Part number:

HYDROMA
HYDRAULICKÉ SYSTÉMY

HIDROMA SISTEMS
UKŁADY HYDRAULICZNE

HYDROMA
ГИДРАВЛИЧЕСКИЕ СИСТЕМЫ

Technical Information

Proportional Valve Group
PVG 32

General description

PVG 32 is a hydraulic load sensing valve designed to give maximum flexibility. From a simple load sensing directional valve, to an advanced electrically controlled load-independent proportional valve.

The PVG 32 modular system makes it possible to build up a valve group to meet requirements precisely. The compact external dimensions of the valve remain unchanged whatever combination is specified.

Features of PVG 32

- Load-independent flow control:
  - Oil flow to an individual function is independent of the load pressure of this function
  - Oil flow to one function is independent of the load pressure of other functions
- Good regulation characteristics
- Energy-saving
- Up to 12 basic modules per valve group
- Several types of connection threads
- Low weight
- Compact design and installation

PVG modules

PVP, pump side modules

- Built-in pressure relief valve
- Pressure gauge connection
- Versions:
  - Open center version for systems with fixed displacement pumps
  - Closed center version for systems with variable displacement pumps
  - Pilot oil supply for electrical actuator built into the pump side module
  - Pilot oil supply for hydraulic actuation built into the pump side module
  - Versions prepared for electrical LS unloading valve PVPX

PVB, basic modules

- Interchangeable spools
- Depending on requirements the basic module can be supplied with:
  - Integrated pressure compensator in channel P
  - Load holding check valve in channel P
  - Shock/suction valves for A and B ports

General description

- LS pressure limiting valves individually adjustable for ports A and B
- Different interchangeable spool variants
- All versions suitable for mechanical, hydraulic and electrical actuation

Actuation modules

The basic module is always fitted with mechanical actuator PVM and PVMD, which can be combined with the following as required:

- Electrical actuator (11 - 32 V ===):
  - PVES – proportional, Super
  - PVEH – proportional, High performance
  - PVEH-F – proportional high performance, Float
  - PVEA – proportional low hysteresis
  - PVEM – proportional, Medium performance
  - PVEO – ON/OFF
  - PVEH-U/PVES-U – proportional, voltage control, 0-10 V
  - PVED-CC – Digital CAN controlled J1939/ISOBUS
  - PVED-CX – Digital CAN controlled CANopen X-tra safety
  - PVEP – PWM voltage controlled (11-32 V)
  - PVHC – High Current actuator for PVG
- PVMR, cover for Mechanical detent
- PVMF, cover for Mechanical Float
- PVH, cover for Hydraulic actuation

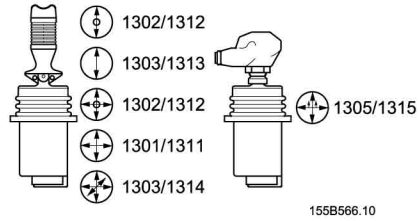
Remote control units

- Electrical remote control units:
  - PVRE, PVRET
  - PVREL
  - PVRES
  - Prof 1
  - Prof 1 CIP
  - JS120
  - JS1000 Ball grip
  - JS1000 PRO grip
  - JS2000
  - JS6000
  - JS7000
- Hydraulic remote control unit: PVRHH

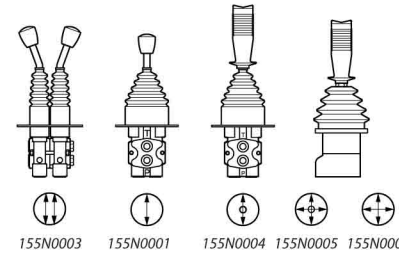
General description

Electrical and hydraulic remote control units

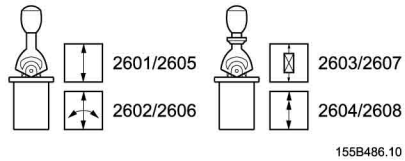
PVRE, electrical control unit, 162F…



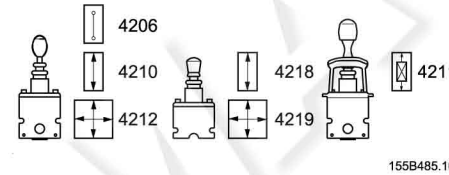
PVRH, hydraulic control unit, 155N…



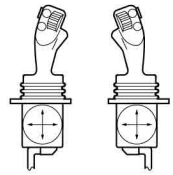
PVREL, electrical control unit, 155U…



PVRES, electrical control unit, 155B…



Prof 1, 162F…



PVG 32 with open center PVP

PVG 32 with open center PVP (fixed displacement pump) and PVB with flow control spool.

When the pump is started and the main spools in the individual basic modules (11) are in the neutral position, oil flows from the pump, through connection P, across the pressure adjustment spool (6) to tank.

The oil flow led across the pressure adjustment 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 (10) to the spring chamber behind the pressure adjustment spool (6), and completely or partially closes the connection to tank to maintain pump pressure.

Pump pressure is applied to the right-hand side of the pressure adjustment spool (6).

The pressure relief valve (1) will open should the load pressure exceed the set value, diverting pump flow back to tank.

In a pressure-compensated basic module the compensator (14) 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.

With a non pressure-compensated basic module incorporating a load drop check valve (18) in channel P, the check valve prevents return oil flow.

The basic module can be supplied without the load drop check valve in channel P for functions with over-center valves.

The shock valves PVLP (13) with fixed setting and the suction valves PVLA (17) on ports A and B are used for the protection of the individual working function against overload and/or cavitation.

General description

An adjustable LS pressure limiting valve (12) can be built into the A and B ports of pressure-compensated basic modules to limit the pressure from the individual working functions. Please see the sectional drawing*PVG 32 sectional view* on page 9 below for better understanding of this example.

The LS pressure limiting valves save energy compared with the shock valves PVLP:

- with PVLP all the oil flow to the working function will be led across the combined shock and suction valves to tank if the pressure exceeds the fixed setting.
- with LS pressure limiting valves an oil flow of about 2 l/min [0.5 US gal/min] will be led across the LS pressure limiting valve to tank if the pressure exceeds the valve setting.

PVG 32 with closed center PVP

PVG 32 with closed center PVP (variable displacement pump) and PVB with flow control spool.

In the closed center version of PVP an orifice (5) and a plug (7) have been fitted instead of the plug (4).

This means that the pressure adjustment spool (6) will only open to tank when the pressure in channel P exceeds the set value of the pressure relief valve (1).

In load sensing systems the load pressure is led to the pump control via the LS connection (8).

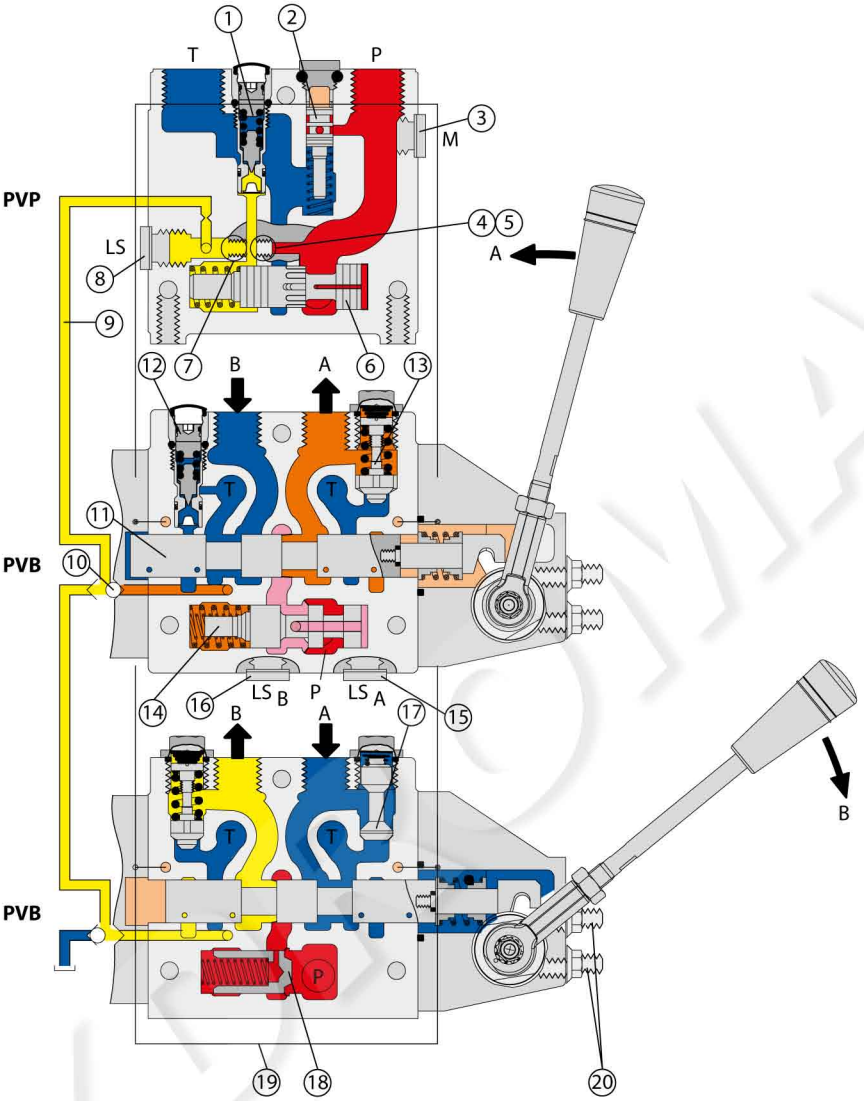
In the neutral position the pump load sense control sets the displacement so that leakage in the system is compensated, to maintain the set stand-by pressure.

When a main spool is actuated the pump load sense control will adjust the displacement so that the set differential pressure (margin) between P and LS is maintained.

The pressure relief valve (1) in PVP should be set at a pressure of approx. 30 bar [435 psi] above maximum system pressure (set on the pump or external pressure relief valve).

General description

PVG 32 sectional view



1. Pressure relief valve
2. Pressure reduction valve for pilot oil supply
3. Pressure gauge connection
4. Plug, open center
5. Orifice, closed center
6. Pressure adjustment spool
7. Plug, closed center
8. LS connection
9. LS signal
10. Shuttle valve
11. Main spool
12. LS pressure limiting valve
13. Shock and suction valve, PVLP
14. Pressure compensator
15. LS connection, port A
16. LS connection, port B
17. Suction valve, PVLA
18. Load drop check valve
19. Pilot oil supply for PVE
20. Maximum oil flow adjustment screws for A/B ports

Load sensing for variable displacement pump supply

The pump receives fluid directly from the reservoir through the inlet line. A screen in the inlet line protects the pump from large contaminants.

General description

The pump outlet feeds directional control valves such as PVG-32, hydraulic integrated circuits (HIC), and other types of control valves.

The PVG valve directs and controls pump flow to cylinders, motors and other work functions. A heat exchanger cools the fluid returning from the valve. A filter cleans the fluid before it returns to the reservoir.

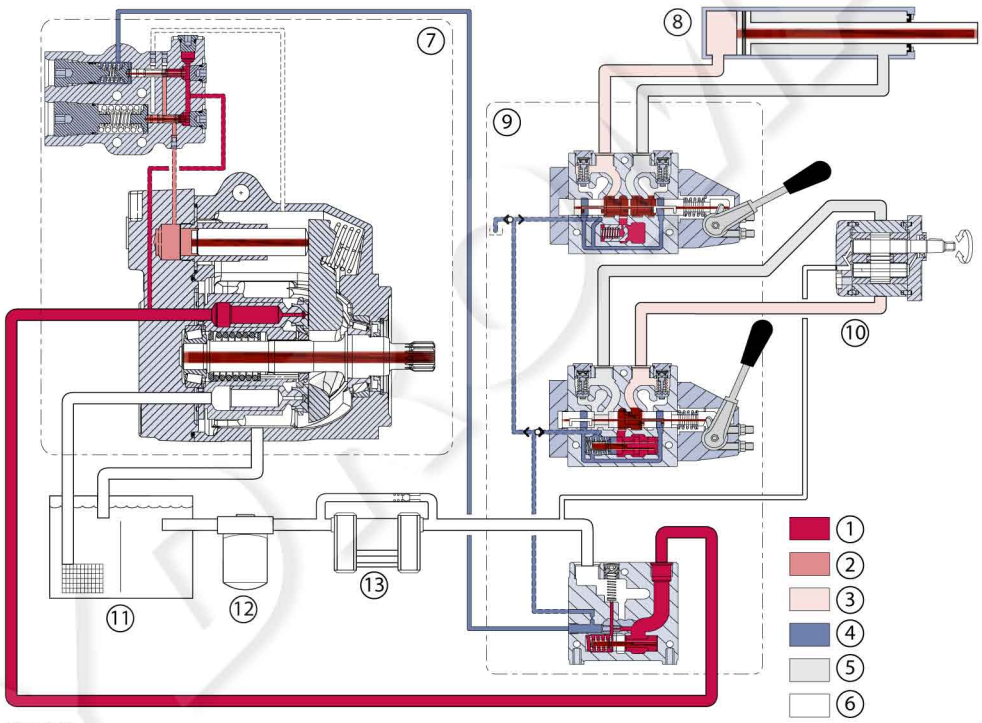
Flow in the circuit determines the speed of the actuators. The position of the PVG valve spool determines the flow demand. A hydraulic pressure signal (LS signal) communicates demand to the pump control.

The pump control monitors the pressure differential between pump outlet and the LS signal, and regulates servo pressure to control the swashplate angle. Swashplate angle determines pump flow.

Actuator load determines system pressure. The pump control monitors system pressure and will decrease the swashplate angle to reduce flow if system pressure reaches the pump control setting.

A secondary system relief valve in the PVG valve acts as a back-up to control system pressure.

Pictorial circuit diagram



P101 658E

PVG 32 technical data

The characteristics in this catalog are typical measured values. During measuring a mineral based hydraulic oil with a viscosity of 21 mm^2/s [102 SUS] at a temperature of 50 °C [122 °F] was used.

PVG 32 technical data

Maximum pressure	Port P, A/B continuous*	350 bar	[5075 psi]
	Port P intermittent**	400 bar	[5800 psi]
	Port A/B intermittent**	420 bar	[6090 psi]
	Port T, static/dynamic	25/40 bar	[365/580 psi]
Oil flow rated	Port P‡§	140/230 l/min	[37/61 US gal/min]
	Port A/B, with press. comp.	100 l/min	[26.4 US gal/min]
	Port A/B witout press. comp.	125 l/min	[33 US gal/min]
Spool travel, standard		± 7 mm	[± 0.28 in]
Spool travel, float position	Proportional range	± 4.8 mm	[± 0.19 in]
	Float position	± 8 mm	[± 0.32 in]
Dead band, flow control spools	Standard	± 1.5 mm	[± 0.06 in]
	Linear characteristic	± 0.8 mm	[± 0.03 in]
Maximum. internal leakage at 100 bar [1450 psi] and 21 mm^2/s [102 SUS]	A/B → T without shock valve	20 cm^3/min	[1.85 in^3/min]
	A/B → T with shock valve	25 cm^3/min	[2.15 in^3/min]
Oil temperature (inlet temperature)	Recommended temperature	30 → 60 °C	[86 → 140°F]
	Minimum temperature	-30 °C	[-22 °F]
	Maximum temperature	+90 °C	[194 °F]
Ambient temperature		-30 → 60 °C	[-22 → 140 °F]
Oil viscosity	Operating range	12 - 75 mm^2/s	[65 - 347 SUS]
	Minimum viscosity	4 mm^2/s	[39 SUS]
	Maximum viscosity	460 mm^2/s	[2128 SUS]
Filtration / maximum contamination according to ISO 4406		23/19/16	
Oil consumption in pilot oil pressure reduction valve		0.5 l/min	[0.13 US gal/min]

* With PVSI end plate. With PVS end plate max. 300 bar [4351 psi].

** Intermittent pressure at max. 250,000 cycles of full PVG life time cycles, with PVSI end plate. The maximum intermittent pressure at max. 250,000 cycles stresses the need to confirm application duty cycle before proceeding with specification.

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‡ In open circuit systems with short P-hoses/tubes, attention should be paid to pressure peaks at flows >100 l/min [26.4 US gal/min].

§ For a system with mid inlet PVPVM.

On standard PVB 32 modules, using main spools with closed neutral position, there will be a pressure build up on the A and B port, when main spool is in neutral, and high P pressure. The pressure build up equals to 0,5x P-pressure can be expected.

Rated pressure

Product	P-port max. continuous pressure
PVG 32; PVG 120/32; PVG 100/32 with PVS	300 bar [4351 psi]
PVG 32; PVG 120/32; PVG 100/32 with PVSI	350 bar [5076 psi]
PVG 32 with PVBZ	250 bar [3626 psi]
PVG 32 with HIC steel	350 bar [5076 psi]
PVG 32 with HIC aluminium	210 bar [3046 psi]

PVG 32 technical data

PVH, hydraulic actuation

Technical data for PVH

Control range pressure	5 – 15 bar [75 – 220 psi]
Max. pilot pressure	30 bar [435 psi]
Max. pressure on port T (the hydraulic remote control lever should be connected directly to tank.)	10 bar [145 psi]

PVM, mechanical actuation

Operating torque for PVM

Spool displacement	**Operating torque N•m [lbf•in]**				
	PVM + PVMD	**PVM + PVE**	**PVM + PVH**	**PVM + PVMR**	**PVM+PVMF**
from neutral position	2.2 ±0.2 [19.5 ±1.8]	2.2 ±0.2 [19.5 ±1.8]	2.5 ±0.2 [22.1 ±1.8]	17 [3.8]	22 [5.0]
max. spool travel	2.8 ±0.2 [24.8 ±1.8]	2.8 ±0.2 [24.8 ±1.8]	6.9 ±0.2 [61.0 ±1.8]	–	–
into float position	–	–	–	–	60 [13.5]
away from float position	–	–	–	–	28 [6.3]
from any other position	–	–	–	8.5 [73.3]	–

No control lever position	2 x 6
Control lever range	±19.5°
Proportional control lever range	±13.4°
Control lever range – float position	22.3°

PVE, electrical actuation

Technical data for PVEO and PVEM

Supply voltage U_{DC}	**rated**	12 V_{DC}	24 V_{DC}
	range	11 V to 15 V	22 V to 30 V
	max. ripple	5%	
Current consumption at rated voltage		0.65 A @ 12 V	0.33 A @ 24 V
Signal voltage (PVEM)	**neutral**	0.5 x U_{DC}	
	A-port ↔ B-port	0.25 • U_{DC} to 0.75 • U_{DC}	
Signal current at rated voltage (PVEM)		0.25 mA	0.50 mA
Input impedance in relation to 0.5 • U_{DC}		12 KΩ	
Power consumption		8 W	

PVG 32 technical data

Technical data for PVEA, PVEH and PVES

Supply voltage U_{DC}		**rated**	11 V to 32 V	
		range	11 V to 32 V	
		max. ripple	5%	
Current consumption at rated voltage		PVEH/PVES (PVEA)	0.57 (33) A @ 12 V	0.3 (17) A @ 24 V
Signal voltage		**neutral**	0.5 x U_{DC}	
		A-port ↔ B-port	0.25 • U_{DC} to 0.75 • U_{DC}	
Signal current at rated voltage			0.25 mA to 0.70 mA	
Input impedance in relation to 0.5 • U_{DC}			12 KΩ	
Input capacitor			100 ηF	
Power consumption		PVEH/PVES (PVEA)	7 (3.5) W	
(PVEH/PVES)		Max. load	100 mA	60 mA
	Active	Reaction time at fault	500 ms (PVEA: 750 ms)	
	Passive	Reaction time at fault	250 ms (PVEA: 750 ms)	

Reaction time for PVEO and PVEM

Supply voltage	**Function**		**PVEO, On/Off**	**PVEO-R, On/Off**	**PVEM, Prop. med.**
Disconnected by means of neutral switch	Reaction time from neutral position to max. spool travel	max.	0.235 s	0.410 s	0.700 s
		rated	0.180 s	0.350 s	0.450 s
		min.	0.120 s	0.250 s	0.230 s
Disconnected by means of neutral switch	Reaction time from max. spool travel to neutral position	max.	0.175 s	0.330 s	0.175 s
		rated	0.090 s	0.270 s	0.090 s
		min.	0.065 s	0.250 s	0.065 s
Constant voltage	Reaction time from neutral position to max. spool position	max.	-	-	0.700 s
		rated	-	-	0.450 s
		min.	-	-	0.230 s
Constant voltage	Reaction time from max. spool travel to neutral position	max.	-	-	0.700 s
		rated	-	-	0.450 s
		min.	-	-	0.230 s
Hysteresis*		rated	-	-	20%

* Hysteresis (control signal/spool travel) is indicated at rated voltage and f = 0.02 Hz for one cycle.
(one cycle = neutral → full A → full B → neutral)

Reaction time for PVEA, PVEH and PVES

Supply voltage	**Function**		**PVEA Prop. fine s**	**PVEH Prop. high s**	**PVES Prop. super s**
Disconnected by means of neutral switch	Reaction time from neutral position to max. spool travel	max.	0.50	0.23	0.23
		rated	0.32	0.15	0.15
		min.	0.25	0.12	0.12

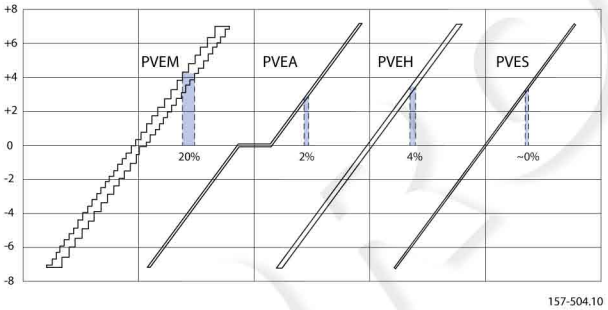
PVG 32 technical data

Reaction time for PVEA, PVEH and PVES (continued)

Supply voltage	Function		PVEA Prop. fine s	PVEH Prop. high s	PVES Prop. super s
Disconnected by means of neutral switch	Reaction time from max. spool travel to neutral position	max.	0.55	0.175	0.175
		rated	0.40	0.09	0.09
		min.	0.30	0.065	0.065
Constant voltage	Reaction time from neutral position to max. spool travel	max.	0.50	0.20	0.20
		rated	0.32	0.12	0.12
		min.	0.25	0.05	0.05
Constant voltage	Reaction time from max. spool travel to neutral position	max.	0.25	0.10	0.10
		rated	0.20	0.09	0.09
		min.	0.15	0.065	0.065
Hysteresis *		rated	2%	4%	~ 0%

The following technical data are from typical test results. For the hydraulic system a mineral based hydraulic oil with a viscosity of 21 mm^2/s [102 SUS] and a temperature of 50 °C [122 °F] were used.

Typical hysteresis characteristics for control signal vs spool travel of different PVE types*



* Hysteresis (control signal/spool travel) is indicated at rated voltage and f = 0.02 Hz. (one cycle = neutral → full A → full B → neutral)

The following technical data are from typical test results. For the hydraulic system a minetal based hydraulic oil with a viscosity of 21 mm^2/s [102 SUS] and a temperature of 50 °C [122 °F] were used.

Pilot oil consumption for PVEA, PVEH, PVES, PVEO and PVEM

Function	PVEA Prop. fine	PVEH Prop. high	PVES Prop. super	PVEO ON/OFF	PVEM Prop. medium
Neutral without supply voltage	0	0	0.3 l/min [0.079 US gal/min]	0	0
Locked with supply voltage	0.4 l/min [0.106 US gal/min]	0.1 l/min [0.026 US gal/min]	0.3 l/min [0.026 US gal/min]	0.1 l/min [0.026 US gal/min]	0.1 l/min [0.026 US gal/min]
Continuous actuations with supply voltage	1.0 l/min [0.26 US gal/min]	0.7 l/min [0.185 US gal/min]	0.8 l/min [0.211 US gal/min]	0.7 l/min [0.185 US gal/min]	0.5 l/min [0.132 US gal/min]
One actuation (neutral → max) with supply voltage	2 cm^3 [0.12 in^3]				

PVG 32 technical data

Fluids parameters

Oil viscosity*	recommended range	12 - 75 mm^2/s	[65 - 347 SUS]
	minimum	4 mm^2/s	[39 SUS]
	maximum	460 mm^2/s	[2128 SUS]
Oil temperature	recommended range	30 - 60°C	[86 -140°F]
	minimum	-30°C	[-22°F]
	maximum	90°C	[194°F]
Ambient temperature recommended range		-30° → 60°C	[-22° → 140°F]
Filtering in the hydraulic system		Max. allowed degree of contamination: 23/19/16 (ISO 4406, 1999 version)	

* Max. start up viscosity 2500 mm^2/s.

PVPX, electrical LS unloading valve

PVPX technical data

Max. operating pressure		350 bar [5075 psi]	
Enclosure to IEC 529		IP65	
Max. pressure drop at an oil flow of 0.1 l/min [2.6 US gal/min]		2 bar [30 psi]	
Oil temperature (Inlet)	**Recommended temperature**	30 °C to 60 °C [86 °F 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 °C to 60 °C [-22 °F 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 LS pressure relief		300 ms	
Rated voltage		12 V	24 V
Max. premissible deviation from rated supply voltage		± 10%	
Current consumption at rated voltage	**at 22 °C [72 °F] coil temperature**	1.55 A	0.78 A
	at 110 °C [230 °F] coil temperature	1 A	0.5 A
Power consumption	**at 22 °C [72 °F] coil temperature**	19 W	
	at 110 °C [230 °F] coil temperature	12 W	

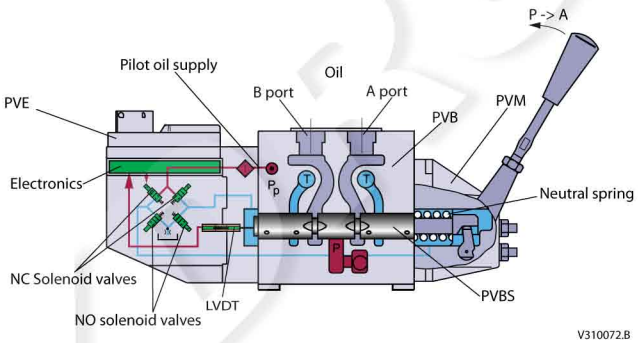
Electrical actuation

Electrical control of PVG

Valve actuation with electrical actuators has been supported by Danfoss for a long time. The actuation can be controlled directly by joystick, by a PLUS+1® controller or by a broad range of third part controllers. The actuator controls the spool by building up pilot oil pressure on the end of the spool. For the PVE a pilot oil pressure between 10 and 15 bar is used. For the PVHC a pilot oil pressure between 20 and 25 bar is used.

PVG with PVE

Valve section with naming - standard mounted - seen from PVP



A detailed description of the variants is presented in:

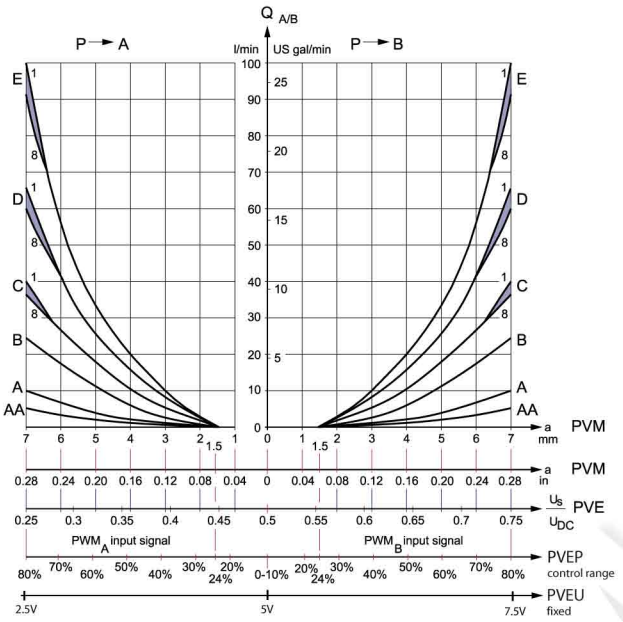
PVE-Series 4 for PVG 32, PVG 100 and PVG 120 Technical Information, **520L0553**, covers all analogue PVE – PVEO, PVEH, PVES, PVEA, PVEM, PVEU, PVEP and the current controlled PVHC.

Electrohydraulic Actuator – PVED-CC Series 4 Technical Information, **520L0665**, covers the ISOBUS/SAE J1939 CAN controlled PVED-CC.

Electrohydraulic Actuator – PVED-CX Series 4 Technical Information, **11070179**, covers the IEC61508 SIL2 certified CANopen controlled PVED-CX.

Electrical actuation

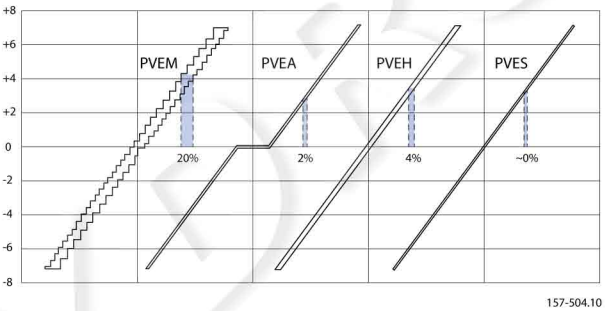
PVE characteristic - control by voltage



Closed loop control

The PVE variants PVEA/H/M/S/U/P and the PVED-CC/-CX has a closed loop control supported by a spool position sensor that ensures integrity towards flow forces and oil viscosity.

*Hysteresus for PVE variants**



* Hysteresis (control signal/spool travel) is indicated at rated voltage and f = 0.02 Hz. (one cycle = neutral → full A → full B → neutral)

The standard PVE's are proportional activated actuator except PVEO which is on/off. The PVE's have fault-monitoring.

- PVEU is available with PVEH and PVES hysteresis
- PVEP, PVED-CC and PVED-CX are available with PVES hysteresis

Electrical actuation

Fault monitoring overview

Type	Fault monitoring	Delay before error out	Error mode	Error output status	Fault output on PVE	LED light	Memory†
PVEO PVEM	No fault monitoring						
PVEA PVEH PVEP PVES PVEU	Active	500 ms (PVEA: 750 ms)	No fault	Low	< 2 V	Green	–
			Input signal faults	High	~U_{DC}	Flashing red	Yes
			Transducer (LVDT)			Constant red	
			Close loop fault				
	Passive	250 ms (PVEA: 750 ms)	No fault	Low	< 2 V	Green	–
			Input signal faults	High	~U_{DC}	Flashing red	No
			Transducer (LVDT)			Constant red	
			Close loop fault				
PVE Float six pin	Active	500 ms	Float not active	High	~U_{DC}	Constant red	Yes
		750 ms	Float still active				

Measured between fault output pin and ground.

† Reset needed

PVEO

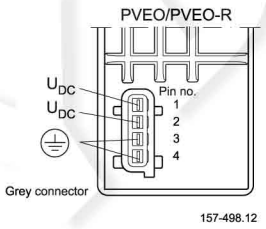
The PVEO is an on/off activated actuator. The PVEO has not fault-monitoring.

Variants:
- PVEO-R with a ramp delayed actuation
- PVEO-DI with direction indication feedback
- Anodized aluminum block
- ATEX certified

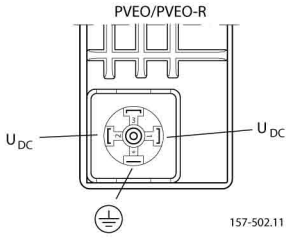
Power supply:
- 12 V
- 24 V

Connectors:
- AMP
- DIN/Hirshmann
- Deutsch®

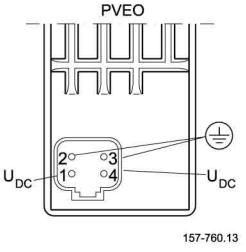
AMP version



DIN/Hirschmann version



Deutsch® version



PVEM

The PVEM is a proportional activated actuator. The PVEM has not fault-monitoring.

Variants:
- PVEM -R with a ramp delayed actuation
- PVEM for float in B-direction and max. flow B at 4.8 mm

Power supply: 12 / 24 V

*Connectors:*DIN/Hirshmann

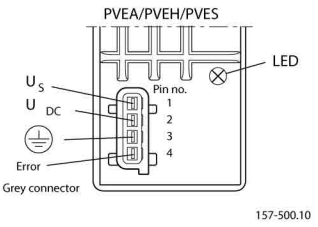
Electrical actuation

PVEA, PVEH, PVES, PVEU

Variants:
- -F for float in B-direction
  max. flow B at 4.8 mm
- -F for float in A-direction
  max. flow A at 5.5 mm
- PVES-SP with spool position feedback
- Anodized aluminum block
- ATEX certified

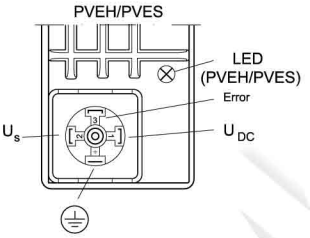
Power supply: 11→ 32 V
Connectors:
- AMP
- DIN/Hirshmann
- Deutsch®

AMP version



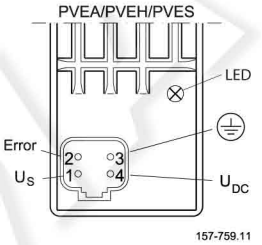
PVEA, PVEH, PVES, PVEU
and PVEH float A

DIN/Hirschmann version



PVEH, PVEM, PVES,
PVEH float B and PVEM float B

Deutsch® version

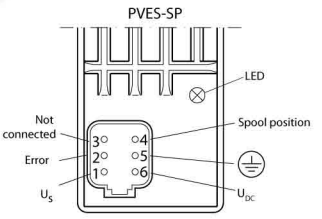


PVEA, PVEH, PVES, PVEU
and PVEH float B

PVEP

The PVEP is controlled with separate PWM control signals for A and B direction.
The PVEP has hysteresis and fault monitoring like the PVES.
Power supply: 11→ 32 V
Connector: Deutsch®

Deutsch® version



PVED-CC and PVED-CX

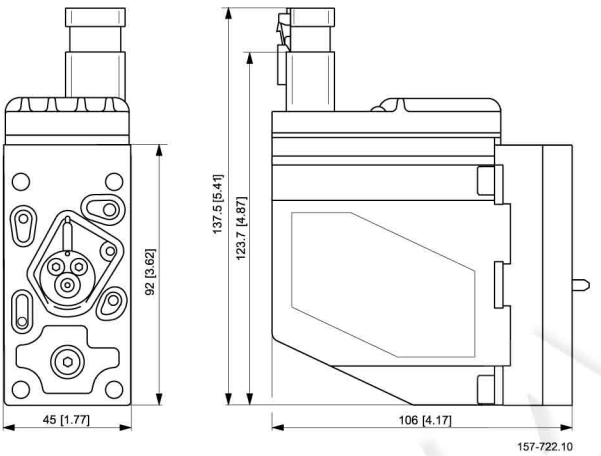
The CAN controlled PVE embedded microcontrollers support the same high spool controllability as the PVES and additional has high quality feedbacks, safety monitoring and detailed diagnostics.

PVED has digital communication, that allows a wide range of feedback, setpoint and highly costumized settings. CAN bus serial communication makes wiring much easier. Only one cable per PVG group.

Electrical actuation

Power supply: 11 → 32 V
Connectors:
- Deutsch® (PVED-CC)
- AMP (PVED-CC and PVED-CX)

PVE with Deutsch® connector incl. female connector



PVHC

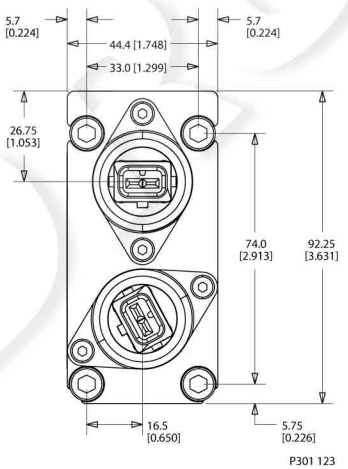
For PVG controlled by PVHC, hysteresis is influenced by lever (PVM). The PVHC control is done by dual Pulse Width Modulated (PVM) high current supply 100-400 Hz PWM control signals.

The PVHC does not have neither fault monitoring nor internal closed loop control of the spool.

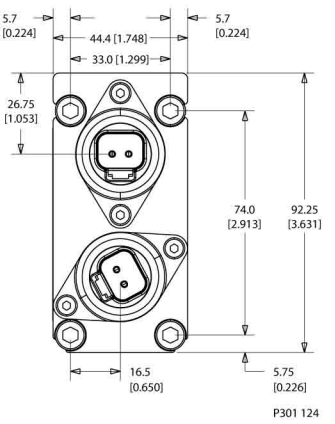
Power supply:
- 12 V
- 24 V

Connectors:
- Deutsch®
- AMP

PVHC with AMP version

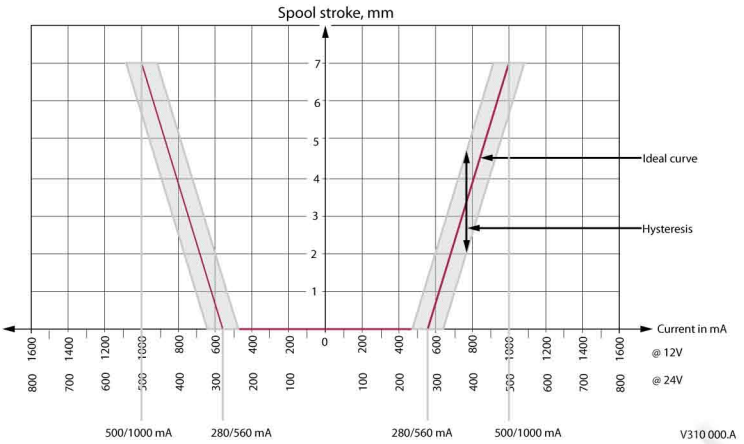


PVHC with Deutsch® version



Electrical actuation

PVHC characteristic - Spool stroke vs current



PVHC current response and hysteresis @ 25 bar Pp, 21 ctS, 25 °C. The ideal curve is determined by the main spool neutral spring. The PVHC has high hysteresis. The hysteresis is affected by viscosity, friction, flow forces, dither frequency and modulation frequency. The spool position will shift when conditions are changed e.g. temperature change.

Technical characteristics

General

The characteristics in this catalog are typical measured values. During measuring a mineral based hydraulic oil with a viscosity of 21 mm2/s [102 SUS] at a temperature of 50°C [122°F] was used.

PVP, pump side module

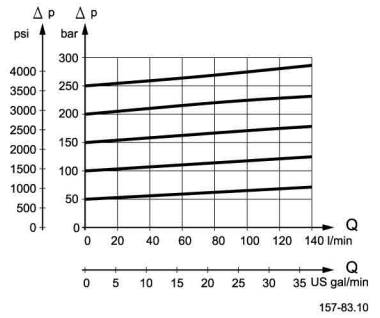
Pressure relief valve characteristic in PVP

The pressure relief valve is set at an oil flow of 15 l/min [4.0 US gal/min].

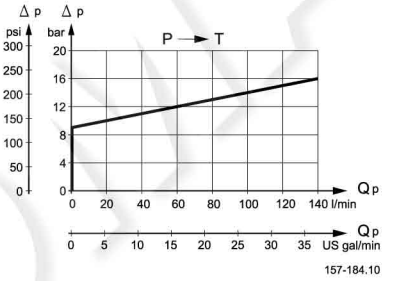
Setting range:

- 30 to 350 bar [435 to 5075 psi] with PVSI end plate
- 30 to 300 bar [435 to 4351 psi] with PVS end plate

Pressure relief valve characteristic



Neutral by-pass pressure drop characteristic (open center)



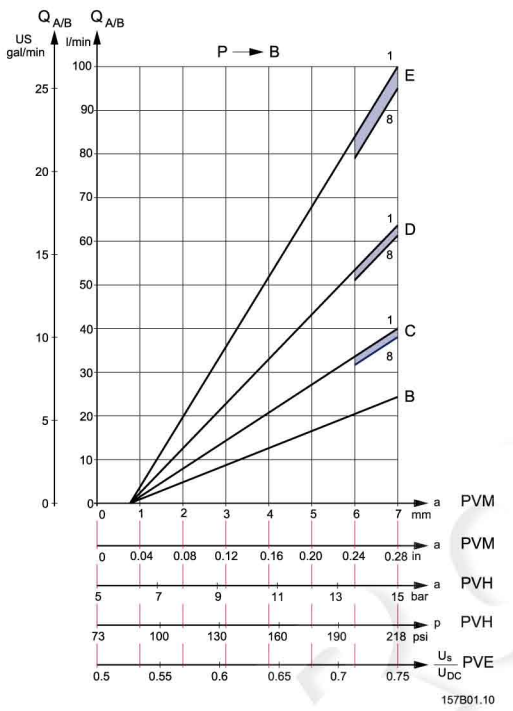
PVB, basic modules oil flow characteristics

The oil flow for the individual spool depends on:

Technical characteristics

- type of basic module (with/without compensation)
- type of pump (fixed or variable displacement).

Linear oil flow depending on spool type



U_S = Signal voltage; U_{DC} = Supply voltage; 1 = First PVB after PVP; 8 = Eighth PVB after

Pressure-compensated PVB, open center PVP

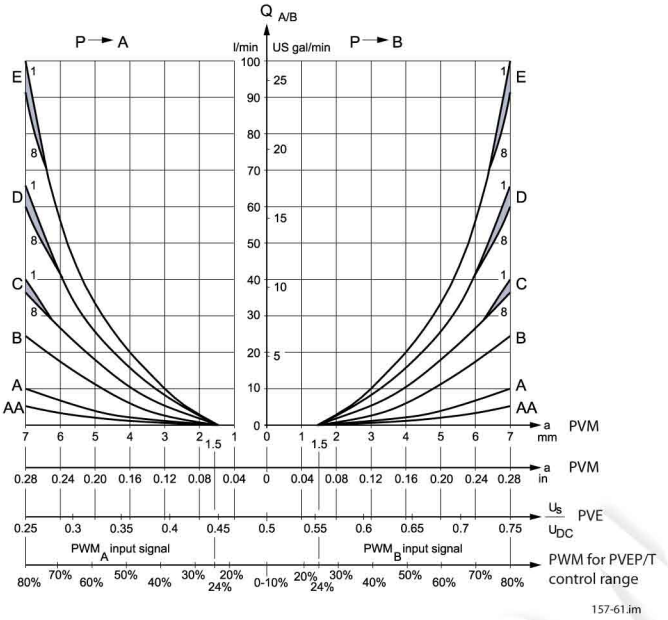
The oil flow is dependent on the supplied pump oil flow.

The characteristics are plotted for a pump oil flow, Q_P, corresponding to the rated maximum spool oil flow, QN. Increasing the pump oil flow to $1,4 \times Q_N$ will give the same oil flow on the eighth as on the first basic module.

The letters AA, A, B, etc. denote spool types. The characteristic below is shown for spool travel in both directions. All other characteristics are shown for spool travel in one direction only.

Technical characteristics

Progressive oil flow characteristic depending on spool type



U_S = Signal voltage; U_{DC} = Supply voltage; 1 = First PVB after PVP; 8 = Eighth PVB after

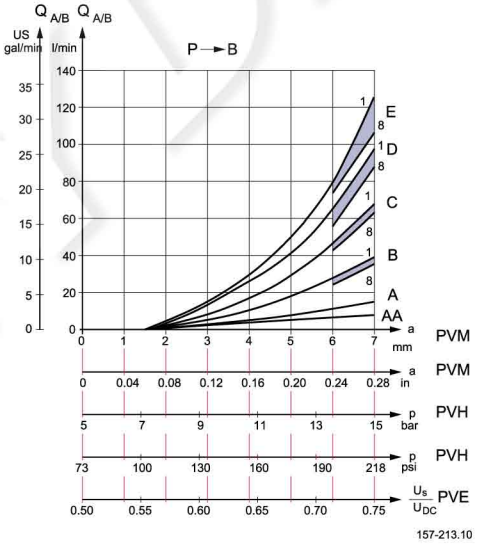
PVB without pressure compensation, open center PVP

The spool flow is dependent on the supplied oil flow, Q_P.

The characteristics apply to supply oil flow of 130 l/min [34.3 US gal/min] with the actuation of one basic module and the supply flow level.

If several basic modules are activated at the same time, the characteristic depends on the load pressure of the actuated basic modules.

Oil flow as a function of spool travel characteristic

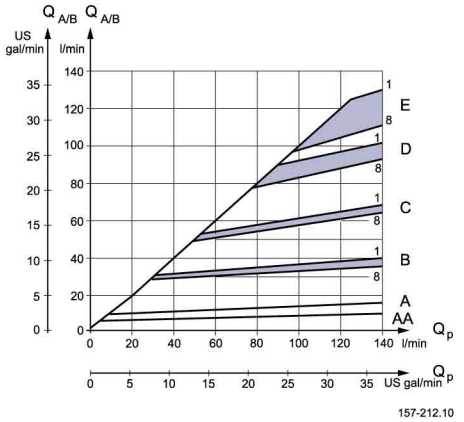


Oil flow $Q_{A/B}$ as a function of supplied pump oil flow (Q_P)

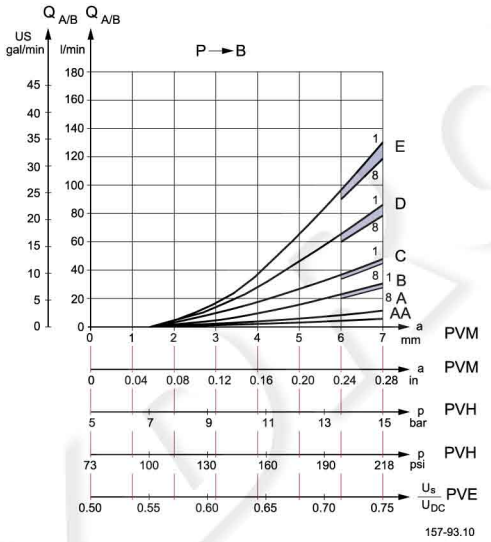
Technical characteristics

The pressure drop of any oil flowing back to tank (Q_P - $Q_{A/B}$) is read on the curve for neutral flow pressure in PVP.

Characteristic for fully displaced flow control spools

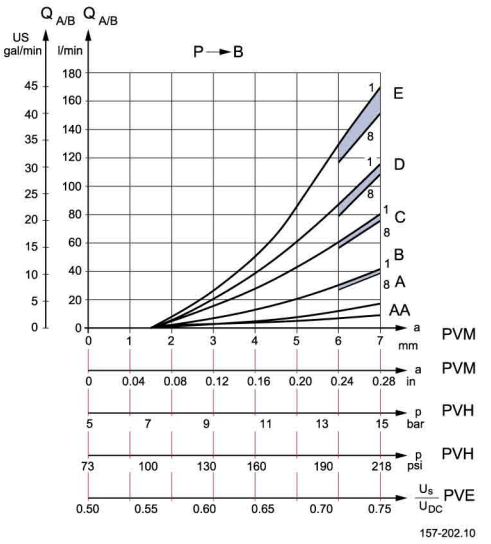


PVB without pressure compensation, closed center PVP



Set pressure difference between pump pressure and LS signal = 10 bar [145 psi].

Technical characteristics

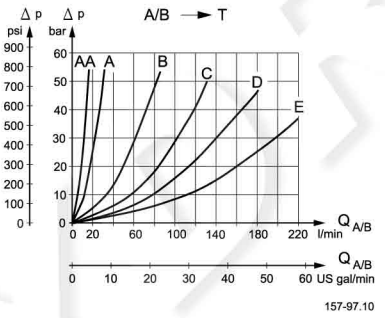


Set pressure difference between pump pressure and LS signal = 20 bar [290 psi].

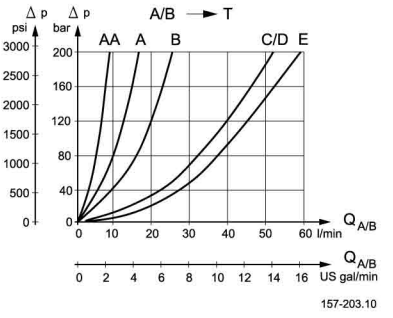
The oil flow is dependent on the pressure difference between the pump pressure and the LS signal. Normally the pressure difference is set at the LS pump regulator. Also take into consideration pressure drop from the pump to the PVG valve group. e.g. long pipeline.

Oil flow characteristics for PVB at

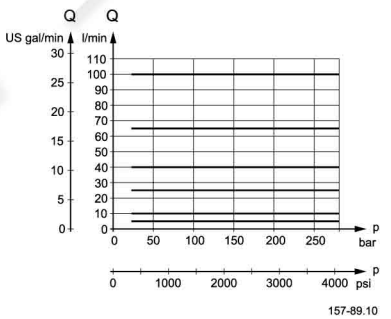
@ pressure drop at max. main spool travel



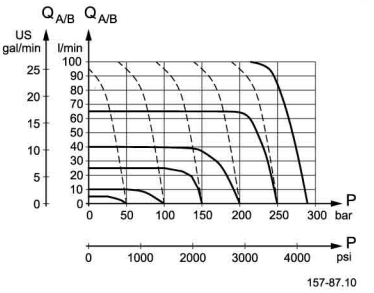
@ pressure drop for open spool in neutral position



Load-independent, pressure-compensated



LS pressure limiting, pressure-compensated PVB



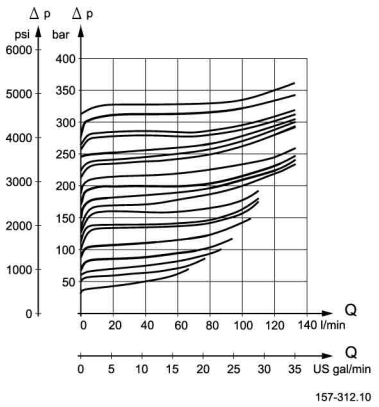
Technical characteristics

PVLP, shock and PVLA, suction valves

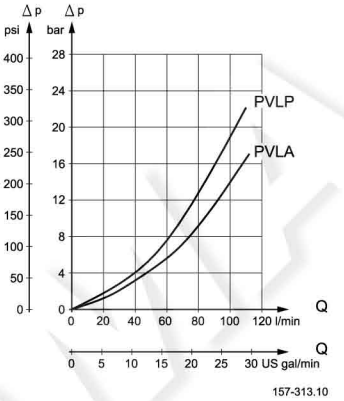
PVLP is set at an oil flow of 10 l/min [2.6 US gal/min]. The shock valve PVLP is designed to absorb shock effects. Consequently, it should not be used as a pressure relief valve.

If the working function requires the use of a pressure relief valve, a PVB basic module with built-in $LS_{A/B}$ pressure limiting valve should be used.

PVLP, shock valve characteristic

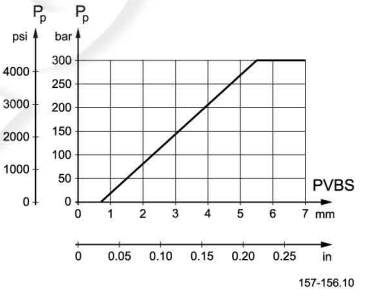


PVLA, suction valve characteristic



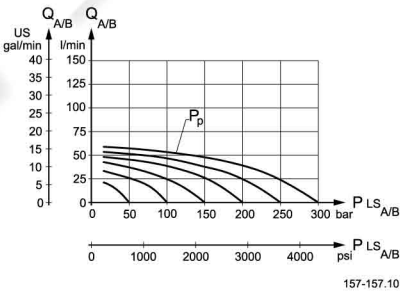
Pressure build-up for pressure controlled spools

Max. oil flow can be reduced by about 50% without limitation of maximum pressure by limiting the main spool travel from 7 mm [0.28 in] to 5.5 mm [0.22 in].

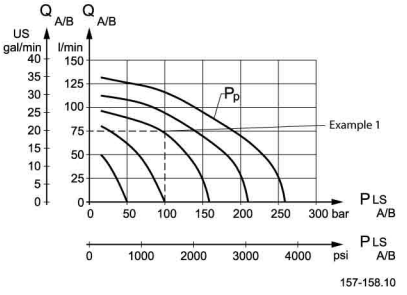


Pressure control spool flow characteristics

Size A:

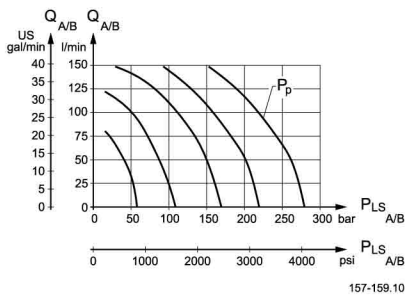


Size B:

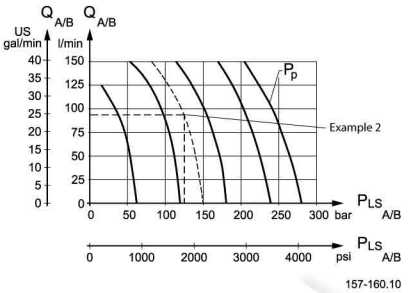


Technical characteristics

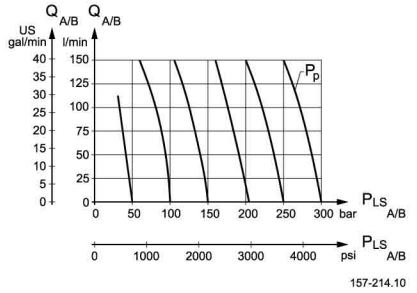
Size C:



Size D:



Size E:



Examples of how to use the characteristics for pressure control spools

Example 1: Determining the oil flow

Given:
- Spool type B
- Pressure setting P_P: 160 bar [2320 psi]
- Load pressure, $LS_{A/B}$: 100 bar [1450 psi]

Result:
Oil flow = 75 l/min [19.8 US gal/min]

Example 2: Determining the spool size

Given:
- Max. oil flow, $Q_{A/B}$: 90 l/min [23.8 US gal/min]
- Pressure setting P_P: 150 bar [2175 psi]
- Load pressure, P_{LSA}: 125 bar [1810 psi]

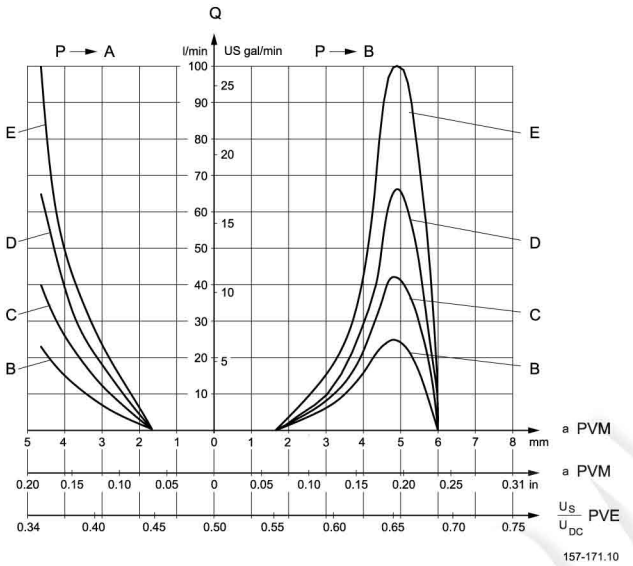
Result: D spool
(see *Pressure CS flow characteristics*, size D)

Normally a smaller spool can be chosen with pressure control. It is our experience that the spool can be one size smaller than with normal flow control.

Technical characteristics

Characteristics for float position main spools

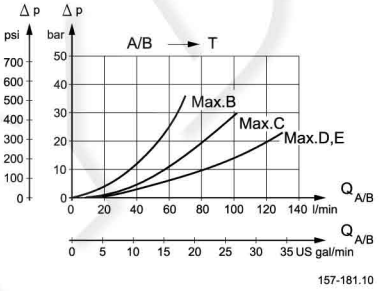
Characteristic of oil flow, spool travel and voltage



- 4.8 mm [0.19 in] spool displacement in direction A gives maximum oil flow to port A
- 4.8 mm [0.19 in] spool displacement in direction B gives maximum oil flow to port B
- 8 mm [0.32 in] spool displacement in direction B gives completely open float position A/B → T.

The spools have 4.8 mm spool travel in direction A and 8 mm travel in direction B:

Pressure drop A/B → T at maximum spool travel within the proportional range (4.8 mm) [0.19 in]

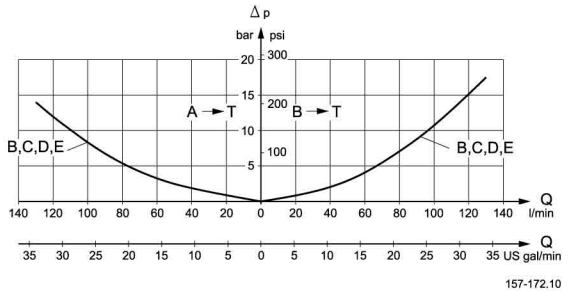


Spools D and E have the same opening area for forward flow and return flow.

Spool E can give 100 l/min [26.4 US gal/min] pressure compensated oil flow due to a higher pressure drop across spool E. This occurs during spool actuation only.

Technical characteristics

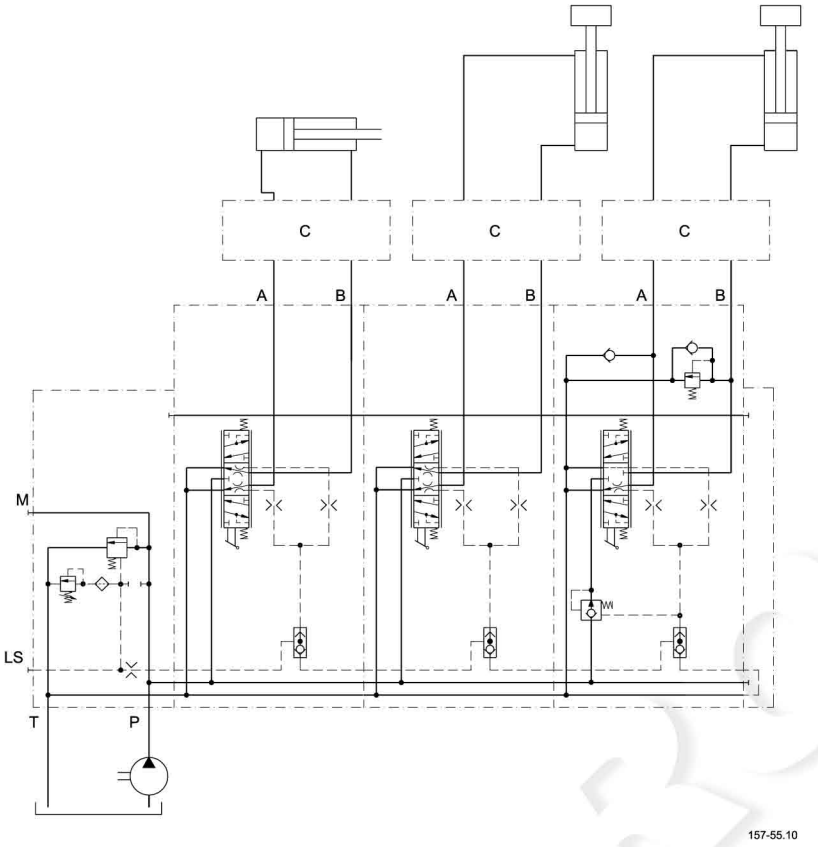
Pressure drop A/B → T in float position



Hydraulic systems

Manually actuated PVG 32 – fixed displ. pump

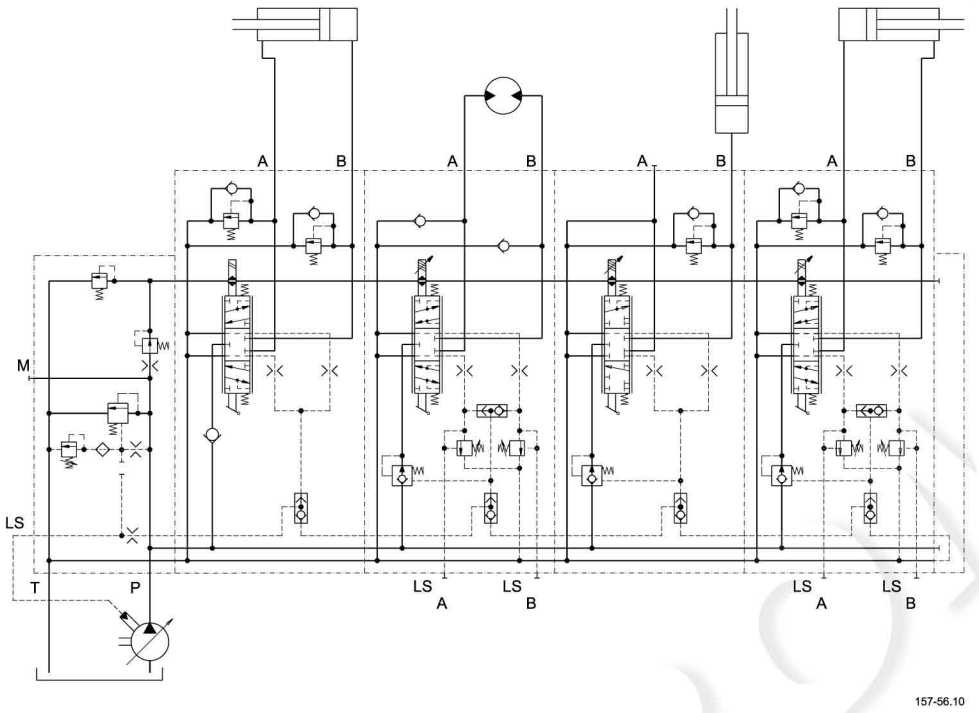
Example schematic of manually actuated PVG 32 – fixed displacement pump



Hydraulic systems

Electrically actuated PVG 32 – variable displ. pump

Example schematic of electrically actuated PVG 32 – variable displacement pump (electrical actuator, shock valves, relief valve)



Other operating conditions

Oil

The main duty of the oil in a hydraulic system is to transfer energy. It must also lubricate the moving parts in hydraulic components, protect them against corrosion, and transport dirt particles and heat out of the system. It is therefore important to choose the correct oil with the correct additives. This gives normal operation and long working life.

Mineral oil

For systems with PVG 32 valves Danfoss recommends the use of mineral-based hydraulic oil containing additives: Type HLP (DIN 51524) or HM (ISO 6743/4).

Non-flammable fluids

Phosphate-esters (HFDR fluids) can be used without special precautions. However, dynamic seals must be replaced with FPM (Viton) seals. Please contact the Danfoss Sales Organization if the PVG 32 valve is to be used with phosphate-esters.

The following fluids should only be used according to agreement with the Danfoss Sales Organization for:

- Water-glycol mixtures (HFC fluids)
- Water-oil emulsions (HFB fluids)
- Oil-water emulsions (HFAE fluids)

Particle content, degree of contamination

Biodegradable oils

PVG 32 valves can be used in systems with rapeseed oil. The use of rapeseed oil is conditioned by:

- complying with the demands on viscosity, water content, temperature and filtering etc. (see chapters below and technical data).
- adapting the operating conditions to the directions of the oil supplier.

Before using other biodegradable fluids, please consult the Danfoss organization. Oil filtration must prevent particle content from exceeding an acceptable level, i.e., an acceptable degree of contamination.

Maximum contamination for PVG 32 is 23/19/16 (see ISO 4406. Calibration in accordance with the ACFTD method). In our experience a degree of contamination of 23/19/16 can be maintained by using a filter fineness as described in the next section.

Filtration

Effective filtration is the most important precondition in ensuring that a hydraulic system performs reliably and has a long working life. Filter manufacturers issue instructions and recommendations. It is advisable to follow these.

System filters

Where demands on safety and reliability are very high a pressure filter with bypass and indicator is recommended. Experience shows that a 10 µm nominal filter (or finer) or a 20 µm absolute filter (or finer) is suitable. It is our experience that a return filter is adequate in a purely mechanically operated valve system. The fineness of a pressure filter must be selected as described by the filter manufacturer so that a particle level of 23/19/16 is not exceeded. The filter must be fitted with pressure gauge or dirt indicator to make it possible to check the condition of the filter. In systems with differential cylinders or accumulators

Other operating conditions

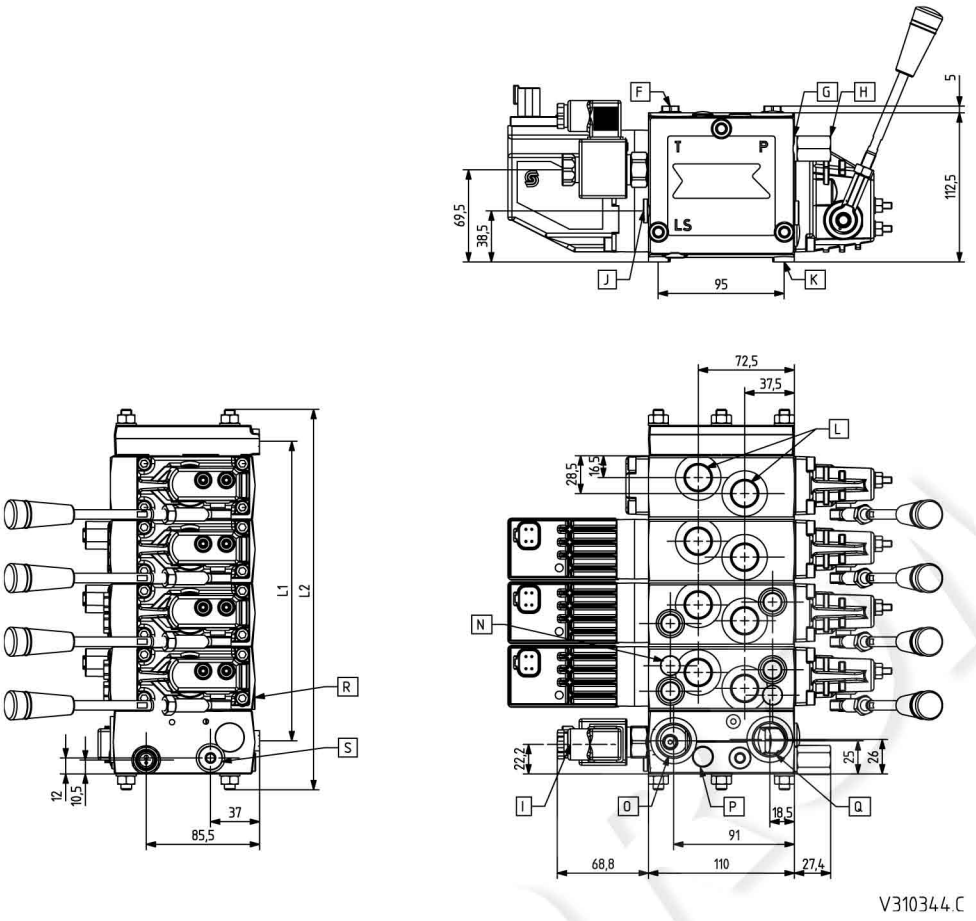
the return filter must be sized to suit the max. return oil flow. Pressure filters must be fitted to suit max. pump oil flow.

Internal filters

The filters built into PVG 32 are not intended to filter the system but to protect important components against large particles. Such particles can appear in the system as a result of pump damage, hose fracture, use of quick-couplings, filter damage, starting up, contamination, etc. The filter in the electrical actuator PVE protecting the solenoid valves has a mesh of 150 µm. Bursting pressure drop for internal filters is 25 bar [360 psi].

Dimensions

PVG 32 Dimensions

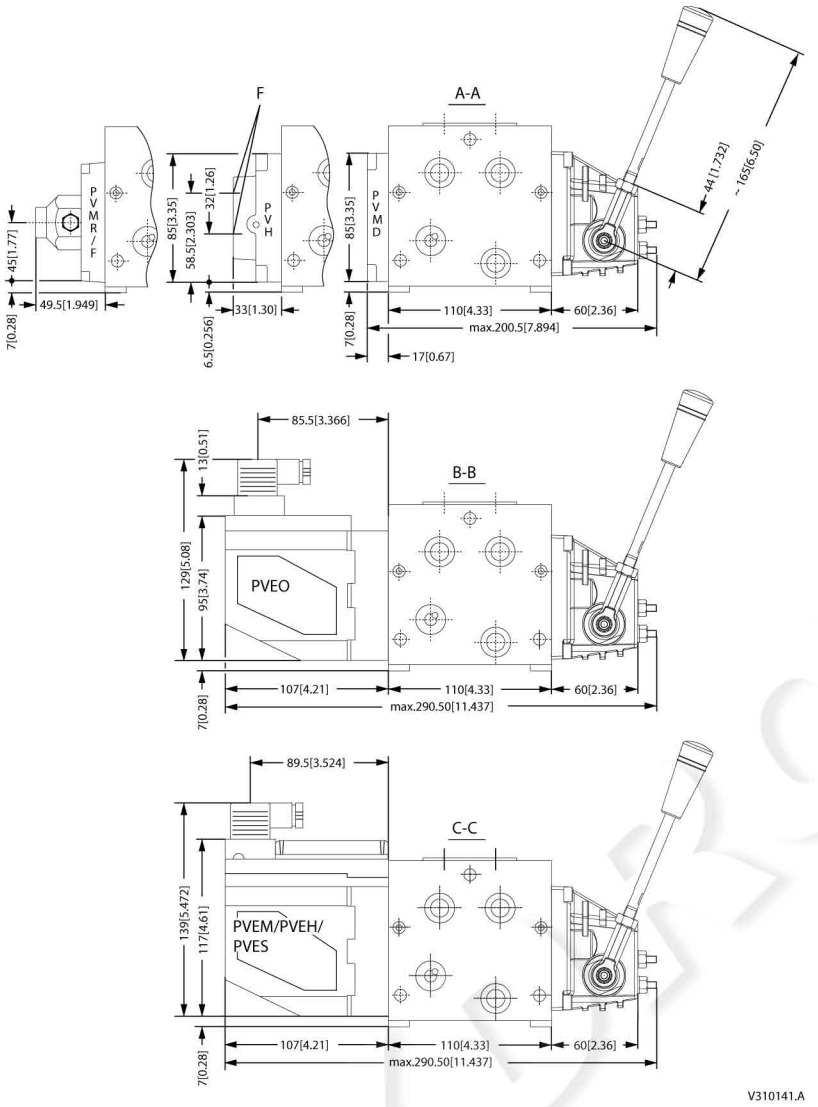


Legend:

F: Shock and suction valve, PVLP
G: Pressure gauge connection: G¼, 12 mm [½ –20, 0.47 in] deep
H: Plug for external pilot oil supply, PVPC: G½, 12 mm [½ –20, 0.47 in] deep
I: Electrical LS unloading valve, PVPX
J: LS connection: G¼, 12 mm [½–20; 0.47 in or $^{9}/_{16}$–18, 0.5 in] deep
K: Fixing holes: M8 × min. 10 [$^{5}/_{16}$–18; 0.39 in] deep
L: Port A and B: G½, 14 mm [$^{7}/_{8}$–14; 0.65 in] deep
M: LX connection: PVS; G $^{1}/_{8}$, 10 mm [$^{3}/_{8}$–24; 0.39 in] deep and
PVSI; G¼, 12 mm [½ –20; 0.47 in] deep
N: LS pressure limiting valve
O: Tank connection; G¾, 16 mm [1 $^{1}/_{16}$–12; 0.75 in] deep
P: Pressure relief valve
Q: Pump connection; G½, 14 mm [$^{7}/_{8}$–14; 0.65 in] deep or G¾, 16 mm [1 $^{1}/_{16}$–12; 0.75 in] deep
R: LS_A and LS_B connections; G¼, 12 mm deep [$^{9}/_{16}$–18, 0.5 in] deep
S: Pp, pilot pressure connection G

PVB		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
L1	mm	82	130	178	226	274	322	370	418	466	514	562	610
	[in]	[3.23]	[5.12]	[7.01]	[8.90]	[10.79]	[12.68]	[14.57]	[16.46]	[18.35]	[20.24]	[562]	[610]
L2	mm	140	189	238	287	336	385	434	483	527	576	622	670
	in]	[5.51]	[7.44]	[9.37]	[11.30]	[13.23]	[15.16]	[17.09]	[19.02]	[20.95]	[22.87]	[622]	[670]

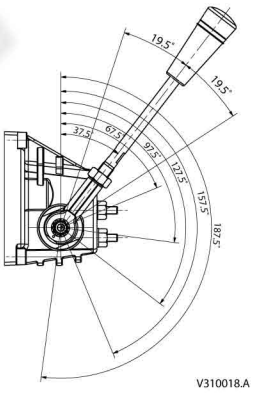
Dimensions



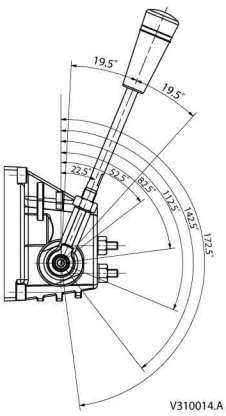
F : G ¼, 12 mm deep [½ in - 20, 0.47 in deep]

PVM, control lever positions

Base with an angle of 37.5°



Base with an angle of 22.5°



Dimensions

The angle of the handle is determined by which side of the handle that is mount towards the base. If a 22.5° angle is needed the "dot" on the handle is not visible. If 37.5° is needed the dot should be visible.

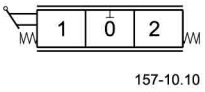
Surface treatment

The PVG valve has as standard, an untreated surface. In certain applications, depend on different factors, such as: salty environment, large temperature changes, high humidity, rust can develope on the surface. This will not affect the performance of the PVG valve group. To prevent/reduce rust development, Danfoss recommend the PVG valve group to be painted. Rust on the surface is not seen as a valid complaint issue, neither on painted or unpainted PVG valve groups.

Modules symbols, description and code numbers

PVM, mechanical actuation

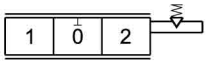
PVM, mechanical actuation

Symbol	Description	Code number with stop screws w/o stop screws	
 157-10.10	PVM, Standard, spring centered Individual oil flow adjustment to ports A and B	157B3171	157B3191
	Without actuation lever and base. Shaft for mounting of actuation lever	157B3173	157B3193
	PVM, as standard, witout actuation lever. With base for mounting of actuation lever	157B3174	157B3194
	PVM, Standard, spring. Individual oil flow adjustment to ports A and B. (Anodized)	157B3184	-

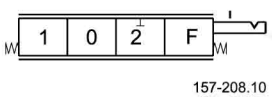
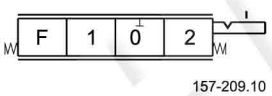
PVMD, cover for mechanical actuation

Symbol	Description	Material	Code No.	Anodized
—	PVMD, Cover for purely mechanically operated valve	aluminium	157B0001	no
		aluminium	157B0009	yes
		cast iron	157B0021	no

PVMR, friction detent

Symbol	Description	Material	Code number	Anodized
 157-210.10	PVMR, Friction detent	aluminium	157B0004	no
		aluminium	157B0012	yes
		cast iron	157B0024	-

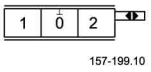
PVMF, mechanical float position

Symbol	Description	Material	Code number	Anodized
 157-208.10  157-209.10	PVMF, Mechanical float position lock	aluminium	157B0005	no

Modules symbols, description and code numbers

PVH, hydraulic actuation

PVH, hydraulic actuation

Symbol	Description	Material	Code number	Anodized
	PVH, Cover for Hydraulic actuation PVH 9/16-18 UNF	aluminium	157B0007	no
		aluminium	157B0010	yes
		cast iron	157B0014	no
	PVH, Cover for Hydraulic actuation PVH G1/4	aluminium	157B0008	no
		aluminium	157B0011	yes
		cast iron	157B0016	no

PVS, end plate

PVS, end plate

Symbol	Description		Mounting threads	Code number
	PVS, without active elements. No connections		BSP	157B2000
			SAE	157B2020
	PVS, without active elements. Max. intermittend LX pressure 250 bar [3625 psi]	G 1/8 10 mm deep	BSP	157B2011
		3/8 in - 24; 0,39 in deep	SAE	157B2021
	PVSI, without active elements Without connections.		BSP	157B2014
			SAE	157B2004
	PVSI, without active elements LX connections. Max. intermittend LX pressure: 350 bar [5075 psi]	G 1/4 10 mm deep	BSP	157B2015
		1/2 in - 20; 0,47 in deep	SAE	157B2005

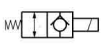
PVAS, assembly kit

PVAS, assembly kit

Code no, 157B...	0	1	2	3	4	5	6	7	8	9	10	11	12
PVB's	8000	8001	8002	8003	8004	8005	8006	8007	8008	8009	8010	8061	8062
PVB + PVPVM	-	8021	8022	8023	8024	8025	8026	8027	8028	8029	8030	8081	8082
Weight kg [lb]	0.1[0.2]	0.15 [0.3]	0.25 [0.6]	0.30 [0.7]	0.40 [0.9]	0.45 [1.0]	0.50 [1.1]	0.60 [1.3]	0.65 [1.4]	0.70 [1.6]	0.80 [1.7]	0.85 [1.8]	0.9 [2.0]

PVPX, electrical LS unloaded valve

PVPX, electrical LS unloaded valve

Symbol	Description		Code number
	PVPX, Normally open: LS pressure relieved with no signal to PVPX	12 V	157B4236
		24 V	157B4238

Module selection chart

PVB, basic valves (continued)

Description		No facilities for shock valves A and B		Facilities for shock valves A and B	
		G ½	7/8 - 14 UNF	G ½	7/8 - 14 UNF
With damped compensator valve, LSA/B relief valve and LSA/B shuttle valve		157B6208	-	157B6238	-
Weight	kg [lb]	3.1 [6.8]		3.0 [6.6]	

PVPC, plugs

Description	G 1/4	1/220 UNF	Weight	
			kg	[lb]
External pilot supply	157B5400	—	0.05	[0.1]
External pilot supply incl. check valve	157B5600	157B5700	0.05	[0.1]

PVM, mechanical actuation

Description	Alu		Alu anodized	Cast iron	Angle
	with stop screws	without stop screws	with stop screws	with stop screws	
Standard	157B3171	157B3191	157B3184	157B3161	22.5°/37.5°
Standard with base, without arm and button	157B3174	157B3194	—	—	22.5°/37.5°
Standard without base, without arm and button	157B3173	157B3193	157B3186	—	—
Weight kg [lb]	0.4 [0.9]			0.8 [1.8]	

PVAS, assembly kit

Code no. 157B....	0	1	2	3	4	5	6	7	8	9	10	11	12
PVB's	8000	8001	8002	8003	8004	8005	8006	8007	8008	8009	8010	8061	8062
PVB + PVPVM	-	8021	8022	8023	8024	8025	8026	17B8027	8028	8029	8030	8081	8082
Weight kg [lb]	0.1 [0.2]	0.15 [0.3]	0.25 [0.6]	0.30 [0.7]	0.40 [0.9]	0.45 [1.0]	0.50 [1.1]	0.60 [1.3]	0.65 [1.4]	0.70 [1.6]	0.80 [1.7]	0.85 [1.8]	0.9 [2.0]

PVP, pump side module

PVP, pump side module

Description		Without pilot supply		With pilot supply			
		for PVE	for PVE with facilit. for PVPX	for PVE	for PVE and facilit. for PVPX	for PVE and pilot oil pressure take-off	for PVH and pilot oil pressure take-off
Open center	P = G1/2, T = G3/4	157B5000	-	157B5010	157B5012	-	-
	P = 7/8 -14, T = 11/16 -12	157B5200	-	157B5210	157B5212	-	-
	P = G3/4, T = G3/4	157B5100	157B5102	157B5110	157B5112	157B5180	157B5190
	P = 1 1/16 -12, T = 11/16 -12	157B5300	-	157B5310	157B5312	157B5380	157B5390

Module selection chart

PVE, electrical actuation

PVE, electrical actuation

Description		Code No.			Weight kg [lb]
		Hirsch	AMP	Deut.	
PVEO, on-off	12 V	157B4216	157B4901	157B4291	0.6 [1.3]
	24 V	157B4228	157B4902	157B4292	
PVEO-R, on/off	12 V	157B4217	157B4903	-	
	24 V	157B4229	157B4904	-	
PVEM, prop. medium – Standard	12 V	157B4116	-	-	0.9 [2.0]
	24 V	157B4128	-	-	
PVEM, prop. medium – Float – > B	12 V	157B4416	-	-	1.0 [2.2]
	24 V	157B4428	-	-	
PVEA, active fault mon. PVEA, passive fault mon.		- -	157B4734 157B4735	157B4792 -	0.9 [2.0]
PVEA-DI, active fault mon. PVEA-DI, passive fault mon.		- -	157B4736 157B4737	157B4796 -	
PVEH active fault mon. PVEH passive fault mon.		157B4032 157B4033	157B4034 157B4035	157B4092 157B4093	1.0 [2.2]
PVEH float – > B, act. fault PVEH float – > A, act. fault		157B4332 -	- 157B4338	157B4392 -	
PVEH- DI active fault mon. PVEH - DI passive fault mon.		- -	157B4036 157B4037	157B4096 -	
PVES, active fault mon. PVES, passive fault mon.		157B4832 157B4833	157B4834 157B4835	157B4892 -	

PVMD, PVMR, PVMF, PVH covers

Description	Code No.	Material	Anodized	Weight kg [lb]
PVMD Cover for PVB	157B0001	aluminium	no	0.1 [0.2]
	157B0009		yes	
	157B0021	cast iron	N/A	0.9 [2.0]
PVMR (Friction Detent)	157B0004	aluminium	no	0.3 [0.6]
	157B0012		yes	
	157B0024	cast iron	N/A	
PVMF (Mech. float position)	157B0005	aluminium	no	
Hydraulic actuation PVH 9/16-18 UNF	157B0007	aluminium	no	0.2 [0.4]
	157B0010		yes	
	157B0014	cast iron	N/A	
Hydraulic actuation PVH G1/4	157B0008	aluminium	no	
	157B0011		yes	
	157B0016	cast iron	N/A	0.9 [2.0]