case pressure, an O-ring must be used to seal the auxiliary pump mounting flange to the pad. The drive coupling is lubricated by oil from the main pump case.



Input shafts

X1P pumps are available with a variety of splined input shafts. For more information refer to the X1P technical information manual.

Control options

The X1P has five control options, a Load Sensing (LS) control with Pressure Compensator (PC), a PC only control, Fan Drive, PS/LS with Bleed and remote PC. For more information refer to the X1P technical information manual.

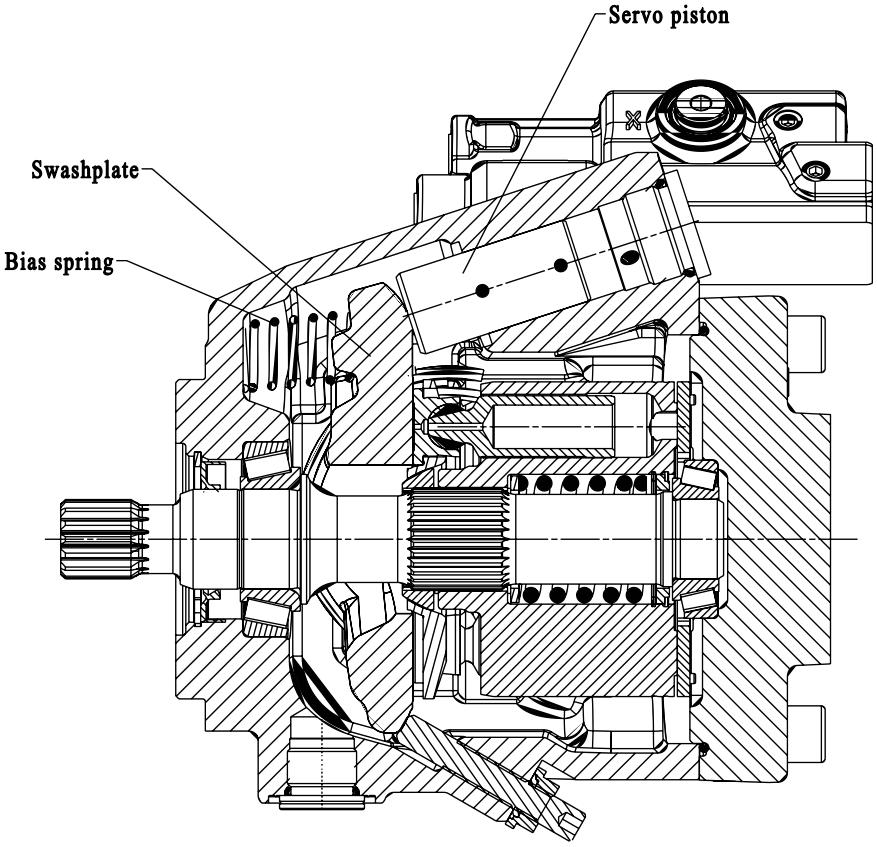
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Operation

General

The bias spring always acts to push the swashplate to maximum angle causing the pump to stroke. The servo piston acts against the bias spring to reduce the swashplate angle causing the pump to destroke. Swashplate angle determines pump outlet flow. The pump control, depending on conditions in the system circuit, sets swashplate angle by metering system pressure to the servo piston.

Cross-section pump: Bias spring and servo piston set swashplate position

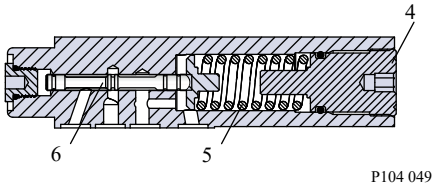


PC control

The PC control is designed to maintain constant pressure in the hydraulic circuit as flow varies. The PC control modulates pump flow accordingly to maintain system pressure at the PC setting as defined by the PC adjustment screw (4) and spring (5).

When system pressure, acting on the non-spring end of the PC spool (6), overcomes the force of the PC spring, the spool shifts porting system pressure to the servo piston and the swashplate angle decreases. When system pressure drops below the PC setting, the PC spring shifts the spool in the opposite direction connecting the servo piston to pump case and the swashplate angle increases. The swashplate is maintained at whatever angle is required to keep system pressure at the PC setting.

Cross-section PC control: PC spool shifts to port system pressure to servo piston

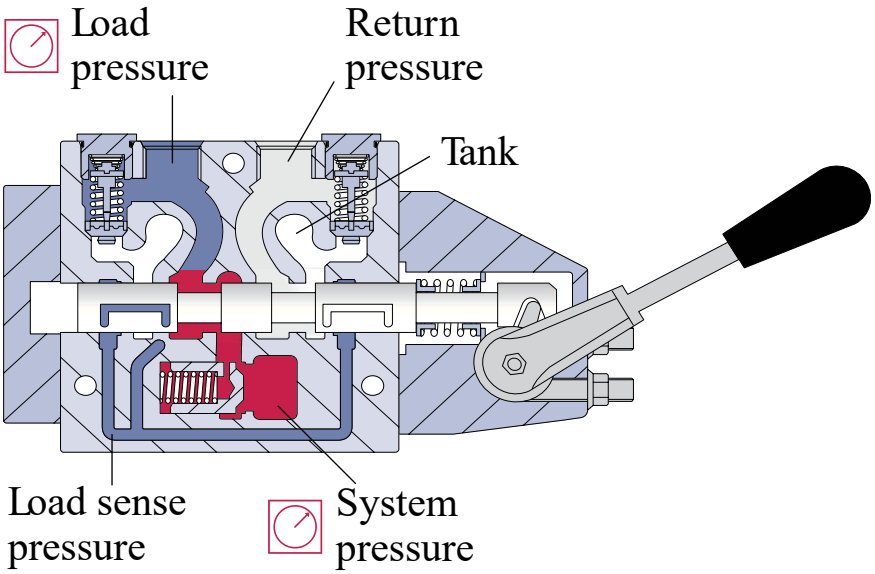


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LS control

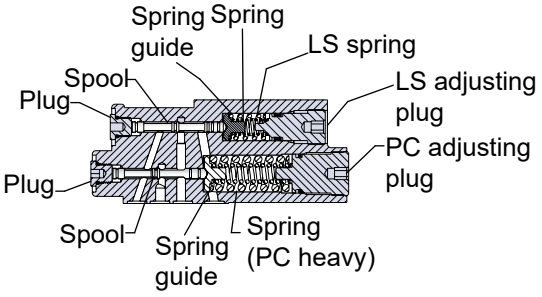
The LS control is designed to match pump flow with system demand. The flow demand of the system is sensed by the LS control as a pressure drop across the External Control Valve (ECV). As the ECV opens and closes, the pressure delta across the valve changes. When opening, the delta decreases. When closing, the delta increases. The LS control then increases or decreases pump flow to the system until the pressure delta becomes equal to the LS setting as defined by the LS adjustment screw and spring.

Typical load-sensing control valve



Pressure drop across external control valve defines system demand

Cross-section LS control: LS spool shifts to port system pressure to servo piston



The LS control consists of two spool valves that connect the servo piston either to pump case or system pressure. The PC spool controls the pressure-compensating function of the control as described in the previous section. The LS spool controls the load-sensing function. The PC spool has priority over the LS spool.

Through internal porting, system pressure (upstream of ECV) is applied to the non-spring end of the LS spool and via hydraulic line connected at port X, LS pressure (downstream of ECV) is applied to the spring end. This arrangement allows the LS spool to act on the delta between system pressure and LS pressure. The LS spring sets the threshold of operation (LS setting).

Because the swashplate is biased to maximum angle, the pump attempts to deliver full flow to the hydraulic system. When the flow being delivered exceeds demand, the pressure delta across the ECV is great enough to overcome spring force and shift the LS spool porting system pressure to the servo piston. The pump de-strokes reducing flow until the delta across the ECV becomes equal to the LS setting. When flow being delivered is less than demand, the delta across the ECV drops below the LS setting and the LS spring shifts the spool connecting the servo piston to pump case. The pump strokes increasing flow until the delta across the ECV becomes equal to the LS setting.

When the external control valve is placed in neutral, it connects the LS signal line to drain. With no LS pressure acting on the non-spring end of the LS spool, the pump adjusts stroke to whatever position necessary to maintain system pressure at the LS setting. The pump is now in standby mode.

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Because of the series arrangement of the LS and PC spools, the PC spool will override the LS spool. If at any time system pressure reaches the PC setting, the PC spool will shift blocking the passage that connects the LS spool with the servo piston and porting system pressure to the servo piston causing the pump to de-stroke.

Electronic Controls

Fan Drive Control

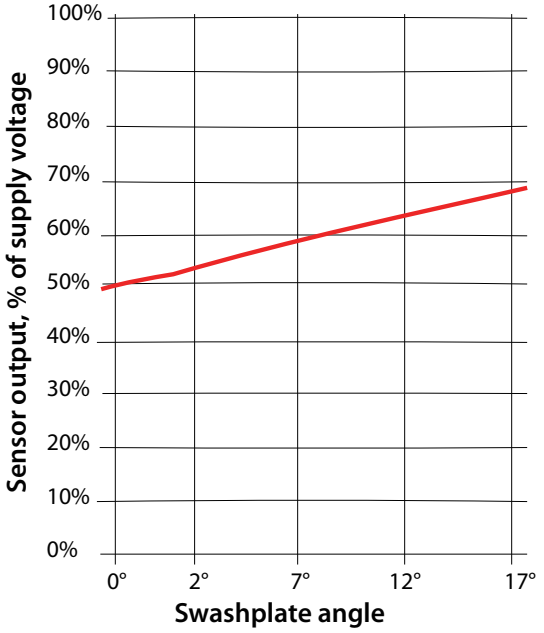
The X1P angle sensor has not met the Danfoss PLUS+1® compliance standards. Compliance and PLUS+1® blocks will be available on the Danfoss website soon.

Angle Sensor Principle

The angle sensor detects the swash plate position with an accuracy dependent upon the calibration effort done for the application.

The sensor works on the hall-effect technology. The implemented technology is based on a measurement of the magnetic field direction in parallel to the chip surface. This field direction is converted to a voltage signal at the output.

Enhanced calibration of the non-linear behavior leads to more exact calculation of the pump swashplate angle. The 4-pin DEUTSCH connector is part of the sensor housing. The swashplate angle sensor is available for all EDC controls for 12 V.



Warning

Strong magnetic fields in the proximity of the sensor can influence the sensor signal and must be avoided.

Note

Cont your Danfoss representative in case the angle sensor will be used for safety functions.

Swash plate angle sensor parameters

Parmeter	Minimum	Typical	Maximum
Supply voltage range	4.5 V_{DC}	5 V_{DC}	5.5 V_{DC}
Supply protection	-	-	18 V_{DC}
Pump neutral output (% of supply voltage)	-	50%	-
Working range (swash plate angle)	0°	-	18°C
Required supply current	-	-	30 mA

Swash plate angle sensor parameters (continued)

Parmeter	Minimum	Typical	Maximum
Output current signal	-	9mA	11 mA
Working temperature	-40°C	80°C	115°C

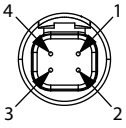
Calibration of the sensor output within the software is mandatory. Vehicle thresholds in the software (±0.5º) are vehicle dependent and must consider different condition, including, but not limited to system temperature, system pressure and/or shaft speed.

Note

For safety function: If the sensor fails (invalid signal 90% of supply voltage), it must be sure that the ECU will go into a diagnostic mode and shift into limited mode. Avoid strong magnetic fields near the sensor that can influence the sensor signal.

Swashplate angle sensor connector

Connector DEUTSCH, 4-pin



1	Ground (GND)
2	Not connected
3	Output signal 1 (Sig 1)
4	Supply (V+)

Description	Quantity	
Mating connector	1	DEUTSCH DTM06-4S-E004
Wedge lock	1	DEUTSCH WM-4S
Socket contact	4	DEUTSCH 0462-201-2031
Blind socket	1	DEUTSCH 0413-204-2005
Danfoss mating connector kit	1	11212713

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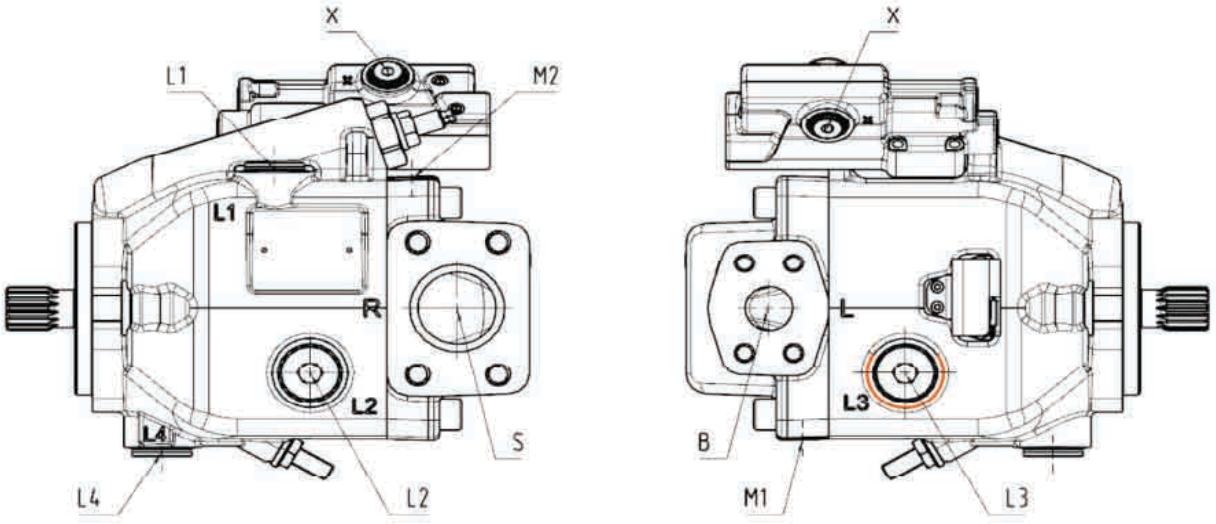
Pressure measurements

Required tools

The service procedures described in this manual can be performed using common mechanic's hand tools. Special tools, if required are shown. Calibrate pressure gauges frequently to ensure accuracy. Use snubbers to protect gauges.

Port locations and gauge installation

Gauge port locations are shown below. General pressure gauges and fittings are detailed in the table.



Port	Description	Mounting	Range of Gauge	Diameter
S	System Port Inlet	SAE J518 CODE 61		2″
B	System port outlet	SAE J518 CODE 61		1″
L1, L2, L3, L4	Case Drain	ISO 6149-1	0-10 bar [0-100 psi]	M22x1.5
M1, M2	Gauge Port	ISO 6149-1	0-300 bar [0-5000 psi]	M14x1.5
X	LS Signal	ISO 6149-1	0-300 bar [0-5000 psi]	M12x1.5

Initial start-up procedures

General

Follow this procedure when starting up a new X1P installation or when restarting an installation in which the pump has been removed.

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 incurred during shipping. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Start-up procedure

1. Connect the pump to the prime mover. Ensure that pump shaft is properly aligned with the shaft of the prime mover.

   Warning

   Incorrect shaft alignment may result in damage to drive shaft, bearings, or seal which can cause external oil leakage.

2. Fill the reservoir with recommended hydraulic fluid. Always filter fluid through a 10 micron filter pouring into the reservoir. Never reuse hydraulic fluid.
3. Fill the main pump housing with clean hydraulic fluid. Pour filtered oil directly into the upper most case drain port.
4. Fill the inlet line leading from the pump to the reservoir. Check the inlet line for properly tightened fittings and be certain it is free of restrictions and air leaks.
5. To ensure the pump stays filled with oil, install the case drain line in the upper most case drain port.
6. Install a gauge at port M2 (or equivalent system pressure measurement port if M2 not present) to monitor system pressure during start up.

   Note

   Follow recommendations in the vehicle/machine operator's manual for prime mover start up procedures.

7. While watching the pressure gauge installed at M2 or equivalent system pressure measurement port, jog the prime mover or run at the lowest possible speed until system pressure builds to normal levels (minimum 11 bar [160psi]). Once system pressure is established, increase to full operating speed. If system pressure is not maintained, shut down the prime mover, determine cause, and take corrective action. Refer to the Troubleshooting chapter.
8. Operate the hydraulic system for at least fifteen minutes under light load conditions.
9. Check and adjust control settings as necessary after installation. Refer to the Adjustments chapter.
10. Shut down the prime mover and remove the pressure gauge. Replace plug at port M2 or equivalent.
11. Check the fluid level in the reservoir; add clean filtered fluid if necessary.

The pump is now ready for operation.

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Fluid and filter maintenance

Recommendations

To ensure optimum life of X1P products, 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. Water in the fluid may be noted by a cloudy or milky appearance or free water 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.

Change the fluid and filter per the vehicle / machine manufacturer's recommendations or at these intervals:

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 that the recommended maximum.

Note

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.

Reservoir type	
Sealed	2000 hours
Breather	500 hours

Troubleshooting

Excessive noise and/or vibration

Item	Description	Action
Check fluid level in reservoir.	nsufficient hydraulic fluid causes cavitation.	Fill the reservoir to proper level.
Check for air in system.	Air in system causes noisy, erratic control.	Purge air and tighten fittings. Check inlet for leaks.
Check pump inlet pressure/vacuum.	Improper inlet conditions cause erratic behavior and low output flow.	Correct pump inlet pressure/vacuum conditions. Refer to the Hydraulic Parameters topic.
Inspect shaft couplings.	A loose or incorrect shaft coupling causes excessive noise and/or vibration.	Repair or replace coupling and ensure that correct coupling is used.
Check shaft alignment.	Misaligned shafts create excessive noise and/or vibration.	Correct shaft misalignment.
Hydraulic fluid viscosity above acceptable limits.	Hydraulic fluid viscosity above acceptable limits or low fluid temperature will not allow the pump to fill or control to operate properly.	Allow system to warm up before operating, or use fluid with the appropriate viscosity grade for expected operating temperatures. See Hydraulic Fluids and Lubricants Technical Information Manual, BC152886484524.

Actuator response is sluggish

Item	Description	Action
Check external system relief valve setting.	Low external relief valve setting slows down system.	Adjust external relief valve setting following manufacturer's recommendations. External relief setting must be above PC setting to operate properly.
Check PC and LS control setting.	Low PC setting prevents the pump from achieving full stroke. Low LS setting limits output flow.	Adjust PC and LS setting. Refer to the Adjustments chapter.
Check LS control signal pressures.	Incorrect LS signal will not allow pump to operate correctly.	Inspect system to ensure that proper LS signal transmit to pump.
Internal system leaks.	Worn internal parts don't allow the pump to operate properly.	Refer to Authorized Service Center for required repair.
Hydraulic fluid viscosity above acceptable limits.	Hydraulic fluid viscosity above acceptable limits or low fluid temperature will not allow the pump to fill or control to operate properly.	Allow system to warm up before operation or sue fluid with the appropriate viscosity grade for expected operating temperatures. See Hydraulic Fluids and Lubricants Technical Information Manual, BC152886484524.
Check external system valving.	Malfunctioning valving may not allow system to respond properly.	Repair or replace system valving as required.
Check pump case pressure.	High case pressure causes the system to be sluggish.	Correct case drain line restrictions. Check pump
Check pump inlet pressure/vacuum.	High inlet vacuum causes low output flow.	Correct inlet pressure conditions.

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System operating hot

Item	Description	Action
Check fluid level in reservoir.	Insufficient volume of hydraulic fluid will not meet cooling demands of system.	Fill reservoir to proper level. Verify proper size of reservoir.
Inspect heat exchanger. Check air flow and input air temperature for the heat exchanger.	Insufficient air flow, high input air temperature, or undersized heat exchanges will not meet cooling demands of the system.	Clean, repair, or replace heat exchanger as required. Verify proper size of heat exchanger.
Check external system relief valve setting.	Fluid passing through relief valve adds heat to system.	Adjust external system relief valve setting following manufacturer's recommendations. External relief valve setting must be above PC setting for proper operation.
Check pump inlet pressure/vacuum.	High inlet vacuum adds heat to system.	Correct inlet pressure/vacuum conditions.

Low pump output flow

Item	Description	Action
Check fluid level in reservoir.	Insufficient hydraulic fluid will limit output flow and cause internal damage to pump.	Fill the reservoir to proper level.
Hydraulic fluid viscosity above acceptable limits.	Fluid viscosity above acceptable limits or low fluid temperature will not allow the pump to fill or control to operate properly.	Allow system to warm up before operating, or use fluid with the appropriate viscosity grade for expected operating temperatures. See Hydraulic Fluids and Lubricants Technical Information Manual, BC152886484524.
Check external system relief valve setting.	Eternal relief valve set below PC setting causes low output flow.	Adjust external relief valve following manufacturer's recommendation. External relief valve setting must be above PC setting to operate properly.
Check PC and LS control setting.	Low PC setting prevents the pump from achieving full stroke.	Adjust PC and LS setting. Refer to the Adjustments chapter.
Check pump inlet pressure/vacuum.	High inlet vacuum causes low output flow.	Correct inlet pressure conditions.
Check input speed.	Low input speeds decrease flow.	Adjust input speed.
Check pump rotation.	Incorrect rotational configuration causes low flow.	Use pump with appropriate rotational configuration.

Pressure or flow instability

Item	Description	Action
Check for air in system.	Air in system causes erratic operation.	Activate PC allowing system to bleed air. Check inlet line for leaks and eliminate source of air ingression.
Check control spools.	Sticking control spools cause erratic operation.	Inspect spools for free movement in bore. Clean or replace.
Check LS setting.	Low LS setting may cause instability.	Adjust LS setting to proper level. See the Adjustments chapter.
Check LS signal line.	Blocked LS signal line interferes with proper LS operation.	Remove blockage.
Check external relief valve and PC setting.	Insufficient pressure differential between PC setting and external relief valve.	Adjust external relief valve or PC control settings to appropriate level. Relief valve setting must be above PC setting to operate properly.
Check external relief valve.	Chattering external relief valve may cause unstable feedback to pump control.	Adjust or replace relief valve.

System pressure not reaching PC setting

Item	Description	Action
Check PC control setting.	System pressure will not rise above PC setting.	Adjust PC to appropriate setting. Refer to the Adjustments chapter.
Check external relief valve.	External relief valve setting below PC setting presents pressure compensation.	Adjust external relief valve according to manufacturer's recommendations. External relief valve must be set above PC setting to operate properly.
Inspect PC control spring.	Broken, damaged, or missing spring will cause erratic operation.	Replace the spring as required.
Inspect PC spool for wear.	Wear of PC spool causes internal leakage in the control.	Replace the spool as required.
Inspect PC spool for proper orientation.	Improper orientation results in poor operation.	Correct orientation of spool.
Check PC control for contamination.	Contamination may interfere with movement of the PC spool.	Clean PC control components, take appropriate action to eliminate contamination.

High inlet vacuum

Caution

High inlet vacuum causes cavitation which can damage internal pump components.

Item	Description	Action
Check fluid temperature.	Low temperature increases viscosity. High fluid viscosity causes high inlet vacuum.	Allow system to warm up before operating.
Inspect inlet screen.	Blocked or restricted inlet screen causes high inlet vacuum.	Clean screen/remove blockage.
Check inlet piping.	Too many fittings, bends, or long piping causes high inlet vacuum.	Eliminate fittings to make path more direct.
Hydraulic fluid viscosity above acceptable limits.	High fluid viscosity causes high inlet vacuum.	Select fluid with appropriate viscosity for expected operating temperature. See Hydraulic Fluids and Lubricants Technical Information Manual, BC152886484524.

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Adjustments

PC control

PC setting is indicated in the pump model code. Refer to the X1P Technical Information Manual for more information.

Before performing adjustments, read Pressure measurement.

1. Install a pressure gauge in port M2 (or equivalent system pressure measurement port if M2 not present) to measure system pressure. Install a pressure gauge in case drain port L1 or L2 to measure case pressure.

   Warning

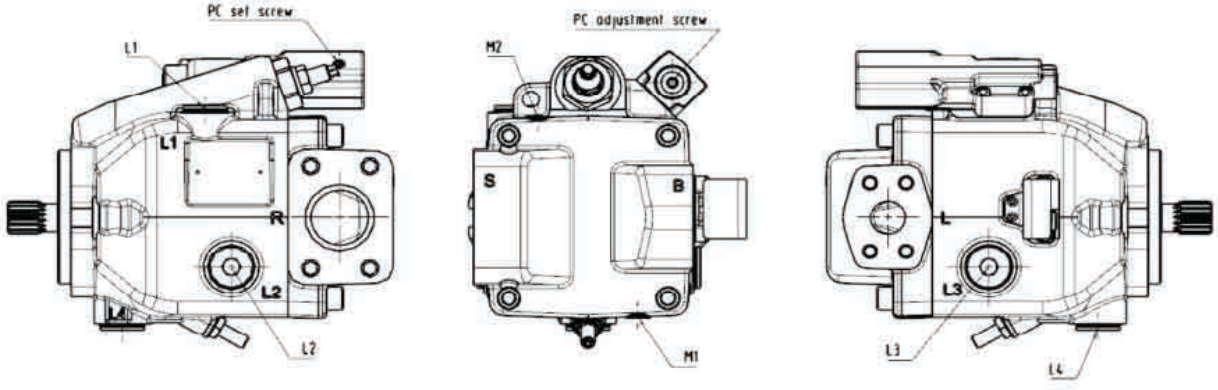
   Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

   Caution

   Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines.
2. Start the prime mover and allow fluid to reach normal operating temperature. Operate a hydraulic function to its full extension, loading the pump at maximum pressure and zero flow.
3. Loosen the PC set screw and turn the PC adjustment screw until the desired setting is indicated on the system pressure gauge (at port M2 or equivalent). Clockwise rotation will increase pressure, counterclockwise rotation will decrease; approximate gain = 35 bar [507 psi] per turn.

   Note

   If the presssure does not increase, an external system relief valve may require adjustment. External system relief valve must be set above the PC setting for proper operation
4. While holding the position of the PC adjustment screw, torque the PC set screw to 9 N•m [7 lbf•ft].
5. Stop the prime mover, remove the pressure gauges, and return the system to its normal operating configuration.



Port	Description	Range of gauge	Port size	Wrench size	Torque
PC adjustment screw	PC adjustment screw	-	-	6mm internal hex	-
PC set screw	PC set screw	-	-	4mm	9 N.m [7 lbf.ft]
L1, L2, L3, L4	Case Drain	0-10 bar [0-100 psi]	M22x1.5	10mm internal hex	61 N.m [45 lbf.ft]
M1, M2	Gauge Port	0-300 bar [0-5000 psi]	M14x1.5	6mm internal hex	42 N.m [32 lbf.ft]
X	LS Signal	0-300 bar [0-5000 psi]	M12x1.5	6mm internal hex	23 N.m [17 lbf.ft]

LS control

The LS setting is indicated in the pump model code. Refer to the X1P Technical Information Manual for more information.

Note

If the pressure does not increase, an external system relief valve may require adjustment. External system relief valve must be set above the PC setting for proper operation. Before performing adjustments, read Pressure measurement.

1. Install a pressure gauge in port M2 (or equivalent system pressure measurement port if M2 not present) to measure system pressure. Install a pressure gauge in drain port L1 or L2 to measure case pressure. Tee-in a gauge to the LS / remote PC signal line (port X).

   Warning

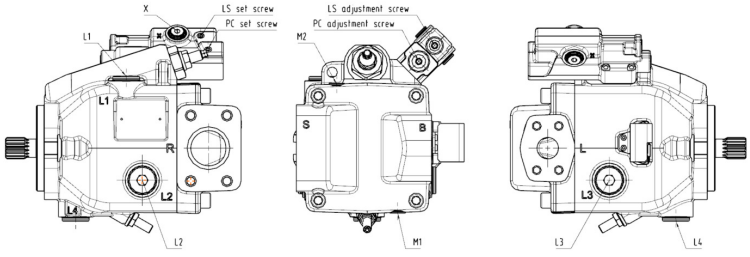
   Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

   Caution

   Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines.
2. Start the prime mover and allow fluid to reach normal operating temperature. Slowly operate a hydraulic function which will demand approximately half flow from the pump, but keep system pressure below the PC set point.
3. Loosen the LS set screw. While watching the pressure gauges, turn the LS adjustment screw until the desired pressure differential between the system port gauge (port M2 if available) and port X is achieved. Clockwise rotation will increase the setting, counterclockwise rotation will decrease; approximate gain = 12 bar [170 psi] per turn.
4. While holding the position of the LS adjustment screw, torque the LS set screw to 9 N•m [7 lbf•ft].
5. Operate a hydraulic function to its full extension loading the pump at maximum pressure and zero flow.
6. Loosen the PC set screw and turn the PC adjustment screw until the desired setting is indicated on the pressure gauge at port M22. Clockwise rotation will increase pressure, counterclockwise rotation will decrease; approximate gain = 35 bar [507 psi] per turn.

   Note

   PC setting is referenced to case pressure. Subtract case pressure from system pressure to compute the actual setting.
7. While holding the position of the PC adjustment screw, torque the PC set screw to 9 N•m [7 lbf•ft].
8. Stop the prime mover, remove the pressure gauges, and return the system to its normal operating configuration.



Port	Description	Range of gauge	Port size	Wrench size	Torque
LS adjustment screw	LS adjustment screw	-	-	6mm internal hex	-
LS set screw	LS set screw	-	-	4mm	9 N.m [7 lbf.ft]
PC adjustment screw	PC adjustment screw	-	-	6mm internal hex	-
PC set screw	PC set screw	-	-	4mm	9 N.m [7 lbf.ft]
L1, L2, L3, L4	Case Drain	0-10 bar [0-100 psi]	M22x1.5	10mm internal hex	61 N.m [45 lbf.ft]
M1, M2	Gauge Port	0-300 bar [0-5000 psi]	M14x1.5	6mm internal hex	42 N.m [32 lbf.ft]
X	LS Signal	0-300 bar [0-5000 psi]	M12x1.5	6mm internal hex	23 N.m [17 lbf.ft]

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Minor repair

Shaft seal replacement

Disassembly

A lip type shaft seal is used in the Series 45 open circuit variable pumps. This seal can be replaced without major disassembly of the unit.

Replacement of the shaft seal requires removal of the pump from the machine.

1. Using the appropriate snap-ring pliers, remove the retaining ring (K010) from the housing.
2. Remove the shaft seal (K020) from the bore in the pump housing and discard.

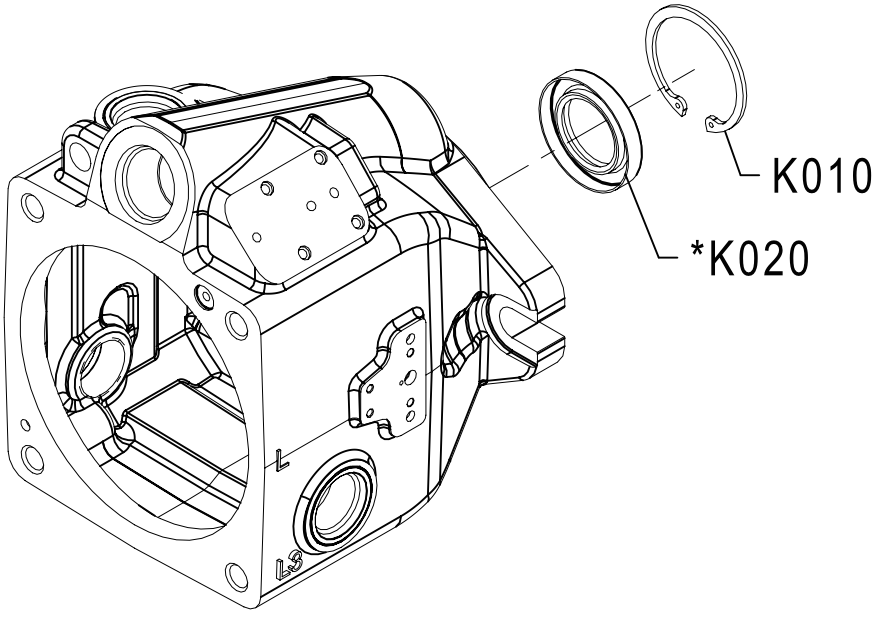
   Avoid damaging the pump housing or shaft. Puncture the face of the seal with a packing hook, or use a slide-hammer type puller to remove the seal.

Inspection

1. Inspect the pump housing and new seal for damage.
2. Inspect the sealing area on the shaft for rust, wear, or contamination.
3. Polish the sealing area on the shaft if necessary.

Reassembly

1. Lubricate the lip of the new shaft seal with clean hydraulic fluid. Place a protective sleeve over the shaft end to prevent damage to the seal during installation.
2. Keeping the seal perpendicular to the shaft, press the new seal into the housing just far enough to clear the retaining ring groove. Install seal with the cupped side toward the shaft bearing. Do not damage the seal during installation.
3. Using the appropriate snap ring pliers, install the seal retaining ring.
4. Remove the installation sleeve.



Displacement limiter

X1P pumps are available with an optional maximum or minimum displacement limiter. If installed, this allows for displacement to be limited and adjustable. For more information refer to the X1P technical information manual.

Disassembly

These instructions apply to both maximum and minimum displacement limiters.

1. Remove the adjustment seal/nut (H030).

   The L030 adjustment seal/nut serves as a locking seal/nut, preventing the L040 screw from backing out.

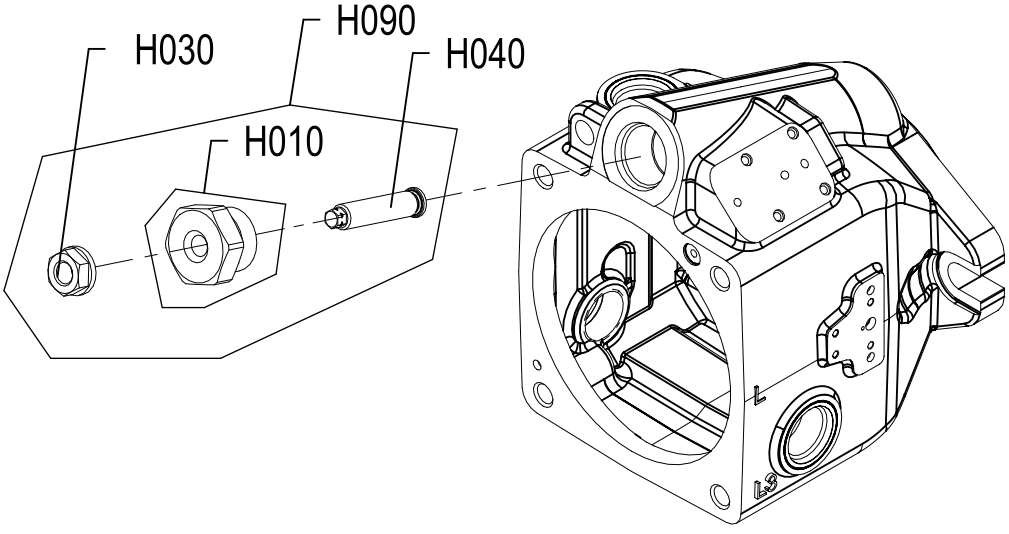
2. Remove the adjustment screw (H040).
3. Remove plug (L010) with a 1 1/4 in. wrench (H010).
4. Discard the O-ring (L010A).

Inspection

1. Inspect the displacement limiter screw threads (H040).
2. Ensure that the screw is not bent.
3. Inspect the seal/nut (L030) for irregular wear. Replace if necessary (H030).
4. Replace the O-ring.

Reassembly

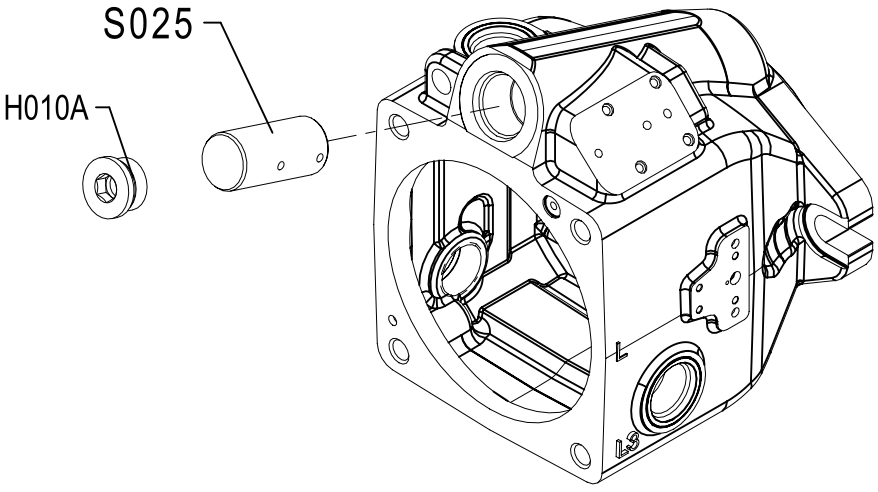
1. Install displacement limiter screw (H040) into plug (H010).
2. Install new O-ring onto plug (H010). Thread plug with limiter into endcap. Torque to 77 N•m [57 lbf•ft].
3. Turn adjustment / seal nut onto displacement limiter.
4. Using a 19mm exter hex wrench torque the adjustment seal/nut (H030) to 54 N•m [40 lbf•ft].



Servo Piston

Disassembly

1. Remove plug (H010A) with a 1 1/4 in. wrench. Discard the O-ring (L010A).
2. Remove servo piston (S025) from housing.



Inspection

1. Check the servo piston assembly (S025) for any obvious wear or damage.
2. Check the corresponding endcap bore for galling or excessive wear.
3. Discard the piston if damaged.
4. Replace the servo piston-rings.

Reassembly

1. Lubricate servo piston and install in the housing.
2. Install plug.

Auxiliary pads

Disassembly

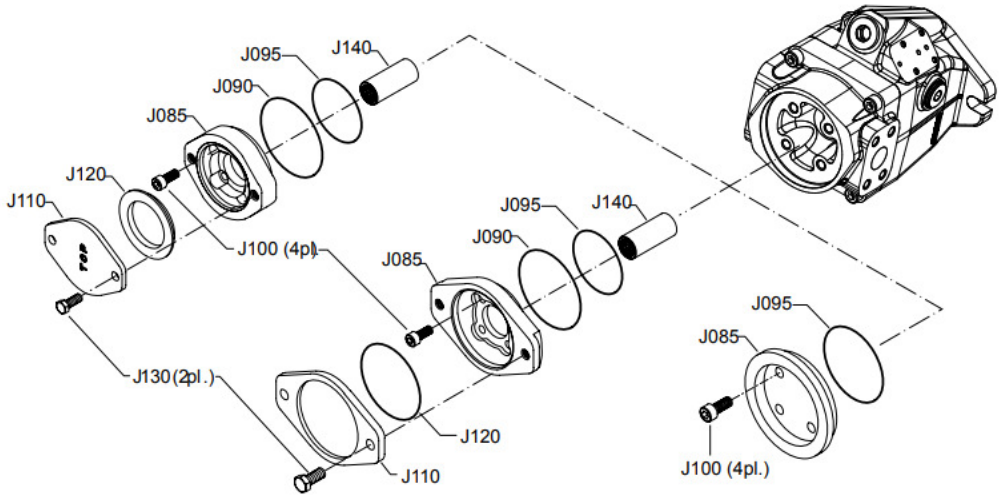
Auxilliary mounting pads may be installed on pumps equipped with through-drive radial ported endcaps. Follow these steps to either remove, replace, or exchange auxilliary mounting pads.

1. Remove two screws (J130) retaining the cover plate (J110) or auxiliary pump (not shown). Remove the shipping cover or auxiliary pump and its sealing O-ring (J120). Discard the O-ring.
2. Remove the drive coupling (J140).
3. Remove the four screws (J100) retaining the pad adapter (J085) to the endcap. Discard the two pad adapter O-rings (J090, J095).

Caution

Shipping cover is intended only to retain coupling during shipment and storage. Do not operate pump with coupling and shipping cover installed.

Auxiliary mounting pads



Wrench size and torque

Item	Description	Wrench size	Torque
J085	Pad adapter	-	-
J090	O-ring	-	-
J095	O-ring	-	-
J100	Cap screw	8 mm internal hex	54 Nm [39 lbf•ft]
J110	Cover plate	-	-
J120	O-ring	-	-
J130	Screw	9/16 inch	44 Nm [32 lbf•ft]
J140	Drive coupling	8 mm internal hex	54 Nm [39 lbf•ft]

Inspection

1. Inspect sealing surfaces on the endcap and auxiliary pad and make sure that they are clean and free of contaminants.
2. Inspect the coupling (J140) for any signs of excessive or abnormal wear.
3. Replace all O-rings.
4. Replace excessively worn parts if necessary.

Reassembly

1. Lubricate new O-rings with petroleum jelly. Install the pad adapter to the endcap.
2. Install the four screws and torque to 54 N•m [39 lbf•ft].
3. Install the drive coupling (if needed).
4. Install shipping cover or auxiliary pump with new O-ring.

LS and PC Controls

Disassembly

1. Remove the 4 screws (C300) holding the control housing onto the endcap.
2. Remove the control and discard the 4 interface O-rings (C200).
3. Remove the PC set screw (C102), PC adjusting plug (C138), O-ring (C138A), springs (C134, C135), and seat (C133). Discard the O-ring.

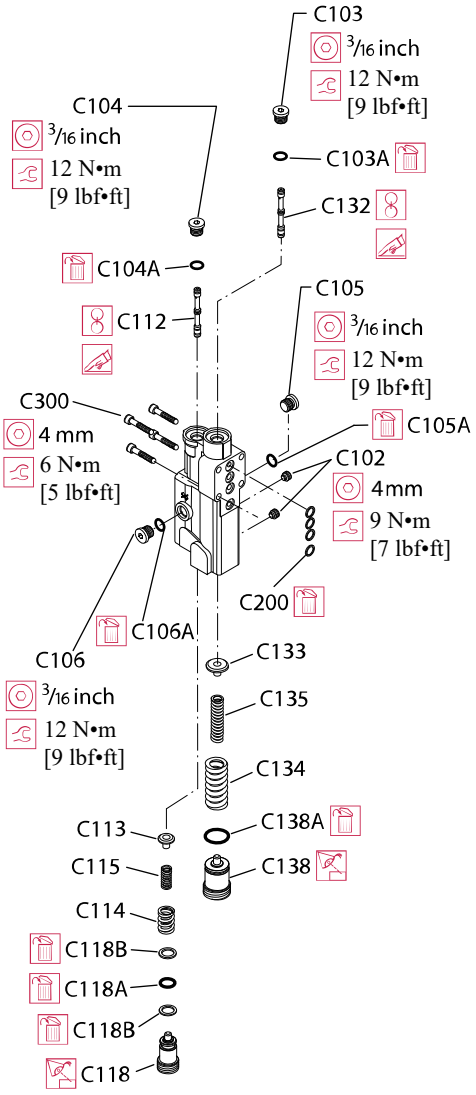
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4. Remove the plug (C103), O-ring (C103A), and PC spool (C132) from the control housing. Discard the O-ring. Note orientation of the spool for reassembly.

Note

For PC only controls, skip steps 5 through 7

5. Remove the plug (C105) and O-ring (C105A), or the plug (C106) and O-ring (C106A). Discard the O-ring (C105A or C106A).
6. Remove the LS set screw (C102), LS adjusting plug (C118), O-ring (C118A), back-up rings (C118B), springs (C114, C115), and seat (C113). Discard the O-ring and back-up rings.
7. Remove the plug (C104), O-ring (C104A), and LS spool (C112) from the control housing; discard the O-ring. Note orientation of the spool for reassembly.



Inspection

1. Inspect the adjusting plugs for wear at the tips and where they contact the seat; replace as necessary.
2. Inspect the springs and spring guides for wear or damage; replace as necessary.
3. Carefully inspect the spools. Ensure the sealing lands are free of nicks and scratches. Check the ends that contact the spring guides for wear. Replace spools as necessary.
4. Inspect the control housing for damage. Check the spool bores for excessive wear.
5. Clean all parts and lubricate spools, springs, guides, and new O-rings with clean hydraulic fluid.

Reassembly

1. Install the PC spool (C132), spherical end first, into the PC bore. Using a new O-ring (C103A), install the plug (C103). Torque the plug (C103) to 12 N•m [9 lbf•ft].
2. Place the two PC springs (C134, C135) onto the spring guide (C133) and install into the PC bore. Place a new O-ring (C138A) onto the PC adjusting screw and thread it into the PC bore until flush, then make another full turn. Install and torque the PC set screw (C102) to 9 N•m [7 lbf•ft].

   Note

   For PC only controls, skip steps 3 through 5.
3. Install the LS spool (C112), spherical end first, into the LS bore. Using a new O-ring (C105A or C106A), install the plug (C105 or C106). Torque the plug (C105 or C106) to 12 N•m [9 lbf•ft].
4. Using a new O-ring (C104A), install the plug (C104). Torque the plug to 12 N•m [9 lbf•ft].
5. Place the two LS springs (C114, C115) onto the spring guide (C113) and install into the LS bore. Place a new O-ring (C118A) and back-up rings (C118B) onto the LS adjusting screw and thread it into the LS bore until flush, then make another full turn. Install and torque the LS set screw (C102) to 9 N•m [7 lbf•ft].
6. Using petroleum jelly to retain them, install 4 new interface O-rings (C200) in the recesses on the control housing.
7. Install the control assembly onto the endcap using the 4 screws (C300). Torque the screws to 6 N•m [5 lbf•ft]. Torque screws in a criss-cross pattern and re-torque the first screw to ensure proper torque retention.
8. Check and adjust the control setting. See Adjustments section.

Electric Control

Fan Drive Control

Disassembly

Use the wrench sizes and torques listed in the table.

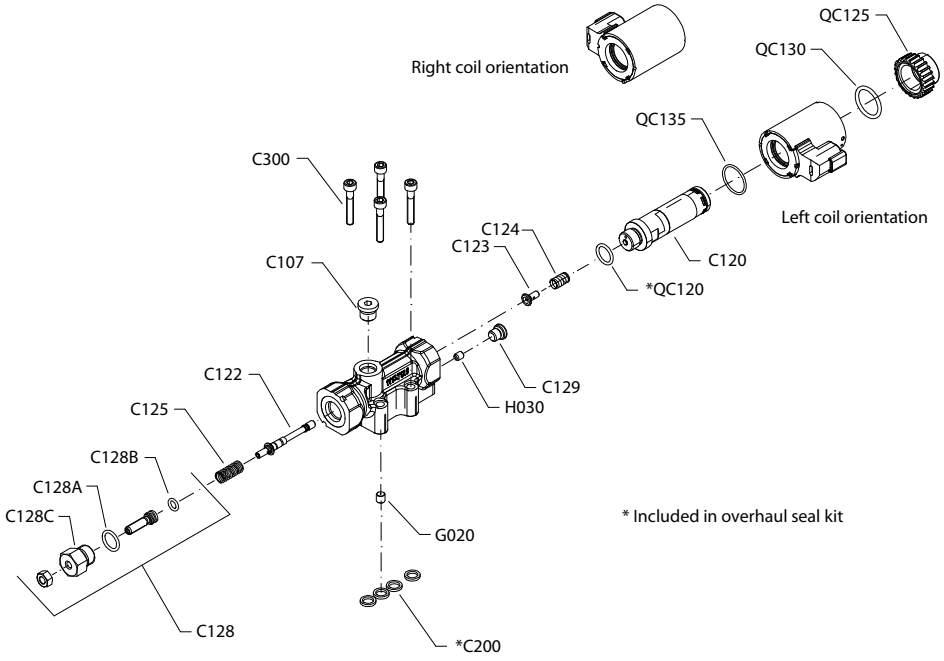
1. Remove four screws (C300).
2. Remove the control and discard the 4 interface O-rings (C200).
3. Remove the coil plastic nut (QC125). Remove the coil.
4. Refer to the following figure.

   Note

   Remember the correct coil connector orientation.
5. Remove the solenoid cartridge (C120). Remove O-ring (QC120).
6. Remove spring (C124) and spring guide (C123).
7. Remove the pressure limiter adjuster (C128).
8. Remove spring (C125) and spool (C122).
9. Remove plug (C107) and plug (C129).
10. Remove gain orifice (H030).

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11. Remove servo control orifice (G020).



Item	Description	Wrench size	Torque
G020	Servo control orifice	3 mm internal hex	2.7 Nm [2 lbf•ft]
H030	Gain orifice	2.5 mm internal hex	2.7 Nm [2 lbf•ft]
C129	Plug 5/16"	1/8" internal hex	6.2 Nm [4.67 lbf•ft]
C107	Plug 7/16"	3/16" internal hex	13.7 Nm [9.9 lbf•ft]
C128C	Nut 9/16"	17 mm exter hex	23.7 Nm [17.5 lbf•ft]
C120	Solenoid cartridge	17 mm exter hex	25.75 Nm [19 lbf•ft]
QC125	Coil plastic nut	26 mm 12 pt socket	3.5 Nm [2 lbf•ft]
C300	Screws	4 mm internal hex	6.5 Nm [4.75 lbf•ft]

Inspection

1. Inspect the pressure limiter for wear. Check for contamination and damage to the O-rings, replace if necessary.
2. Inspect the control housing for damage. Check the spool bores for excessive wear. Remove debris from orifices if necessary.
3. Carefully inspect the spool. Ensure the sealing lands are free of nicks, burrs and scratches. Check the ends that contact the spring guides for wear. Replace the spool if necessary.
4. Check the spool for free (smooth) movement in housing bore.
5. Check the orifices (H030 and G020) for contamination, and for cavitation damage.
6. Check the solenoid cartridge for damage, bending, free pin movement.
7. Check the coil for damage. Check the plastic plug for contamination.
8. Check the coil connector for contamination or overheat marks, deformation, connector pins are not damaged or bent, or missing. Replace the coil if necessary.
9. Check the control o-rings for damage, or cracks and replace if necessary.
10. Clean and lubricate all spools, bores, and seals with a light coating of hydraulic oil.

Reassembly

1. Install the servo control orifice (G020). Install the gain orifice (H030).
2. Install plugs (C129) and (C107).
3. Install spool (C122) spherical end first, into the spool bore. Install spring (C125).
4. Install the pressure limiter adjuster (C128).

5. Install the spring guide (C123) and spring (C124). Ensure the spring guide is properly seated on the spools spherical head.
6. Install the solenoid cartridge with its O-ring.
7. Install the coil and O-rings. Ensure that the O-rings are correctly installed. Ensure the coil connector is in right orientation.
8. Install the coil plastic nut (QC125).

Note

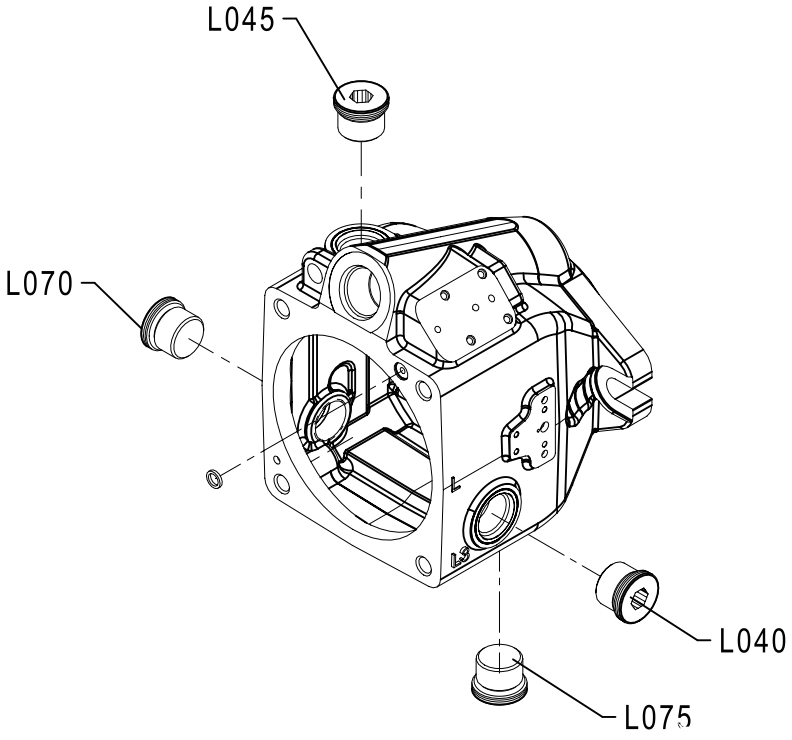
Use the proper wrench, do not damage the plastic nut.

9. Using petroleum jelly to retain them, install the four interface O-rings (C200) in the recesses on the control housing.
10. Install the control assembly onto the endcap using four screws (C300). Torque screws in a crisscross pattern and re-torque the first screw to ensure proper torque retention.

Plug and fitting sizes and torques

If any plugs or fittings are removed from the unit during service, install and torque as indicated here.

This drawing is a composite. Your configuration may differ but the appropriate wrench size and torque can be found here.



Port	Wrench size	Torque
L040, L045, L070, L075	3/8 inch	95 N.m [70 lbf.ft]

Hydro-Gear
www.hydro-gear.com

Daikin-Sauer-Danfoss
www.daikin-sauer-danfoss.com

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