Valvistor® Proportional Throttles to ISO 7368 (DIN 24342)

CVCS-**-HFV, 10 Series, Covers
CVI-**-HFV-A/B, 10 Series, Inserts

General Description

The HFV (Hydraulic Feedback Valvistor®) range of slip-in cartridge valves uses a self-regulating hydraulic design for the control of flow rate by a current-controlled PWM signal. The design achieves servo-type control of the main poppet without using an electrical feedback transducer.

The construction and features of these valves open up a wide range of applications with hydraulic cylinders and motors. Such applications include die casting, deep drawn presses, injection molding, container handling, shovel loaders, forestry and dump trucks.

With the addition of HFV valves to the established ISO 7368 (DIN 24342) cartridge valves, Vickers has further enhanced an already comprehensive range.

Valvistor® Technology◆

In “Valvistor” designs a main poppet amplifies a small flow through the pilot circuit, comparable to a transistor. Thus the name “Valvistor”, derived from “valve” and “transistor”.

Figures 1 and 2 show the construction of proportional throttles to ISO 7368. In both cases a Vickers type KTG4V-3S proportional valve is used as the pilot control valve.

Hydraulic position feedback is obtained by providing the main poppet with a longitudinal slot (5) in its cylindrical surface. This slot, together with a metering edge inside the sleeve, forms a variable orifice between the inlet of the valve and the volume above the main poppet (3). When the valve is closed and the main poppet is seated, the variable orifice area is almost closed.

Basic Characteristics

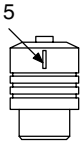
Nominal sizes:

ISO 7368	DIN 24342
06	NG16
08	NG25
09	NG32
10	NG40
11	NG50
12	NG63

Max. operating pressure . . . . . 350 bar (5000 psi)

Flow ratings . . . . . up to 2160 L/min (571 USgpm)

Catalog data based on pilot valve KTG4V-3S-EN427.



◆ *Patents applied for worldwide*

Figure 1
Construction for flow direction A to B; poppet in the closed (no flow) condition. (Note: For flow A-B, poppet drilled from A.)

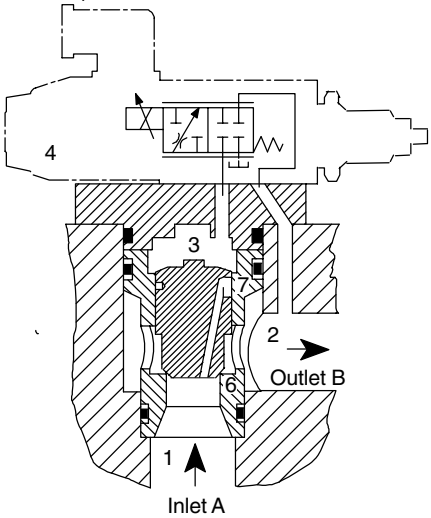
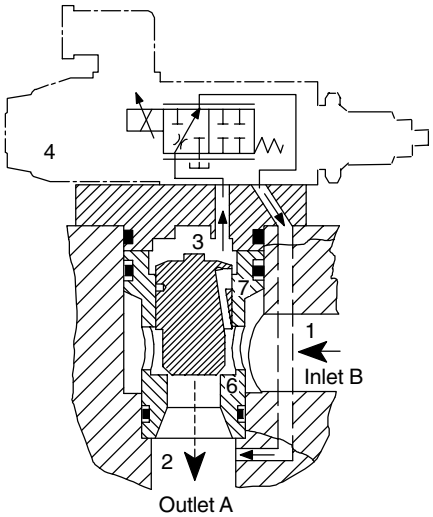


Figure 2
Construction for flow direction B to A; poppet partially open. (Note: For flow B-A, poppet drilled from B.)



As the main poppet opens, the variable orifice area increases. The slot is a part of one leg of a hydraulic bridge circuit and provides an internal position feedback.

With the pilot throttle valve closed (figure 1), there is no pilot flow through the closed-off slot in the seated poppet. The pressure above the main poppet (3) is equal to the pressure at the valve inlet (1), due to the controlled small opening at the variable orifice. As the upper area of the poppet is greater than the area facing the inlet (1), the poppet is held against its seat (6) by a force proportional to the difference between valve inlet and outlet pressures.

Opening the pilot throttle valve (figure 2) lowers the pressure in volume (3) allowing the main poppet to move off its seat. As this occurs the slot passes the metering edge (7), opening the variable orifice and allowing flow through the pilot circuit. Initially the flow through the pilot valve equals the flow through the slot *plus* the volume displaced by the opening movement of the main poppet.

The main poppet moves upwards until the pressure drops across the slot and the pilot effects a force balance on the poppet. The poppet is then held in a steady-state condition with equal flow across the slot and the pilot.

If the flow through the pilot valve is reduced (by reducing the command current to the solenoid), the force balance of the main poppet is again disturbed and the main poppet moves downwards reducing the slot area and decreasing flow to the upper chamber until the force balance is restored.

Thus by controlling flow through the pilot valve, the main poppet can be controlled in any position from fully closed to fully open. In this manner a very simple, effective servo-control of the main poppet is obtained.

As the pilot flow is returned to the valve outlet (i.e. no “drain” connection) the valve is energy efficient.

If the outlet pressure exceeds inlet pressure when the pilot valve is closed, the main poppet allows reverse flow (see CVCS model code 4).

The main valve function is determined by the type of pilot fitted. If pressure compensation is added to the pilot stage, the complete valve is pressure compensated. If a pilot relief valve is fitted, the mainstage operates as a relief valve.

Therefore the position of the main poppet is controlled by a closed-loop system with a variable orifice in the poppet acting as the internal position feedback element. The command signal in this feedback system is pilot flow, as set at the proportional pilot throttle valve (4).

Features and Benefits

The HFV range with its simplicity, cost effectiveness and performance level can be applied in almost all applications from high performance industrial areas such as injection molding to those applications just requiring proportional functionality. The data in this catalog is based on the specially developed proportional pilot KTG4V-3S-60-EN427. The functional flexibility of the Valvistor may be extended by the use of different pilots. Contact Vickers for application assistance.

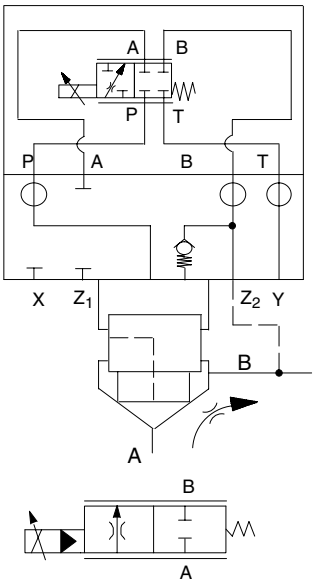
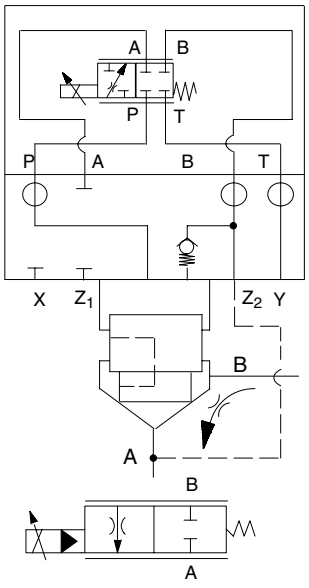
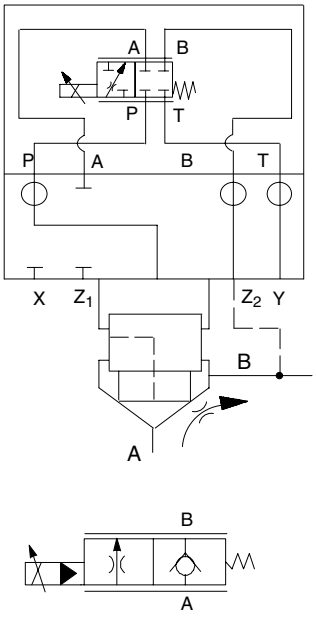
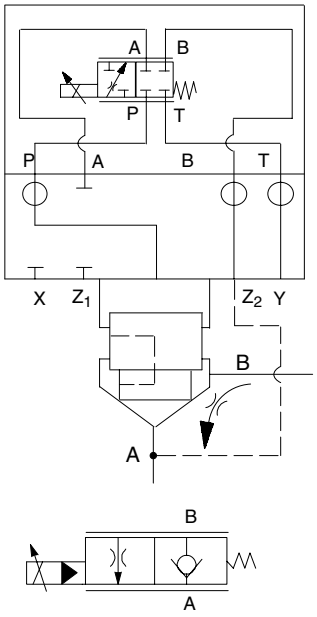
In addition, the HFV range offers:

Unequalled simplicity	No inner electrical feedback loop and associated electronics
Two models: for flow direction A to B or B to A	Provides system design options and flexibility
Free flow in reverse direction	Provides system design options and flexibility
Poppet valve construction	Provides tight shut-off and load holding
Internal pilot flow	Simple installation and energy efficient
Very fast response	Provides the system designer with high dynamic acceleration/velocity/deceleration profiles for demanding performance requirements such as: • Cylinder position control including lift/lower • Rotary actuator dynamic control • Velocity profile control
Smooth closing and opening	Shock-free start-up and shut-off allow high velocities to be maintained for longer periods, thus reducing cycle times
Low hysteresis	Typically less than 8% with a PWM signal. Permits accurate positioning
Integral feedback	Internal hydraulic feedback provides effective, low-cost position control of main poppet
Repeatability	Provides repeatable and accurate actuator velocity to a given operator command input
Electrical operation	Current-controlled PWM signal, see pilot valve electrical data, page 6
Pressure compensation	Can be achieved by pressure compensating pilot stage only
Cost-effective design	Provides multiple functions such as pressure compensation, flow control and reverse free flow check valve
Optional manual override	Pin design
Compatible with antiwear hydraulic oils and phosphate esters (non alkyl)	Flexible application for broad range of installations
Electrical connections DIN or conduit box	Provides design flexibility to meet OEM or user preference
Inherent benefits of Vickers cartridge valve technology are applicable to the Valvistor range.	

Functional Symbols

Complete valve assembly comprises insert, cover and proportional solenoid operated pilot valve (pilot valve to be specified and ordered separately).

Direction of controlled flow

	A to B Use insert type CVI-**-HFV-20-**A**-***-1*	B to A Use insert type CVI-**-HFV-20-**B**-***-1*
Models without free reverse flow capability Use cover type CVCS-**-HFV*-**W**-*2(9)-1*		
Simplified symbol		
Models with free reverse flow capability Use cover type CVCS-**-HFV*-*2(9)-1* *Note: Omit W from model code position* 4, *see page 5*		
Simplified symbol		

Model Codes

Valvistor Throttle Inserts

(F3-) CVI - ** - HFV - 20 - * - *** - 1*

1 2 3 4 5 6

1 Fluid compatibility

F3 = Seals for phosphate esters or chlorinated hydrocarbons
Omit for all other fluid types

2 Nominal size to ISO 7368 (DIN 24342)

16 = 06 (NG16)
25 = 08 (NG25)
32 = 09 (NG32)
40 = 10 (NG40)
50 = 11 (NG50)
63 = 12 (NG63)

3 Area ratio

20 = 1:2.0 area ratio

4 Flow direction

A = For flow A to B
B = For flow B to A

5 Flow capacity at Δp = 10 bar (150 psi)

Valve size	**Code**	L/min	USgpm
16	**18**	175	46
25	**40**	405	107
32	**63**	630	166
40	**81**	810	214
50	**130**	1305	345
63	**216**	2160	571

6 Design number, 1* series

Subject to change. Installation dimensions unaltered for design numbers 10 to 19.

Valvistor Throttle Covers
(Suitable for flows A to B and B to A)

(F3-) CVCS - ** - HFV * * - * 2 (9) - 1*

1 2 3 4 5 6 7

1 Fluid compatibility

F3 = Seals for phosphate esters or chlorinated hydrocarbons
Omit for all other fluid types

2 Nominal size to ISO 7368 (DIN 24342)

16 = 06 (NG16)
25 = 08 (NG25)
32 = 09 (NG32)
40 = 10 (NG40)
50 = 11 (NG50)
63 = 12 (NG63)

3 Size 3 pilot valve mounting bolts

1 = Imperial threads
3 = Metric threads

4 Control option

W = Mainstage Valvistor without free reverse flow capability
Omit for standard mainstage Valvistor with free reverse flow capability

5 Thread/seal combination

B = G (BSPF) threads for gage ports; metric threads for orifices (only available when “3” specified at position 3)
S = SAE O-ring gage ports; inch threads for orifices (only available when “1” specified at position 3)

6 Mounting bolts Sizes 16-40 only

9 = Metric mounting bolts supplied as standard when “B” (BSPF threads) specified at position 5
Omit for sizes 50 and 63

7 Design number, 1* series

Subject to change. Installation dimensions unaltered for design numbers 10 to 19.

Operating Data

Data is typical with fluid at 36 cSt (168 SUS) and 50°C (122°F).

Maximum pressure	350 bar (5000 psi)					
Flow ratings	See model code (CVI) 5					
Controlled flow characteristics	See graphs on pages 7 and 8					
Pressure drop, free return flow	See graphs on page 9					
Dynamic performance:	06 (NG16)	08 (NG25)	09 (NG32)	10 (NG40)	11 (NG50)	12 (NG63)
Step input s response at Δp = 10 bar (145 psi)						
Opening time (ms)	50	85	130	240	280	340
Closing time (ms)	40	60	85	130	200	300
Hysteresis s	<8%	<8%	<8%	<8%	<8%	<8%
Repeatability s	<3%	<3%	<3%	<3%	<3%	<3%
Area ratio (all sizes)	2.0:1					
Hydraulic fluids	See page 10					
Temperature limits	See page 10					
Filtration requirements	See page 10					
Mounting bolts and assembly torques	See page 11					
Seal kits	See page 11					
Mass	See page 11					

s *Data quoted with KTG4V-3S---60-EN427 as pilot valve, driven by EEA-PAM-520-A-12*

Pilot Valve Electrical Data
Full performance data and model code breakdown can be found in catalog 539 rev. 8/93.

Type	KTG4V-3S---60-EN427 (denotes special spool)	
	Coil type G	H
Max. current at 50°C (122°F)	3.2A	1.6A
Coil resistance at 20°C (68°F)	1.8 ohms	7.3 ohms
Coil inductance at 1000 Hz	7.5 mH	29 mH
Relative duty factor	Continuous rating (ED = 100%)	
Electrical protection with plugs fitted correctly	IEC 947 class IP65	
Recommended amplifier	EEA-PAM-520-A-12	

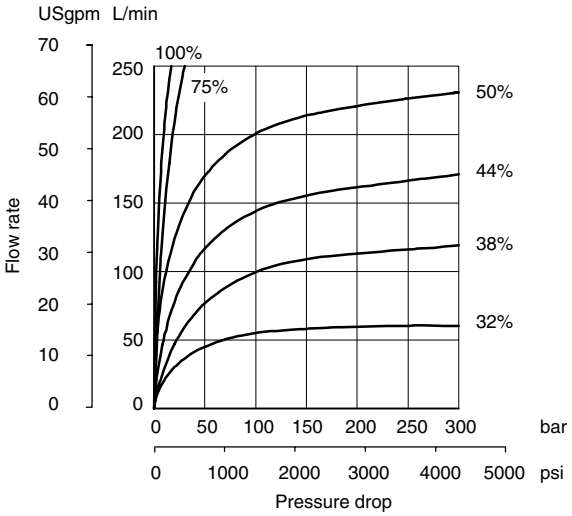
Performance Characteristics
The graphs on the following two pages show typical flow characteristics for different values of input current to pilot valve plotted against flow rate and valve pressure drop. They are based on a standard HFV insert and cover with a KTG4V-3S---EN427 pilot valve.

A minimum pressure drop of 5 bar (72 psi) is recommended. Higher pressure drops result in improved control.

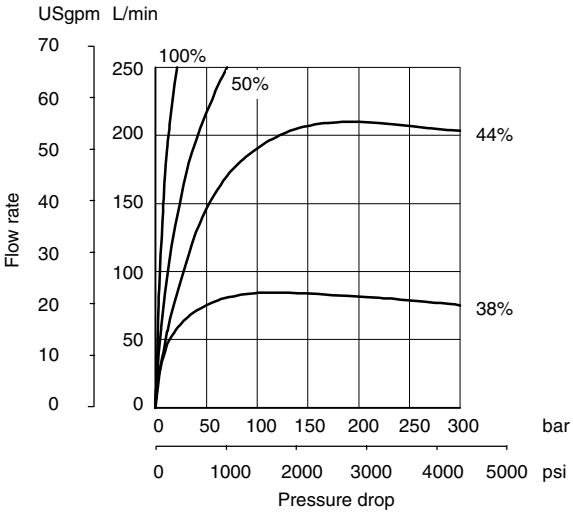
Flow/Pressure Drop vs Solenoid Current (% of max.) 2.

Size 16

Flow A → B



Flow B → A



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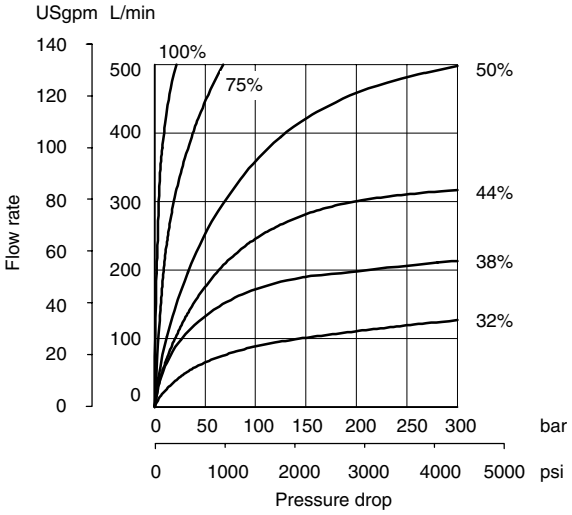
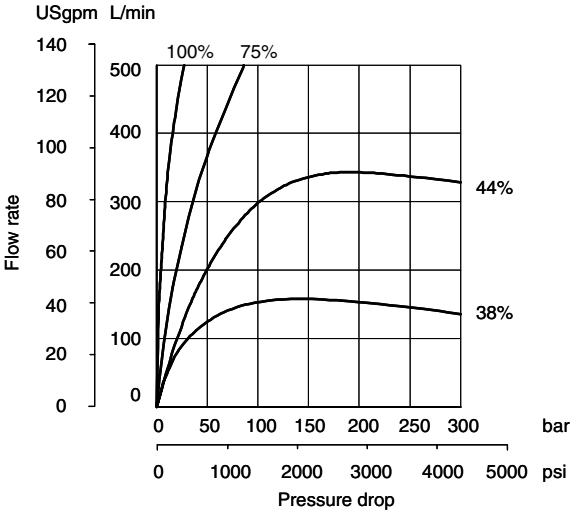
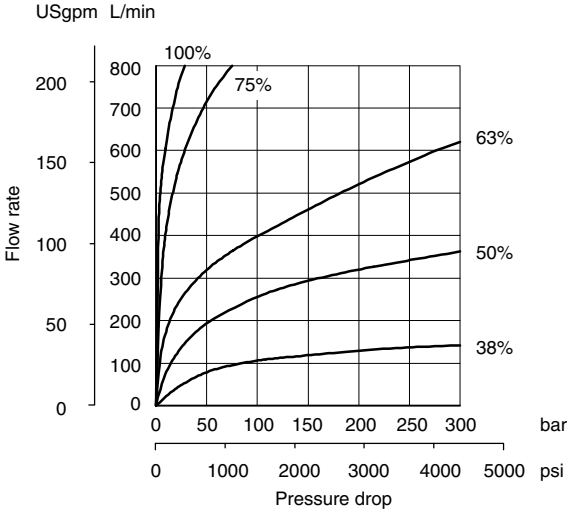
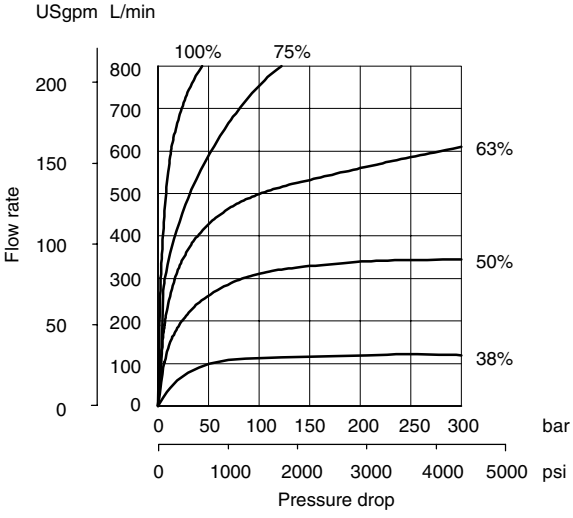




Size 32

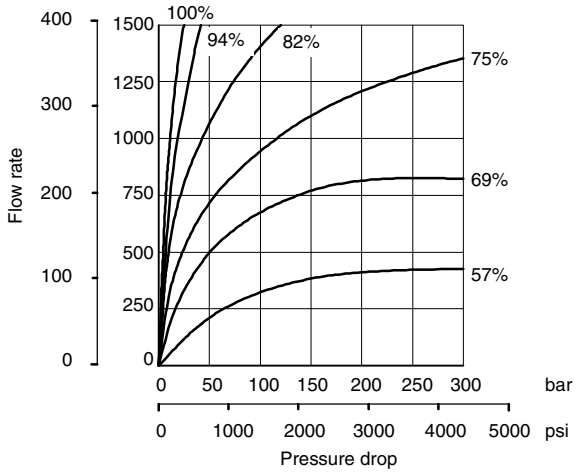




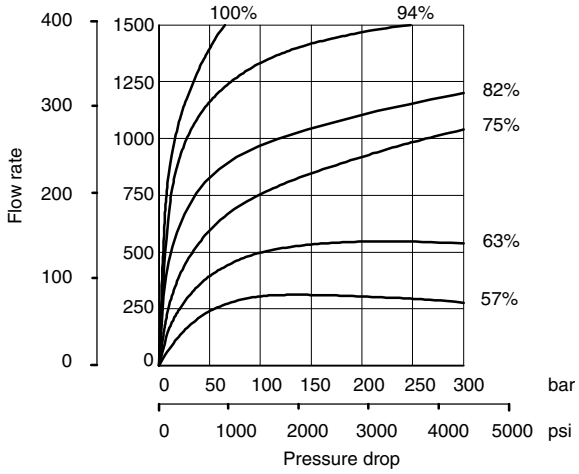
Size 40

Flow A → B

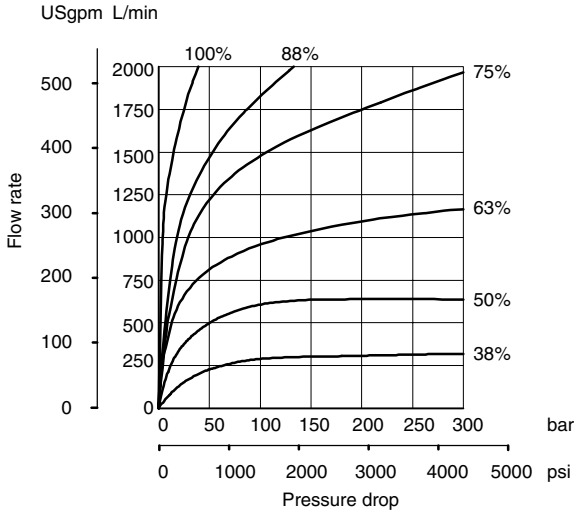
3.

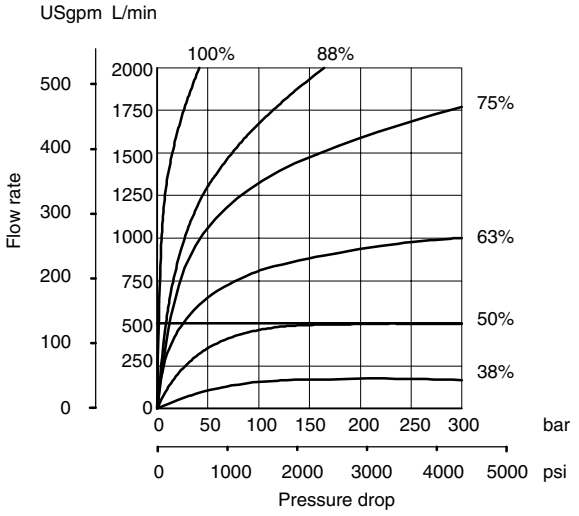


Flow B → A

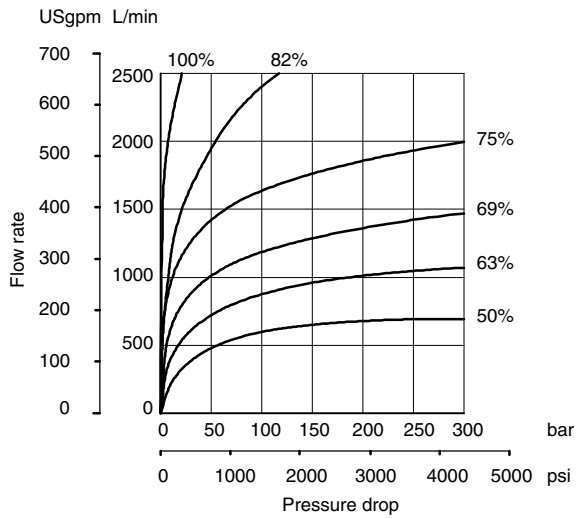


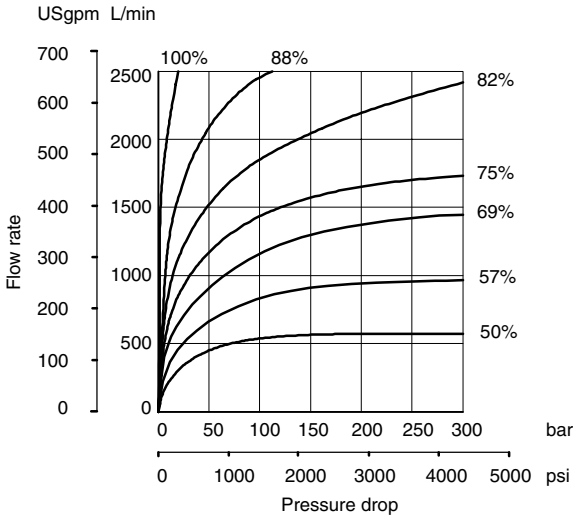
Size 50





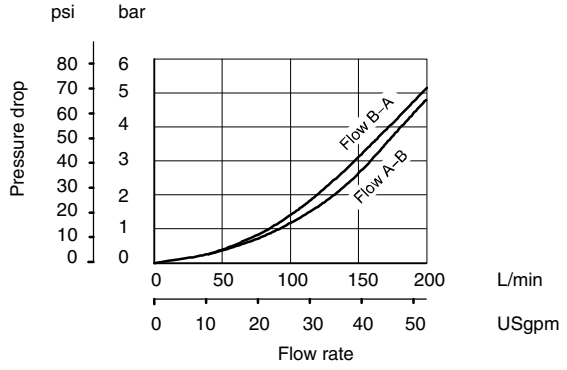
Size 63





Pressure Drops – Free Return Flow 4.
See CVCS model code 4

Size 16



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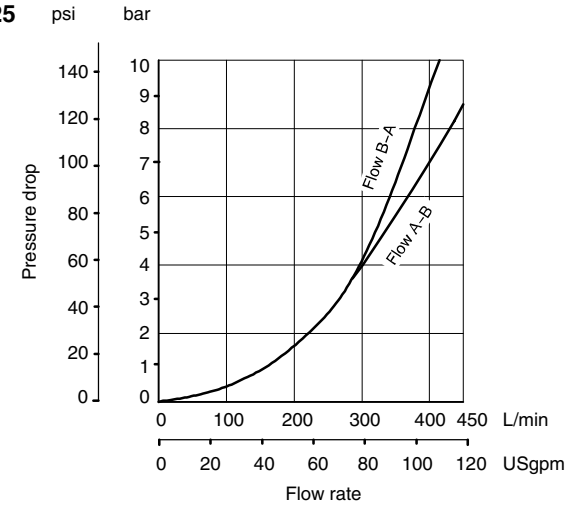
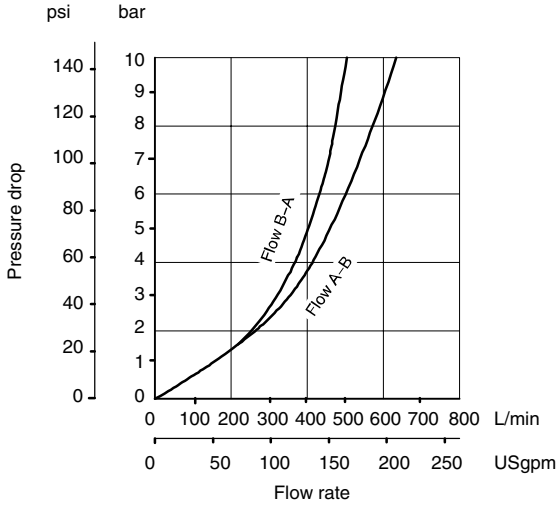
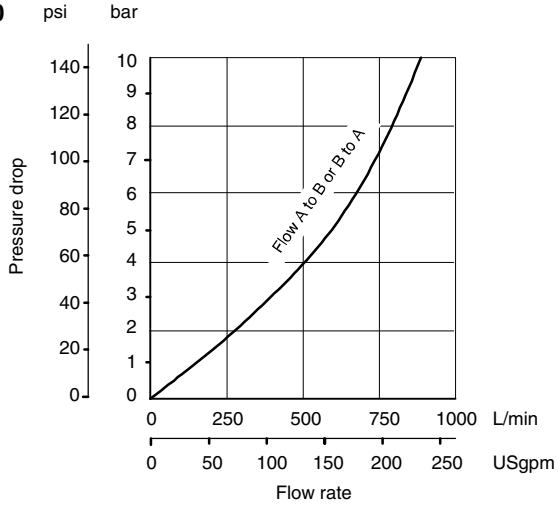


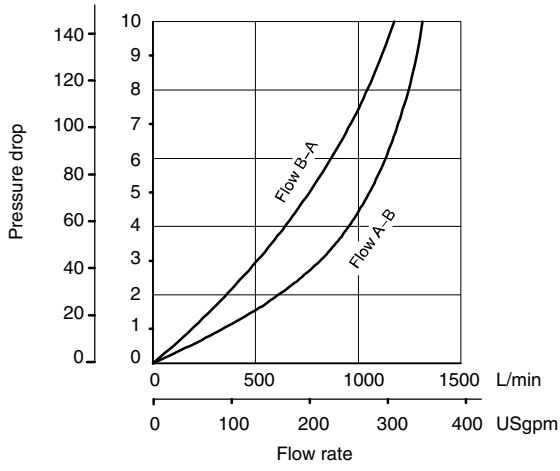
Size 32



Size 40



Size 50



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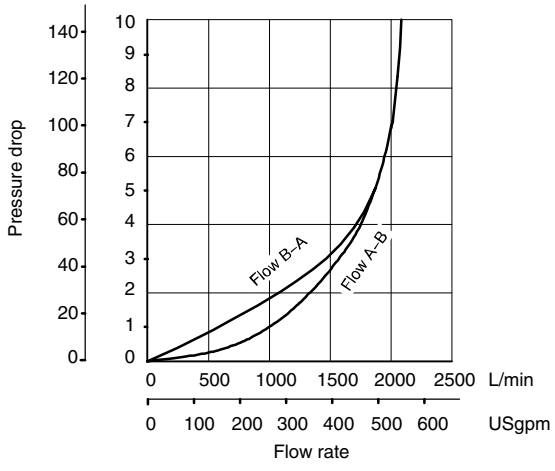


Hydraulic Fluids

All cartridge valves can be used with antiwear hydraulic oils, and certain low viscosity fluids. Add prefix “F3” to model designations when phosphate esters (not alkyl-based) or chlorinated hydrocarbons are to be used. The extreme viscosity range is from 500 to 5 cSt (2270 to 42 SUS) but the recommended running range is from 54 to 13 cSt (245 to 70 SUS).

Temperature Limits

Ambient min. . . . . – 20°C (–4°F)
Ambient max. . . . . +70°C (+158°F)

Fluid temperatures

	Petroleum oil	Water-containing
Min.	–20°C (–4°F)	+10°C (+50°F)
Max.	+80°C (+176°F)	+54°C (+130°F)

Filtration Requirements

Essential information on the correct methods for treating hydraulic fluid is included in the Vickers publication 561 “Vickers Guide to Systemic Contamination Control”, available from your local Vickers distributor or by contacting Vickers, Incorporated.

Recommendations on filtration and the selection of products to control fluid condition are included in Vickers publication 561.

Recommended cleanliness levels using petroleum oil under common conditions is based on the highest fluid pressure levels in the system.

In referencing the table below, the shaded area highlights the recommended cleanliness level for Valvistor proportional throttles.

Fluids other than petroleum, severe service cycles or temperature extremes are cause for adjustment of these cleanliness codes. See Vickers publication 561 for exact details.

	SYSTEM PRESSURE LEVEL		
PRODUCT	**69 bar (1000 psi)**	**138 bar (2000 psi)**	**210+ bar (3000 psi)**
Vane Pumps – Fixed	20/18/15	19/17/14	18/16/13
Vane Pumps – Variable	18/16/14	17/15/13	
Piston Pumps – Fixed	19/17/15	18/16/14	17/15/13
Piston Pumps – Variable	18/16/14	17/15/13	16/14/12
Directional Valves	20/18/15	20/18/15	19/17/14
Pressure/Flow Control Valves	19/17/14	19/17/14	19/17/14
Servo Valves	16/14/11	16/14/11	16/13/10
Proportional Valves	17/15/12	17/15/12	15/13/11
Cylinders	20/18/15	20/18/15	20/18/15
Vane Motors	20/18/15	19/17/14	18/16/13
Axial Piston Pumps	19/17/14	18/16/13	17/15/12
Radial Piston Pumps	20/18/14	19/17/13	18/16/13

Mounting Bolts and Assembly Torques

For Covers

As noted in CVCS model code position 6, cover types CVCS-**-HFV**1**-(W)-**B29**-1*, sizes 16 to 40 inclusive, are supplied complete with metric mounting bolts. For correct installation of all other CVCS-**-HFV* cover types, the following Vickers bolt kits are recommended.

Inch threads

Nominal size	Bolt size	Vickers bolt kit model code	Recommended assembly torque, lbf ft [s]
16	5/16”-18 x 1.50	BKDNG16-700	26
25	1/2”-13 x 1.50	BKDPNG25-704	81
32	5/8”-11 x 2.00	BKDNG32-713	210
40	3/4”-10 x 2.25	BKDPNG40-706	370
50	3/4”-10 x 3.00	BKDNG50-708	429
63	1 1/4”-7 x 3.50	BKDNG63-710	888

Metric threads

Nominal size	Bolt size	Vickers bolt kit model code	Recommended assembly torque, Nm [s]
16	[t]	–	35
25	[t]	–	110
32	[t]	–	285
40	[t]	–	500
50	M20 x 80	BKDNG50-709M	580
63	M30 x 90	BKDNG63-711M	1200

[s] *With threads lubricated.*

[t] *See installation drawing, next page.*

For Pilot Valve

See catalog 539

Seal Kits

For CVI-**-HFV inserts

Nominal size	Seal kit type, see model code 1	
	Standard	F3-
16	456173	02-157617
25	456926	02-157618
32	479449	02-157619
40	478732	514808
50	478733	02-157620
63	456798	02-157621

For CVCS-**-HFV covers

Nominal size	Seal kit type, see model code 1	
	Standard	F3-
16	02-157672	02-157671
25	02-157674	02-157673
32	02-157905	02-157906
40	02-157712	02-157713
50	02-310971	02-310973
63	02-310975	02-310976

Mass Approx., kg (lb)

Nominal size	CVI-**-HFV insert	CVCS-**-HFV cover
16	0,13 (0.29)	1,2 (2.6)
25	0,33 (0.73)	1,9 (4.2)
32	0,9 (1.98)	3,3 (7.3)
40	1,35 (3.0)	6,3 (13.9)
50	2,2 (4.8)	9,6 (21.0)
63	5,4 (11.9)	19,4 (42.7)

Ordering Procedure

The component parts of the Valvistor proportional throttle assembly, including the pilot control valve, must be ordered individually. In addition there is a choice of electronics: typically a Vickers Eurocard drive amplifier, alternatively a Vickers 12V DC or 24V DC proportional power plug. The full model code must be specified in all cases.

Typical Valvistor Component Selection

1 x CVI-**-HFV-20-*-**-10 insert, see this catalog
1 x CVCS-**-HFV**-*2*-10 cover, see this catalog
1 x cover mounting bolt kit [u], see this catalog
1 x KTG4V-3S- - - 60-EN427, see product catalog 539
1 x pilot valve mounting bolt kit, product catalog 539

Plus:

Drive Electronics for 24V DC System

1 x EEA-PAM-520-A-14 Eurocard amplifier, see catalog 2270

or

1 x EHH-AMP-702-*-10 proportional power plug, see catalog 2115

Drive Electronics for 12V DC System

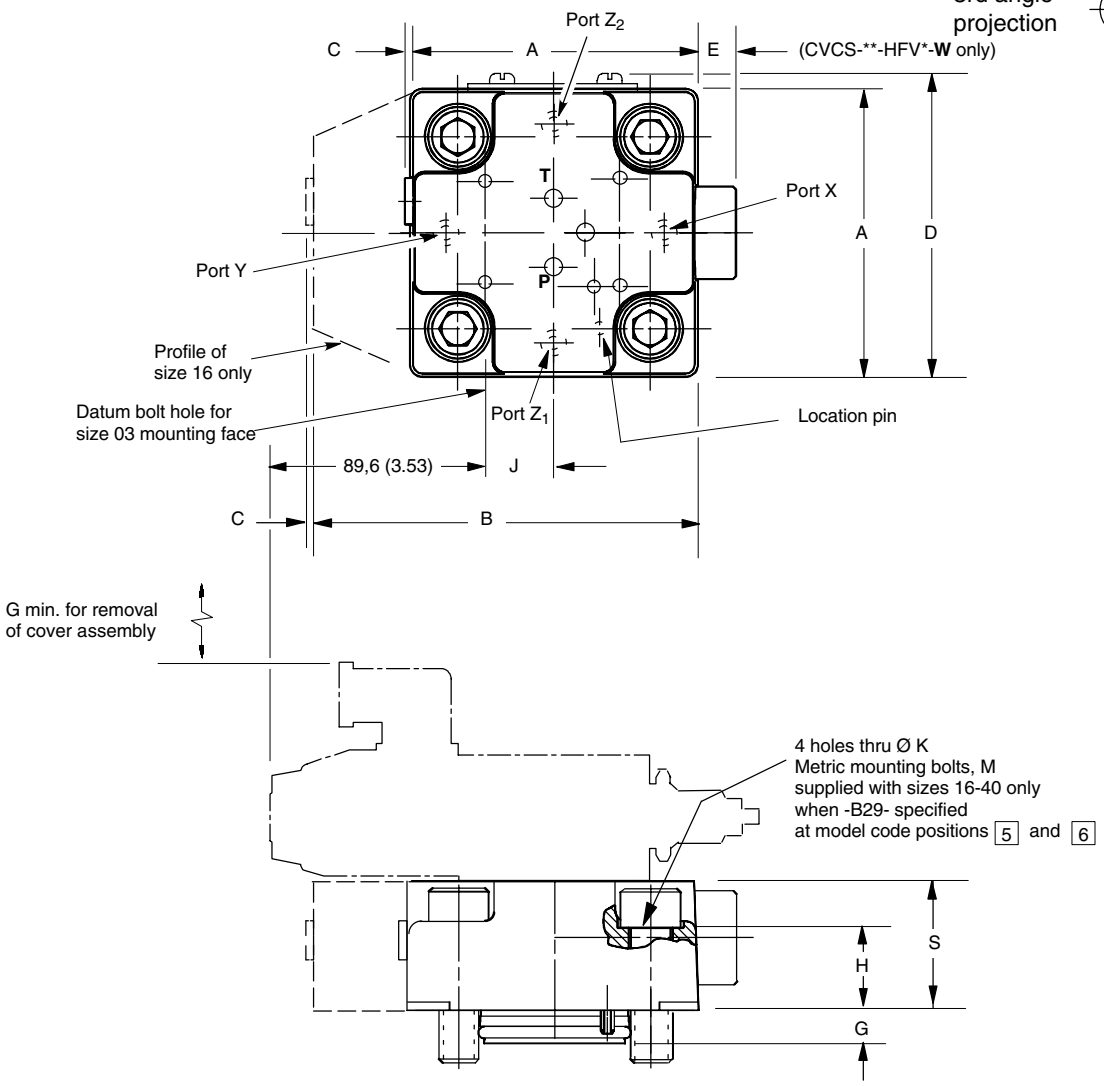
1 x EHH-AMP-712-*-10 proportional power plug, catalog 2282

[u] *Metric bolts supplied with cover sizes 16 to 40 incl. type -B29-, see CVCS model code 6 on page 81.*

Installation Dimensions in mm (inches)

CVCS--HFV***

3rd angle projection



Valve size	A sq.	B	C max.	D	E max.	G	H	J	Ø K (K dia.)	M Mounting bolts (supplied)	S
16	66,0 (2.6)	85,5 (3.36)	4,5 (0.18)	68,5 (2.7)	14,5 (0.57)	8,0 (0.32)	36,0 (1.42)	32,50 (1.28)	8,75/9,25 (0.344/0.364)	M8 x 50 cap hd. screw	48,0 (1.89)
25	86,0 (3.38)	–	3,5 (0.14)	88,5 (3.5)	13,5 (0.53)	10,5 (0.42)	25,0 (0.98)	20,75 (0.82)	13,75/14,25 (0.541/0.561)	M12 x 40 cap hd. screw	39,0 (1.54)
32	102,5 (4.0)	–	3,5 (0.14)	104,5 (4.2)	13,5 (0.53)	13,0 (0.52)	30,0 (1.18)	21,50 (0.85)	17,75/18,25 (0.699/0.718)	M16 x 55 cap hd. screw	48,0 (1.89)
40	126,0 (5.0)	–	2,0 (0.08)	128,5 (5.1)	11,0 (0.43)	15,0 (0.59)	35,0 (1.38)	21,50 (0.85)	21,75/22,25 (0.856/0.875)	M20 x 60 cap hd. screw	58,0 (2.28)
50	142,5 (5.6)	–	4,5 (0.18)	145,0 (5.7)	0 (0)	18,0 (0.71)	42,0 (1.66)	21,50 (0.85)	21,75/22,25 (0.856/0.875)	–	68,0 (2.68)
63	183,0 (7.2)	–	4,5 (0.18)	185,5 (7.3)	0 (0)	20,0 (0.79)	48,0 (1.89)	21,50 (0.85)	32,75/33,25 (1.289/1.309)	–	83,0 (3.27)