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INSTALLATION DIMENSION KBSDG4V-3

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This product has been designed and tested to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 2014/30/EU which repealed Directive 89/336/EEC, amended by Directives 91/263/EEC, 92/31/EEC, 93/68/EEC and 93/97/EEC. For instructions on installation requirements to achieve effective protection levels, see the leaflet and Installation Wiring Practices for Eaton's Electronic Products leaflet 2468. Wiring practices relevant to this Directive are indicated by Δ Electromagnetic Compatibility (EMC).

General description

The KBSDG4V-3 line offers a range of proportional directional valves with integral control electronics. Factory-set adjustments of gain and offset ensure consistent reproducibility valve-to-valve.

These four-way solenoid operated proportional valves have a high dynamic performance which enables them to be used in closedloop applications, previously possible only with servo valves. Various spool options are available for rated flows up to 40 L/min (10.6 USgpm). Working pressures are to 350 bar (5000 psi). The spool position is monitored by an LVDT which feeds back information to the amplifier, enabling spool position to be accurately maintained.

This valve type can be supplied with or without an integral amplifier built directly onto the valve.

KSDG4V-3

Without the integral amplifier.

Features and benefits

- Wide range of spool and flow rate options.
- Supported by a broad range of amplifiers and auxiliary function modules.
- Electronic feedback LVDT ensures accurate spool position control.
- Internal current feedback provides optimal control.
- Vibration and shock tested.
- Full CE electromagnetic compatibility.

KBSDG4V-3

With integral control electronics.

Factory-set adjustments of gain and offset ensure consistent repeatability valve-to-valve.

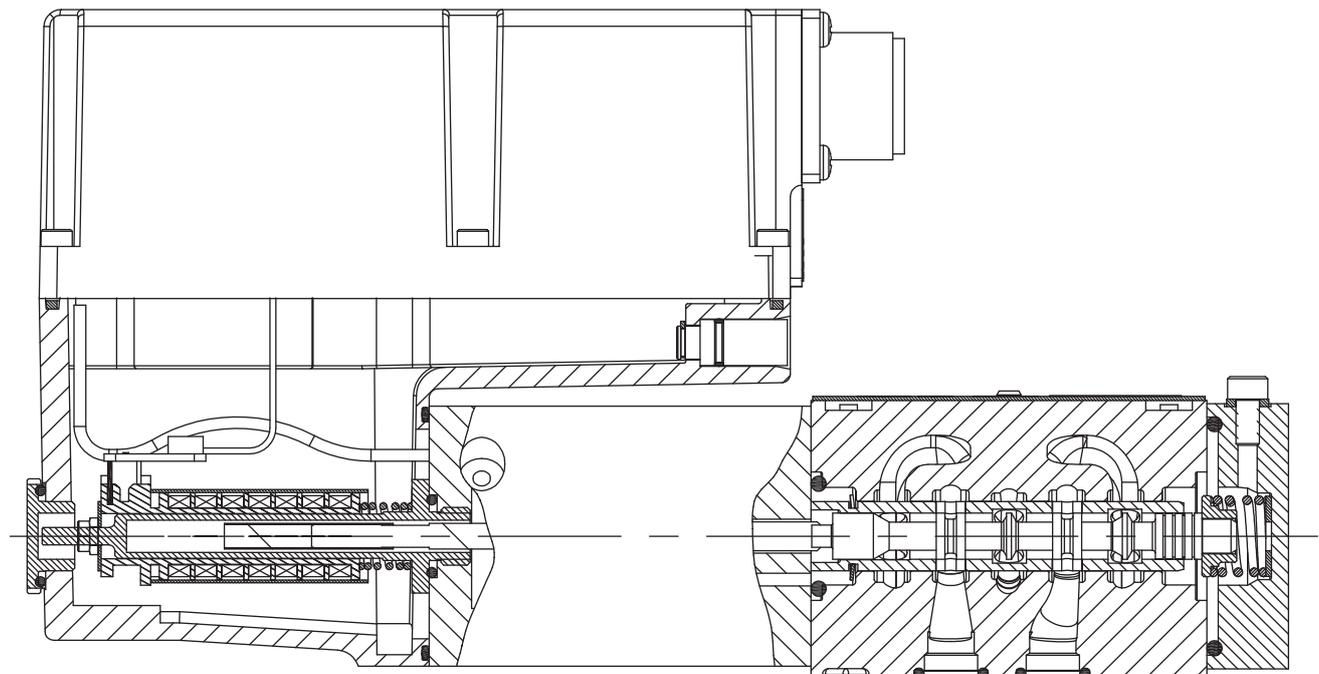
The only electrical inputs required are power supply (24V) and a command signal, either $\pm 10V$ or 4-20 mA (model code selectable). The amplifier is housed in a robust metal enclosure, sealed against ingress of water and other fluids. Electrical connections are via a standard 7-pin plug.

A spool position monitor pin allows the function of the valve to be electrically monitored. Ramp functions, if required, can be generated externally.

Features and benefits

- Factory-sealed adjustments ensure valve to-valve reproducibility.
- Installation wiring reduced and simplified.
- Standard 7-pin connector.
- Standard 24V DC supply with wide tolerance band.
- Optional command signal, $\pm 10V$ or 4-20 mA (model code selectable).
- Valve with integrated amplifier selected, ordered, delivered and installed as one performance-tested package.
- Spool position monitor pin to help with troubleshooting.
- Simple valve removal and replacement for service (plug & play).
- Vibration and shock tested.
- Auxiliary DIN rail mounted electronic function modules available.
- Full CE electromagnetic compatibility. - 2014/30/EU
- IP67 valve, environmental protection rating.
- Optional valve enable function.

Typical section view



KBSDG4V-3

Model code

K	(B)	S	D	G	4	V	-3-	9	*	L-	**	-M*	-U1-	**	-H	7	-1*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

1	Valve type K Proportional valve	12	Rated flow at 70 bar (1000 psi) loop Δp pressure drop 5 5 L/min (1.3 USgpm) 12 12 L/min (3.2 USgpm) 24 24 L/min (6.3 USgpm) 40 40 L/min (10.6 USgpm) For actual maximum flow refer to power capacity envelope curves, page 8.
2	Integral amplifier B Integral amplifier “B” series Omit for models without integrated amplifiers.	13	LVDT plug (omit for valves with integral amplifier) M1 +/-10V command and +/-10V feedback M2 4-20mA command and +/-10V feedback M3 +/-10V command and 4-20mA feedback M4 4-20mA command and 4-20mA feedback
3	Feedback arrangement S Closed-loop	14	Solenoid connector (omit for valves with integral amplifier) U1 ISO 4400/DIN 43650, non-integral amplifier type only (mating plugs supplied)
4	Control type D Directional valve	15	Electrical connection (KBS valves only) PE7 7 pin electrical plug with mating half PH7 As PE7 but with pin “C” used for enable signal
5	Mounting G Subplate mounted	16	Coil rating H 24V DC amplifier supply
6	Operation 4 Solenoid operated	17	Port T pressure limit code 7 For all spools
7	Pressure rating V >250 bar (3625 psi) on ports P,A, & B	18	Design number 1* Series. Subject to change
8	Interface 3 ISO 4401, size 03-02-0-94 ANSI/B93.7M-D03	19	Special features EN083 Special Amplifier and spool used for EPQ valves EN090 Resin filled amplifier
9	Spool type (center condition) 8 Port P blocked, A & B, to Tank (Reduced Pressure at null) 9 Zero lap (biased underlap)		
10	Spool type, spring offset condition 2 Ports P, A, & T blocked 6 Port P blocked, A & B to tank		
11	Valve build L Standard build		

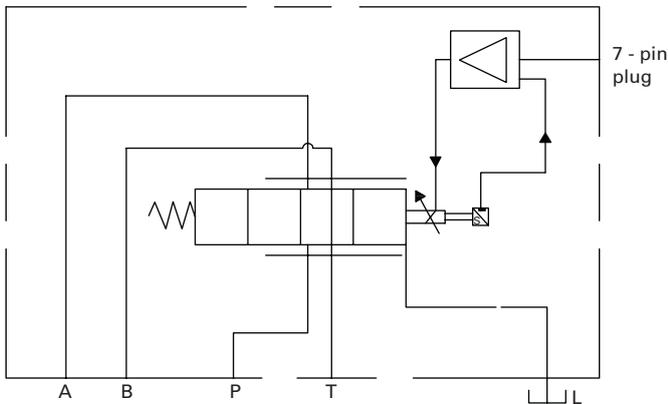
Note: Additional configurations available upon request. Please contact your customer sales representative for details.

WARNING

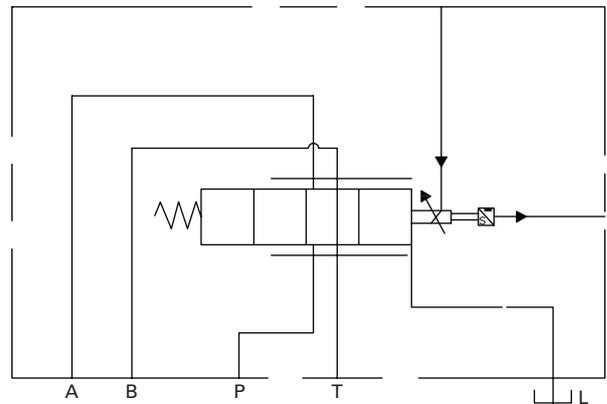
Valves with integral amplifiers are supplied with or without the metal 7-pin plug. The Eaton™ plug, part no. 934939, must be correctly fitted to ensure that the EMC rating and IP67 rating are achieved. The plug retaining nut must be tightened with a torque of 2-2.0 Nm (1.5-2.5 lbf ft) to effect a proper seal.

Spool symbols

Functional symbol



Model types KBSDG4V-3
Proportional directional valve (with integral electronics)



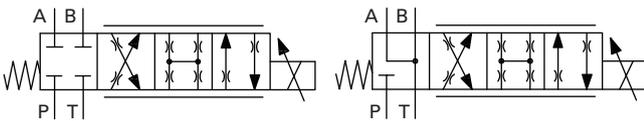
Model types KSDG4V-3
Proportional directional valve (requires amplifier card)

Spool types and flow ratings

Symmetric spools

Base line starting at $\Delta p = 35$ bar (500 psi) per metering flow path, e.g. B to T. For actual maximum flow refer to power capacity envelope curves.

Available spools for K(B)SDG4V-3



Spool type 92L

Spool type 96L

Spool code	Spool symbol	Flow rating
For K(B)SDG4V-3 valves:		
92L05	92L	5 L/min (1.3 USgpm)
92L12	92L	12 L/min (3.2 USgpm)
92L24	92L	24 L/min (6.3 USgpm)
92L40	92L	40 L/min (10.6 USgpm)
96L05	96L	5 L/min (1.3 USgpm)
96L12	96L	12 L/min (3.2 USgpm)
96L24	96L	24 L/min (6.3 USgpm)
96L40	96L	40 L/min (10.6 USgpm)
86L**	86L	

Operating data

KBSDG4V-3 Valves with integral amplifier: Data is typical, with fluid at 36 cSt (168 SUS) and 50°C (122°F).

Power supply	24V DC (18V to 36V including 10% peak-to-peak max. ripple) max current 3A																		
Command signal																			
Voltage mode	0 to 10V DC, or 0 to -10V DC, or -10V to + 10V DC																		
• Input impedance	M1: 47 kΩ																		
• Common mode voltage to pin D	18V (max)																		
Current mode	4-20 mA																		
The content of row input impedance	100 ohms																		
• Max differential voltage to pin E to pin B	10V																		
Valve enable signal for model code PH7																			
Enable	>8.5V (36V max)																		
Disable	<6.5V																		
Input impedance	10 kΩ																		
7-pin plug connector	<table border="1"> <thead> <tr> <th>Pin</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Power supply positive (+)</td> </tr> <tr> <td>B</td> <td>Power supply 0V</td> </tr> <tr> <td>C</td> <td>Not connected (PE7)</td> </tr> <tr> <td>C</td> <td>Valve enable (PH7)</td> </tr> <tr> <td>D</td> <td>Command signal (+V or current in)</td> </tr> <tr> <td>E</td> <td>Command signal (-V or current GND)</td> </tr> <tr> <td>F</td> <td>Output monitor</td> </tr> <tr> <td>G</td> <td>Protective ground</td> </tr> </tbody> </table>	Pin	Description	A	Power supply positive (+)	B	Power supply 0V	C	Not connected (PE7)	C	Valve enable (PH7)	D	Command signal (+V or current in)	E	Command signal (-V or current GND)	F	Output monitor	G	Protective ground
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E	Command signal (-V or current GND)																		
F	Output monitor																		
G	Protective ground																		
Electromagnetic compatibility (EMC)	IEC 61326-2-1 (Electrical equipment for measurement, control and laboratory use)																		
	Conducted Emissions CISPR11 -2015-06 Ed 6.0/EN55011 - Class A, 150kHz to 30MHz																		
	Radiated Emissions CISPR11 -2015-06 Ed 6.0 /EN55011 - Class A, 30MHz – 1GHz																		
	RF Continuous Conducted disturbances IEC 61000-4-6, Class A 150 KHz to 80 MHz																		
	• DC Power Port : 10Vrms																		
	• Signal/Control Port : 10Vrms																		
	RF Electromagnetic Field, 80 MHz to 2700 MHz, 10V/m, Meets Criterion A																		
	Surge: IEC 61000-4-5																		
	• DC Power Port : ±1kV																		
	• Signal/Control Port : ±1kV																		
Electrical Fast Transients IEC 61000-4-4, Class B																			
• DC Power Port : ±2kV																			
• Signal/Control Port : ±1kV																			
Electrostatic discharges (ESD) IEC 61000-4-2, Class B																			
• Air ±8kV																			
• Contact ±4kV																			
Zero adjustment	±18% mechanical adjustment accessible under plug in LVDT																		
Monitor points signal																			
Voltage mode	+/- 10V DC for full stroke																		
Output impedance	10KOhm																		
Current mode	4mA to 20mA																		
Output impedance	Upto 200 ohm																		
Power stage PWM frequency	10 kHz nominal																		
Reproducibility, valve-to-valve (at factory settings): Flow gain at 100% command signal	≤5%																		
Protection:	Time to reach 90% of required step:																		
Electrical	17 ms																		
Mechanical	16 ms																		
Relative humidity	85 to 95% at 20 to 70°C (68 to 158°F)																		
Ambient air temperature range for full performance	-40°C to +85°C (-40°F to 185°F)																		
Oil temperature range for full performance	0°C to 70°C (32°F to 158°F)																		
Minimum temperature at which valves will work at reduced performance	-40°C (-40°F)																		
Storage temperature range	-40°C to +85°C (-40°F to +185°F)																		
ROHS compliance	Electronic amplifier is compliant to 2011/65/EU ROHS2																		
Supporting products: Auxiliary electronic modules (DIN-rail mounting):																			
EHD-DSG-201-A-1* command signal generator	See catalog GB 2470																		
EHA-RMP-201-A-2* ramp generator	See catalog GB 2410A																		
EHA-PID-201-A-2* PID controller	See catalog GB 2427																		

KSDG4V-3 Valves without integral amplifier (requires a Eurocard amplifier, refer to supporting products)

Standing current at null	1.7A
Max current, at 50°C (122°F) ambient	3.2A
Coil resistance, at 20°C (68°F)	1.87Ω
Coil inductance, at 1000 Hz & 150 mV	7.2 mH
Max solenoid power	30W
LVDT supply voltage	+15V DC
LVDT output signal	4 to 20 mA for spool stroke of 2.1 mm
Electromagnetic compatibility (EMC)	IEC61326-2-1
Base amplifier	EEA-PAM-553-A-3* Power requirements: 20 to 40V DC at 40W
Mechanical protection	IEC 144, Class IP65
Maximum allowable ambient air temperature	60°C (140°F)
Maximum allowable oil temperature	60°C (140°F)

KSDG4V-3 and KBSDG4V3 valves (all valves)

Relative duty factor	Continuous rating (ED = 100%)
Hysteresis	<0.5%

Step response:

Step size (% of max spool stroke):	Time to reach 90% of required step:
0-100% or 100-0%	10 mS
10-90% or 90-10%	6 mS
±10% to ±10%	4 mS
±25% to ±25%	5 mS
10-90%	6 mS

Mass:

KSDG4V-3	2.09 kg (4.6 lb) approx.
KBSDG4V-3	2.49 kg (5.5 lb) approx.

Pressures and flow rates

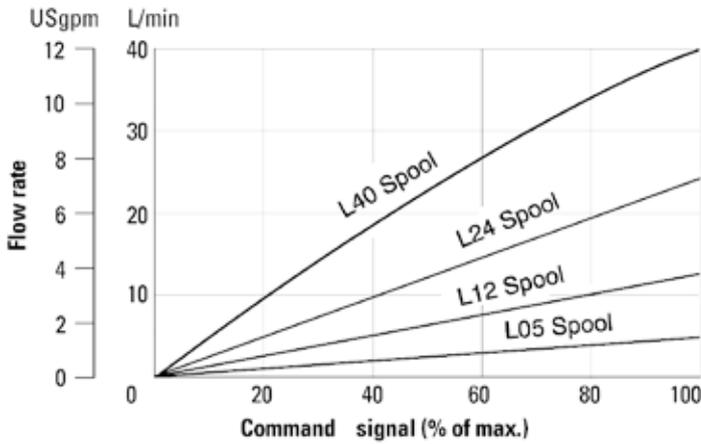
Maximum pressures, bar (psi)

Port L condition	Ports P, A, B	T	L
Normally blocked by mounting surface	350 (5000)	50 (720)	50 (720)
Drained directly to tank	350 (5000)	210 (3000)	10 (145)

Performance curves

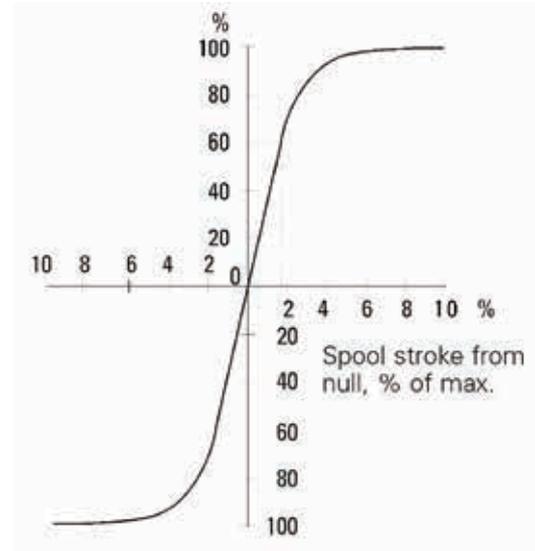
Flow gain

Flow from port P-A-B-T or P-B-A-T at 70 bar (1000 psi) total valve Δp , 35 bar (500 psi) per metering edge



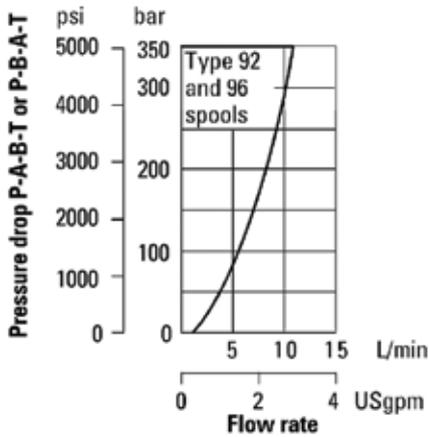
Pressure gain

Δp between ports A and B or B and A, as % of port P pressure

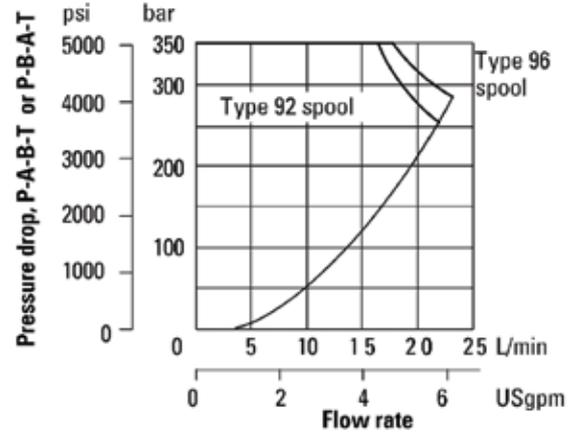


Power capacity envelopes

K(B)SDG4V-3-9*L-05 Valves

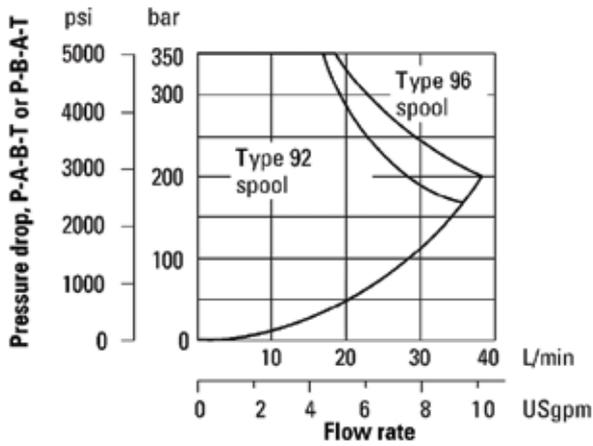


K(B)SDG4V-3-9*L-12 Valves

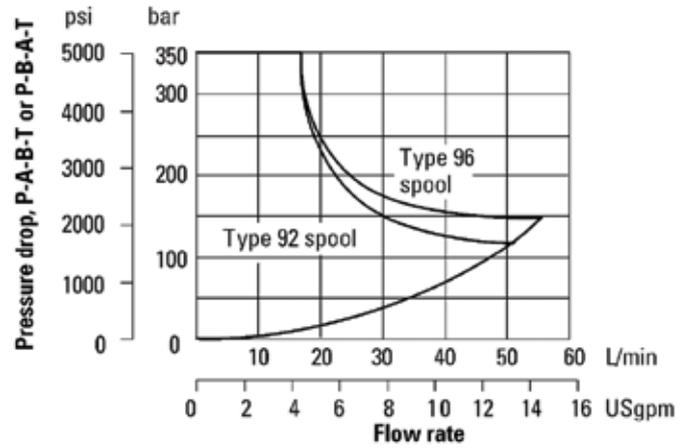


Power capacity envelopes

K(B)SDG4V-3-9*L-24 Valves

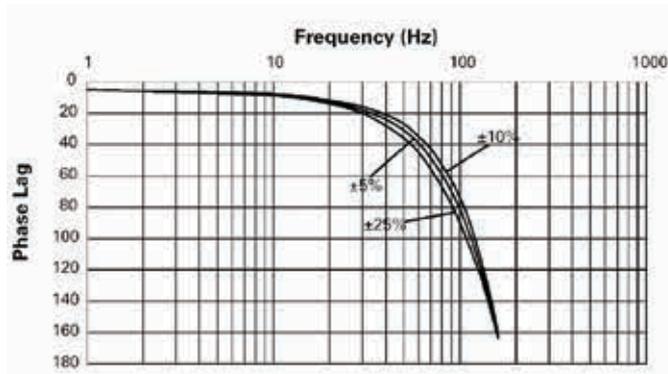


K(B)SDG4V-3-9*L-40 Valves



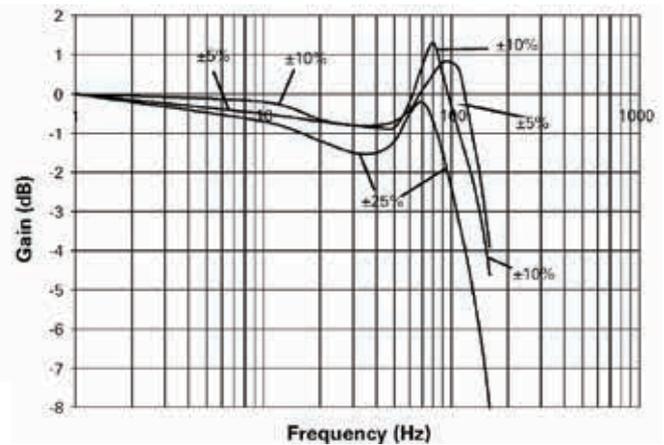
Frequency response, typical

For amplitudes of $\pm 5\%$, $\pm 10\%$, $\pm 25\%$ with zero offset. Δp (P to T) = 70 bar (1000 psi)



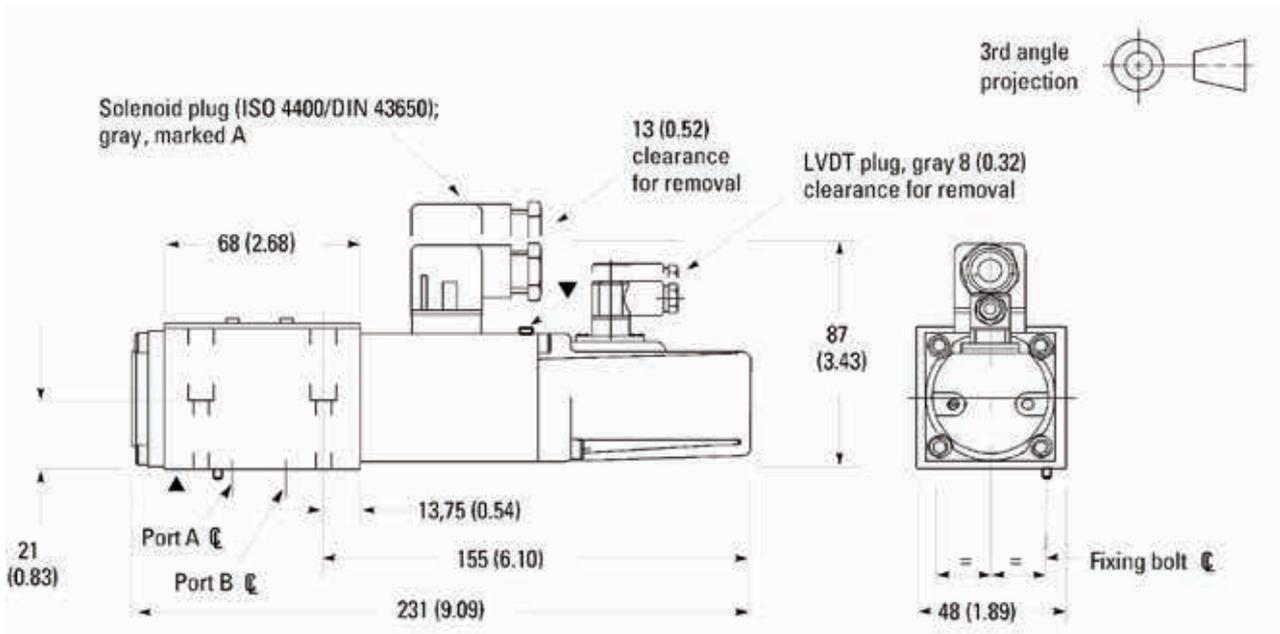
Frequency response

Looped flow at 70 bar valve pressure drop Amplitudes based on % of rated flow

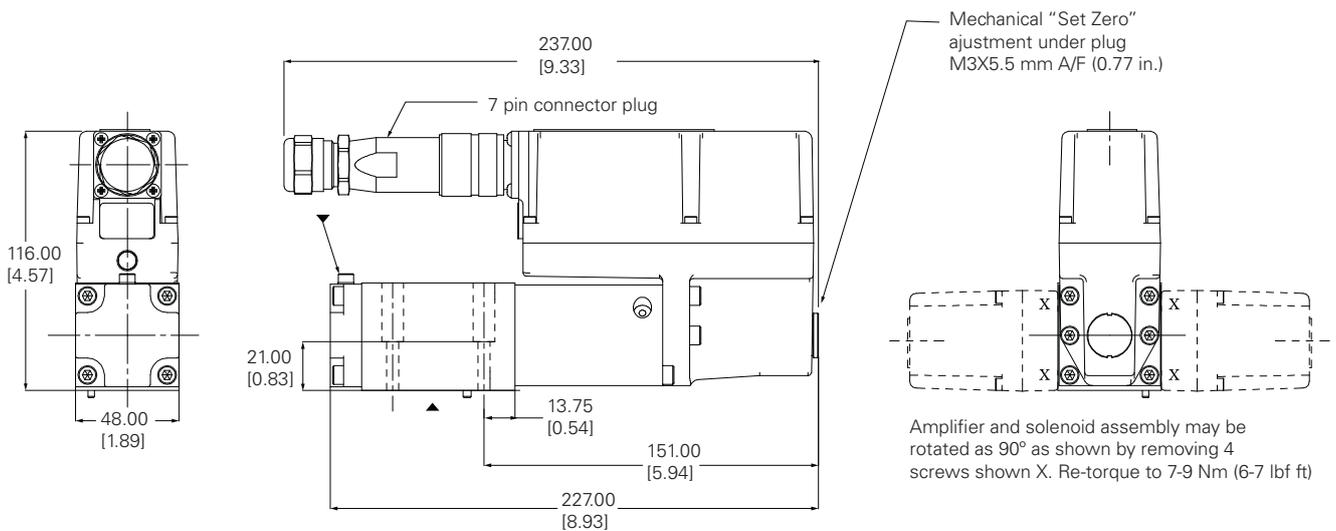


Installation dimensions

K(B)SDG4V-3-9*L-24 Valves



K(B)SDG4V-3-9*L-40 Valves



▲ Mounting surface seals supplied. For mounting surface dimensions and subplate options see page 11.

▼ Bleed screw location Air bleed, socket head cap screw Torque to 2.5-3.0 Nm (2.0-2.5 lbf ft)

WARNING

Valves with integral amplifiers are supplied with or without the metal 7-pin plug. The Eaton™ plug, part no. 934939, must be correctly fitted to ensure that the EMC rating and IP67 rating are achieved. The plug retaining nut must be tightened with a torque of 2-2.5 Nm (1.5-2.0 lbf ft) to effect a proper seal.

General description

If a subplate is not used, a machined pad must be provided for valve mounting. Pad must be flat within 0.0127 mm (.0005 inch) and smooth within 1.6 µm (63 microinch). Mounting bolts, when provided by customer, should be ISO 898 class 12.9 or better.

Dimensional tolerances

Dimensional tolerance on interface drawings is ±0.2 mm (±0.008") except where otherwise stated. ISO 4401 specifies inch conversion to ±0.01".

Conversion from metric

ISO 4401 gives dimensions in mm. Inch conversions are accurate to 0.01" unless otherwise stated.

Mounting bolt tappings

ISO 4401 gives metric thread tappings. Alternate UNC tappings are Eaton recommendations that allow these plates and associated valves to be used up to their maximum pressures, when using Eaton recommended bolt kits, or bolts of an equivalent strength. It is recommended that Customer's own manifold blocks for UNC bolts should be tapped to the minimum depths given in the footnotes.

Subplates

Description and mass kg (lb)	Functional Symbol	Model code	Max. Pressure
Single-station subplate; rear ports P, T, A, B; side port L Cast iron 1.3 (2.9)		KDGMV-3-1*-R ▲ KDGMV-3-676803-1* (SAE/UNF ports)	250 bar (3600 psi)

* Design number subject to change. No change of installation dimensions for design numbers 10 to 19 or 21 to 29 inclusive.

▲ "S" suffix = SAE/UNC ports and/or UNC fixing bolt tappings and/or orifice plugs as appropriate.

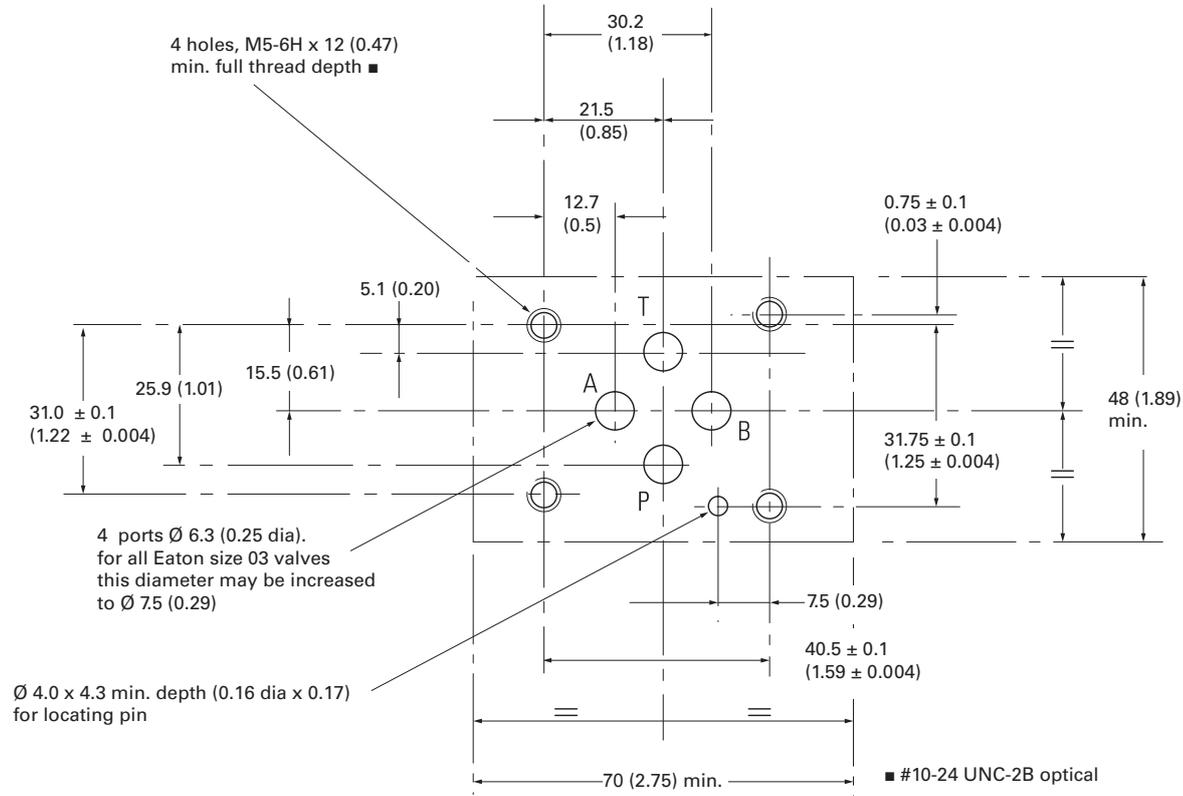
"R" or "B" = ISO 228 (BSPF) ports and/or metric fixing bolt tappings and/or orifice plugs as appropriate.

Port threads model	Ports P, T, A, B, at rear or side	Port L
BSPF ports/M5 mounting bolts: KDGMV-3-1*-R	Rear G3/8 (3/8" BSPF) x 12.0 (0.47) deep	G1/8 (1/8" BSPF) x 12.0 (0.47) deep
SAE ports/#10-24 UNC mounting bolts: KDGMV-3-676803-1*	Rear 3/4"-16 UNF-2Bx14.3 (0.56) deep (SAE)	7/16" -20 UNF-2B x 11.6 (0.46) deep (SAE)

Mounting surfaces

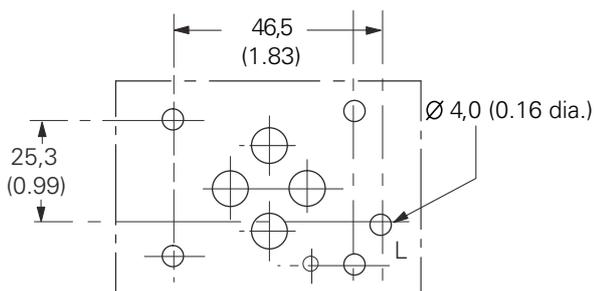
Mounting surfaces to ISO 4401 (size 03)

This interface conforms to: ISO 4401-03-02-0-94 plus location pin hole ANSI/B93.7M (and NFPA) size 03 CETOP R35H4.2-4-03, plus location pin hole DIN 24340 Form A6 plus location pin hole



Interface with additional drain port

The interface conforms to Eaton standard, plus hole "L" Typically used for proportional and other valves requiring an additional drain port.



Block diagram

Voltage input (M1) KBSDG4V-3

KBSDG4V-3 Wiring

Connections must be made via the 7-pin plug mounted on the amplifier. See page 15 of this leaflet and Eaton's Installation Wiring Practices for Eaton™ Electronic Products, leaflet 2468. Recommended cable sizes are:

Power cables:

For 24V supply

0.75 mm² (18 AWG) up to 20m (65 ft)

1.00 mm² (16 AWG) up to 40m (130 ft)

Signal cables:

0.50 mm² (20 AWG)

Screen (shield):

A suitable cable would have 7 cores, a separate screen for the signal wires and an overall screen.

Cable outside diameter 8.0–10.5 mm (0.31–0.41 inches)

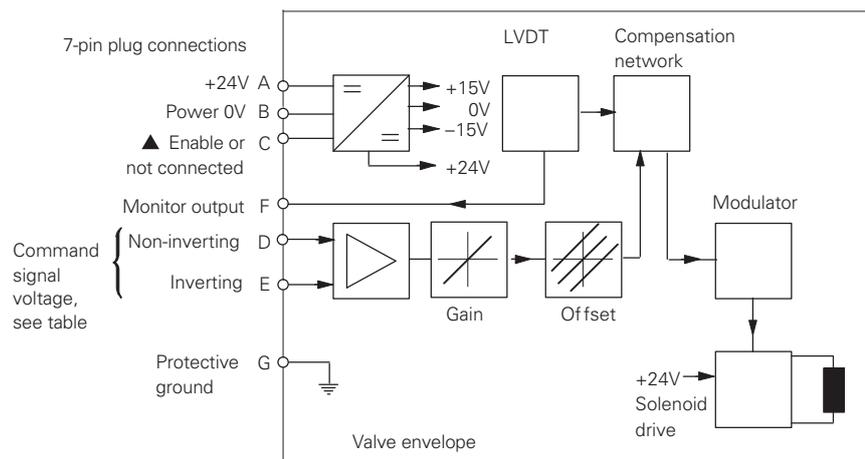
See connection diagram on next page.

KSDG4V-3 Wiring

Wiring details for these valves are contained in the appropriate Eurocard literature and Eaton's Installation Wiring Practices for Eaton™ Electronic Products leaflet 2468.

Command signals and outputs, M1

7-pin plug		Flow direction
Pin D	Pin E	
Positive	0V	
0V	Negative	P to A
	$U_a - U_e = \text{Positive}$	
Negative	0V	
0V	Positive	P to B
	$U_a - U_e = \text{Negative}$	



▲ Pin C is used for a valve enable signal with electrical connections PH7

WARNING

All power must be switched off before connecting/ disconnecting any plugs.

Electrical information

Block diagram

Current input (M2) KBSDG4V-3

KBSDG4V-3 Wiring

Connections must be made via the 7-pin plug mounted on the amplifier. See page 15 of this leaflet and Eaton's Installation Wiring Practices for Eaton™ Electronic Products, leaflet 2468. Recommended cable sizes are:

Power cables:

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0.75 mm² (18 AWG) up to 20m (65 ft)

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Signal cables:

0.50 mm² (20 AWG)

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Cable outside diameter 8.0–10.5 mm (0.31–0.41 inches)
See connection diagram on next page.

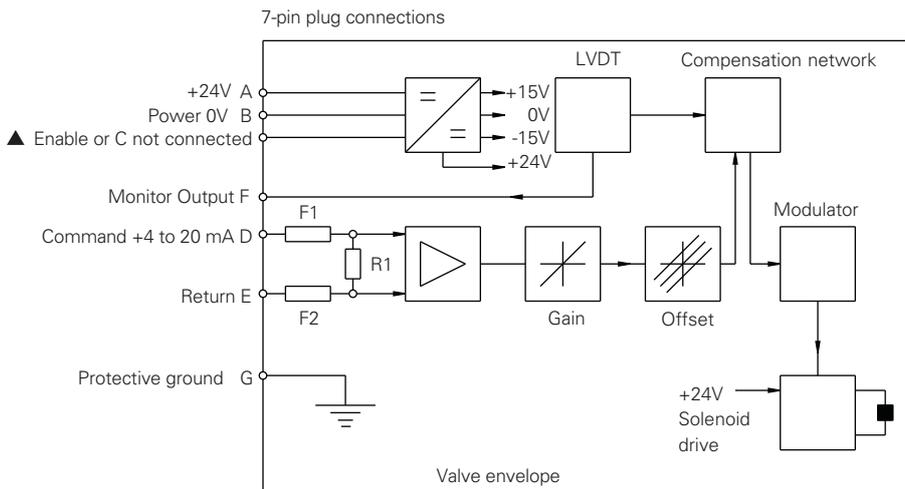
KSDG4V-3 Wiring

Wiring details for these valves are contained in the appropriate Eurocard literature and Eaton's Installation Wiring Practices for Eaton™ Electronic Products leaflet 2468.

Command signals and outputs, M2

7-pin plug

Pin D	Pin E	Pin B	Flow direction
More than 12 mA	Current return	Power ground	P to A
Less than 12 mA	Current return	Power ground	P to B



▲ Pin C is used for a valve enable signal with electrical connections PH7.

R1 Shunt resistor 100R

F1, F2 Resettable fuse

WARNING

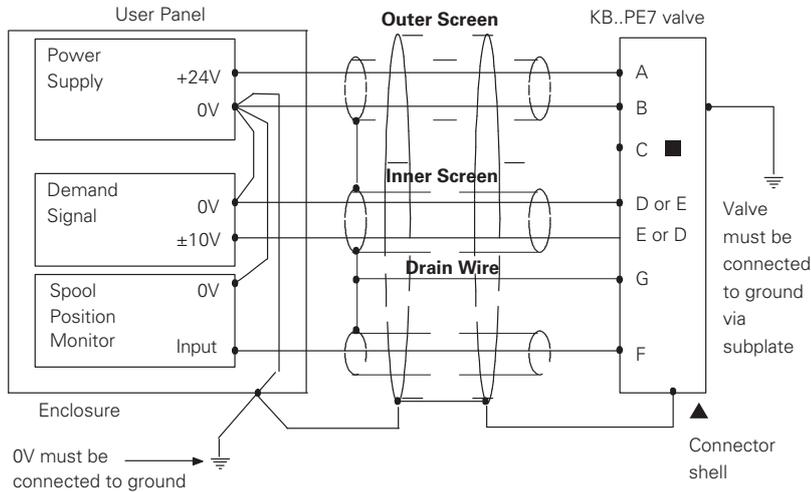
All power must be switched off before connecting/
disconnecting any plugs.

Block diagram

Current input (M2) KBSDG4V-3

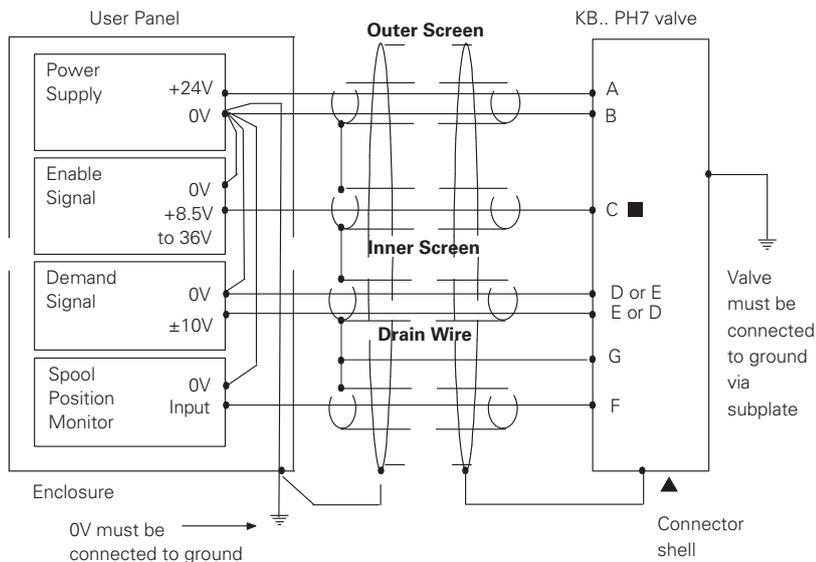
KBSDG4V-3 wiring

■ Spool position monitor voltage (pin F) will be referenced to the KB valve local ground.



Wiring connections for M1 valves with enable feature

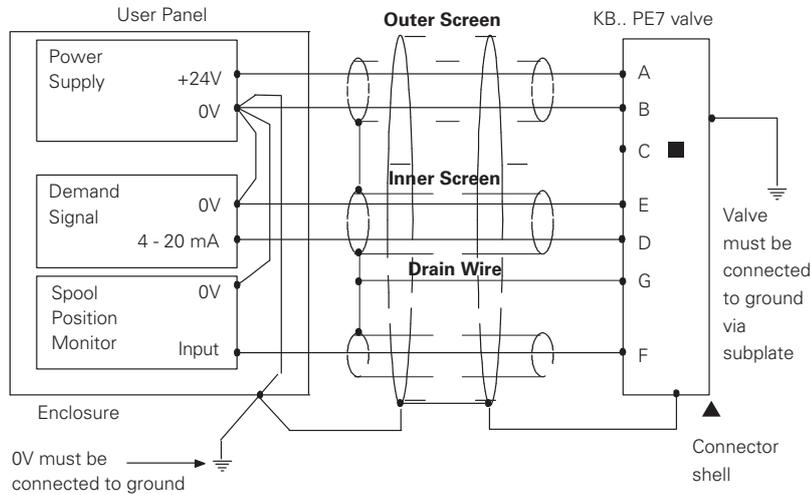
▲ **Note:** In applications where the valve must conform to European RFI/EMC regulations, the outer screen (shield) must be connected to the outer shell of the 7 pin connector, and the valve body must be fastened to the earth ground. Proper earth grounding practices must be observed in this case, as any differences in command source and valve ground potentials will result in a screen (shield) ground loop.



Electrical information

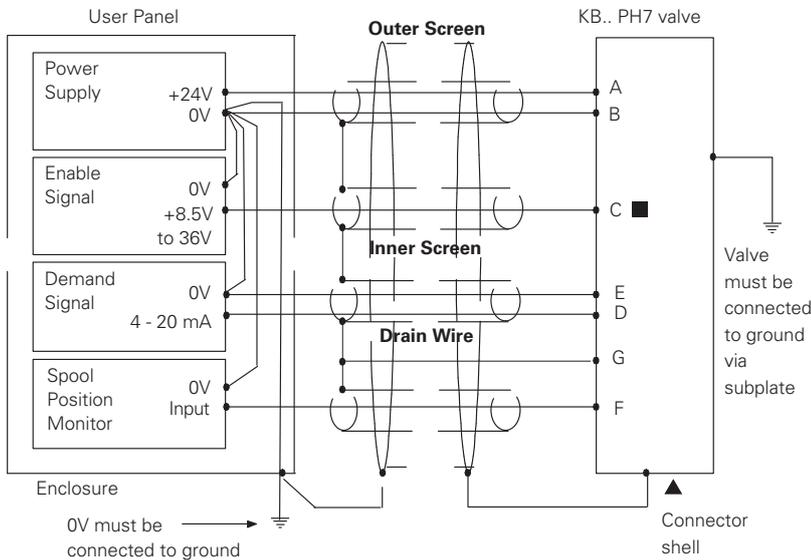
Wiring connections current input (M2)

■ Spool position monitor voltage (pin F) will be referenced to the KB valve local ground.



Wiring connections for M2 valves with enable feature

▲ **Note:** In applications where the valve must conform to European RFI/EMC regulations, the outer screen (shield) must be connected to the outer shell of the 7 pin connector, and the valve body must be fastened to the earth ground. Proper earth grounding practices must be observed in this case, as any differences in command source and valve ground potentials will result in a screen (shield) ground loop.



▲ WARNING

Electromagnetic Compatibility (EMC)
It is necessary to ensure that the valve is wired up as above. For effective protection the user electrical cabinet, the valve subplate or manifold and the cable screens should be connected to efficient ground points. The metal 7 pin connector part no. 934939 should be used for the integral amplifier. In all cases both valve and cable should be kept as far away as possible from any sources of electromagnetic radiation such as cables carrying heavy current, relays and certain kinds of portable radio transmitters, etc. Difficult environments could mean that extra screening may be necessary to avoid the interference. It is important to connect the 0V lines as shown above. The multi-core cable should have at least two screens to separate the demand signal and monitor output from the power lines. The enable line to pin C should be outside the screen which contains the demand signal cables.

Fluid cleanliness

Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials and additives for protection against wear of components, elevated viscosity and inclusion of air.

Recommendations on contamination control methods and the selection of products to control fluid condition are included in Eaton's publication 9132 or 561, "Eaton™ Guide to Systemic Contamination Control". The book also includes information on the Eaton concept of "ProActive Maintenance". The following recommendations are based on ISO cleanliness levels at 2 µm, 5 µm and 15 µm.

For products in this catalog the recommended levels are:

- 0 to 70 bar (1000 psi): 18/16/13
- 70+ bar (1000 + psi): 17/15/12

Eaton products, as any components, will operate with apparent satisfaction in fluids with higher cleanliness codes than those described. Other manufacturers will often recommend levels above those specified. Experience has shown, however, that life of any hydraulic components is shortened in fluids with higher cleanliness codes than those listed above. These codes have been proven to provide a long trouble-free service life for the products shown, regardless of the manufacturer.

Hydraulic fluids

Materials and seals used in these valves are compatible with antiwear hydraulic oils, and non-alkyl-based phosphate esters. The extreme operating viscosity range is 500 to 13 cSt (2270 to 70 SUS) but the recommended running range is 54 to 13 cSt (245 to 70 SUS).

Installation

The proportional valves in this catalog can be mounted in any attitude, but it may be necessary in certain demanding applications, to ensure that the solenoids are kept full of hydraulic fluid. Good installation practice dictates that the tank port and any drain port are piped so as to keep the valves full of fluid once the system start-up has been completed.

Service information

The products from this range are preset at the factory for optimum performance; disassembling critical items would destroy these settings. It is therefore recommended that should any mechanical or electronic repair be necessary they should be returned to the nearest Eaton repair center. The products will be refurbished as necessary and retested to specification before return.

Field repair is restricted to the replacement of the seals.

Note: The feedback/solenoid assembly installed in this valve should not be disassembled.

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