MAKING MODERN LIVING POSSIBLE

Service Manual

PVG 100 Proportional Valves

powersolutions.danfoss.com

Revision history

Table of revisions

Date	Changed	Rev
October 2014	Danfoss layout	BA
June 2009	First edition	AA

Contents

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Introduction

Overview

This manual includes information for servicing PVG 100 valves. It includes a description of the units and their individual components, troubleshooting information, and minor repair procedures.

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

A worldwide network of Danfoss Global Service Partners is available for major repairs. Danfoss Global Service Partners are trained by the factory and certified on a regular basis. You can locate your nearest Global Service Partner using the distributor locator at www.Danfoss.com. Click on the Sales and Service link.

For specifications and operating parameters on PVG 100 valves, refer to PVG 100 Technical Information Manual **520L0720**.

Caution

Do not attempt to service PVG valves without build sheet specifications for reference.

General Instructions

Follow these general procedures when repairing PVG 100 valves.

Remove the unit

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

Keep it clean

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

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

Replace all O-rings and gaskets

It is recommended that all O-rings be replaced. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.

Secure the unit

Introduction

For repair, place the unit in a stable position with the shaft pointing downward. Secure the motor while removing and torquing controls, and valves.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.

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.

Hazardous material

Warning

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

Introduction

Acronyms

This table provides a definition of commonly used terms.

P = Proportional V = Valve	
PVP/PVPF	Pump side module, Open center
PVPV	Pump side module, Closed center
PVB	Basic module
PVLA	Anti-cavitation valve
PVLP	Shock and anti-cavitation valve
PVT	End plate
PVAS	Assembly kit for PVP, PVPV/M
PVTI	PVG 100/32 interface module
PVPE	Unloading valve
PVPP	Pilot shut off valve
PVPC	Plug for external pilot oil supply
PVBS	Main spool
PVM	Mechanical activation
PVMD	Cover for mechanical activation
PVH	Cover for hydraulic activation
PVMF	Cover for mechanical float
PVMR	Cover for friction detent PVMR or float position
PVEH, PVES, PVEA	Electrical activation
PVEO	Electrical activation
PVBZ	Without shock valve

Operation

PVG 100 Group with Open Center PVPF

When the pump is started and the main spools in the individual basic modules are in the neutral position, oil flows from the pump, through connection P, across the pressure matching spool to tank. The oil flow led across the pressure matching spool determines the pump pressure (stand-by pressure).

When one or more of the main spools are actuated, the highest load pressure is fed through the shuttle valve circuit to the spring chamber behind the pressure matching spool, and completely or partially closes the connection to tank.

Pump pressure is applied to the opposite side of the pressure matching spool. The pressure relief valve will open should the load pressure exceed the set value, diverting pump flow back to tank.

In a pressure-compensated basic module the compensator maintains a constant pressure drop across the main spool – both when the load changes and when a module with a higher load pressure is actuated.

Besides independent flow the other advantage of post-compensated work sections is the ability to control multifunction operation when flow demand exceeds pump capacity. This means that all work sections will continue to function regardless of differences in their load and regardless of the pump flow. The flow relationships specified between functions will be maintained over the full flow range of the pump.

The shock valves PVLP with fixed setting and the suction valves PVLA on ports A and B are used for the protection of the individual working function against overload and/or cavitation.

PVG 100 Group with Closed Center PVPV

In load sensing systems, the load pressure is led to the pump regulator via the LS connection. In the neutral position, the pump control sets the displacement so that leakage in the system is compensated for, to maintain the set stand-by pressure.

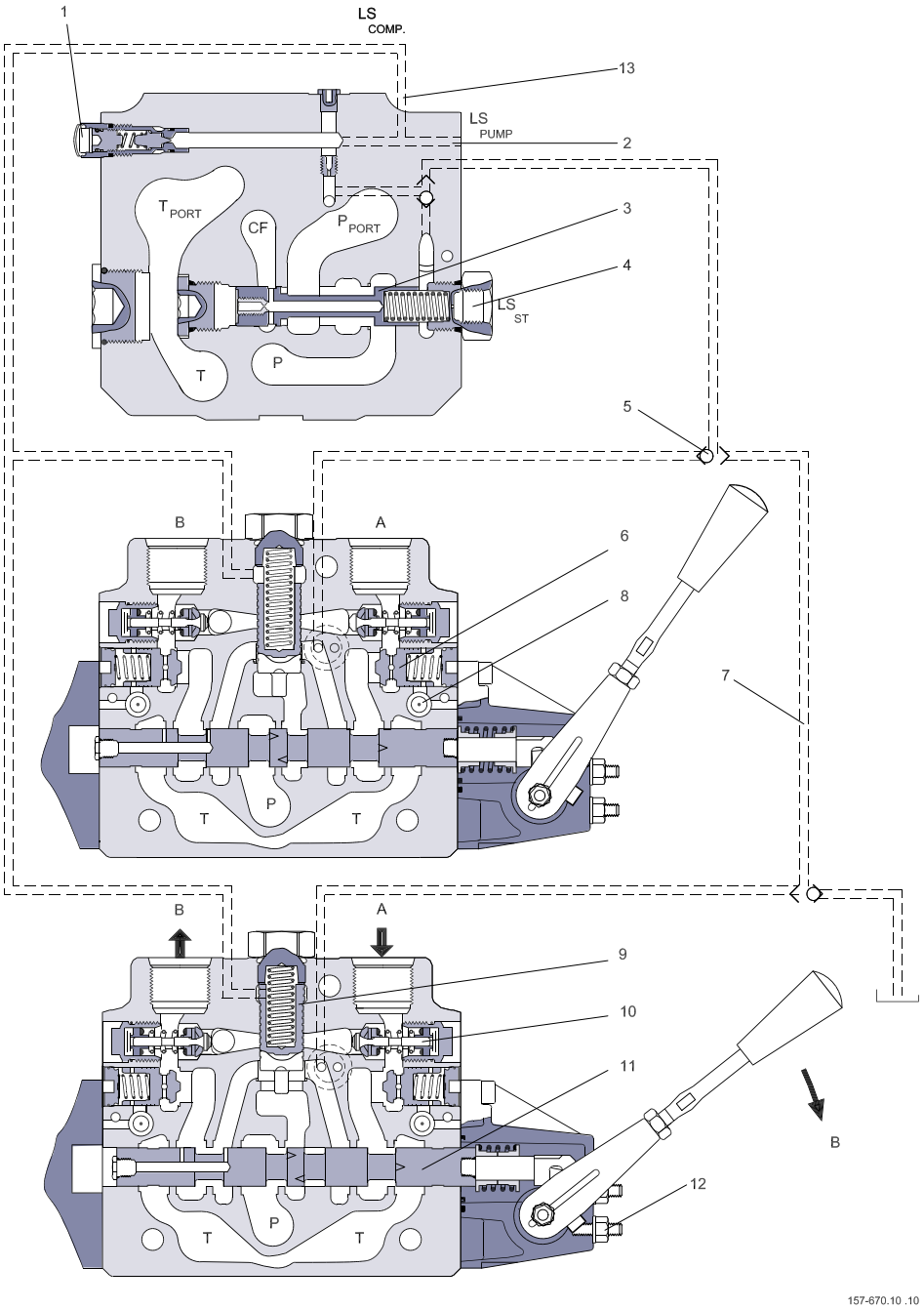
When a main spool is actuated, the pump regulator will adjust the displacement so that the set differential pressure between P and LS is maintained. The load sense relief valve in PVP should be set at a pressure of approximately 30 bar [435 psi] below the maximum system pressure (set on the pump or external pressure relief valve).

With post-compensated valves, the rating of the A and B work-port flow will depend on the pressure drop across the main spool PVBS. In open center systems, this pressure drop (standby-pressure) is generated by the volume of pump flow led to tank across the pressure adjusting spool in the inlet PVPF. Since the pressure drop varies with pump flow volume led to tank, also the A and B work-port flow will vary.

In closed center systems, the pressure drop across the main spool equals the standby setting of the pump, measured at the P port of the valve. The A and B work port flow will remain unchanged as long as the standby is unchanged.

Operation

PVG 100 Sectional Drawing



1. LS relief valve
2. LS connection
3. Priority spool for CF
4. LS connection for steering unit
5. Shuttle valve
6. Pilot operated check valve, POC
7. LS line
8. Logic cartridge for POC
9. Pressure compensator
10. Shock and suction valve, PVLP
11. Main spool, PVBS
12. Max. oil flow adjustment screws for ports A and B
13. LS comp (LS signal sent back to compensators)

Operation

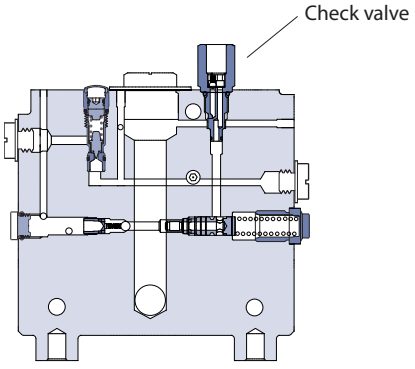
PVPC Plug for External Pilot Oil Supply

PVPC with Check Valve for Open Center PVP

PVPC, with check valve, is used in systems where it is necessary to operate the PVG 100 valve by means of the electrical remote control without pump flow. When the external solenoid valve is opened, oil from the pressure side of the cylinder is fed via the PVPC through the pressure reducing valve to act as the pilot supply for the electrical actuators.

This means that a load can be lowered by means of the remote control lever without starting the pump. The built-in check valve prevents the oil from flowing via the pressure adjustment spool to tank.

With the pump functioning normally, the external solenoid valve is closed to ensure that the load is not lowered due to the pilot supply oil flow requirement of approximately
1 l/min [0.25 US gal/min].



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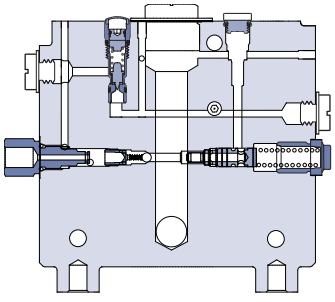
PVPC without Check Valve for Open Center PVP

PVPC, without check valve, is used in systems where it is necessary to supply the PVG 100 valve with oil from a manually operated emergency pump without directing oil flow to the pilot oil supply (oil consumption about 1 l/min) [0.25 US gal/min].

When the main pump is working normally, the oil is directed through the PVPC plug through the pressure reduction valve to the electrical actuators.

When the main pump flow fails, the external shuttle valve ensures that the oil flow from the manually operated emergency pump is used to pilot open the over center valve and lower the load. The load can only be lowered using the mechanical operating lever of the PVG 100 valve.



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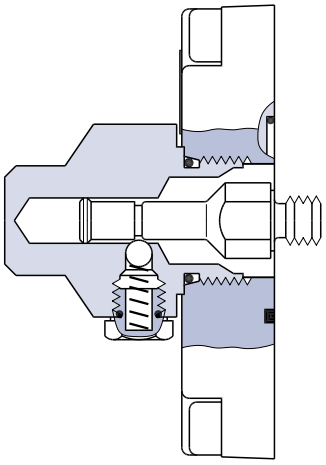
For specifications on PVG 100 valves, refer to PVG 100 Technical Information Manual **520L0344**.

Operation

Friction detent

PVMR Friction Detent

The friction detent PVMR allows the directional spool to be held in any position, resulting in infinitely variable, pressure compensated flow. The spool position will be held indefinitely without the necessity of holding the mechanical lever.



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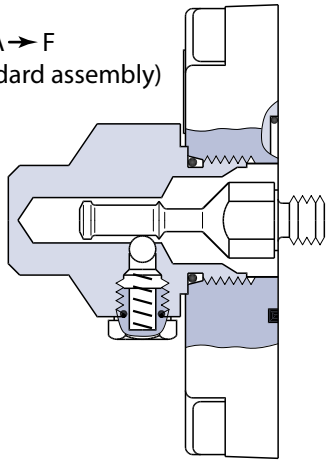
PVMF Mechanical Float Position Lock

This allows the float spool to be held in the float position after release of the mechanical handle.

PVMF
P ➔ A ➔ F
(Standard assembly)



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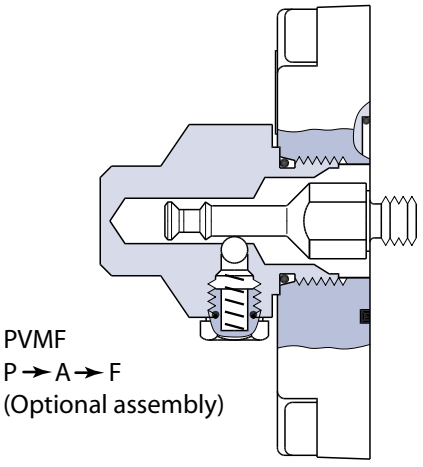
Operation



PVBS, Main Spools for Flow Control (standard)

When using standard flow control spools, the pump pressure is determined by the highest load pressure. This is done either via the pressure adjustment spool in open center PVP (fixed displacement pumps) or via the pump regulator (variable displacement pumps).

In this way the pump pressure will always correspond to the load pressure plus the stand-by pressure of the pressure adjustment spool or the pump regulator.

This will normally give optimum and stable adjustment of the oil flow.

PVBS, Main Spools for Flow Control (with linear characteristics)

PVBS main spools with linear characteristic have a completely proportional ratio between control signal and oil flow in the range beyond the dead band.

PVPP Electrical Pilot Shut-Off Valve

The PVPP is an electrical pilot shut off valve. When de-energized, the valve connects the pilot supply to the TØ gallery. In the event of a loss of electrical power, the valve is spring-biased with a connection to TØ.

The coil on the valve must be energized for pilot oil to be available in the valve stack.

This safety feature vents all hydraulic controls dependant on the PVG 100 pilot supply to the TØ gallery, thus reducing the possibility of accidental activation of a hydraulic work function.

Operation

PVPE Electrical Full Flow Unloading Valve

Max. operation pressure		350 bar [5085 psi]	
Max. pressure drop a an flow of 0.20 l/min. [0.053 US gal/min]		1.2 bar [17 psi]	
Oil temperature (inlet temperature)	Recommended temperature	30 to 60°C [86 to 140°F]	
	Min. temperature	–30°C [–22°F]	
	Max. temperature	+90°C [+194°F]	
Max. coil surface temperature		155°C [311°F]	
Ambient temperature		–30 to +60°C [–22 to +140°F]	
Oil viscosity	Operating range	12 to 75 mm^2/s [65 to 347 SUS]	
	Min. viscosity	4 mm^2/s [39 SUS]	
	Max. viscosity	460 mm^2/s [2128 SUS]	
Response time for pressure relief to tank		600 ms	
Enclosure to. IEC 529		IP 65	
Rated voltage		12 V	24 V
Max.permissible deviation from rated supply voltage		± 10 %	± 10 %
Current consumption at rated voltage	at 22°C [72°F] coil temperature	1.55 A	0.78 A
	at 85°C [230°F] coil temperature	1.00 A	0.50 A
Power consumption	at 22°C [72°F] coil temperature	19 W	19 W
	at 85°C [230°F] coil temperature	12 W	12 W

System Troubleshooting

Overview

This section provides general steps to follow if undesirable system conditions are observed. Follow the steps listed until the problem is solved. Some of the items will be system specific. Always observe the safety precautions listed in the *Introduction* section and related to your specific equipment.

Confirm that valve is built properly according to the specification sheet.

If necessary, install a lever to the valve to verify proper mechanical function.

Refer to PVG 100 Technical Information Manual **520L0720** for valve configuration information.

Refer to PVG 100 Parts Manual **520L0888** for part numbers.

Warning

This troubleshooting guide for the PVG valve assemblies does not cover valves that have been altered from original valve build specifications

Troubleshooting a PVG Valve

THINK - before troubleshooting a problem.

Every fault location process should follow a logical and systematic order.

It is wisest to start at the beginning:

- Is the oil level correct when the pump is operating?
- Is the condition of oil and filters acceptable?
- Are pressure, flow, and flow direction as specified?
- Is the oil temperature too high or too low (oil viscosity)?
- Are there any unusual vibrations or noise (cavitation)?

If the driver of the vehicle is available, ask him:

- What type of fault it is and how it affects the system?
- How long he has felt that something has been wrong?
- If he has “fiddled” with the components?
- If he has any hydraulic and electrical diagrams available?

Diagrams are often found in the instructions included with vehicles/machines.

Unfortunately they are often so technical that they are not of much use in a fault location situation. However; the diagram usually shows the order of, and the connections between, the individual components.

When a defective component is identified, clean the component and its surroundings before removal.

Remove loose paint from pipes and fittings.

Cover all holes, hoses and pipe ends with plugs or seal with, for example, plastic bags after removal to avoid the entry of dirt during repairs.

Never disassemble hydraulic components outside.

Perform repairs in a workshop on a clean workbench (covered with clean cloth or newspaper).

Make sure that a Danfoss service manual for with the product is handy.

Follow the instructions word for word during disassembly and assembly.

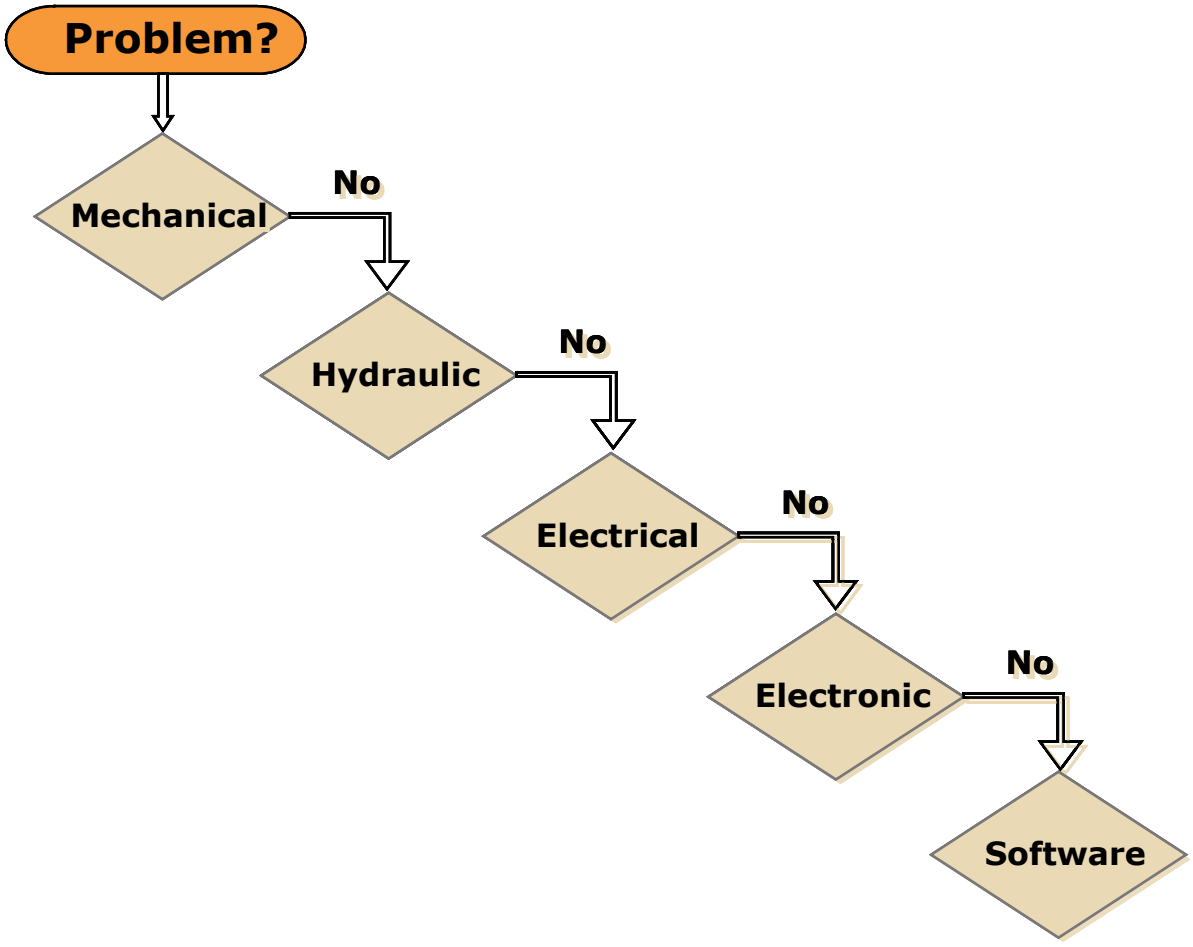
If these instructions are not followed closely the system may not operate correctly after repairs are completed.

Note that in some cases special tools are necessary for assembling the product.

System Troubleshooting

Our service manuals give full guidance on use of special tools.

Troubleshooting flow chart



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System Troubleshooting

No Cylinder/Motor Response in Either Direction when Remote Controller is Actuated

Cause	Check	Corrective action
Verify if fault is mechanical, electrical or hydraulic	Operate manual lever to confirm mechanical or electrical or hydraulic	If moving the manual lever operates the cylinder/ motor check electrical or hydraulic
Sticking main spool	Remove manual, electrical, and hydraulic actuators from the valve section. Remove main spool from valve section and inspected for damage. If no damage reinstall the main valve spool and it should move freely in the valve section bore.	Replace the valve module and main spool. If any damage is found on the main spool
	Check movement of manual lever when electrical controller is operated	If manual lever does not move check electrical voltage signal from controller, wiring at the PVE module
	Check movement of manual lever when hydraulic controller is operated	If manual lever does not move check hydraulic controller pressure at the PVG valve module - 25 Bar [360 PSI]
	If none of the above check pump per manufacturers recommended procedure	Repair or replace pump per manufacturers recommended procedure
Internal filters blocked	Check for blockage in internal filters	Remove blockage

Cylinder/Motor Responds in One Direction Only

Cause	Check	Corrective action
Verify if fault is mechanical, electrical or hydraulic	Operate manual lever in both directions to confirm if mechanical or electrical or hydraulic	If moving the manual lever operates the cylinder/ motor in both directions check electrical or hydraulic
	If operating the manual lever strokes the cylinder/ motor in one direction only, check manual stop screw adjustment	Back out manual stop on manual controller and torque the jam not to 8 Nm [70 lbf•in] Do not exceed maximum torque
	Check movement of manual lever when electrical controller is operated	If manual lever does not move in one direction check electrical signal from controller and wiring at the PVE module
	Check movement of manual lever when hydraulic controller is operated	If manual lever does not move in both directions check hydraulic pressure at the PVG module
Air in system	Entrained air generates heat under pressure	Look for foam or bubbles in reservoir. Check for leaks on inlet side of charge pump.
Internal leakage	Excessive internal leakage may overheat the system.	Install loop flushing defeat option and monitor case flow. If case flow is excessive, motor may require major repair. Contact Danfoss Service.
Shock valves	Swap and see if problem follows	Replace valves
Solenoid actuation	If power is OK from controller	Repair wiring to PVE module
Main spool travel restricted	Stop on manual controller turned in too far	Back out manual stop on manual controller
Remote electrical controller	Insufficient signal from electrical controller	Repair or replace electrical controller
PVEO connections	Incorrect PVE/PVEO connections	Connect correct way
Remote hydraulic controller PVRH	Insufficient pilot oil pressure from remote hydraulic controller Pressure needs to be 25 Bar [360 psi]	Repair or replace remote hydraulic controller

System Troubleshooting

Main Valve Spool Moves without Oil Passing to Cylinder/Motor

Cause	Check	Corrective action
Insufficient oil supply to valve	Check the pump per manufacturers procedure	Repair or replace pump per manufacturers procedure
Optional pressure compensator in valve section not functioning	Check compensator spool	Replace spool
Insufficient load pressure at compensator spring chamber	LS drilling holes plugged	Clean or replace
Cylinder/motor load too high for pressure setting of the system	Check pressure at the valve	If pressure is set to spec. per valve lower load on cylinder/motor
Blocked LS galleries	Inspect for blockage in LS galleries	Remove blockage in LS galleries
Shuttle valve faulty	Inspect shuttle valve	Repair or replace
Blocked LS lines to pump controller	Inspect LS lines from PCG to pump controller	Remove blockage in LS lines from the PVG valve to pump controller
Oil bypassing at shock valve/anticavitation check valve	Check if stuck open or damaged	Replace valve
Internal leakage in cylinder/motor	Inspect for by-passing of oil per cylinder/motor manufacture per manufactures procedure	Repair or replace cylinder/motor per manufactures procedure
Too much leakage in LS spool in pump control	Check bleed orifice in LS control	Use a LS pump control with no bleed orifice
Load too high for system	Check for proper system pressure	Adjust pressure to valve specification
Internal leakage in cylinder/motor	Inspect for bypassing of oil per cylinder/motor manufacturer specification	Repair or replace cylinder/motor
Shock valve or anti-cavitation check valve faulty	Inspect for damage and contamination	Repair or replace cylinder/motor
System relief valve pressure set too low for load	Install pressure gauge and check pressure	Adjust pressure to system specification Lower load
Cylinder/motor load too high for pressure settings of system	Check load pressure at PVB-LS port	Reduce load pressure if exceeds maximum pressure limit of the system
	Maximum system pressure should be approx. 25 Bar [365 PSI] above highest load pressure	Adjust maximum system pressure if necessary
	Check pump pressure compensator setting	Adjust pump pressure compensator setting if necessary

Cylinder/Motor Operates without Remote Controller being Operated

Cause	Check	Corrective action
Spool control tension rod loose	Confirm torque on spool control tension rod	Torque to 8 Nm [70 lbf•in]
Electrical feedback transducer not in neutral position	Check the feedback pin in the PVE. It should be loose	Replace module
Remote electrical controller neutral position switch faulty	Disconnect the connection at the PVE. It should come back to neutral	Repair or replace faulty switch or wiring at remote controller
Sticking pressure control valve in remote hydraulic controller	Disconnect the hydraulic signal line from valve	Repair or replace faulty remote hydraulic controller
Sticking main spool in valve section	Remove manual, electrical, and hydraulic actuators from the valve section. Remove main spool from valve section and inspected for damage. If no damage reinstall the main valve spool. Spool should move freely in the valve section bore.	Replace the valve module and main spool if any damage is found on the main spool
Internal fault in the PVE/PVEH/PVEO	PVEO check continuity. All other PVE, check LED (Red means internal error)	Replace faulty PVE/PVEH/PVEO

System Troubleshooting

Cause	Check	Corrective action
Contamination in the hydraulic oil	Take oil samples to confirm	Flush hydraulic system. Fill with clean filtered oil.

Cylinder/Motor Responds Slowly to Remote Electrical or Hydraulic Controller

Cause	Check	Corrective action
Insufficient system pressure	Install pressure gauge and record pressure	If pressure is low adjust pressure setting to valve specification or pump manufacturers specification
Main spool travel limited	Check stops on manual lever controller end for proper adjustment. Refer to *Component troubleshooting*.	Adjust the manual lever stops and torque the jam nuts to 8 Nm [70 lbf•in] Do not exceed maximum torque
Incorrect signal voltage from electrical controller	Check the signal voltage from the controller with a volt meter	If signal voltage is incorrect repair or replace electrical controller
Incorrect hydraulic pressure signal from remote hydraulic controller	Check pressure from the remote hydraulic controller - 25 Bar [360 PSI]	If pressure is too low, repair or replace remote hydraulic controller per manufacturers instructions.
Insufficient pilot oil - all sections	Check pilot for contamination and correctly assembled parts - 10-15 bar [145-218 psi] Electric - 25 bar [360 psi] Hydraulic	Replace inlet module Check with your Danfoss representative
Insufficient LS pump stand by pressure	Check pilot PSI - 10-15 bar [145-218 psi] Electric - 25 bar [360 psi] Hydraulic	Adjust or replace pump
Flow is not load independent	PVLP check for cracks Check LS pressure vs load pressure	Replace valve

Erratic Cylinder/Motor Response to Electrical or Hydraulic Controller Operation

Cause	Check	Corrective action
Electrical actuator faulty	Check signal from controller to PVE	Repair or replace PVE
Main spool centering spring damaged	Check tension rod for correct torque or damage	Torque to 8 Nm [70 lbf•in] or replace
Main spool position feedback transducer signal incorrect	Check feedback pin for damage	Replace PVE
Contamination in hydraulic oil	Take oil sample	Flush complete system. Fill reservoir with clean filtered fluid per OEM specification
Air in hydraulic pilot lines	Check for air trapped in signal lines from the controller to the valve section module	Bleed air from the hose connection at the valve section
Hydraulic remote actuator faulty	Check signal pressure from the remote hydraulic controller	Repair or replace cylinder/motor
Low hydraulic oil supply	Check fluid level in reservoir	Fill reservoir with clean filtered fluid per OEM specification

Hydraulic Oil Supply

Cause	Check	Corrective action
Pump not running	Check prime mover for operation	Repair or replace prime mover
	Check condition of drive coupling	Repair or replace drive coupling
Insufficient oil in reservoir	Check fluid level in reservoir	Fill with clean filtered oil

System Troubleshooting

Cause	Check	Corrective action
Leaking or burst supply hose	Inspect lines to valve stack	Repair or replace damaged hose
Relief valve malfunction	Check for contamination and operation of relief valve	Repair or replace relief valve
Isolating valves are closed	Check that all isolating valves are open and clear	
Faulty pump control	Check pump compensator for correct operation and setting per pump manufacturers	Repair or replace pump compensator per pump manufacturers recommendations
Low standby pressure in PVP - open center pump	Check idle standby pressure - 10 Bar [145 PSI]	Replace
	Check condition of compensator spool spring	Replace module due to worn components
Low standby pressure in pump control - variable pump	Check pump LS control for operation and setting Stand by pressure should be 15 bar [220 psi] minimum	Repair or replace LS control per pump manufacturers procedures
PVP pressure relief valve faulty	Check pressure relief valve spool and spring for freedom of operation	Replace
PVP orifices blocked	Check PVP orifices for blockage	Remove blockage
Internal filters blocked	Check for blockage in internal filters	Remove blockage
Supply lines blocked	Inspect supply lines for blockages	Remove blockage
Internal hydraulic pilot pressure insufficient	Inspect pilot oil pressure reducing valve for proper operation	Repair or replace
Blocked LS galleries	Check LS galleries for blockage	Clean blockage from LS galleries
Shuttle valves faulty	Check LS system shuttle valves for wear and damage	Replace as needed

Check for contamination per specification **HPP 030**. Refer to Design Guideline for Hydraulic Fluid Cleanliness, Technical Information Manual **520L0467**. If fluid is out of specification, flush hydraulic system and fill with clean filtered oil.

Electrical Supply

Cause	Check	Corrective action
No electrical power	Check electrical circuit	Repair as needed
	Verify emergency stop switch is in the proper operating position	Reset
Neutral position switch faulty	Check operation of neutral position switch in remote controller (if connected in circuit) PVRE/ PVRES/PVREL	Replace switch
Incorrect signal voltage	Check voltage levels at solenoid plug	
	Proportional operation	
	Udc: Supply voltage (100%)	
	Us: Supply signal voltage (25-50-75%)	
	Ground: Live or ground connection	
	On-Off Operation	
	Udc: Supply voltage if selected	
	Us: Supply voltage if selected	
	Ground: Live or ground connection	
Solenoid valve faulty PVHC	Check coil resistance	Check data for resistance
Insufficient pilot supply	Check pilot pressure - 10-15 bar [145-218 psi]/ PVHC 25 bar [360 psi]	Replace

System Troubleshooting

Cause	Check	Corrective action
Main spool position feedback transducer signal incorrect	Test oil for contamination and or water content	If oil contamination is too high, flush hydraulic system or replace oil if necessary. If problem persists change PVE
Incorrect PVE connections	Check that the proportional remote electrical controller has not been connected to an ON-OFF PVEO solenoid	Connect wires correctly

Hydraulic (remote) Pilot Control Pressure

Cause	Check	Corrective action
Insufficient pilot pressure	Check pilot oil pressure 5-15 bar [72-220 psi] delta between A and B port on remote	
	PVG100: 5-15 Bar [72-217 PSI]	
Insufficient pilot oil supply	Check pilot oil flow rate is adequate	
	Pilot flow should be 1.0 L/min [0.264 GPM] per section	
	Check pilot lines for blockage	Remove blockage
Air in pilot line	Check for trapped air in pilot lines	Bleed air from pilot lines at PVH
Pilot lines incorrectly sized	Check pressure drop	Check and reduce length or pilot lines
		Increase diameter of pilot lines
		Use steel tube for long pilot line runs
Hydraulic remote pilot operator faulty	Check operation of hydraulic remote pilot controller	Repair or replace
	Check supply pressure to hydraulic remote controller - minimum 25 bar [360 psi]	Repair or replace
	Check and inspect movement of pressure control valve in hydraulic controller	Repair per manufacturers procedure, or replace
	Check operation of remote hydraulic controller	Clean and/or repair as necessary

PVG 100 Component Troubleshooting

Open Center Pressure Relief Valve

Description: Adjustable relief valve. Adjustment range 50 Bar [700 PSI] to 350 Bar [5000 PSI].

Location: The relief is in all PVP Inlet modules

Function: Pilots the unloading valve to open when the load exceeda a set pressure.

Failure mode	Cause	Corrective action
Will not build pressure	Contamination	While under pressure, back out to minimum pressure and allow oil to leak by for approx. 5 seconds and then readjust to correct pressure - Replace valve
External leaking	Damaged seat and poppet	Replace complete assembly
Pressure setting is wrong	Pressure adjustment backs off (on open center application)	Adjust to model code specification

Serviceability: Non serviceable.

Valve removal tool P/N: **155L6485**. Torque to 20 Nm [180 lbf•in].

Closed Center Pressure Relief Valve

Description: Adjustable relief valve. Adjustment range 50 Bar [700 PSI] to 350 Bar [5000 PSI].

Location: The relief is in all PVP Inlet modules

Function: Provides maximum pressure setting below pump pressure setting 30 Bar [450 PSI] Delta for closed center.

Failure mode	Cause	Corrective action
Will not build pressure	Contamination	While under pressure, back out to minimum pressure and allow oil to leak by for approx. 5 seconds and then readjust to correct pressure - Replace valve
External leaking	Damaged seat and poppet	Replace complete assembly
Pressure setting is wrong	Pressure adjustment backs off (on open center application)	Adjust to model code specification
Instability when PC and inlet relief has too low of a delta between them	PC at pump should be set 30 bar above relief valve	Adjust to model code specification

Serviceability: Non serviceable.

Valve removal tool P/N: **155L6485**. Torque to 20 Nm [180 lbf•in].

Pressure Reducing Pilot Valve

Description: Pressure reducing valve at fixed pressure.

Location: The pressure reducing valve is in all PVP Inlet modules.

Function: Provides 10-15 bar [145-218 psi] internal pressure for electrical (PVE) actuators or provide 25 Bar (360 PSI) (PVHC) and supply for external remote hydraulic actuators (HRC). These pressures are only present when the load pressures are high enough to satisfy the required regulated pressure. The open center system at low pump flow may only develop 9 Bar (130 PSI)

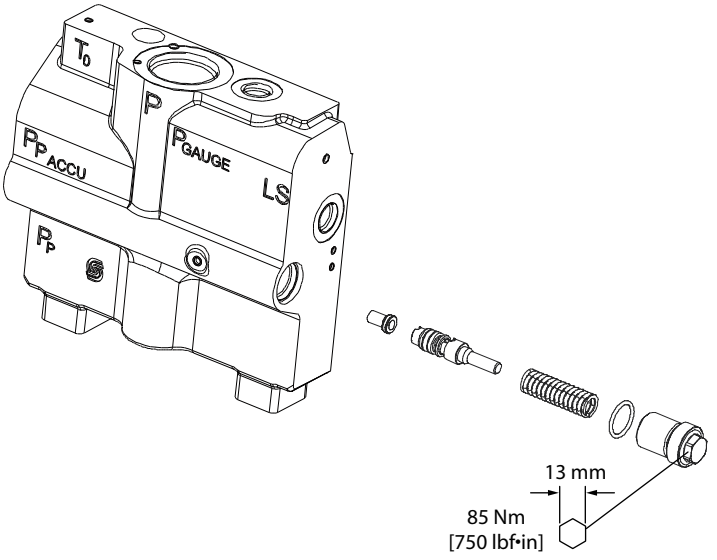
PVG 100 Component Troubleshooting

Failure mode	Cause	Corrective action
Main spools are slow, driven by PVE 13 Bar [190 PSI] pilot system	Contamination	Disassemble and clean
	Pump pressure too low - below 9 Bar [130 PSI]	Closed center: System increase stand-by to 13 Bar [190 PSI] Open center: Check gear per pump manufacture procedure Check system for other components before valve inlet that may provide a path to tank
	High **T0** pressure. Do not exceed 5 Bar [73 PSI] tank pressure	Clear restrictions in return system.
	Oil viscosity 460 mm2/S [2128 SUS] too high (cold oil or incorrect viscosity oil)	Warm up system or replace oil with correct viscosity
Main spools will not move mechanically or electrical	**T0** not being connected to tank or is restricted to tank	Connect **T0** (PVP) port option to tank or remove restriction
	Internal pressure reducing valve parts misassembled	Reassemble the internal pressure reducing valve parts correctly
PVHC 25 bar [360 psi] pilot system - main spools are slow	Contamination	Disassemble and clean
	Pump pressure too low - below 20 Bar [290 PSI]	Closed center: System increase stand-by to 20 Bar [290 PSI] Open center: Check gear per pump manufacturers procedure Check system for other components before valve inlet that may provide a path tank
	High tank port pressure. Tank pressure should not exceed 5 Bar [73 PSI]	Check for restrictions in return system and remove
	Oil viscosity - 460 mm2/S [2128 SUS] too high (cold oil or incorrect viscosity oil)	Warm up system or replace oil with correct viscosity

Serviceability: All internal components can be removed from the cavity, cleaned, inspected and reassembled back into the valve

1. Use a 13 mm hex wrench to remove the plug, and then remove the spring. Spool and cone are not removeable.
2. Clean all components with clean solvent
3. Correctly reassemble the components back into the cavity and torque the plug to 85 Nm [750 lbf•in].Pressure reducing pilot valve

PVG 100 Component Troubleshooting



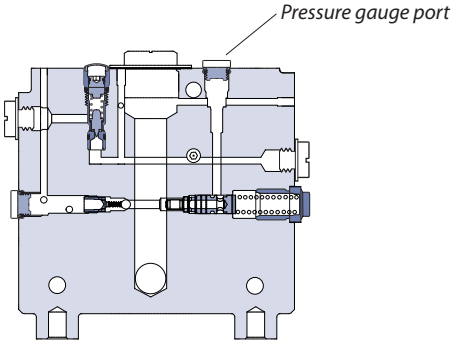
Pressure Gauge Connection

Description: Port to install a pressure gauge to check pressure relief valve setting to valve specification.

Location: On inlet cover to valve stack.

1. Use a 6 mm internal hex to remove and install plug.
2. Torque plug to 35 Nm [308 lbf•in].

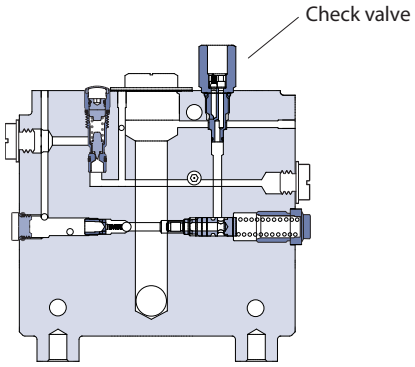
Failure mode	Cause	Corrective action
Leaking	Bad seal	Replace with new seal (same type as original seal)



Pressure gauge port

When valve is equipped with the PVPC option use a running tee to measure pressure. Torque tee to hose adaptor torque specification.

PVG 100 Component Troubleshooting



PVPC with check valve P107 958E

Pressure Matching Spool

Description: Main pump flow unloading spool.

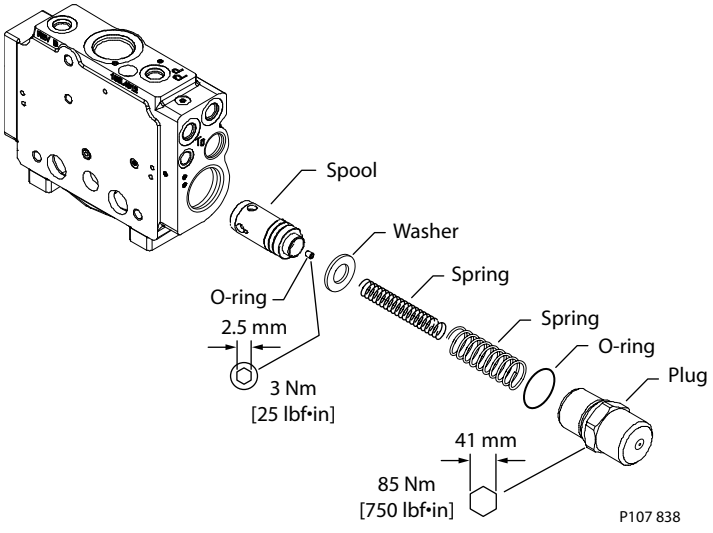
Location: PVP (inlet) module.

Function: Unloading spool.Serviceability: All internal components can be removed from the cavity, cleaned, inspected and reassembled back into the valve Pressure adjustment spool

Failure mode	Cause	Corrective action
In open center systems the valve sections are unstable	High wear allows leakage to tank	Replace compete module
The adjusted pressure will not remain static in a closed center system	Low viscosity oil allowing high leakage around spool to tank.	Remove and clean orifice. Reinstall
	High wear	Replace compete module

Serviceability: All internal components can be removed from the cavity, cleaned, inspected and reassembled back into the valve

Pressure adjustment spool



LS Connection

Description: Port for LS signal for LS (static) option only controller for variable flow pump.

PVG 100 Component Troubleshooting

Location: PVP (inlet) module.

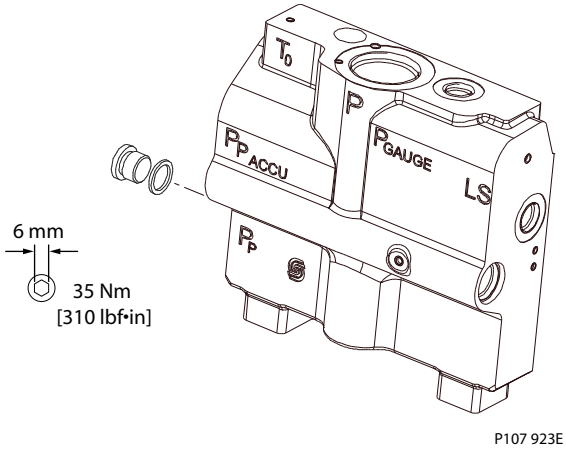
Function: Provide a signal to the variable pump controller to create a pressure differential to have the pump come on stroke for a closed center system.

Failure mode	Cause	Corrective action
In closed center systems the valve sections are unstable	Insufficient LS flow to satisfy pump controller	Ensure that the LS controller on the pump does not have excessive internal leakage - 0.4 l/min [0.106 gal/min]. Repair or replace the variable pump controller per pump manufactures specifications If there is more than one valve in the system ensure that the LS shuttles are all working properly
	Excessive air entrained in the hydraulic oil	Ensure that the oil has enough dwell time in tank, has good anti-foaming agent, and pump inlet vacuum is within manufacturers specifications
	Air trapped in LS line	Bleed air for LS line at highest point
Valve operation is slow to respond or does not respond	Insufficient LS flow to satisfy pump controller	If more than one section, ensure that the LS controller on the pump does not have excessive internal leakage. Repair or replace the variable pump controller per pump manufactures specifications
	Excessive air entrained in the hydraulic oil	Ensure that the oil has enough dwell time in tank, has good anti-foaming agent, and pump inlet vacuum is within specifications
	Air trapped in LS line	Bleed air for LS line at highest point

PVG valve is mounted above hydraulic oil reservoir when shut down and sits idle for some time, the valve could be voided of oil and this would cause the valve to operate erratically and be slow to respond.

Serviceability: Port is serviceable. Connect hose to LS port on pump.

LS connection plug



P107 923E

LS Signal

Description: The PVG100 uses an internal LS signal network for both Open Center and Closed Center systems. In Open Center systems the internal LS signal network provides a resolved load sense signal to the pressure adjustment spool controlling the proper amount of flow and pressure to the operating valve sections. In Closed Center systems the internal LS signal network provides a resolved load sense signal directly to the LS pump control which in turn provides the proper amount of flow and pressure to the operating valve sections.

PVG 100 Component Troubleshooting

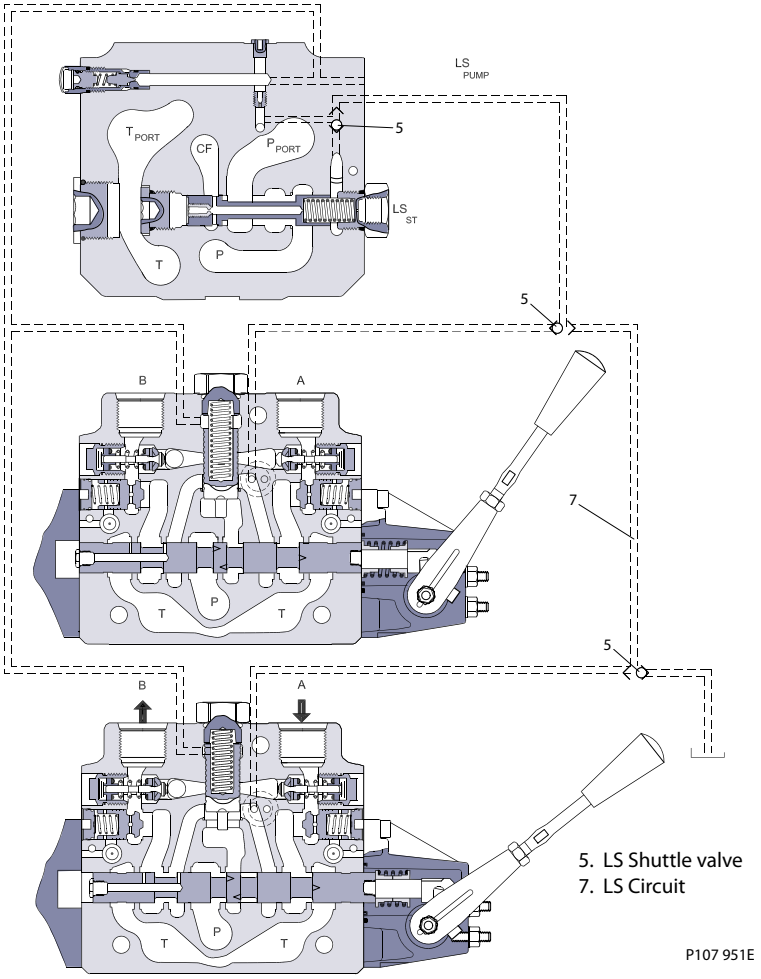
Location: PVP/PVB Modules.

Function: Directs the highest load pressure to either OC or CC pump control to satisfy the operating valve section.

Failure mode	Cause	Corrective action
No pump pressure developed in one or more valve sections	LS passages blocked or restricted	Disassemble valve. Inspect passages for blockage

Serviceability: Not serviceable. Ensure entire system is clean.

LS circuit



Shuttle Valve

Description: Self cleaning internal shuttle system.

Location: PVB (valve section) module.

Function: Determines which valve section is developing highest load pressure.

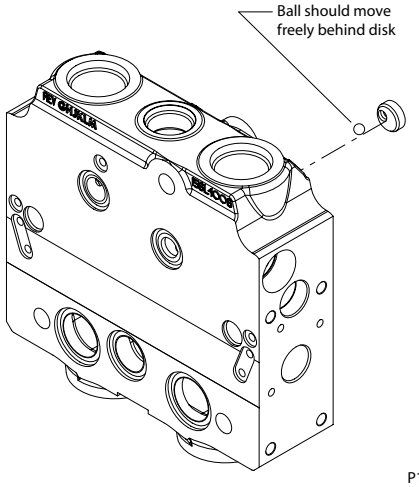
PVG 100 Component Troubleshooting

Failure mode	Cause	Corrective action
Valve sections will not build pressure Normally it will be one section, but not all sections	Worn shuttle disc	Replace complete module (seat is pressed into module)
	Excessive air entrained in the hydraulic oil	Ensure that the oil has enough dwell time in tank, has good anti-foaming agent, and pump inlet vacuum is within specifications
	Shuttle disk accidentally pushed in	Check disk spacing - replace module

Serviceability: Not serviceable. Ensure entire system is clean.

Shuttle valve

Exploded view shows internal parts.
Do not disassemble valve.



P107 841

Main Spool

Description: Main directional control.

Location: PVB (valve section) module.

Function: Controls oil flow from pump to work ports A or B.

Failure mode	Cause	Corrective action
Section will not build pressure in one spool direction	Load sense passages in spool are blocked	Flush out load sense passages in the spool. Spool will need to be removed to clean
Main valve spool stuck in valve body (if being used with electrical actuator)	Refer to *Pressure reducing valve*	Replace PVM and PVE. Be sure that pilot valve is assembled correctly.
Mechanical actuator main valve spool stuck in valve body	Hard particle binding spool in bore	Look down into the A and B work ports to see if the particle can be removed while the spool is in the valve body. Replace valve section. Valve body and spool will need to be replaced per valve specifications
Main spool stuck in valve body	Tie rod over torqued	Replace tie rod kit which includes section seals and torque to 28 Nm [248 lbf•in]
	Valve stack mounting surface is not flat causing a bind on the valve stack	Ensure the mounting surface is flat*
Section will not stroke off	Load sense drain holes are plugged	Flush out load sense passages in the spool. Spool will need to be removed to clean

PVG 100 Component Troubleshooting

Serviceability: Main spool is serviceable depending on failure mode.

1. Remove manual actuator (not shown) using a 5 mm internal hex wrench to remove the four mounting screws. Pull the spool out of the valve body.

   CAREFULLY place the main spool in to an appropriate fixture or vice with cardboard, rubber hose or heavy shop towels on the jaws and tighten just enough to keep the spool from turning in the vice.

   Warning

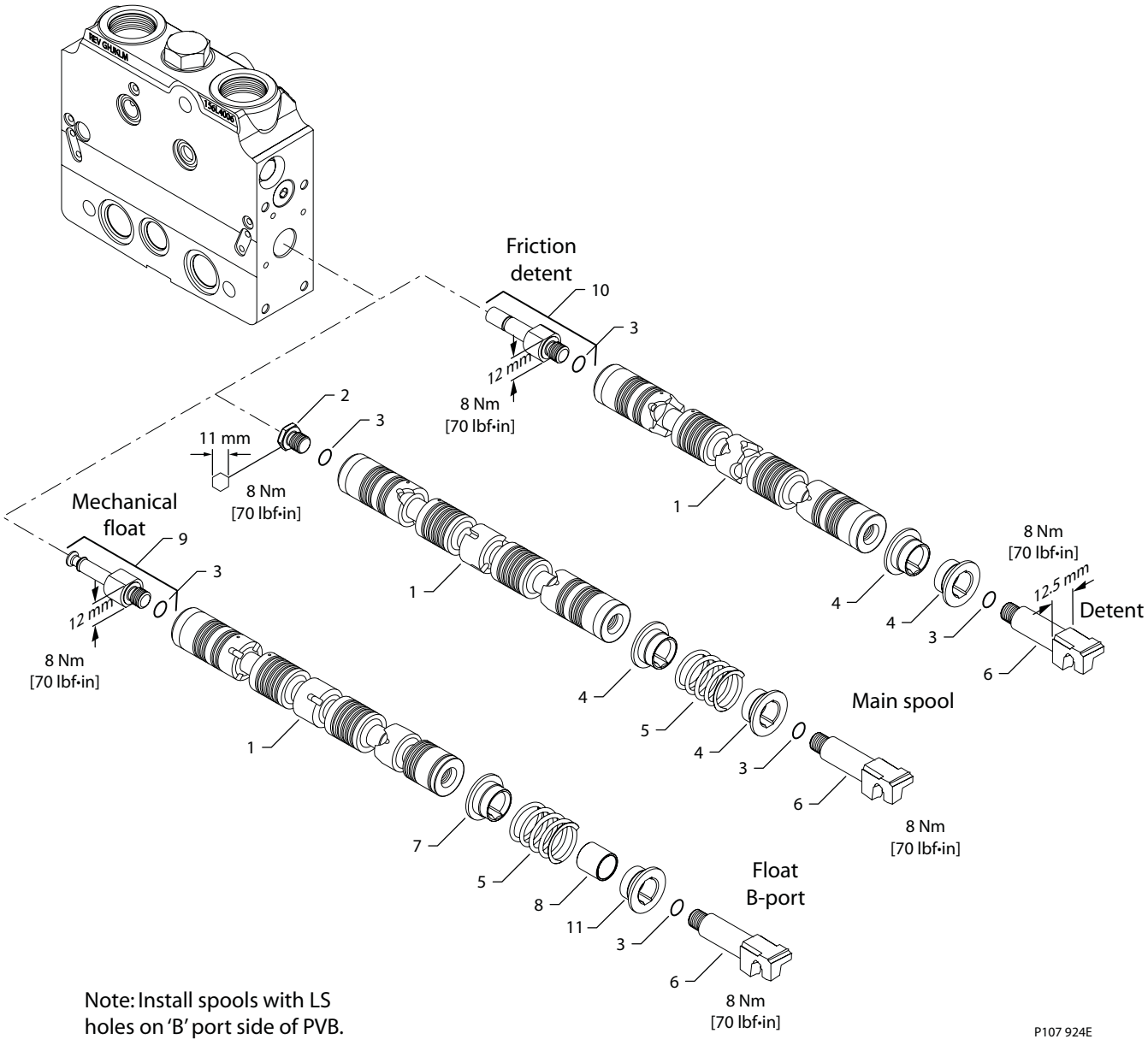
   DO NOT over tighten the main spool in the vice as it will be distorted and or scratched on sealing lands and the spool will need to be replaced.

2. Remove the tension rod end (6) using a 13 mm open end wrench.
3. Remove the plug at the other end (2, 9, 10) using an 11 mm, or if it has a detent option, use a 12 mm open end wrench.
4. Flush out openings into the main spool cavity at each end.
5. Install plug (6) with a 11 mm or 12 mm open end wrench. Torque to 8 Nm [70 lbf•in].
6. Install centering spring and tension rod (7, 5, 8, 11, 3, 6,) using a 13 mm open end wrench and torque to 8 Nm [70 lbf•in].
7. Lubricate and carefully insert main valve spool into valve housing. Do not force the main spool back into the housing as you will damage the sealing lands in the valve housing. The spool should move freely in the main spool bore when installed.
8. Install a manual actuator (not shown). Reassemble in reverse order and torque the four mounting screws to 8 Nm [70 lbf•in]

   If section does not build pressure in one direction, wrong spool may have been installed in valve.

PVG 100 Component Troubleshooting

Main spool



Shock and Anti-Cavitation Valve PVLP

Description: Optional work ports non adjustable pressure relief valve.

Location: PVB (valve section) Module.

Function: Removes any transient pressure spikes generated by the load.

The shock valves PVLP with fixed setting and the anti-cavitation valves PVLA on ports A and B are used for the protection of the individual work function against overload and/or cavitation.

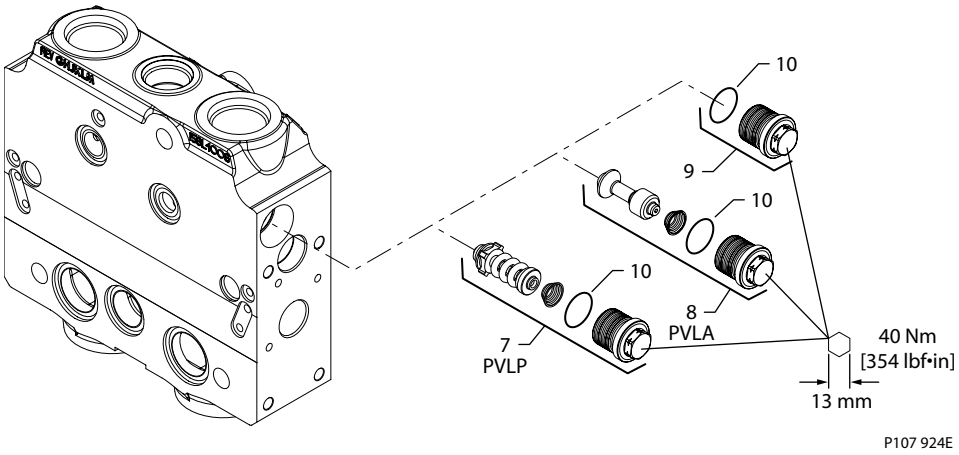
There is one shock valve for each work port.

PVG 100 Component Troubleshooting

Failure mode	Cause	Corrective action
Will not build pressure in A or B port	Valve may be damaged and not able to seal	Replace with correct part number per valve specification

Serviceability: This valve may be disassembled and cleaned, however, internal parts are not available separately. If you suspect valve malfunction, replace with a new valve and test system operation.

PVLP valve



Pressure Compensator

Description: Maintains a pump margin across the compensator.

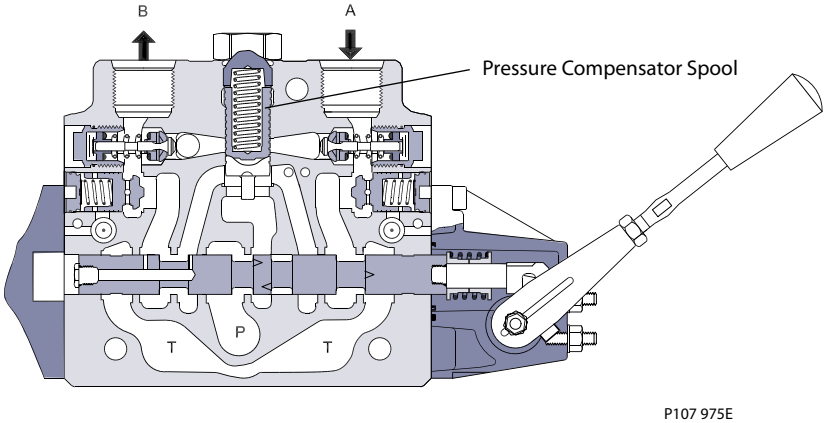
Location: PVB (Valve section) Module.

Function: In a pressure-compensated basic module the compensator maintains a constant pressure drop across the main spool – both when the load changes and when a module with a higher load pressure is actuated.

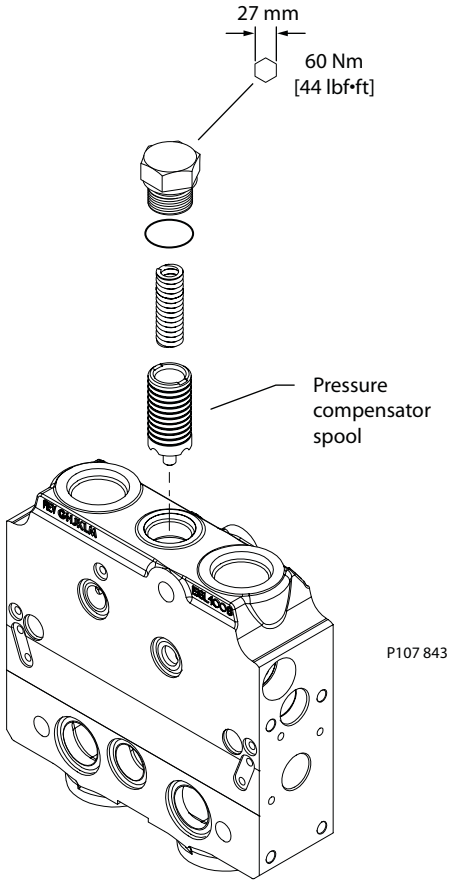
Failure mode	Cause	Corrective action
Valve section unstable flow	High wear allows leakage	Replace complete module

Serviceability: This valve may be disassembled and cleaned, however, internal parts are not available separately. If you suspect valve malfunction, replace with a new valve and test system operation.

Pressure compensator valve



PVG 100 Component Troubleshooting



Maximum Oil Flow Adjustment Screws for Ports A and B

Description: Optional mechanical flow limiter.

Location: PVM manual control handle.

Function: Determines the stroke of the main spool in the PVB.

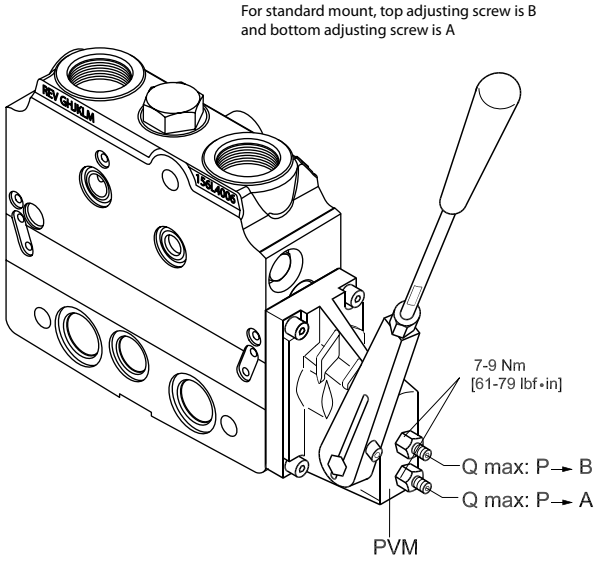
Failure mode	Cause	Corrective action
Cylinder/motor functions too slow or too fast	Mechanical stop screws out of adjustment per valve spec.	Use a 8mm open end wrench to loosen the jam nut and then 3mm internal hex wrench to adjust the mechanical adjusting screw CCW to increase speed. After adjusting hold the adjusting screw and torque the jam nut to 8 Nm [70 lbf•in] maximum
Leaking past adjusting screws	Check torque on seal nut 8 Nm [71 lbf•in]	Retorque or replace seal nuts

Caution

When adjusting main spool flow ensure that electrical or hydraulic actuators are not active at the time, if so equipped.

PVG 100 Component Troubleshooting

Adjusting screws for ports A and B



PVM Module

Description: Manual control lever.

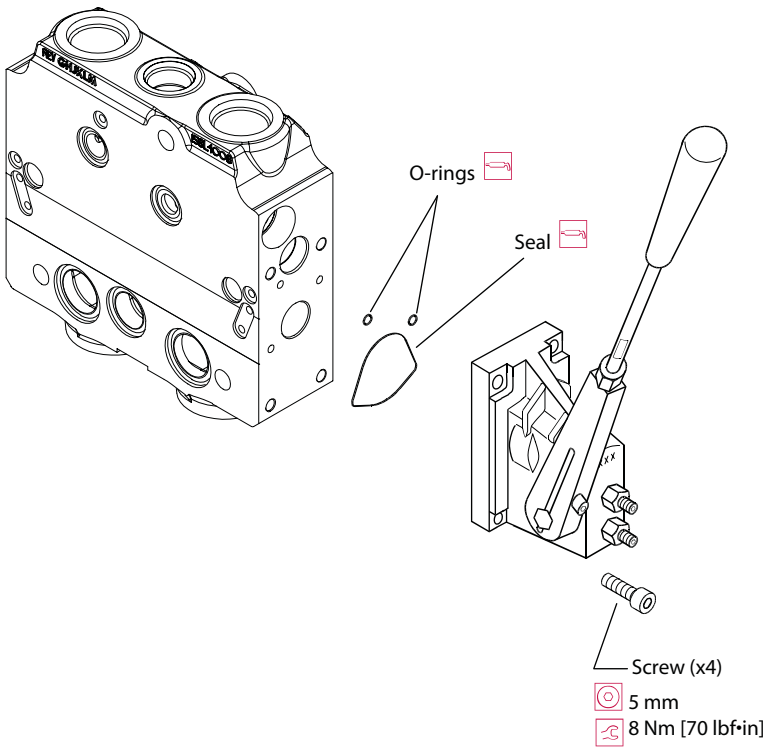
Location: Mounted on either end of the PVB main spool.

Function: Manual override capable of limiting the stroke of the main spool, and is used to center the spool in neutral.

Failure mode	Cause	Corrective action
Leaking externally between PVM and PVB	Back pressure is exceeding 40 Bar [580 PSI] on tank line	Replace PVM module, seals, and lower tank port pressure
	T0 port not connected to tank or restricted or blocked	Connect to tank, remove restriction, and remove blockage

PVG 100 Component Troubleshooting

PVM module



PVT/PVTI Module

Description: End cover.

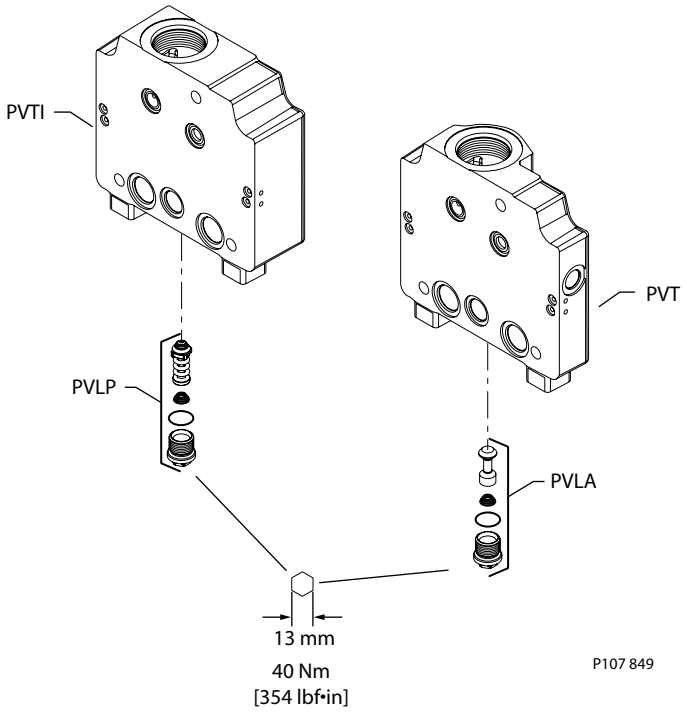
Location: Mounted on the last PVT of the valve stack.

Function: Serves as blanking cover and drain for LS circuit.

Failure mode	Cause	Corrective action
External leaking	Back pressure is exceeding 40 Bar [580 PSI] on tank line	Replace PVS module, seals, and lower tank line pressure
	Maximum pressure: Aluminum - 300 bar [4500 psi] Steel - 350 bar [5000 psi]	Reduce system pressure
Valve stack does not build pressure per valve specification	Optional PVLP (shock valve) not seating correctly in cavity caused by valve not being installed correctly, or it has failed	Install components correctly, or replace damaged components

PVG 100 Component Troubleshooting

PVLP, PVLA plugs



For specifications and operating parameters on PVG 100 valves, refer to PVG 100 Technical Information Manual **520L0720**.

PVAS Module

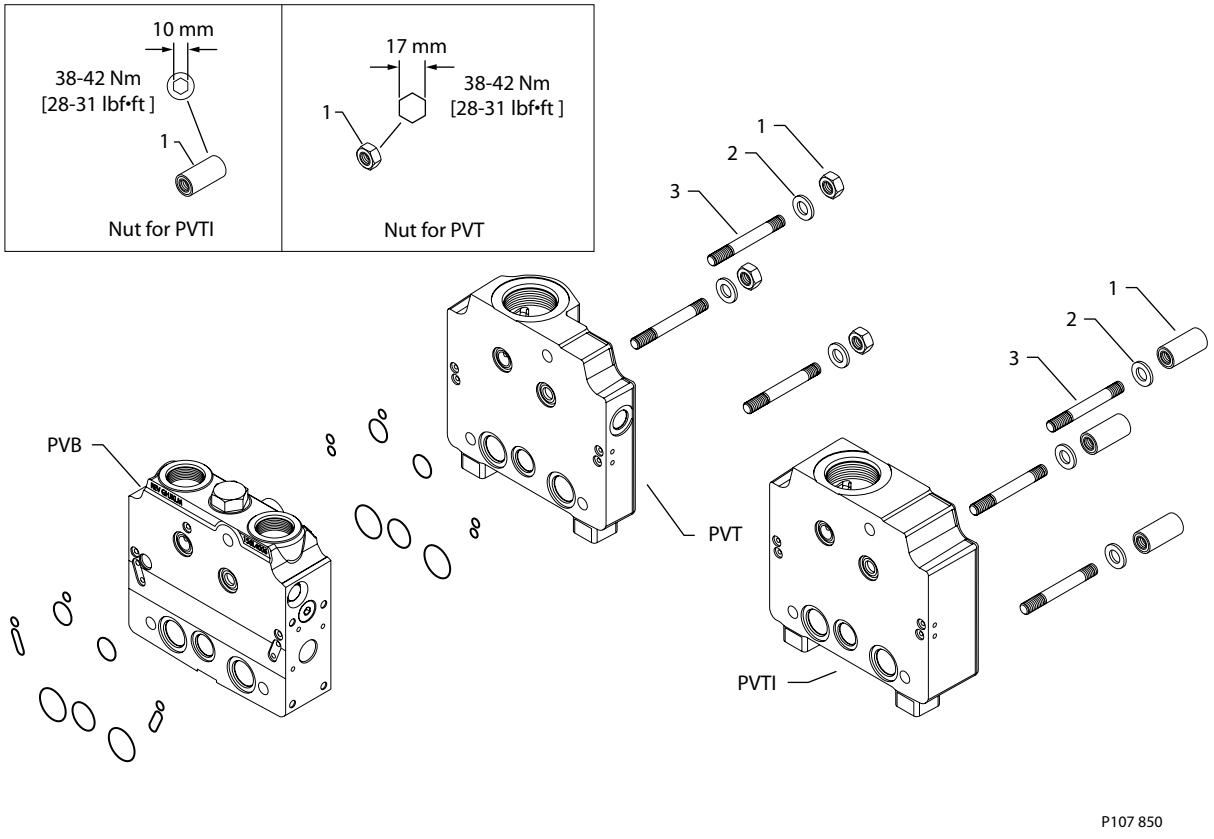
Description: Tie rod kit.

Location: Through the valve stack.

Function: Holds the stack together.

Failure mode	Cause	Corrective action
Leaking externally between sections	Tie rods under torqued	Check and retorque - 38-42 Nm [28-31 lbf•ft]
	Tie rods torque too tight	Replace and retorque - 38-42 Nm [28-31 lbf•ft]

PVG 100 Component Troubleshooting



PVPP Pilot Shut Off Valve

Description: Optional two way position solenoid normally closed

Location: In the PVPF/PVPV

Function: Pilot shut off valve

Failure mode	Cause	Corrective action
Solenoid will not shift	Coil not working	Replace coil per valve specification
	Voltage too high or too low	Confirm voltage in system

PVPE Unloading Valve

Description: Optional two way position solenoid normally open

Location: In the PVPF

Function: Full flow dump

Failure mode	Cause	Corrective action
Solenoid will not shift	Coil not working	Replace coil per valve spec
	Voltage too high or too low	Confirm voltage in system

PVB Pilot Check Valve

Description: Pilot operated check valve

PVG 100 Component Troubleshooting

Location: In the PVB

Function: Low leakage on the work ports

Failure mode	Cause	Corrective action
Internal leakage	Component wear	Replace module
	Contamination	Replace module

PVEH, PVES, Electrical Actuators

Description: Proportional electrical actuator.

Location: On the end of the main spool of the PVB.

Function: Convert an electrical command to move the main spool to a set position.

Troubleshooting Considerations

Wiring Check: It is highly possible that in the case of one PVE failing that there could be a poor connection between the joystick and the PVE in question. The PVE is reverse polarity protected and suppression protected; however an intermittent connection could degrade the input electronics to a point of failure. Inspect all wiring and connectors for corrosion and or pinch points.

Hirshman Receptacle and Mating Connector: Each PVE is supplied with a field installable 4-pin Hirshman mating connector and gasket. It is recommended that the gasket be installed between the mating connector and PVE receptacle also the rubber grommet be sealed around a multi-wire jacket in order to seal off moisture from the wiring connections. The PVE is rated for IP65 only when the Hirshman connector is sealed.

Temperature Capability: The PVE is rated for 1000 hours @ 160 °F. ambient temperature. Oil temperature wise, the area of the valve that creates the highest horsepower loss usually creates the highest temperature in the system. If one PVE section is operated more frequently than others this would create more heat than any other part of the valve. Under these conditions it is extremely important to insure that the hydraulic system is well cooled. Oil temperature measurements at the reservoir and at the center of the PVG100 valve stack. The valve should be mounted to provide the best ventilation for the PVE electronics. Poor filtration and low fluid levels may also add to temperature.

Failure mode	Cause	Corrective action
Does not work in either direction LED is green	No control voltage from the electrical controller	While under pressure, back out to minimum pressure and allow oil to leak by for approx. 5 seconds and then readjust to correct pressure - Replace valve
	Command pin wire in mating connector is broken	Repair broken wire
	Connector corroded - This condition is caused by water ingression or ground connection	Replace PVE and mating connector
Does not work in either direction LED is off	No power from the battery	Check power to electrical actuator
	Power pin wire in mating connector is broken	Repair broken wire
	Connector corroded - This condition is caused by water ingression or ground connection	Replace PVE and mating connector
	Ground connection must be hard wired straight from the battery or from the electrical controller	Repair ground connection
LED is flashing Red	Control signal is out of range	Check wiring harness for short

PVG 100 Component Troubleshooting

Failure mode	Cause	Corrective action
Works in one direction (Assuming that the manual control lever and the main spool move freely both directions)	No control voltage from the electrical controller	Ensure voltage from the electrical controller exists for that direction
	Lack of voltage to actuator (Minimum voltage 11 volts for 12 volt system and 22 volts for 24 volt system)	Check system voltage
	Electrical actuator is defective	Replace electrical actuator per spec. on the valve
Works intermittently (if LED is green it indicates a long on/off	Loose connection between the electrical actuator and controller	Repair connector
	Electrical actuator is defective	Replace electrical actuator per spec. on the valve
	Short in wiring harness	Repair wiring harness
Works with no command from controller	Short in wiring harness	Repair wiring harness
	Electrical actuator position feed back out of adjustment	Replace the electrical actuator per valve spec.
	Fine particulate contamination	Replace PVE or electric actuator per valve specs.

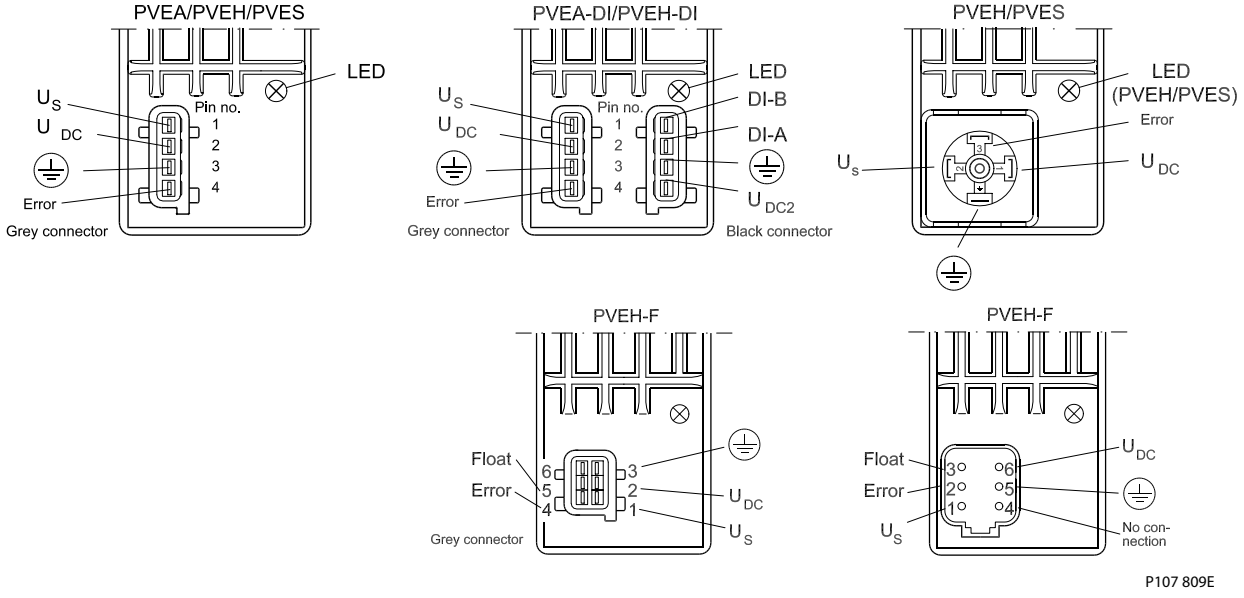
Checking input control signal:

1. Install volt meter to ground pin connection and signal pin with PVE in circuit.
2. Turn the power on for the electrical controller.
3. Actuate the electrical controller and read the voltage.
4. The control voltage should be per the electrical controller output signal.

On electrical actuators - coil resistance can not be measured at the pins.

When replacing an electrical actuator be sure that it has the same part number on it to ensure original functionality.

If filter in the electrical actuator has pieces of contamination trapped in it, this is a good indication that the complete system is contaminated and needs to be flushed. The filter in the electrical actuator can be removed and cleaned.



PVEO On/Off Electrical Actuator

Description: Proportional electrical actuator.

PVG 100 Component Troubleshooting

Location: On the end of the main spool of the PVB.

Function: Convert an electrical command to move the main spool to a set position.

Failure mode	Cause	Corrective action
Does not work in either direction LED is green	No control voltage from the electrical controller	Check voltage from the electrical controller Resistance check (measures between pin 2 and ground): 17 OHMs for 12 volt systems 63 OHMs for 24 volt systems
	Command pin wire in mating connector is broken	Repair broken wire
	Connector corroded	Replace PVE and mating connector - This condition is caused by water ingression or ground connection
	24 volt electrical actuator used on a 12 volt system	Replace with the correct electrical actuator for a 24 volt system
	No power from the battery	Check power to electrical actuator
	Power pin wire in mating connector is broken	Repair broken wire
	Ground connection must be hard wired straight from the battery or from the electrical controller	Repair ground connection
Works in one direction (Assuming that the manual control lever and the main spool moves freely both directions)	No control voltage from the electrical controller	Ensure voltage from the electrical controller exists for that direction
	Lack of voltage to actuator (Minimum voltage 11 volts for 12 volt system and 22 volts for 24 volt system	Check system voltage
	Electrical actuator is defective	Replace electrical actuator per spec. on the valve
Works intermittently (if LED is green it indicates a long on/off	Loose connection between the electrical actuator and controller	Repair connector
	Electrical actuator is defective	Replace electrical actuator per spec. on the valve
	Short in wiring harness	Repair wiring harness
Works with no command from controller	Fine contamination	Replace the electrical actuator per valve spec. and flush the complete system and fill with filtered oil
	Short in wiring harness	Repair wiring harness

PVPC Plug for External Pilot Control

Description: Pilot oil supply from another pump.

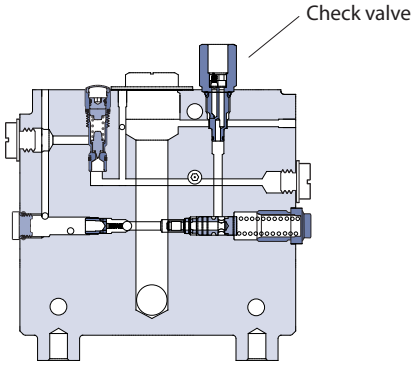
Location: On the top of the PVP.

Function: Provides a hydraulic pilot supply to the valve stack.

Failure mode	Cause	Corrective action
Main spool moves slow, or not at all, in all sections	External hydraulic pilot pressure is too low	Check external hydraulic pressure from pilot pump and/or restrictions

PVG 100 Component Troubleshooting

PVPC plug for external pilot



PVMR Friction Module

Description: Mechanical friction hold.

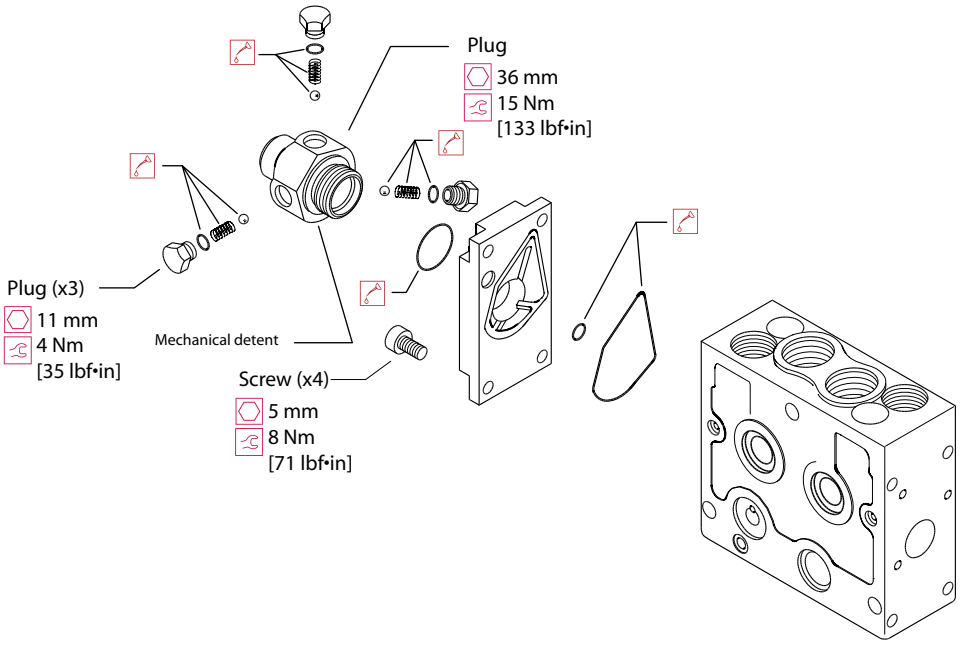
Location: Mounted on main spool in the PVB.

Function: Infinite mechanical positioning of the main spool.

Failure mode	Cause	Corrective action
Flow changes	Excessive flow across the main spool	Reduce flow
	Vibration	Reduce vibration
	Broken spring	Replace broken springs
Flow changes or will not stay in detent	Check for proper assembly of parts	Install parts correctly per specification sheet

PVG 100 Component Troubleshooting

PVMR module



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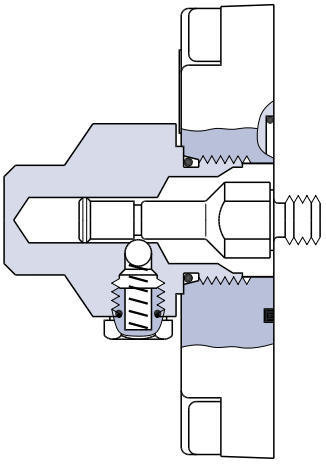

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Danfoss Power Solutions is a global manufacturer and supplier of high-quality hydraulic and electronic components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway 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.

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