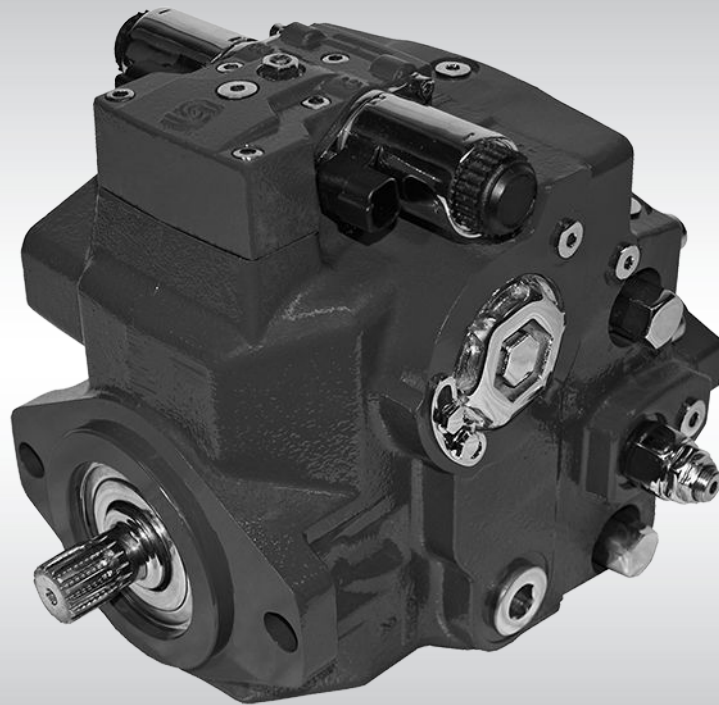




Repair Instructions

# Closed Circuit Axial Piston Pumps

## H1 45/53/60/68



**Revision history***Table of revisions*

<b>Date</b>	<b>Changed</b>	<b>Rev</b>
September 2014	add MDC control	CB
March 2014	Danfoss Layout	CA
March 2013	Control topic titles - to be more generic	BC
June 2011	add protection shield for automotive control	BB
October 2010	add 060-068	BA
August 2010	new back page	AH
March 2010	add automotive control	AG
February 2010	Fix Osaka address	AF
April 2008	many minor edits	AC
July 2007	First edition	AA

**Contents**
**Introduction**

Overview.....	5
General Instructions.....	5
Remove the unit.....	5
Keep it clean.....	5
Lubricate moving parts.....	5
Replace all O-rings and gaskets.....	5
Secure the unit.....	6
Safety Precautions.....	6
Unintended machine movement.....	6
Flammable cleaning solvents.....	6
Fluid under pressure.....	6
Personal safety.....	6
Symbols used in Danfoss literature.....	7

**Disassembly**

Shaft Seal Removal.....	8
Input Shaft.....	8
Control Removal.....	9
Control Disassembly.....	10
Remove the Automotive Control.....	10
Auxiliary Pad or End Cover Removal.....	11
Charge Pump Removal.....	12
Pressure Limiter Removal.....	13
Charge Pressure Relief Valve Removal.....	13
High Pressure Relief Valve Removal.....	14
Endcap Removal.....	14
Cylinder Block Kit Removal.....	15
Servo Sleeve Removal.....	16
Servo Piston Removal.....	17
Swashplate and Swashplate Bearing Removal.....	17
Servo Piston Disassembly.....	18
Cylinder Kit.....	19
Disassemble the cylinder block kit.....	19
Block spring removal.....	19

**Inspection**

Overview.....	21
Pistons and Slippers.....	21
Ball Guide, Slipper Retainer, and Hold-Down Pins.....	21
Block Spring, and Washers.....	21
Cylinder Block .....	22
Shaft .....	22
Shaft Bearing.....	22
Swashplate.....	23
Valve Plate.....	23
Endcap.....	24
Housing .....	24
Pressure Limiter.....	25
HPRV Valve.....	25
Cradle Bearings.....	26
Optional Displacement Limiter.....	26
Charge Pressure Relief Valve.....	27
Servo Piston Assembly.....	27
Control.....	28

**Assembly**

Overview.....	29
Shaft and Seal Installation.....	29
Cradle Bearings and Swashplate Installation.....	30
Servo Piston Assembly.....	32

**Contents**

Servo Piston Installation.....	32
Servo Cylinder Installation.....	33
Cylinder Kit Assembly.....	34
Cylinder Kit Installation.....	35
Timing Pin and Endcap Bushing Installation.....	35
Endcap Bushing Installation tools.....	36
Endcap Bushing Orientation.....	36
Valve Plate and Endcap Installation.....	37
Charge Pump Installation.....	38
Auxiliary Pad or End Cover Installation.....	39
Charge Pressure Relief Valve Installation.....	40
Pressure Limiter Installation.....	41
HPRV Valve Installation.....	41
Optional Displacement Limiter Installation.....	42
Control Assembly.....	43
Control Installation.....	44
MDC Control.....	44
Reassembly.....	47
Automotive Control Installation.....	48

**Startup procedures**

Overview.....	50
Initial Startup Procedures.....	50
Adjustments.....	50
Pressure Measurements.....	50

**Port locations**

Port Locations and Gauge Installation.....	51
--	----

**Torque chart**

Fastener Size and Torque Chart.....	52
Plug Size and Torque Chart.....	52
Fasteners and Plugs.....	53

## Introduction

## Overview

This manual details major repair procedures for H1 pumps. These include the complete disassembly, inspection, and reassembly of the unit. Where rework of worn or damaged components is possible, specifications appear to ensure these parts meet factory tolerances. Only Danfoss Global Service Partners (GSPs) are authorized to perform major repairs. Danfoss trains Global Service Partners and certifies their facilities on a regular basis.

### **Warning**

---

Use of components that do not comply with rework specifications may result in loss of performance, which may constitute a safety hazard. Do not reuse components that don't comply to given specifications: replace with genuine Danfoss service parts.

---

Minor repair procedures, adjustments, and troubleshooting information appear in the *H1 078/147/165 Closed Circuit Axial Piston Pumps Service Manual*, **520L0848**. Minor repairs include service operations you can perform without removing the unit's endcap. Removal of the endcap voids your warranty.

## General Instructions

Follow these general procedures when repairing H1 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 and plug ports 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 using a clean solvent wash and air drying is usually adequate.

As with any precision equipment, 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 clean hydraulic fluid. This assures that these parts are lubricated during start-up.

### **Replace all O-rings and gaskets**



Danfoss recommends you replace all O-rings, seals, and gaskets during repair. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly. Grease must be soluble in hydraulic fluid.

## Introduction

### Secure the unit



For major repair, place the unit in a stable position with the shaft pointing downward. It is 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.

---

**Introduction**
**Symbols used in Danfoss literature**

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

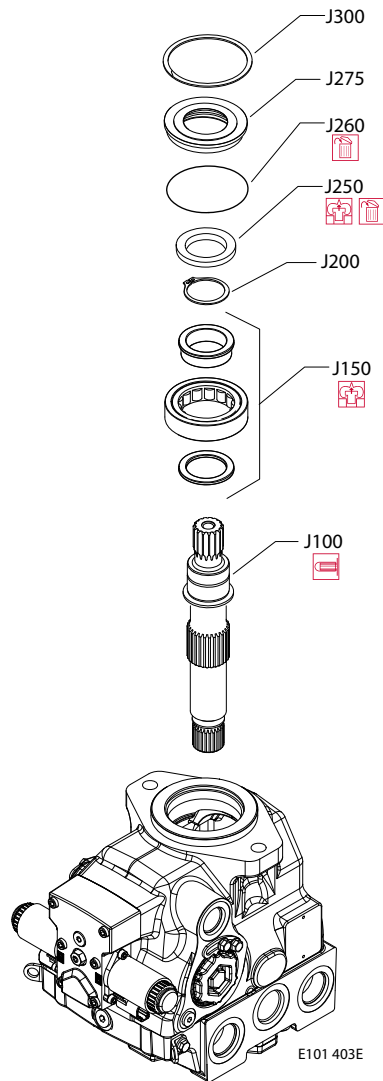
The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains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

Disassembly

Shaft Seal Removal

1. Orient pump with the shaft pointing up.
2. Remove the spiral ring (J300) from the front housing to release the shaft seal carrier (J275).
3. Pry on the lip of the seal carrier to remove it from the pump.
4. Remove and discard the O-ring (J260) and seal (J250) from the seal carrier.

*Remove shaft /seal/bearing*



Input Shaft

1. Pull the shaft with bearing out of the pump. If necessary, tap lightly on the shaft to dislodge it from the internal pump components.

**Warning**

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

2. Remove the snap ring (J200) using snap ring pliers.



**Disassembly**

3. Use an adequate press to remove the bearing from the shaft.

**Control Removal**

1. Remove control screws (D250) using a 5 mm internal hex wrench. Remove the control from the pump.
2. Remove and discard the gasket (D150).
3. Using a 13 mm deep well socket wrench, remove feedback pin (D200) from top of swashplate.
4. If necessary, remove the screen (D084).

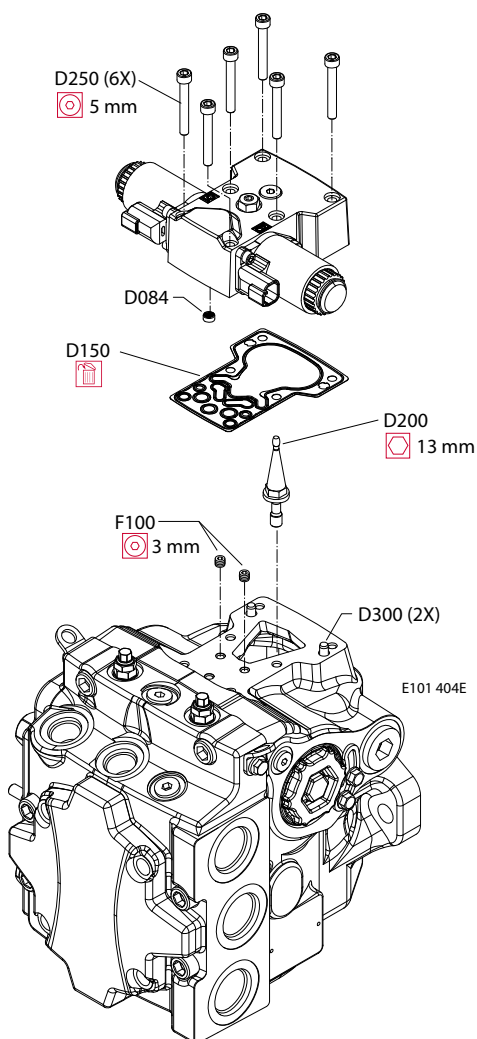
**⚠ Caution**

Screen (D084) may be loose and fall out of control. Take caution not to lose it.

5. If necessary, remove orifices (F100) using a 3 mm internal hex wrench.

Dowel pins (D300) are a press fit and will remain in housing.

*Remove control*



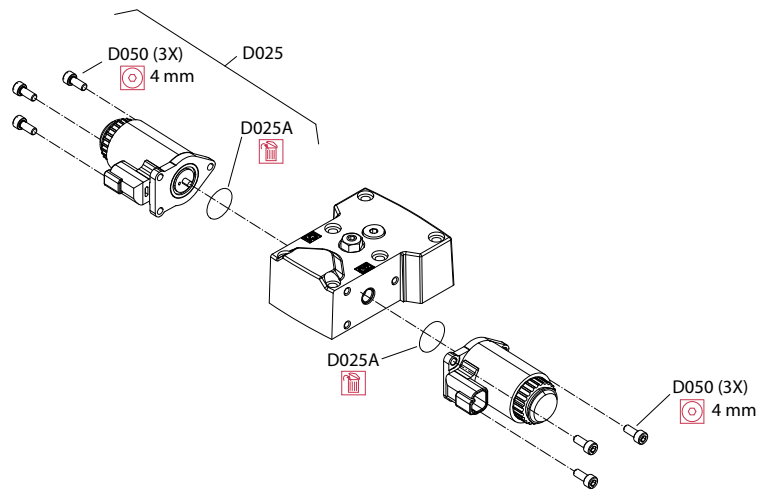
**Disassembly**
**Control Disassembly**

If you suspect a coil malfunction, remove the coil. Remove the plastic nut with a 26 mm 12 point socket. Install a new coil. Torque nut to 5 N·m [3.7 lbf·ft].

It is not necessary to remove solenoids (D025) unless you are replacing them.

1. Use a 4 mm internal hex wrench to remove cap screws (D050).
2. Remove solenoids (D025). Remove and discard O-rings (D025A).

Do not disassemble internal parts of control. Internal parts are not available separately. Control is sold as a complete unit only.

*Disassemble the control*


E101 405E

**Remove the Automotive Control**

1. Drain pump completely before removing control. Disconnect and remove wiring (D640).
2. Fabricate a special tool to remove two plastic plugs (D610). See drawing below for tool dimensions. Push down on plug and turn 45 degrees counterclockwise. Discard plugs.

Wax seals will be destroyed when the plugs are removed. Do not damage the housing in the plug sealing area.

3. Use a 5 mm internal hex to remove two screws (D674). Remove shield (D672).
4. Use a 5 mm internal hex to remove six screws (D250). Remove control from pump. Remove and discard gasket (D150).

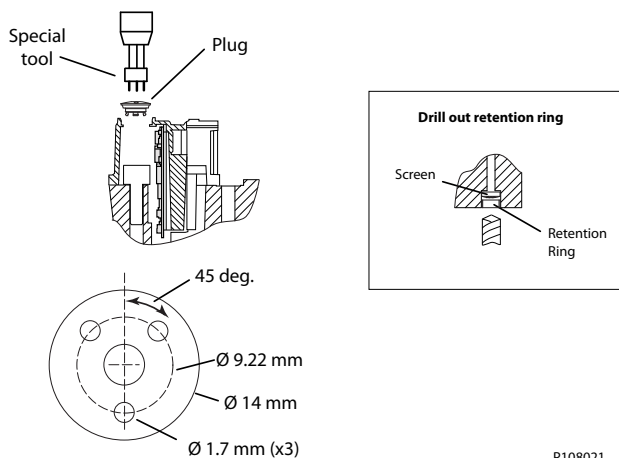
Alignment pins are pressed into control. Do not remove them.

5. If necessary, use a 3 mm internal hex to remove orifices (F00A, F00B) from housing. Tag each orifice for reinstallation. Each orifice may be a different size.
6. If it is necessary to remove the screens (D084), drill out screen retention ring (D098) and remove and discard screen. Note screen orientation for proper reassembly.

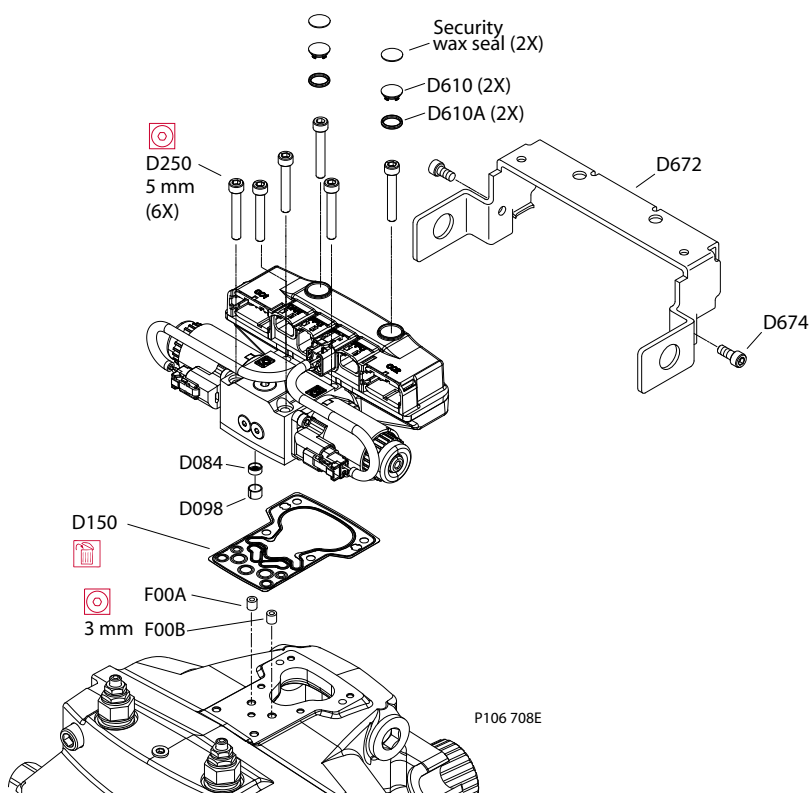
**⚠ Warning**

Do not allow metal fragments to fall into control housing. This may cause erratic pump operation.

Disassembly



Remove control



Auxiliary Pad or End Cover Removal

Remove auxiliary pump, if present.

1. Position pump so end cover (K100) or auxiliary pad is on top.
2. Remove end cover/auxiliary pad screws (K400) using an 8 mm internal hex wrench.

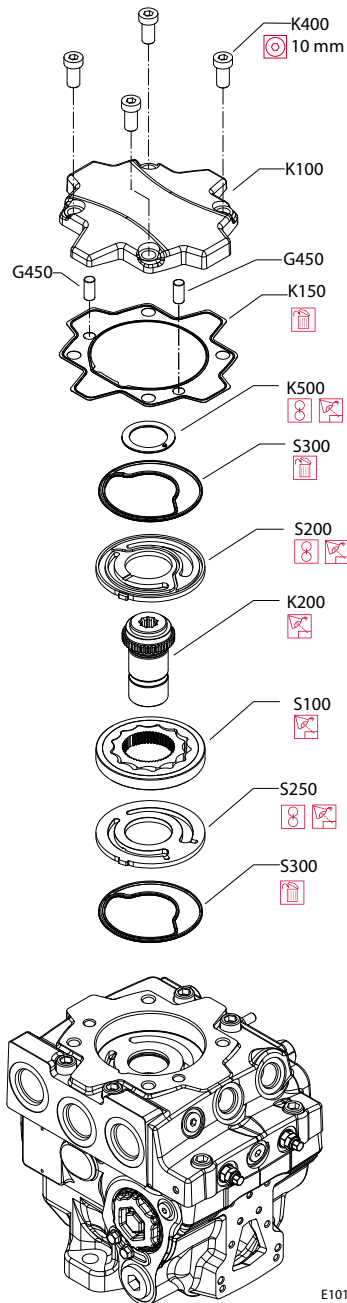
Alignment pins (G450) are in end cover. They may dislodge during disassembly.

3. Remove and discard gasket (K150).

Disassembly

4. Remove thrust washer (K500). Note thrust washer orientation.
5. Remove pressure balance plate (S200) and seal (S300). Note plate orientation. Discard seal (S300).
6. Remove coupling (K200).

*Remove end cover and charge pump*

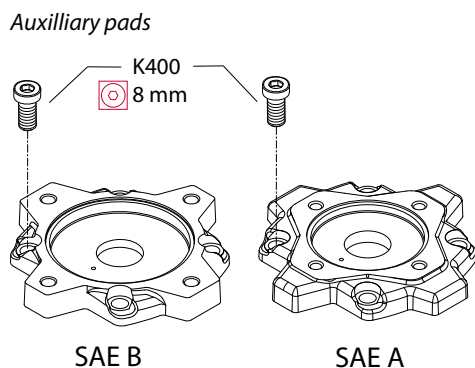


E101 406E

**Charge Pump Removal**

1. Remove charge pump outer ring (S150), and gearset (S100).
2. Remove valve plate (S250) with seal (S300). Discard seal (S300).

If charge pump requires replacement, replace as a kit. Kit includes (S300), (S250), (S100), and (S200).

**Disassembly**


E101 533E

**Pressure Limiter Removal**

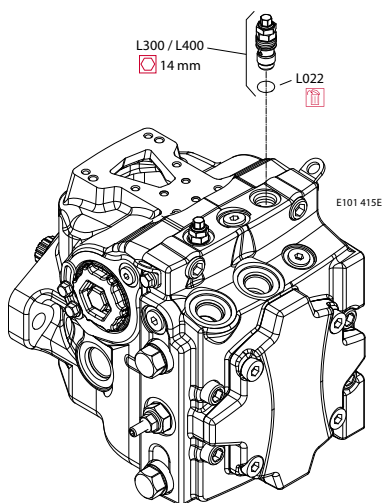
- Using a 14 mm wrench, remove pressure limiter cartridges (L300) and (L400).

Pressure limiter (L300 / L400) is available as complete unit only. Seal (L022) is available separately.

- Remove and discard O-ring (L022).

Right and left pressure settings are different. Tag each valve for later re-assembly

Remove pressure limiter

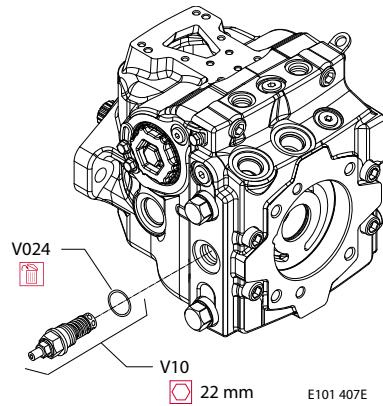

**Charge Pressure Relief Valve Removal**

Using a 22 mm wrench, remove the charge pressure relief valve (V10). Discard O-ring (V024).

Charge pressure relief valve (V10) is available as complete unit only. Seal (V024) is available separately.

Disassembly

Remove charge pressure relief valve

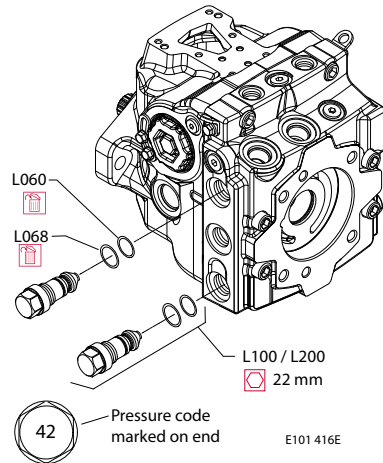


High Pressure Relief Valve Removal

Using a 22 mm wrench, remove the HPRV valves (L100 / L200). Discard O-rings (L060) and seals (L068).

HPRV valves may not have the same pressure setting. Tag each valve for re-assembly.

Remove high pressure relief valves



Endcap Removal

1. Remove two endcap screws (G400) using a 10 mm internal hex wrench.
2. Remove four endcap screws (G350) using a 10 mm internal hex wrench.
3. Carefully remove the endcap (G100), and valveplate (C025). Valveplate may be stuck to endcap. Alignment pin (C020) may remain in endcap.

**Caution**

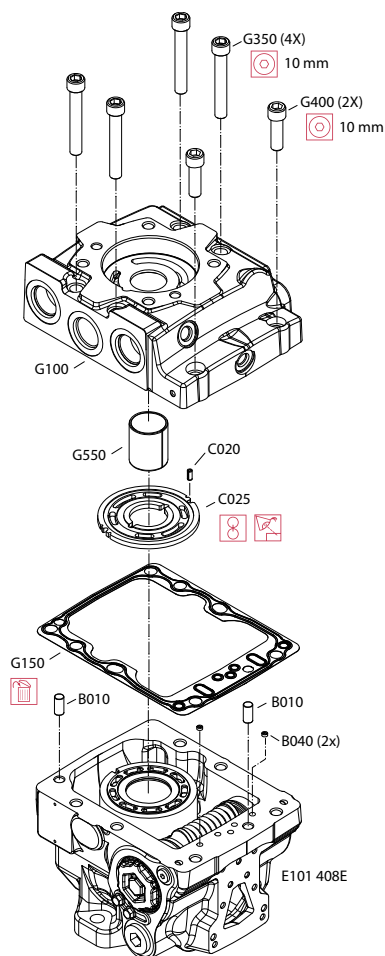
Note valveplate orientation for proper reassembly.

4. Place the endcap and valve plate in a clean area, protecting them from contamination.
5. Remove and discard gasket (G150).
6. If necessary, remove bushing (G550) using a suitable puller.
7. Remove locating pins (B010).

If necessary, use a hook to remove screens (B040) and discard.

Disassembly

Remove endcap and components



Cylinder Block Kit Removal

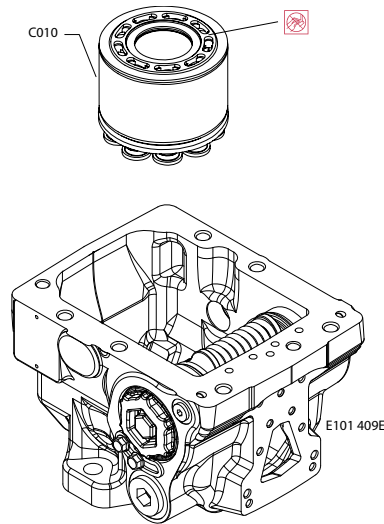
1. Remove cylinder block assembly (C010).
2. Set cylinder block and components on a clean dry surface.

**Caution**

Do not scratch the running surfaces of the cylinder block or slippers. Scratches in these surfaces can lead to poor performance or pump failure.

Disassembly

Remove cylinder block kit



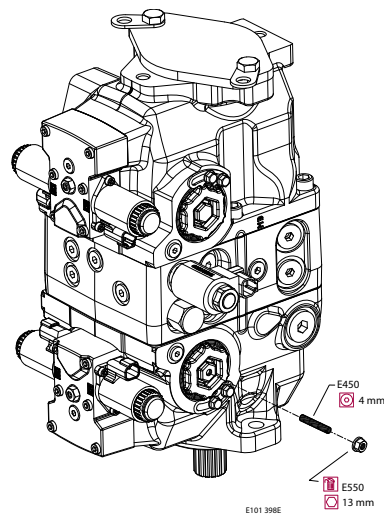
Servo Sleeve Removal

1. If equipped with displacement limiter, remove and discard locking nut (E550) and remove displacement limiter screw (E450).
2. Remove the locking screws (E350) with a 10 mm hex wrench. Remove the locking plates (E300).
3. Using a 3/4 inch deep socket, unthread the servo sleeves (E600) from each side of the pump. Servo piston will be loose after servo cylinders are removed. Discard O-rings (E250).

**Caution**

Do not allow loose servo piston to damage internal machined surfaces of pump.

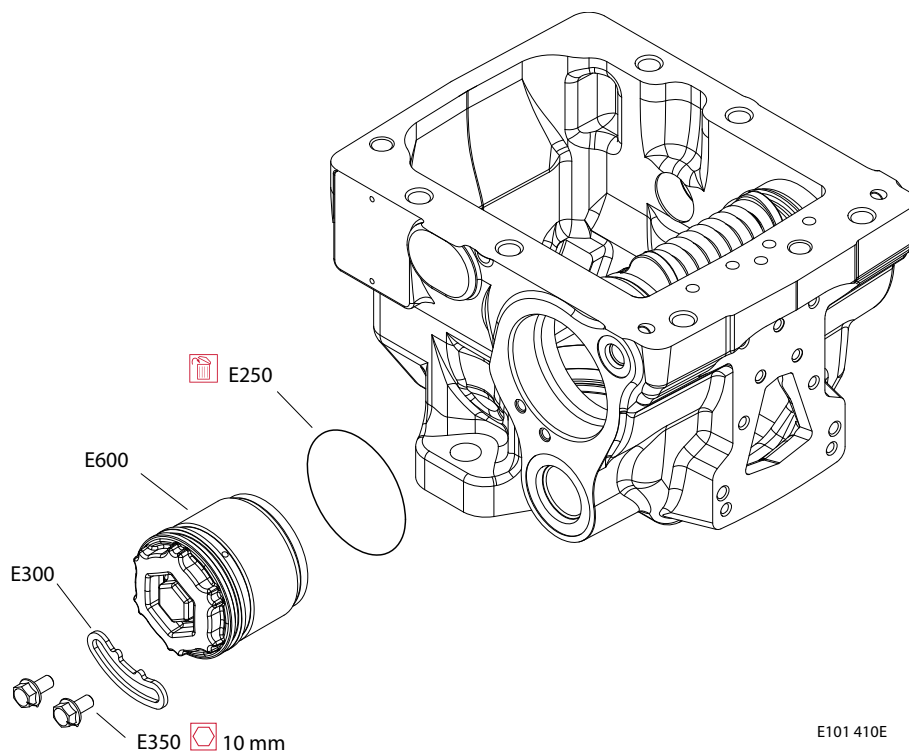
Remove optional displacement limiter





**Disassembly**

*Remove servo cylinders*

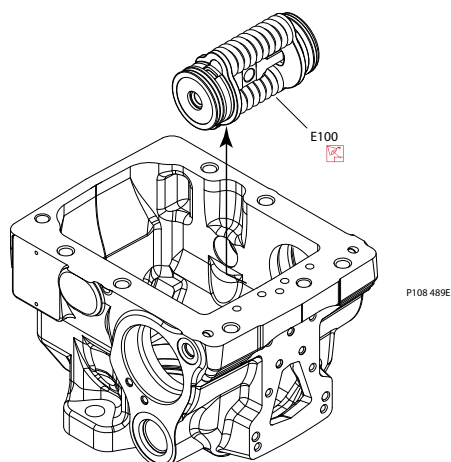


E101 410E

**Servo Piston Removal**

Tilt swashplate up to disengage servo arm from piston. Remove the servo piston assembly (E100).

*Remove servo piston*



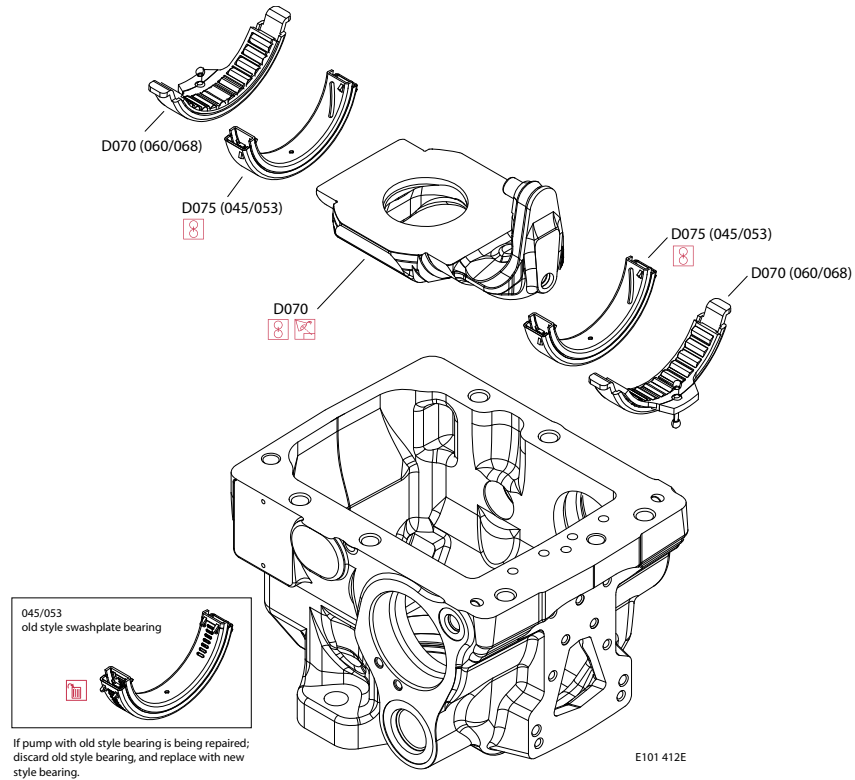
P108 489E

**Swashplate and Swashplate Bearing Removal**

1. Lift the swashplate (D070) out by grasping the swashplate pin. Swashplate bearings will remain on the swashplate.
2. Remove bearings. Note bearing orientation.

Disassembly

Remove swashplate and swashplate bearings

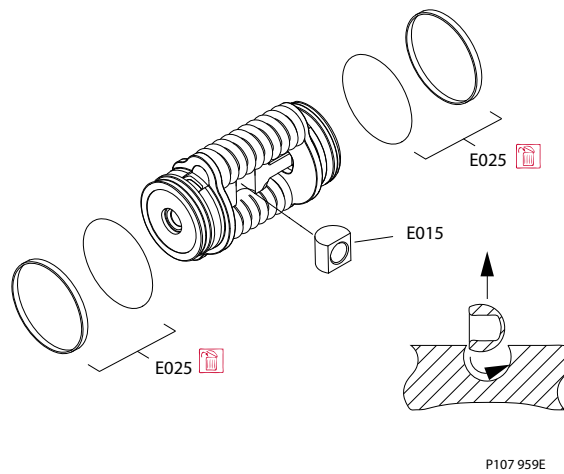


Servo Piston Disassembly

1. Remove and discard seals (E025).
2. Remove slider block (E015).

Servo (E100) is available as an assembly only. Seals (E025) and slider block (E015) are available as repair items.

Remove O-rings, seals, and slider block



**Disassembly****Cylinder Kit****Disassemble the cylinder block kit**

1. Pull to remove the slipper retainer (C20) with the pistons (C10) from the cylinder kit.

---

The pistons are not selectively fitted, however units with high hourly usage may develop wear patterns. Number the pistons and bores for reassembly if they are to be reused.

---

2. Remove the ball guide (C15).
3. Remove the three pins (C25).

**Block spring removal**

---

Most repairs do not require block spring removal. Perform this procedure only if you suspect problems with the block spring.

---

Turn the block over. Using a press, apply pressure on the block spring washer (C35) to compress the block spring (C30). Compress the spring enough to safely remove the spiral retaining ring (C45). While maintaining pressure, unwind the spiral retaining ring. Carefully release the pressure and remove the outer block spring washer, block spring, and inner block spring washer (C40) from the cylinder block.

** Warning**

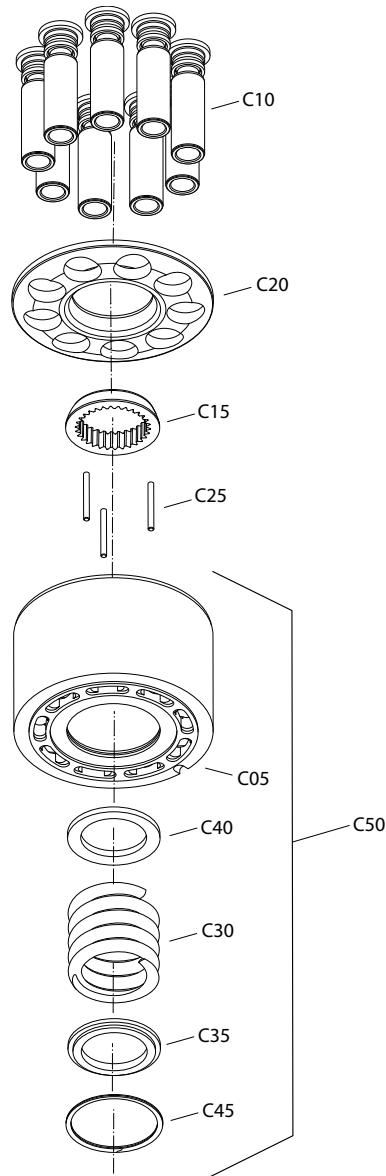
---

Risk of personal injury: Compressing the block spring requires about 350 to 400 N [80 to 90 lbf]. Use a press sufficient to maintain this force with reasonable effort. Ensure the spring is secure before attempting to remove the spiral retaining ring. Release the pressure slowly after the retaining ring is removed.

---

Disassembly

Disassemble cylinder block kit



E101 395E

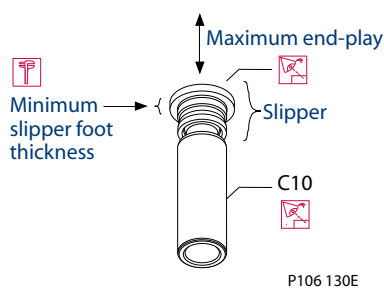
**Inspection**
**Overview**

Wash all parts (including the endcap and housing) thoroughly with clean solvent and allow to air dry. Blow out oil passages in the housing and endcap with compressed air. Conduct inspection in a clean area and keep all parts free from contamination. Clean and dry parts again after a rework or resurfacing.

**Pistons and Slippers**

Inspect the pistons for damage and discoloration. Discolored pistons may indicate excessive heat; do not reuse.

*Inspect pistons*



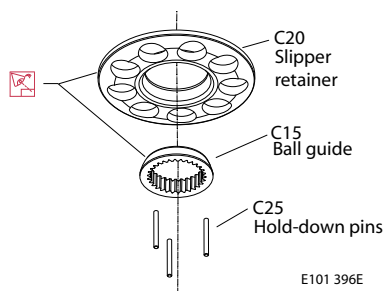
Inspect the running surface of the slippers. Replace any piston assemblies with scored or excessively rounded slipper edges. Replace any piston assemblies with excessively worn slippers. Check the slipper axial end-play. Replace any piston assemblies with excessive end-play.

Minimum slipper foot thickness and maximum axial end-play are given in *ReWork Specifications 520L1033*.

**Ball Guide, Slipper Retainer, and Hold-Down Pins**

Ensure ball guide is free of nicks and scratches, and not scored. Examine for discoloration that may indicate excessive heat or lack of lubrication. The slipper retainer should be flat, and slippers should fit in the retainer with minimal side play. Place the hold-down pins on a flat surface and roll them to make sure they are straight. Discard and replace any damaged parts.

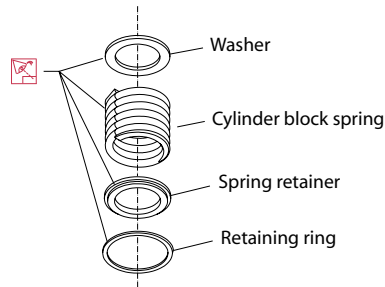
*Inspect guide, retainer, and pins*


**Block Spring, and Washers**

If cylinder kit was fully disassembled, visual inspection of the cylinder block, spring, and washers should indicate minimal wear. Replace if cracks or other damage are present.

Inspection

*Inspect block spring and washers*



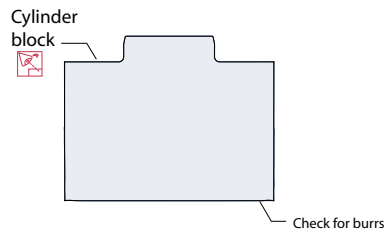
P101 472

Cylinder Block

Examine the running face of the cylinder block. The surface should be smooth and free of nicks and burrs. Ensure that no scratches or grooves exist; these may drastically reduce output flow.

Cylinder block rework specifications are given in *ReWork Specifications 520L1033*.

*Inspect cylinder block*

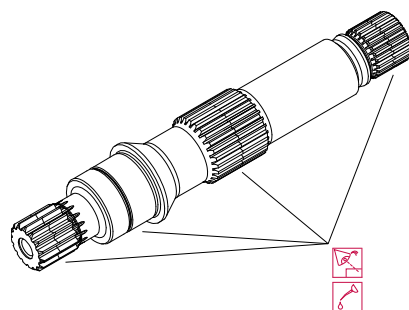


P106 132E

Shaft

Check to see that the shaft 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 where it meets the shaft seal. Clean the sealing area with a nonabrasive material if necessary. Lubricate the shaft with a light coat of hydraulic fluid before reassembly.

*Inspect shaft*



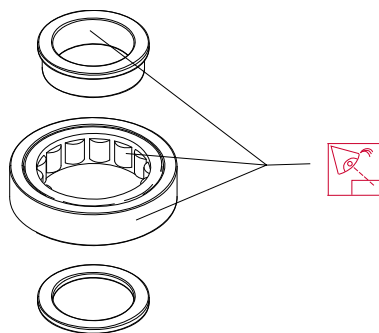
E101 375E

Shaft Bearing

Clean bearing with a solvent and lubricate with hydraulic fluid. Inspect for wear, or pitting. Rotate the bearing in your hand. Replace if it does not rotate smoothly.

**Inspection**

*Inspect shaft bearing*

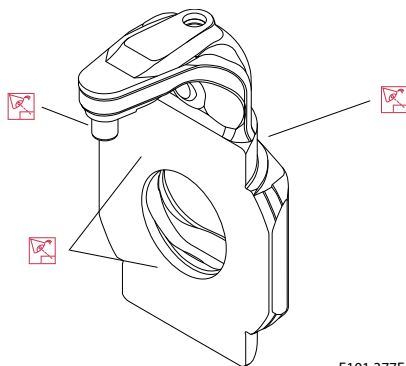


E101 376E

**Swashplate**

Carefully inspect each machined surface of the swashplate for wear. Ensure all swashplate surfaces are smooth. Inspect the swashplate's slipper running surface for flatness and brass transfer. Excessive brass transfer from slippers may indicate you should replace the slippers. Check the journals for scratches. Replace swashplate if necessary.

*Inspect swashplate*



E101 377E

**Valve Plate**

Inspect the valve plate for scratches and grooves. Check the plate for pitting along the running face. If pitting from cavitation exists, replace the valve plate. Check for excess wear on the brass running face. If you observe any discoloration or burn marks, replace the valve plate.

Run a fingernail or pencil tip across the diameter of the sealing land surface (see illustration). You should feel no deep or outstanding grooves. These may decrease pump flow. Lap or replace if grooves or nicks are present. Inspect the mating surfaces of the endcap and valve plate for any possible contamination; even a few thousandths of an inch may affect pump operation.

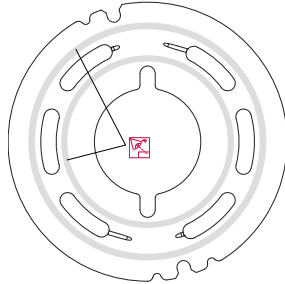
Valve plate rework specifications are given in *ReWork Specifications* **520L1033**.

Ensure plate appears flat and smooth on both the running face and the bottom surface. Perform a magnetic particle inspection to detect cracks. Replace if any cracks exist.

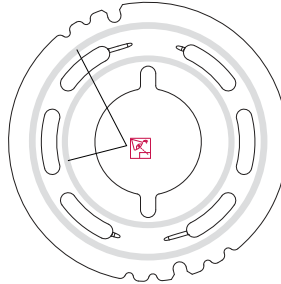
Inspection

*Inspect valve plate*

Clockwise valveplate



Counterclockwise valveplate

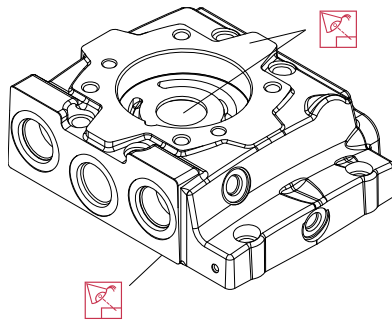


P108 061E

Endcap

Inspect the endcap. Inspect all machined surfaces for scratches or pits. Carefully check the bearing surface for wear. Inspect valve seats carefully for wear or cracks. Replace if damaged.

*Inspect endcap*



P106 223E

End cap rework specifications are given in *ReWork Specifications 520L1033*.

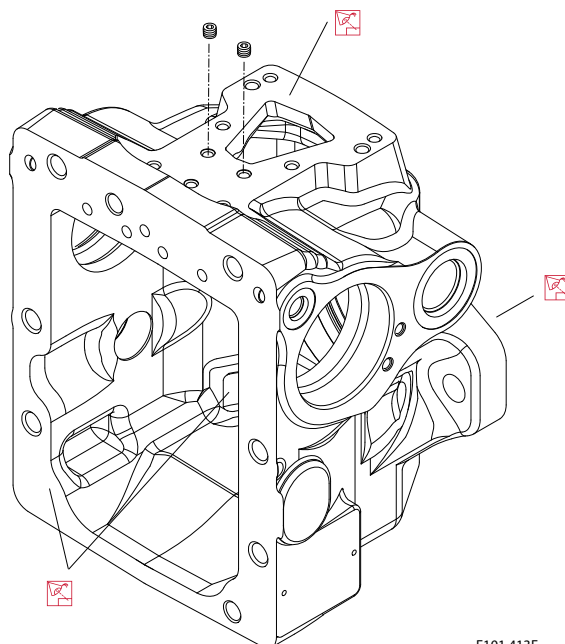
Housing

Inspect the housing to ensure that it is clean and free of foreign material. Inspect the swashplate bearing surfaces, and endcap and control mating surfaces.



**Inspection**

*Inspect housing*

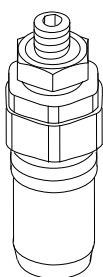


E101 413E

**Pressure Limiter**

Pressure limiter valves are available as complete units only. If you suspect valve malfunction, replace the valve(s) and test pump operation. Replace O-rings before reassembly.

*Inspect pressure limiter valve*



E101 435E

**HPRV Valve**

HPRV valves are available as complete units only. If you suspect valve malfunction, replace the valve(s) and test pump operation. Replace O-rings before reassembly.

*Pressures marked on HPRV valve*

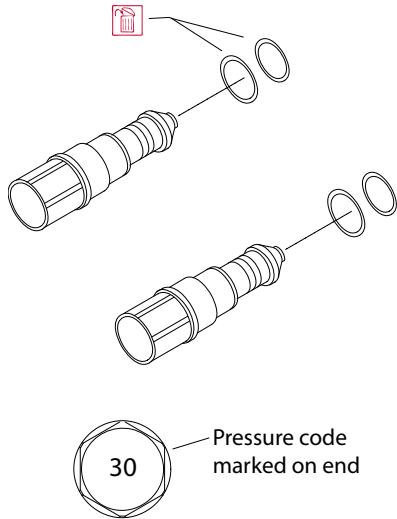
Code	Pressure bar [psi]
20	200 [2900]
23	230 [3336]
25	250 [3626]
28	208 [4061]
30	300 [4351]
33	330 [4786]

**Inspection**

*Pressures marked on HPRV valve (continued)*

Code	Pressure bar [psi]
35	350 [5076]
38	380 [5511]
40	400 [5801]

*Inspect HPRV valve*



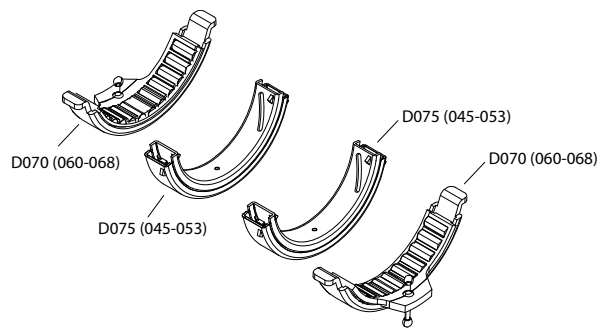
P106 662E

**Cradle Bearings**

Inspect the cradle bearings for damage or excessive wear. Slide the bearings by hand and feel for roughness. Replace cradle bearings if scratched, warped, or worn.

[Replace cradle bearings as a pair.](#)

*Inspect cradle bearings*



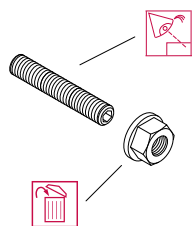
P108 490E

**Optional Displacement Limiter**

Inspect the displacement limiter screw threads. Ensure that the screw is not bent. Replace the seal/nut.

**Inspection**

*Inspect displacement limiter*

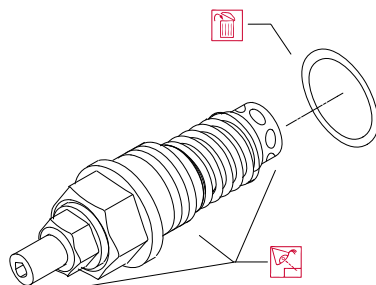


P106 131E

**Charge Pressure Relief Valve**

Charge pressure relief valve is available as a complete unit only. If you suspect valve malfunction, replace the valve and test pump operation. Replace O-rings before assembly.

*Inspect charge pressure relief valve*



P106 040E

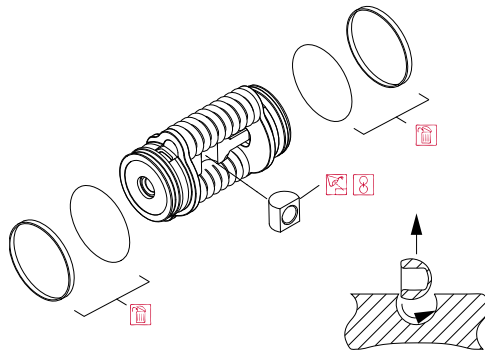
**Servo Piston Assembly**

Inspect slider block for wear or damage. Replace if necessary. Inspect springs for warping or cracking. Replace entire assembly if springs are damaged. Inspect servo piston for wear, cracks, or damage. Replace entire assembly if servo piston is damaged.

Do not disassemble servo piston assembly. Replacement servo piston assembly is available as a complete unit only.

Inspection

*Inspect servo assembly*



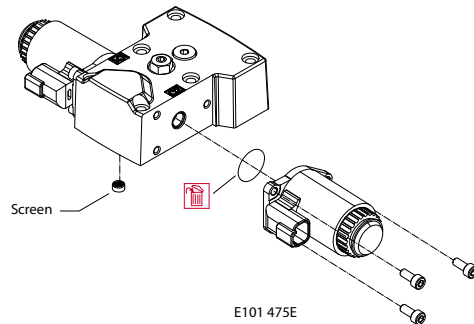
P101 337E

Control

Inspect sealing surfaces of control. If you find nicks or scratches that may allow fluid leakage, replace control. Inspect feedback spring and linkage. Control is available as a complete unit only. If you suspect control operation problems, replace control with a new unit and test pump. If necessary, you may remove and clean the control orifices. Use a 3 mm internal hex. wrench Torque to 2.5 N·m [1.8 lbf·ft]. Remove and replace the screen if it is clogged.

If you suspect a coil malfunction, remove the coil by removing the plastic nut with a 26 mm 12 point socket. Install a new coil. Torque nut to 5 N·m [3.7 lbf·ft].

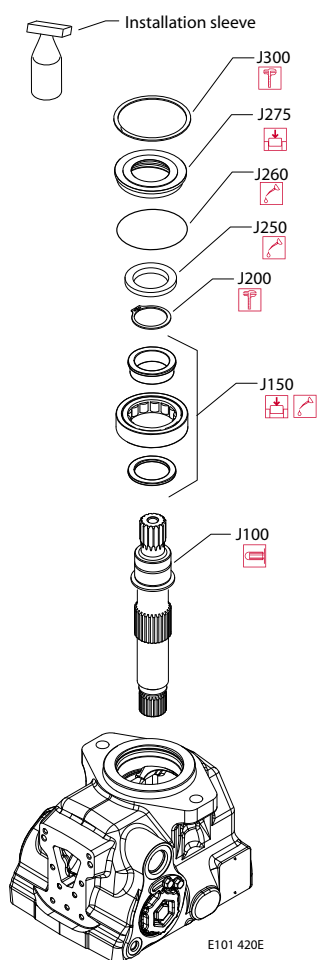
*Inspect control*



E101 475E

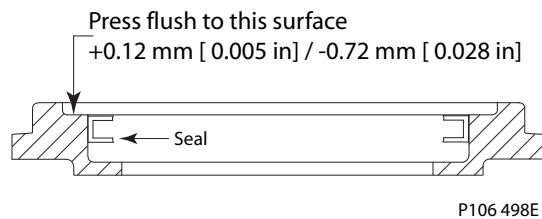
**Assembly**
**Overview**

The following section describes assembly procedures for the H1 45/53 pump. If special tools are needed for assembly or adjustment, they appear in this section. After assembly, adjust the pump according to the settings listed on the model code stamped on the serial number plate. Connect the pump to an appropriate test stand. Refer to *H1 45/53/60/68 Closed Circuit Axial Piston Pumps Service Manual 520L0958* for further instructions and adjustments.

**Shaft and Seal Installation**
*Install shaft /seal/bearing*


1. Orient pump with the mounting flange pointing up.
2. Using an adequate press, press the bearing (J150) onto the shaft (J100) and install the retaining ring (J200). Ensure the retaining ring diameter is less than 38.84 mm [1.53 in] once installed on the shaft.
3. Lubricate and install a new O-ring (J260) onto seal carrier (J275). Press a new seal (J250) into the seal carrier so the solid side of the seal is against the shoulder of the seal carrier.

*Seal does not need to be flush with surface of seal carrier. Top of seal may be 0.12 mm [0.005 in] above surface or 0.72 mm [0.028 in] below surface of seal carrier.*

**Assembly**
*Positioning seal in seal carrier*


4. Install the shaft assembly into the front housing. Cover the shaft with an installation sleeve to protect it during installation of the seal carrier.
5. Hand press the seal carrier (J275) into the housing. Ensure the seal carrier clears the spiral ring groove in the housing. Remove protective cover from shaft end.
6. Install the spiral ring (J300) into the housing. The inside diameter of the ring must be at least 68 mm [2.677 in] after installation.

**Cradle Bearings and Swashplate Installation**

1. Position housing as shown in illustration.
2. Coat the cradle bearings with hydraulic fluid and install them into the pump housing. Fit retaining pins into holes in housing.

---

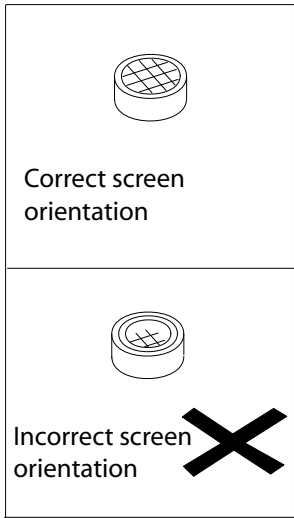
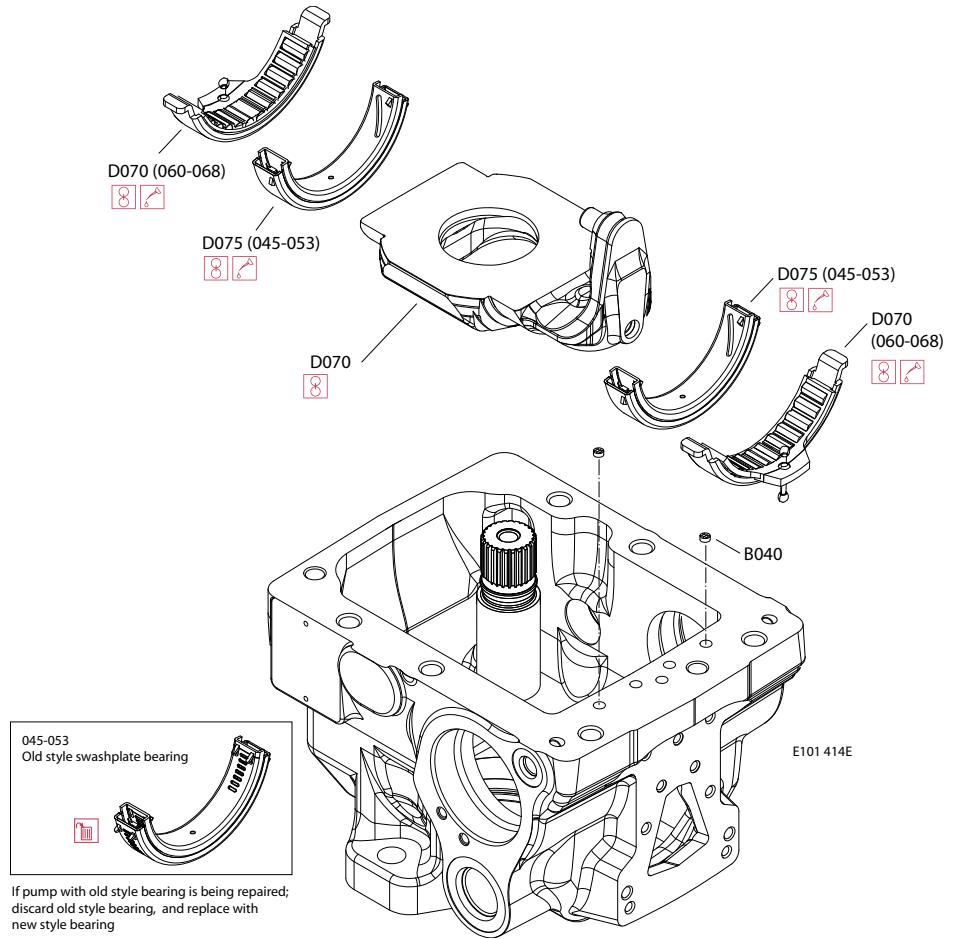
*If cradle bearings are reused, reinstall them in their original orientation and position.*

---

3. Swing bearings fully to each side to check for smooth operation.
4. Install swashplate. Ensure retaining pins fit securely in swashplate. Check that swashplate moves correctly on cradle bearings.
5. Position swashplate in neutral (flat) position.
6. If previously removed, press new filter screens (B040) into the housing. Install screens and in same orientation as when removed. Press in retaining ring (B060).

Assembly

Install cradle bearings and swashplate



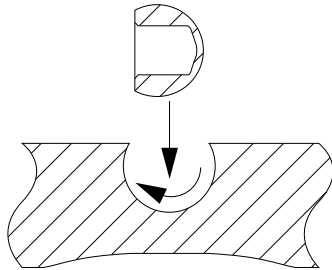
P108 491E

Assembly

Servo Piston Assembly

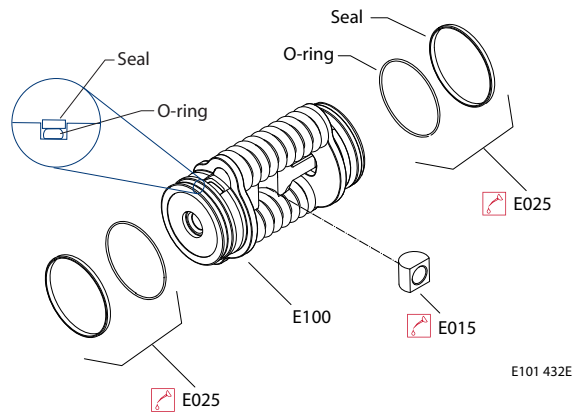
1. Lubricate and install new piston seals and O-rings (E025). Stretch O-rings onto servo piston, then install piston seals outboard of the O-rings. Allow seals to relax before installing servo piston. Use the servo cylinder to resize the seals before installing servo piston.
2. Lubricate and install slider block (E015).

*Install slider block*



P106 235E

*Assemble servo piston*



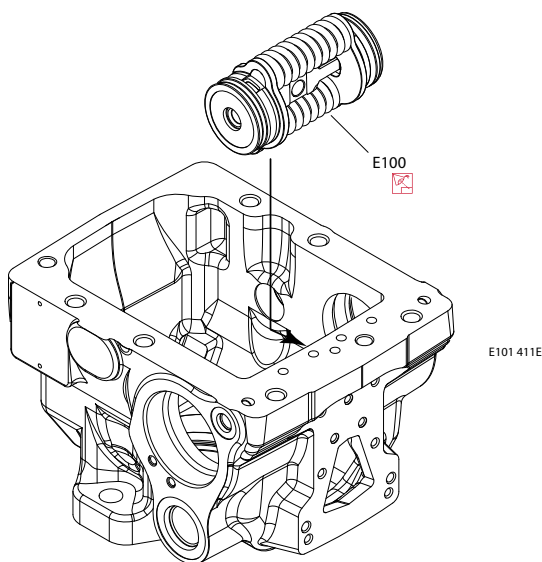
Servo Piston Installation

Install servo piston assembly (E100). Ensure swashplate pin fits properly in servo slider block (E015).



Assembly

Install servo piston



Servo Cylinder Installation

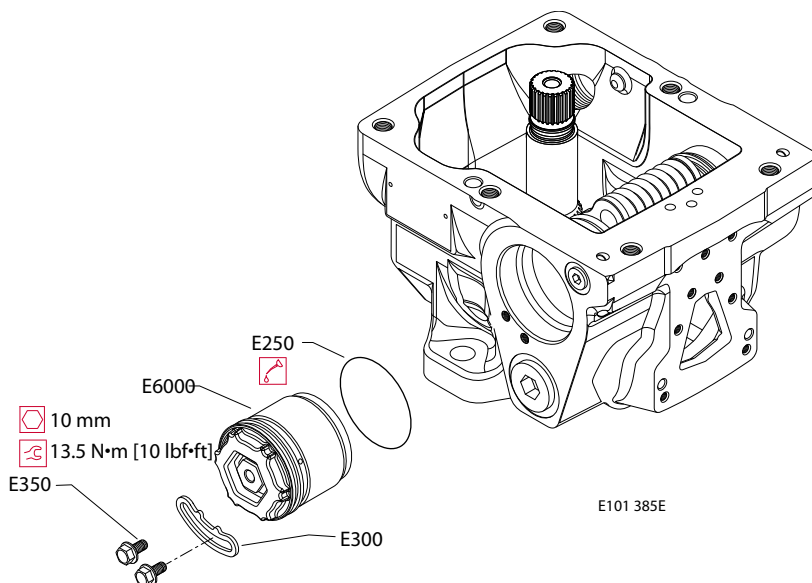
1. Lubricate new O-rings (E250) and install on each servo cylinder.
2. While holding the servo piston in place, thread servo cylinders into housing using a 3/4 in socket. Thread cylinders equal distance in each side of pump until each cylinder contacts servo cylinder. Do not compress servo piston springs.

**Caution**

Do not allow loose servo piston to damage internal machined surfaces of pump.

Do not damage seals when installing servo cylinders.

Install servo cylinders



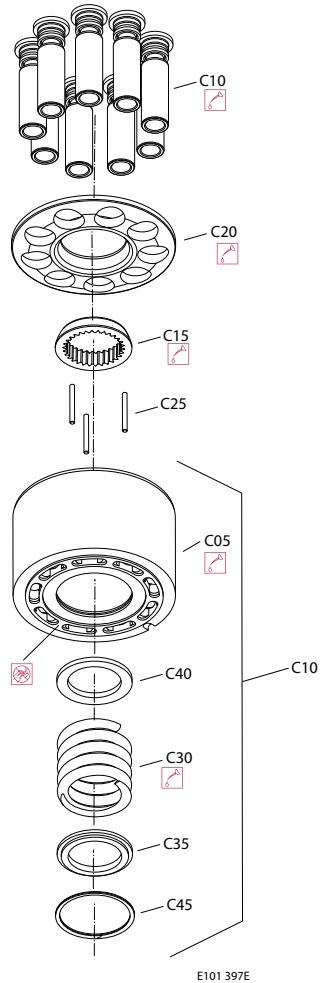
3. Install locking plates (E300). Using a 10 mm wrench, install locking plate screws (E350). Torque screws to 12-16.1 N·m [9.7-11.9 lbf·ft].

Assembly

After pump assembly is complete, mount pump on test stand. Perform mechanical neutral adjustment and control neutral adjustment. Refer to *H1 Closed Circuit Axial Piston Pumps 045/053/060/068 Service Manual 520L0958* for adjustment procedures.

Cylinder Kit Assembly

Assemble cylinder block kit



1. Coat all parts with hydraulic fluid prior to reassembly.
2. Install the inner block spring washer (C40), block spring (C30), and outer washer (C35) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (C45) into the groove in the cylinder block.

**Warning**

**Risk of personal injury:** Compressing the block spring requires about 350 to 400 N [80 to 90 lbf]. Use a press sufficient to maintain this force with reasonable effort. Ensure the spring is secure before attempting to install the spiral retaining ring. Release the pressure slowly after the retaining ring is installed.

3. Turn the block over and install the hold-down pins (C25) and ball guide (C15) into the cylinder block.
4. Insert the pistons (C10) into the slipper retainer (C20). Install the piston/retainer assembly into the cylinder block. Ensure the concave surface of the retainer seats on the ball guide. If you are reusing the pistons, install them to the original block bores. Lubricate the pistons, slippers, retainer, and ball guide before assembly. Set the cylinder kit aside on a clean surface until needed.

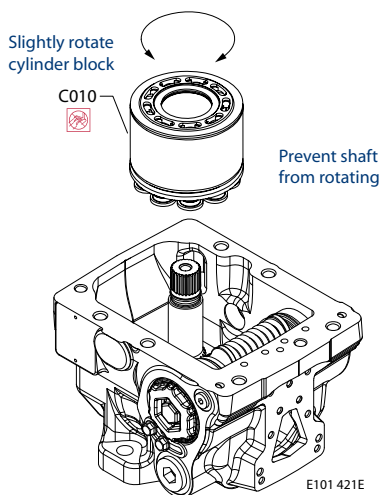
**Assembly**

Be sure to install the slipper retainer (C20) so it mates correctly with the ball guide (C15) (concave side of the slipper retainer against the convex side of the ball guide).

**Cylinder Kit Installation**

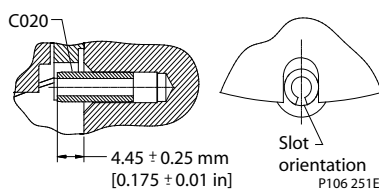
1. Position pump with shaft pointing down.
2. Insert the cylinder block kit onto the shaft. While holding the shaft, slightly rotate the cylinder block kit to help start the shaft splines over the ball guide and align it with the block splines.

*Install cylinder block*


**Timing Pin and Endcap Bushing Installation**

1. Install timing pin (C020) in endcap as shown. Orient slot away from valve plate. Install the alignment pins (B010) in housing. Measure pin insertion depth to verify proper pin insertion.
2. Orient endcap bushing slots towards top or bottom of endcap. Lubricate and press the bushings (G550) into the end cap to depth shown below.

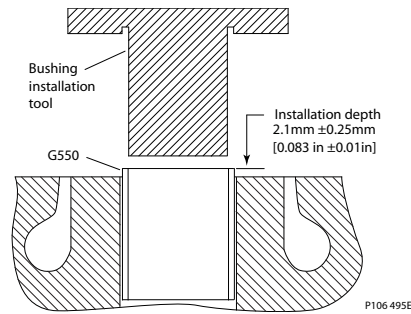
*Timing pin installation*



Ensure that bushing is properly installed. Improper installation resulting in improper depth or misalignment will result in premature bushing and charge pump failure.

Assembly

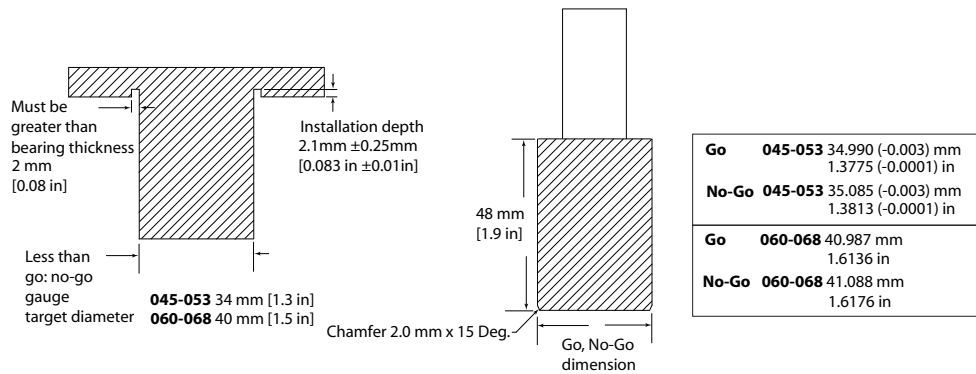
Install bushings in endcap



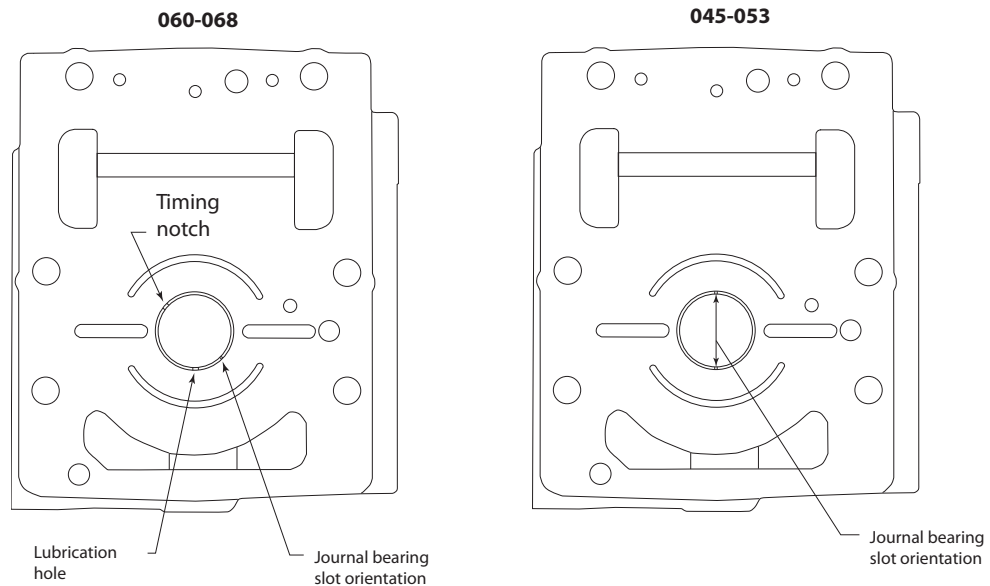
Endcap Bushing Installation tools

Bushing installation tool

Go, No-Go gauge



Endcap Bushing Orientation



**Assembly**
**Valve Plate and Endcap Installation**

1. Install the alignment pins (B010) in housing.
2. Clean the valve plate (C025) and endcap (G100).

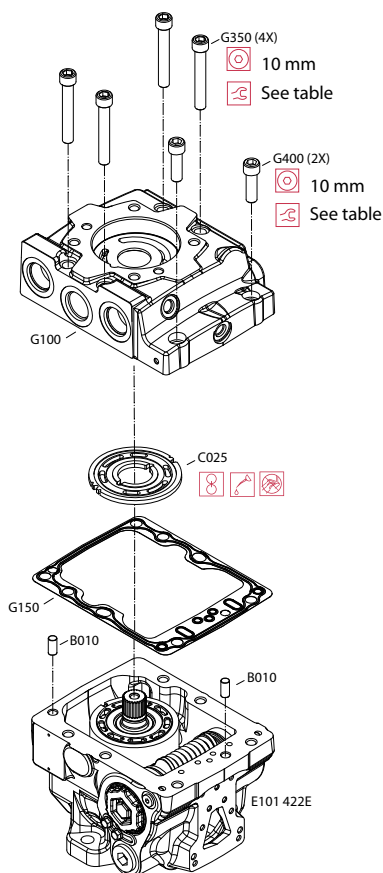
For proper pump operation, it is extremely important to ensure that there is no contamination between the endcap and valve plate.

3. Apply a liberal amount of assembly grease to the backside of the valve plate surface to hold it in place and position on endcap in original position.
4. Install new gasket (G150).

Do not bend or warp the gasket in an attempt to straighten it. This may damage the embossing which is not visible under the rubber coating.

5. Install endcap. Using a 10 mm internal hex wrench install cap screws (G350) and (G400).
6. Use torque sequence shown at right.

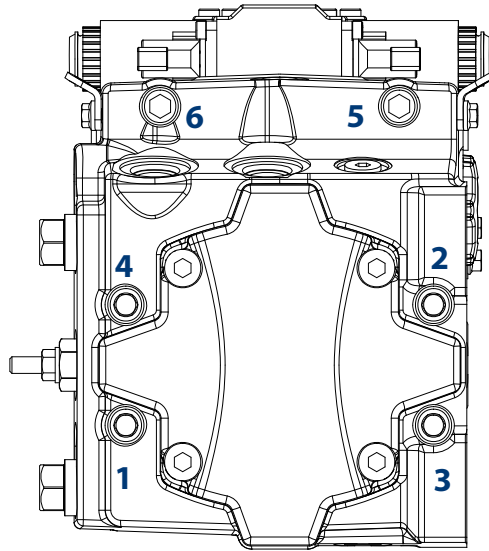
Install endcap components


**Endcap bolt torque**

	Item	Torque
045/053	G350	110 N•m [81 lbf•ft]
	G400	110 N•m [81 lbf•ft]
060/068	G350	177 N•m [131 lbf•ft]
	G400	32 N•m [24 lbf•ft]

**Endcap torque sequence**

Assembly

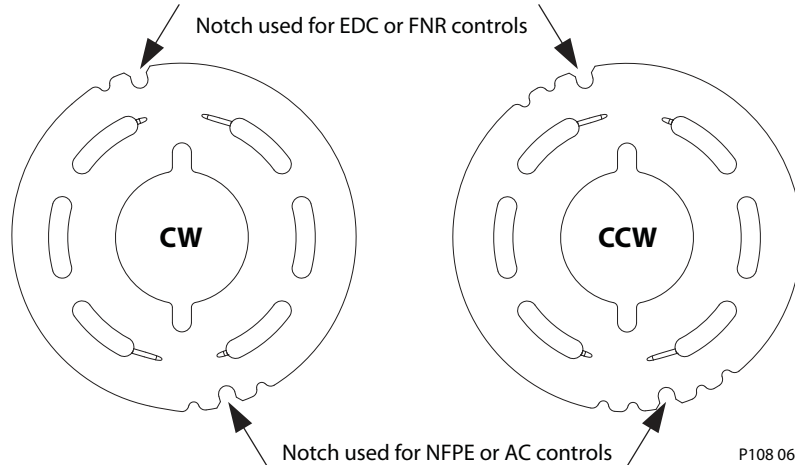


P106 230E

Valveplate orientation

Clockwise valveplate

Counterclockwise valveplate



P108 060E

Charge Pump Installation

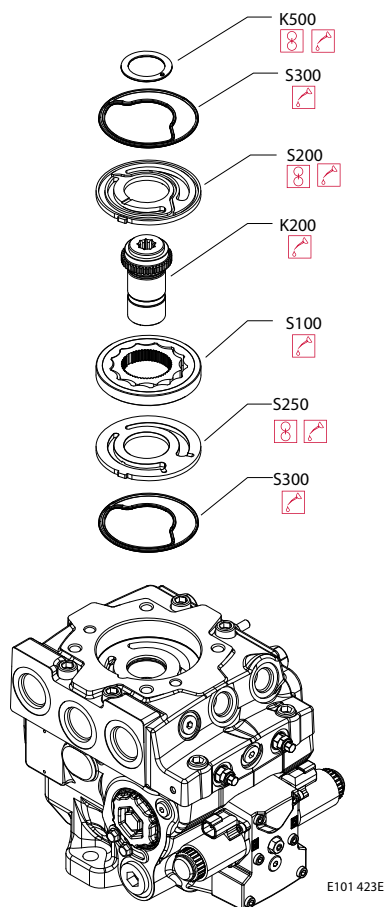
Charge pump components are available as a complete kit only. Kit includes (S300), (S250), (S100), (S150), and (S200).

1. Install new seal (S300) to valve plate (S250). Lubricate valve plate (S250) and install in same orientation as when it was removed.
2. Lubricate and install outer ring (S150) and charge pump gearset (S100). Lubricate and install coupling (K200).
3. Lubricate and install pressure-balance plate (S200) in same orientation as when it was removed. Install new outer seal (S300).
4. Lubricate and install thrust washer (K500) in same orientation as when it was removed.

Bump on thrust washer fits into hole in cover.

**Assembly**

Remove end cover and charge pump


**Auxiliary Pad or End Cover Installation**

1. Install alignment pins (G450). Install gasket (K150).
2. Install end cover or auxiliary pad with cap screws (K400) using an 10 mm internal hex wrench. Torque to 92 N·m [68 lbf·ft]. Follow torque sequence below.

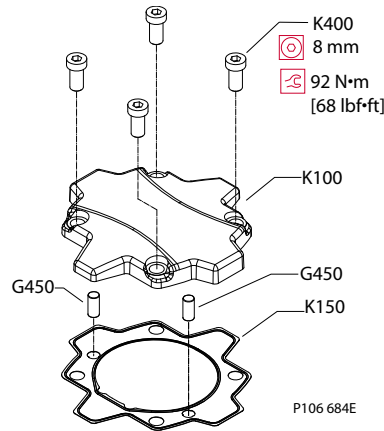
Ensure proper torque on aux pad screws (K400). If necessary, replace screws.

3. Install auxiliary pump or seal (K250) and cover (K300) and screws (K350). See illustration for wrench sizes and torques.

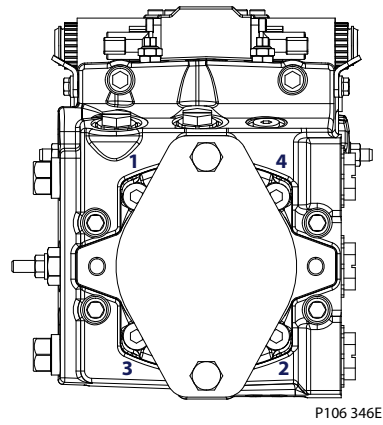
If a second pump is used, reinstall it on auxiliary pad.

Assembly

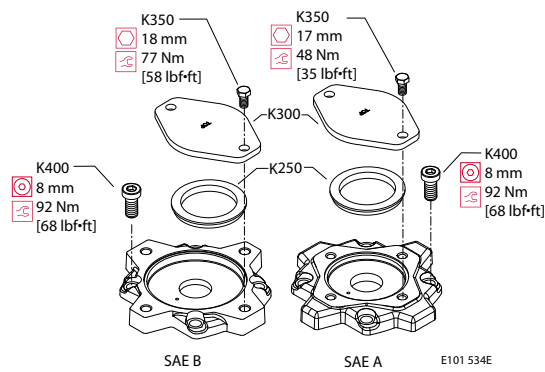
End cover



Torque sequence



Auxiliary pads



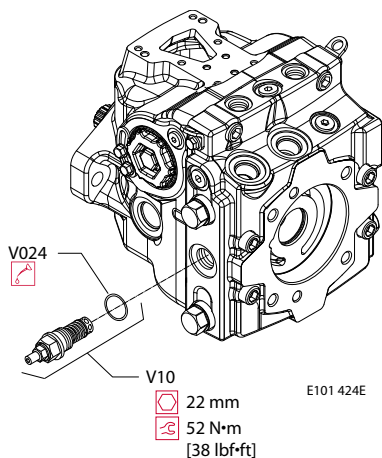
Charge Pressure Relief Valve Installation

1. Install new O-ring (V024).
2. Using a 22 mm wrench, install the charge pressure relief valve (V10).
3. Torque to 52 N·m [38 lbf·ft].



Assembly

Install charge pressure relief valve

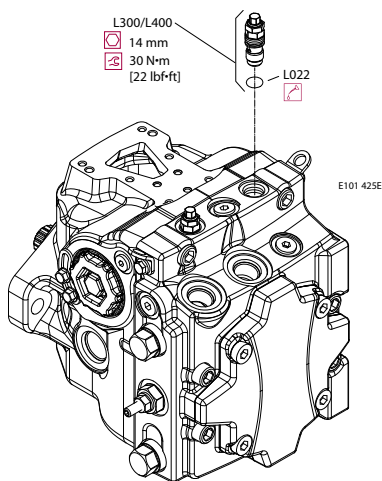


Pressure Limiter Installation

1. Lubricate and install O-rings (L022).
2. Using a 14 mm wrench, install pressure limiter cartridges (L300) and (L400).
3. Torque to 30 N·m [22 lbf·ft].

Refer to Danfoss publication *H1 45/53/60/68 Closed Circuit Axial Piston Pumps Service Manual 520L0958* for instructions on adjusting pressure limiter.

Install pressure limiter

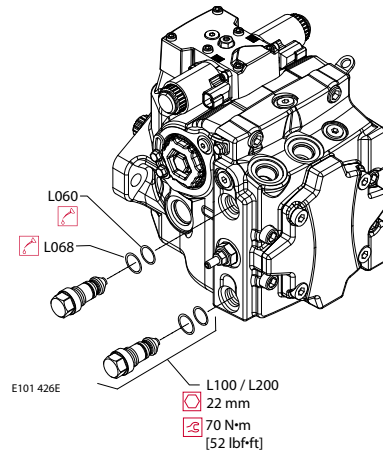


HPRV Valve Installation

1. Replace and lubricate O-rings (L060) and backup rings (L068) before re-assembly.
2. Using a 22 mm wrench, install HPRV valves (L100) and (L200).
3. Torque to 70 N·m [52 lbf·ft].

Assembly

Install HPRV valve



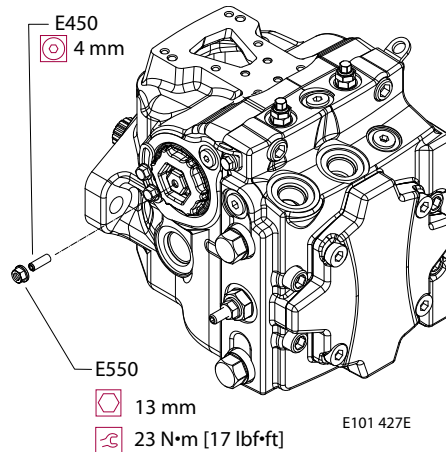
Optional Displacement Limiter Installation

1. Thread displacement limiter adjusting screw (E450) into servo sleeve.
2. Thread a new locking nut onto adjustment screw. Torque to 23 N·m [17 lbf·ft] using a 13mm hex wrench.

Refer to Danfoss publication *H1 45/53/60/68 Closed Circuit Axial Piston Pumps Service Manual 520L0958* for instructions on adjusting displacement limiter.

Set the approximate displacement limiter depth based on the pump model code. See to table below for displacement change per turn. Run screw in until it contacts the servo piston, then back out the appropriate number of turns.

Install the displacement limiter



Displacement limiter adjustment data

Displacement	Locknut wrench size and torque	Adjusting screw size	Approximate displacement change per revolution of adjusting screw
45	13 mm 23 N·m [17 lbf·ft]	4 mm internal hex	5.1 cm <sup>3</sup> [0.31 in <sup>3</sup> ]
53	13 mm 23 N·m [17 lbf·ft]	4 mm internal hex	6.0 cm <sup>3</sup> [0.37 in <sup>3</sup> ]
60	13 mm 23 N·m [17 lbf·ft]	4 mm internal hex	1. 6.8 cm <sup>3</sup> [0.41 in <sup>3</sup> ]

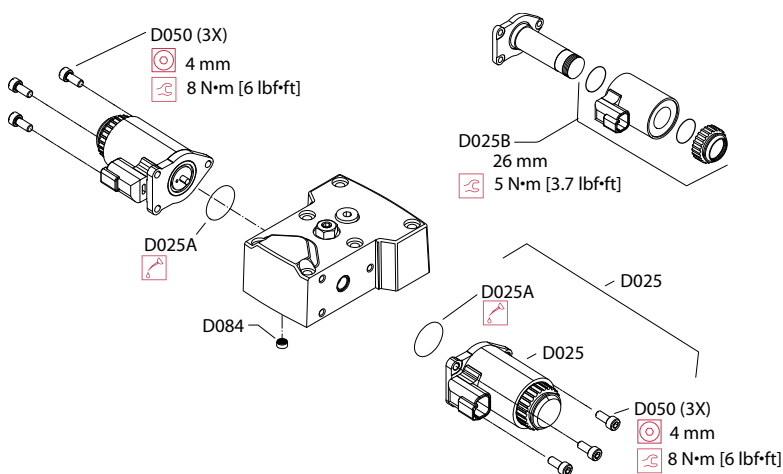
**Assembly**
*Displacement limiter adjustment data (continued)*

Displacement	Locknut wrench size and torque	Adjusting screw size	Approximate displacement change per revolution of adjusting screw
68	13 mm 23 N•m [17 lbf•ft]	4 mm internal hex	7.7 cm <sup>3</sup> [0.47 in <sup>3</sup> ]

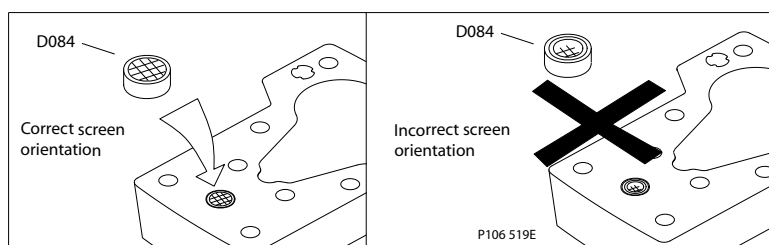
**Control Assembly**

1. Install new O-rings (D025A) into solenoids (D025), and attach solenoids with cap screws (D050) using 4 mm internal hex wrench. Torque to 8 N•m [6 lbf•ft].
2. Replace screen (D084) if previously removed. Drawing shows proper screen orientation.

If you suspect coil malfunction, remove the coil (D025B) by removing the plastic nut with a 26 mm 12 point socket. Install a new coil and torque the nut to 5 N•m [3.7 lbf•ft].

*Assemble control*


E101 352E

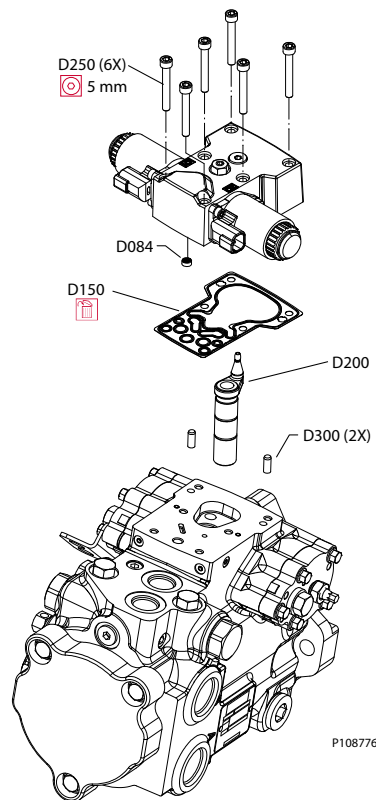
*Proper screen orientation*


P106 519E

Assembly

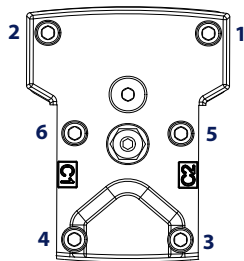
Control Installation

*Install the control*



P108776

*Torque sequence*



P106 231E

1. Install feedback spool into housing. Carefully engage the spool in the swashplate
2. Install the dowel pins (D300).
3. Install the new gasket (D150).
4. Position the control on the pump housing. Remove plug on top of control to visually ensure that feedback pin is engaged properly in control arms.
5. Using a 5 mm internal hex wrench, fasten control to pump with hex screws (D250). Torque screws to 13 N•m [10 lbf•ft]. Follow the torque sequence shown.

MDC Control

**Assembly****Removal**

Refer to exploded diagram, below.

1. Using a 5 mm internal hex wrench, remove the six cap screws (D250).
2. Remove the control module and gasket (D150). Discard the gasket.
3. If necessary, remove servo orifices (F00A, F00B), supply orifice (F00P), and tank orifices (F00T) using a 3 mm internal hex wrench. Tag and number them for reinstallation.
4. If screen (D084) is clogged, use a hook to remove the retaining ring (D098) and the screen. Discard the screen and replace with a new screen.
5. Before removing the control, note the position of the control lever for reassembly.

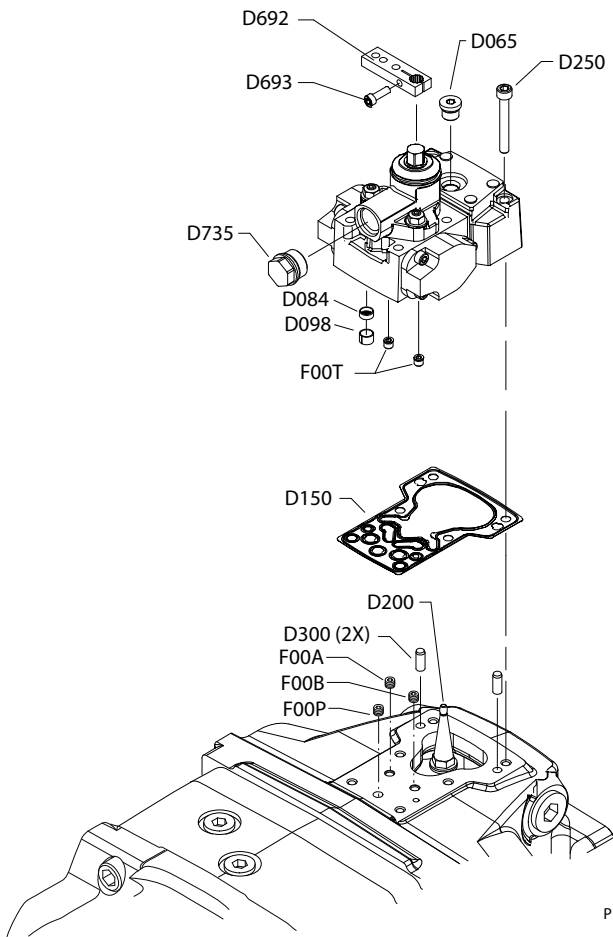
** Caution**

Do not disassemble the control, otherwise the functionality of the control and the neutral position of the pump can be lost!

---

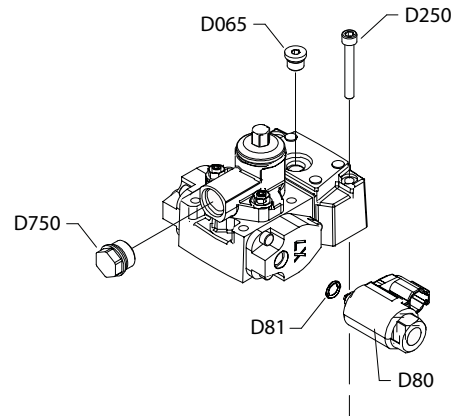
Assembly

MDC illustration - single pumps

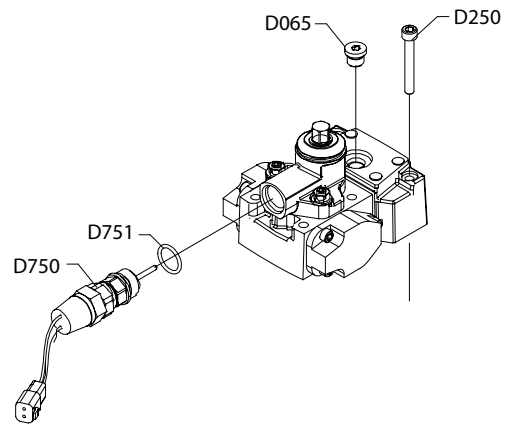


P108784

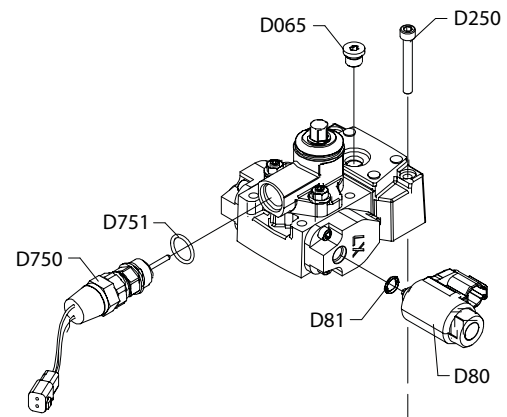
MDC with CCO



MDC with neutral start switch



MDC with neutral start switch and CCO



**Assembly**
**MDC Legend - single pumps**
*Wrench size and torque*

Item	Description	Wrench size	Torque
D065	O-ring plug	3/16 internal hex	12 N·m [9 lbf·ft]
D084	screen	-	-
D098	ring	-	-
D200	feedback pin	13 mm deep well socket	22.5-27.5 Nm [16.6-20.3 lbf·ft]
D250	cap screw	5 mm internal hex	13.3 Nm [9.8 lbf·ft]
D80	solenoid	-	-
D81	Oring	-	-
D750	neutral start switch	-	-
D751	Oring	-	-
D735	plug	3/4 inch	
F00A	servo orifice	3 mm internal hex	2.5 Nm [1.8 lbf·ft]
F00B	servo orifice	3 mm internal hex	2.5 Nm [1.8 lbf·ft]
F00P	supply orifice	3 mm internal hex	2.5 Nm [1.8 lbf·ft]
F00T	tank orifice	3 mm internal hex	2.5 Nm [1.8 lbf·ft]

**Inspection**

Inspect the machined surfaces on the control and top of the pump. If you find any nicks or scratches, replace the component.

**Reassembly**

Ensure you install dowel pins (D300) in the housing before installing the control.

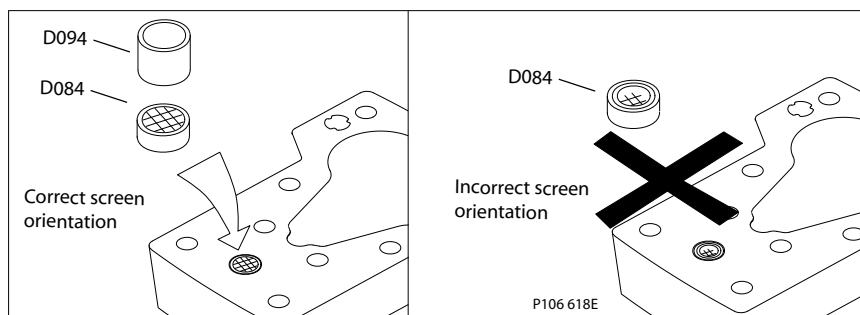
1. Install a new gasket (D150).
2. Install dowel pins (D300) in the housing.

**⚠ Warning**

If the feedback pin comes off during operation, the pump will lose controllability causing a potentially hazardous situation. Insure feedback pin is properly torqued before continuing with reassembly.

3. If you removed screen (D084), install a new one. Install it with the mesh facing outward (see drawing). Install retaining ring (D098).

*Proper screen orientation*



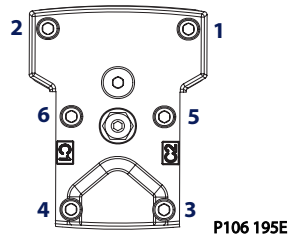
4. If previously removed, install orifices using a 3 mm internal hex wrench. Torque to 2.5 Nm [1.8 lbf ft].

**Assembly**

Remove the plug on top of the control to ensure the swashplate feedback pin is properly positioned in the center of the control module when installing control.

5. Install the control module and six cap screws (D250).

*Torque sequence*



6. Using a 5 mm internal hex wrench, torque the cap screws (D250) to 13.3 Nm [9.8 lbf ft].

**Automotive Control Installation**

1. If previously removed, install new screen (D084) in original orientation. Press in new retention ring (D098). Be sure screen will not move axially in bore after retention ring is installed.

**⚠ Warning**

Failure to install screen will result in erratic pump operation.

2. If previously removed, use a 3 mm internal hex to install orifices (F00A, F00B) in original orientation. Torque to 5 N•m [1.8 lbf•ft].
3. Install new gasket (D150) to bottom of control.
4. Install control on pump. Use a 5 mm internal hex to install six screws (D250). Torque to 13.3 N•m [9.8 lbf•ft]. Follow torque sequence shown on page 40.

Do not damage the plastic housing when installing the screws.

5. Connect wiring (D640).
6. Use the specially fabricated tool to install new plastic plugs with O-rings (D610). Press in and turn 45 degrees clockwise.

If control will continue to be under warranty, install new sealing wax. Pumps without sealing wax installed will not be warrantied.

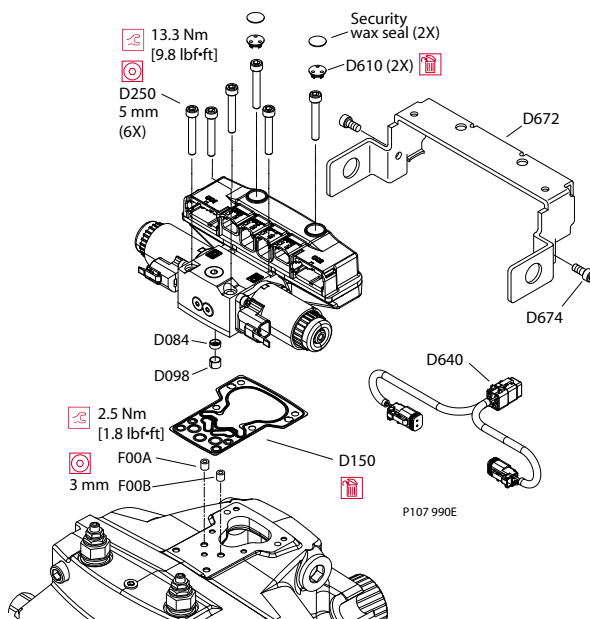
7. Install protection bracket (D672). Install screws (D674). Torque to 5 N•m [3.7 lbf•ft].

If pump has been rebuilt or a new control is being installed, control software must be recalibrated. Refer to H1-Automotive Control User Manual 70012797 for recalibration instructions.

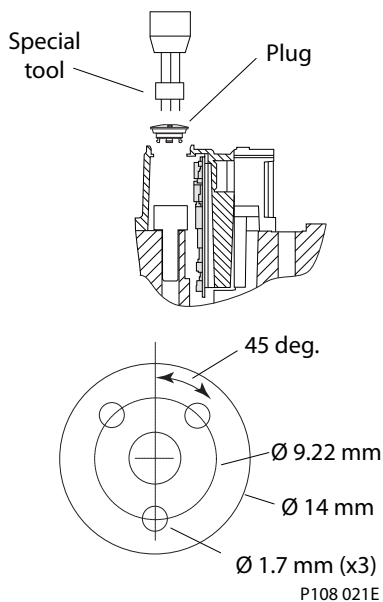


Assembly

Install control



Special plug installation tool



Replacing solenoids

Follow solenoid replacement procedure in [Control Assembly](#) on page 43 .

---

**Repair Instructions      H1 45/53/60/68 Closed Circuit Axial Piston Pumps**

---

**Startup procedures****Overview**

Install pump on test stand. Refer to *H1 45/53/60/68 Closed Circuit Axial Piston Pumps Service Manual 520L0958* for startup procedures, adjustments, and pressure measurements for H1 45/53/60/68 pump.

**Initial Startup Procedures**

- Ensure system components are clean
- Install new filters
- Fill system with fluid
- Disable engine
- Disconnect control
- Crank engine and check for adequate charge pressure
- Check for proper control function

**Adjustments**

- Charge pressure relief adjustment
- Pressure limiter adjustment
- Displacement limiter adjustment
- Electronic displacement control (EDC) adjustment

**Pressure Measurements**

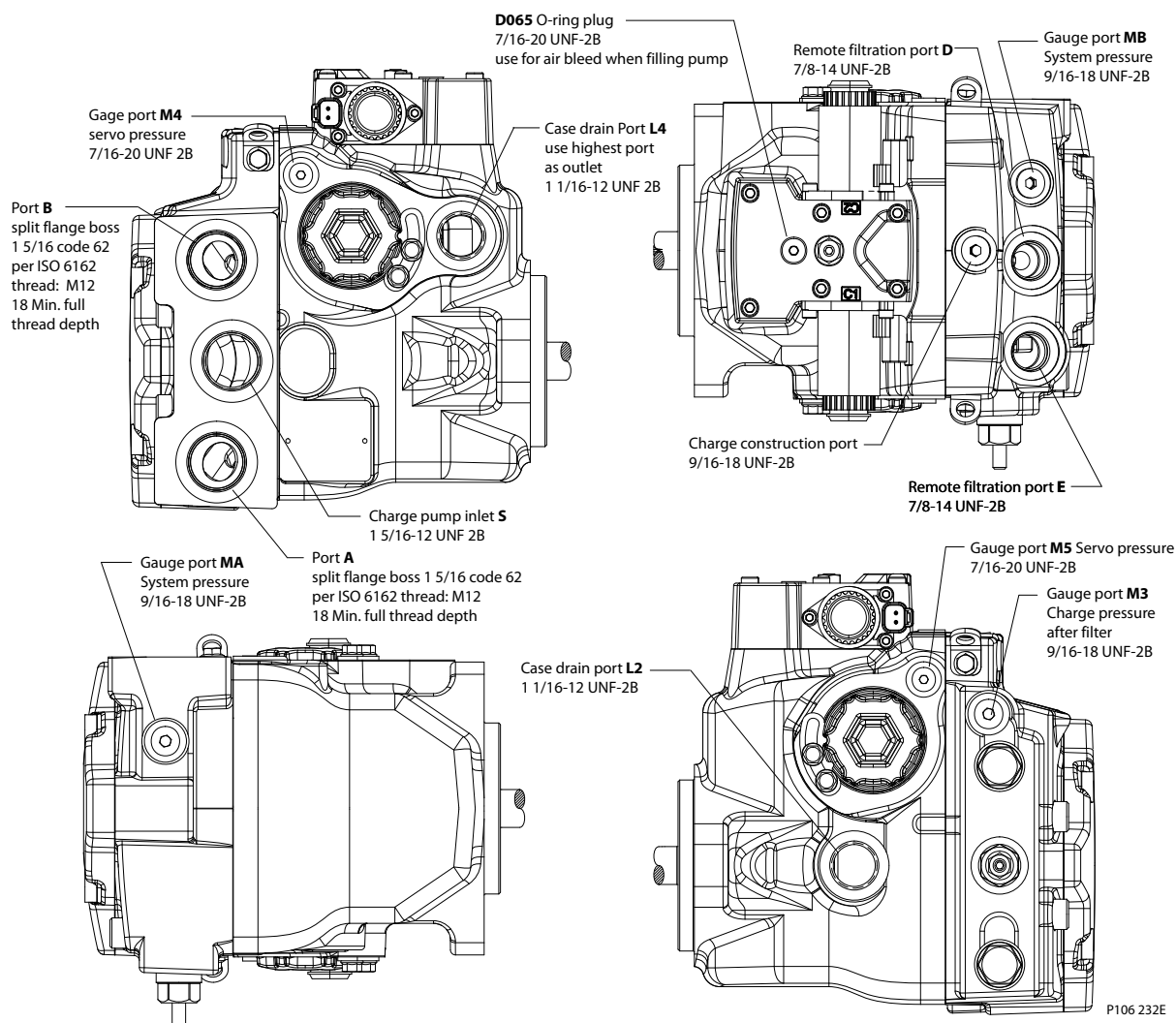
- Required tools
- Port locations
- Gauge installation

**Port locations**
**Port Locations and Gauge Installation**

The following table and drawing show the port locations and gauge sizes needed. When testing system pressures, calibrate pressure gauges frequently to ensure accuracy. Use snubbers to protect gauges.

*Port information*

Port identifier	Port size	Wrench size	Pressure obtained	Gauge size, bar [psi]
L2, L4	1 1/16-12 UNF 2B	9/16 internal hex	Case drain	10 bar [100 psi]
MA, MB,	9/16-18 UNF	1/4 internal hex	System pressure	600 bar [10,000 psi]
M3	9/16-18 UNF 2B	1/4 internal hex	Charge pressure	50 bar [1000 psi]
M4, M5	7/16-20 UNF 2B	3/16 internal hex	Servo pressure	50 bar [1000 psi]

*Port locations*


## Repair Instructions H1 45/53/60/68 Closed Circuit Axial Piston Pumps

### Torque chart

#### Fastener Size and Torque Chart

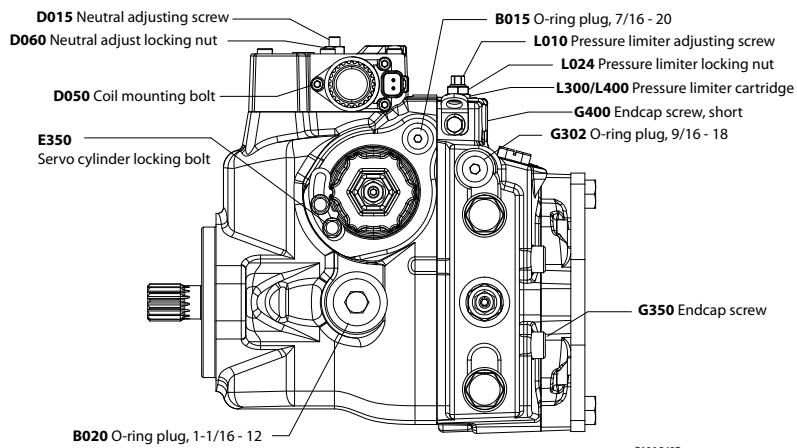
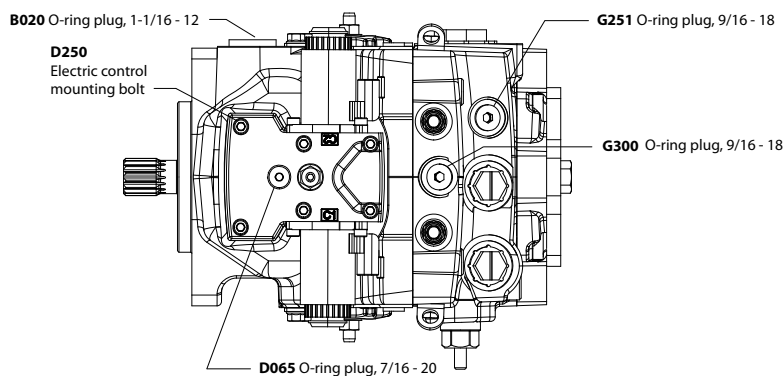
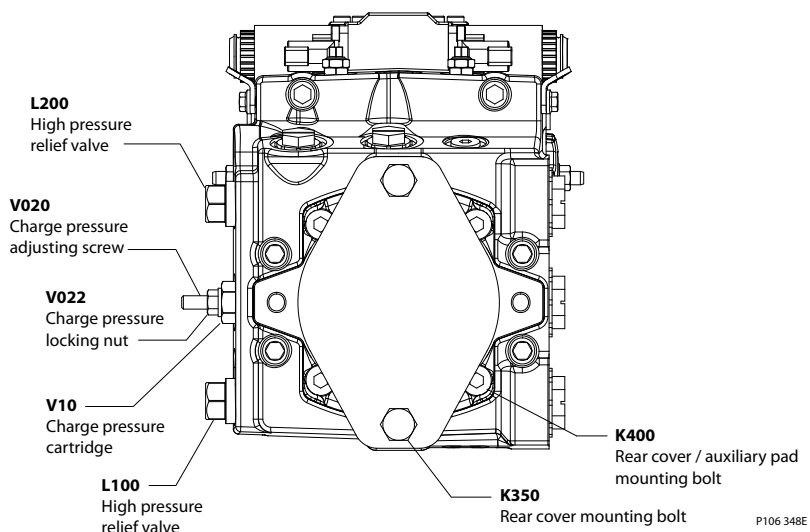
Item	Fastener	Wrench size	Torque
D015	Neutral adjust screw	4 mm internal hex	NA
D050	Coil mounting bolt	4 mm internal hex	8 N•m [9 lbf•ft]
D060	Neutral adjust locking nut	13 mm	10 N•m [7 lbf•ft]
D250	Electric control mounting bolt	5 mm internal hex	13 N•m [10 lbf•ft]
E350	Servo cylinder locking bolt	11 mm	14.5 N•m [11 lbf•ft]
G350 (45/53)	Endcap screw, short	10 mm internal hex	110 N•m [81 lbf•ft]
G350 (60/68)		10 mm internal hex	177 N•m [131 lbf•ft]
G400 (45/53)	Endcap screw	10 mm internal hex	110 N•m [81 lbf•ft]
G400 (60/68)		10 mm internal hex	32 N•m [24 lbf•ft]
K350 Apad	Shipping cover mounting bolt	17 mm	48 N•m [35 lbf•ft]
K350 Bpad	Shipping cover mounting bolt	18 mm	77 N•m [58 lbf•ft]
K400	Rear cover/aux pad mounting bolt	8 mm internal hex	92 N•m [68 lbf•ft]
L010	Pressure limiter adjust screw	8 mm	NA
L300/L400	Pressure limiter cartridge	14 mm	30 Nm [22 lbf•ft]
L024	Pressure limiter locking nut	14 mm	20 N•m [15 lbf•ft]
L100/L200	High pressure relief valve	22 mm	70 N•m [52 lbf•ft]
V10	Charge pressure cartridge	22 mm	52 N•m [38 lbf•ft]
V020	Charge pressure adjusting screw	4 mm internal hex	NA
V022	Charge pressure locking nut	13 mm	12 Nm [9 lbf•ft]

#### Plug Size and Torque Chart

Item	O-ring plug	Wrench size	Torque
B015	7/16 - 20	3/16 in internal hex	19 N•m [14 lbf•ft]
B020	1-1/16 - 12	9/16 in internal hex	49 N•m [36 lbf•ft]
D065	7/16 - 20	3/16 in internal hex	19 N•m [14 lbf•ft]
G250	9/16 - 18	7 mm internal hex	42 N•m [30 lbf•ft]
G300/G302	9/16-18 UNF	1/4 in internal hex	42 N•m [30 lbf•ft]

Torque chart

Fasteners and Plugs









**Products we offer:**

- Bent Axis Motors
- Closed Circuit Axial Piston Pumps and Motors
- Displays
- Electrohydraulic Power Steering
- Electrohydraulics
- Hydraulic Power Steering
- Integrated Systems
- Joysticks and Control Handles
- Microcontrollers and Software
- Open Circuit Axial Piston Pumps
- Orbital Motors
- PLUS+1® GUIDE
- Proportional Valves
- Sensors
- Steering
- Transit Mixer Drives

**Danfoss Power Solutions** is a global manufacturer and supplier of high-quality hydraulic and electronic components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway market. Building on our extensive applications expertise, we work closely with our customers to ensure exceptional performance for a broad range of off-highway vehicles.

We help OEMs around the world speed up system development, reduce costs and bring vehicles to market faster.

Danfoss – Your Strongest Partner in Mobile Hydraulics.

**Go to [www.powersolutions.danfoss.com](http://www.powersolutions.danfoss.com) for further product information.**

Wherever off-highway vehicles are at work, so is Danfoss. We offer expert worldwide support for our customers, ensuring the best possible solutions for outstanding performance. And with an extensive network of Global Service Partners, we also provide comprehensive global service for all of our components.

Please contact the Danfoss Power Solution representative nearest you.

**Comatrol**

[www.comatrol.com](http://www.comatrol.com)

**Schwarzmueller-Inverter**

[www.schwarzmueller-inverter.com](http://www.schwarzmueller-inverter.com)

**Turolla**

[www.turollaocg.com](http://www.turollaocg.com)

**Valmova**

[www.valmova.com](http://www.valmova.com)

**Hydro-Gear**

[www.hydro-gear.com](http://www.hydro-gear.com)

**Daikin-Sauer-Danfoss**

[www.daikin-sauer-danfoss.com](http://www.daikin-sauer-danfoss.com)

Local address:

**Danfoss Power Solutions US Company**  
2800 East 13th Street  
Ames, IA 50010, USA  
Phone: +1 515 239 6000

**Danfoss Power Solutions GmbH & Co. OHG**  
Krokamp 35  
D-24539 Neumünster, Germany  
Phone: +49 4321 871 0

**Danfoss Power Solutions ApS**  
Nordborgvej 81  
DK-6430 Nordborg, Denmark  
Phone: +45 7488 2222

**Danfoss Power Solutions (Shanghai) Co., Ltd.**  
Building #22, No. 1000 Jin Hai Rd  
Jin Qiao, Pudong New District  
Shanghai, China 201206  
Phone: +86 21 3418 5200

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without changes being necessary in specifications already agreed. All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved.