

Over 35 New Products in this Catalogue

Relief Cartridge Valves

Page 7: The **RDDA-3**** (series 1) and **RDFA-3**** (series 2) are non-adjustable direct-acting relief cartridges. They are normally closed, pressure-limiting valves used to protect hydraulic components from pressure transients. When the pressure at the inlet (port 1) reaches the valve setting, the valve starts to open to tank (port 2), throttling the flow to limit the pressure rise. These valves are smooth and quiet, with essentially zero leakage, dirt tolerant, immune to silting, and are very fast.

Page 8: The **RDDT-Q**** (series 1) and **RDFT-Q**** (series 2) are direct-acting relief cartridges. They are normally closed, pressure-limiting valves used to protect hydraulic components from pressure transients. When the pressure at the inlet (port 1) reaches the valve setting, the valve starts to open to tank (port 2), throttling the flow to limit the pressure rise. These valves are smooth and quiet, with essentially zero leakage, dirt tolerant, immune to silting, and are very fast. These CE marked valves are safety valves that meet the requirements of the European Directive for Pressurized Devices (PED) 97/23/EC.

Page 12: **RP*S** are pilot-operated, balanced-poppet relief cartridges and are normally closed pressure regulating valves. When the pressure at the inlet (port 1) reaches the valve setting, the valve starts to open to tank (port 2), throttling flow to regulate the pressure. These valves are accurate, smooth, quiet, fast, and have low pressure rise vs. flow.

Page 11: The **RPET**, **RPGT**, **RPIT**, and **RPKT** are series 1, 2, 3, and 4 pilot operated soft relief valves which control the rate of pressure rise in a system as well as maximum pressure. These valves provide excellent pressure protection and reduced system shock.

Page 12: The **RQCB** is a series 0 kick-down, relief valve which works like a circuit breaker in an electrical system. When the pressure setting is reached, the valve kicks wide open, passing flow at low pressure. It stays open until flow to the valve stops.

Page 15: The **RBAN-X**** is an electro-proportional, direct acting pilot relief valve which fits into the Sun T-8A cavity. This valve has an inverse operation, meaning the valve is at a maximum setting with no signal to the solenoid coil. The setting decreases as the signal increases.

Page 17: The **RP*S-8**** are seated-style, normally closed modulating valves with a T-8A cavity. When used with RBAP proportional relief fitted into this cavity, the RPES becomes a series 1 proportional relief with low main stage leakage.

Page 19: **RV*S-***** are vented, pilot operated, relief valves with a seated style main stage. When compared to a standard spool-type vented relief, this valve provides lower leakage, and faster response resulting in reduced overshoot and improved pressure control.

Page 20: The **RV*T** is a vented, pilot operated, soft relief valve which controls the rate of pressure rise in a system as well as the maximum pressure. By providing a smoother, controlled pressure loading in the non-vented condition, this valve minimizes shock in systems.

Sequence Cartridge Valves

Page 28: The **SQBB** is a series 0 kick-down sequence valve used to sequence a function in a system when pressure on the inlet reaches the valve setting. The valve goes wide open and stays open until flow to the valve stops.

Reducing/Relieving Cartridge Valves

Page 42: The **PS*T-***** is a direct acting, pressure reducing/relieving valve mainstage piloted from port 4. This valve incorporates a damped construction for stable operation allowing the use of high reduced pressure.

Counterbalance Cartridge Valves

Sun has added a number of fixed setting valves to its counterbalance line of products: **CBB*-X****, (Semi-restrictive, 40 L/min.), **CBA*-X** (Restrictive, 10 L/min.), **CBB*-X** (Restrictive, 20 L/min.) and **CBC*-X** (Standard, 60 L/min.). Fixed-setting, 3-port, T-11A cavity, counterbalance valves with pilot assist function similar to the adjustable versions except the fixed setting is pre-set to a nominal value. These fixed-setting valves are meant to control an overrunning load. The check valve allows free flow from the directional valve (port 2) to the load (port 1), while a direct-acting, pilot-assisted relief valve controls flow from port 1 to port 2. Pilot assist at port 3 lowers the effective setting of the relief valve at a rate determined by the pilot ratio. **See page 72. Also review these products at www.sunhydraulics.com. Products: Counterbalance: Click View All Counterbalance Valves.**

Load Control: Load Reactive Cartridge Valves

Page 64: **MB*A-L**** (3:1 pilot ratio), **MB*B-L**** (1.5:1 pilot ratio), **MB*G-L**** (4.5:1 pilot ratio) are load reactive, non-vented load control valves. This valve is functionally a 3 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.

Page 65: **MB*A-X**** (3:1 pilot ratio), **MB*B-X**** (1.5:1 pilot ratio), **MB*G-X**** (4.5:1 pilot ratio) are load reactive, non-vented, fixed setting, load control valves. This valve is functionally a 3 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.

Page 66: **MW*A-L**** (3:1 pilot ratio), **MW*B-L**** (1.5:1 pilot ratio), **MW*G-L**** (4.5:1 pilot ratio) are load reactive, vented, load control valves. This valve is functionally a 4 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.

Over 35 New Products in this Catalogue

Load Control: Load Reactive Cartridge Valves (Continued)

Page 67: **MW*A-X**** (3:1 pilot ratio), **MW*B-X**** (1.5:1 pilot ratio), **MW*G-X**** (4.5:1 pilot ratio) are load reactive, vented, load control valves. This valve is functionally a 4 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.

Load Control: Balanced Cartridge Valves

Page 70: The **MB*M-X**** is a balanced, non-vented, non-relieving load control valve. This valve displays characteristics of a pressure compensating flow control valve. Performance is best in the meter-out mode with port 1 being the load and port 2 being tank.

Page 71: The **MW*M-X**** is a vented, balanced non-relieving, load control valves that combines a balanced modulating element with a reverse flow check. This valve displays characteristics of a pressure compensating flow control valve. Performance is best in the meter-out mode with port 1 being the load and port 2 being tank.

Check Cartridge Valves

Page 74: **CXAA-XB*** is a free flow, nose-to-side, check valve which fits into T-8A cavity.

Logic Element Cartridge Valves

Page 110: **LO*C-ZD*** is a balanced poppet, pilot-to-close, spring biased closed, logic element with position indicating switch.

Page 111: **LO*O-ZD*** is a balanced poppet, pilot-to-close, spring biased open, logic element with position indicating switch.

Page 116: The **LH*A-X**** is a bypass/restrictive, priority modulating element.

Solenoid Operated Cartridge Valves

Page 132: The **DTDA-S**** is a 2-position, 2-way direct operating poppet-type directional solenoid valve with soft shift armature.

Page 133: The **DAAL-S**** is a 2-position, 2-way, spool-type pilot solenoid valve with soft shift armature.

Page 134: The **DLDA-S**** is a 2-position, 2-way spool-type directional solenoid valve with soft shift armature.

Page 135: The **DWDA-X**** is a 2-position, 3-way poppet-type directional solenoid valve.

Page 136: The **DBAL-S**** is a 2-position, 3-way, spool-type pilot solenoid valve with soft shift armature.

Page 137: The **DMDA-S**** is a 2-position, 3-way spool-type directional solenoid valve with soft shift armature.

Page 138: The **DNDA-S**** is a 2-position, 4-way spool-type directional solenoid valve with soft shift armature.

Page 139: The **DNDC-X**** is a direct acting, solenoid-operated, 4-way, 3-position spool valve that is spring centred to the neutral position.

Pilot Control Cartridge Valves

Page 146: **DAAL-X**** is a 2-way, solenoid operated, directional spool-type, pilot valve.

Page 146: **DAAL-S**** is a 2-position, 2-way, spool-type pilot solenoid valve with soft shift armature.

Page 150: The **DBAL-X**** is a 3-way, 2-position, solenoid operated, directional spool-type, pilot valve.

Page 150: **DBAL-S**** is a 3-way, 2-position, solenoid operated, directional spool-type pilot valve with soft shift armature.

Corrosion Resistant Cartridge Valves

Sun is continually adding to its line of corrosion resistant valves. These valve have stainless steel and titanium external components with heat treated internal components in carbon and alloy steels. These valves are recommended for marine, oil and gas industries and for use in stationary aero-drives. All external components are qualified by a 1,000 hour salt spray test to ASTM B117-03. In all cases, the internal working components remain the same as the standard Sun valve. Where the cartridge product is offered in corrosion resistant materials, you will see a note in the bottom right corner of the page. Visit www.sunhydraulics.com for complete information on our Corrosion Resistant Cartridges. Products: Cartridges: Corrosion Resistant: View All Corrosion Resistant Cartridges for complete information about these cartridges.

Weatherized Coils and Weatherized Coil Kits

Page 190, 191: Sun's new weatherized coils and kits are designed for Sun's full flow solenoid operated and electro-proportional cartridge valves. They are protection against high-pressure wash-downs or marine environments for Sun's electrically-actuated cartridge valves. These coil kits are only available with the Metri-Pack Series 150-2M connector with a choice of four voltages.

A weatherization kit is required in conjunction with a weatherized coil and a modified cavity (consult the Sun website to view cavity modification instructions for the use of each kit). The coil is not included in the kits and must be purchased separately. Weatherization kits are cartridge model code and cavity dependant. **These kits are intended for new installations only and are not suitable for retrofitting existing equipment or for standard Sun bodies.**

Consult www.sunhydraulics.com for complete details on weatherized coils and weatherized coil kits. Go to Products: Cartridges: Coils: View All Coils: Weatherized Coils. View individual Weatherized Coil Seal Kit page for detailed installation instructions.

Contents

Model Codes printed in Red are Preferred Versions of Products shown in this catalogue and most readily available.

Relief Cartridge Valves	5	Shuttle Cartridge Valves	155
Sequence Cartridge Valves	25	Circuit Savers	163
Reducing and Reducing/Relieving Cartridge Valves	33	Hybrid Relief Cartridge Valves	171
Pilot-to-Open Check Cartridge Valves	47	General Information	177
Counterbalance Cartridge Valves	51	Cartridge Control Options	178
Load Control: Reactive Cartridge Valves	63	Cartridge Control Kits	179
Load Control: Balanced Cartridge Valves	69	Cavity Plugs	183
Check Cartridge Valves	73	Sun Coil Options for Solenoids (Metal Housing, Round)	187
Flow Control Cartridge Valves	79	Sun Coil Options with Embedded Electronic Proportional Amplifiers	188
Flow Divider / Combiner Cartridge Valves	93	Sun Weatherized Coils and Coil Kits	190
Logic Elements	99	Sun Coil 790-***** Part Numbering System	191
Directional Cartridge Valves	117	Orifice Pressure Drop Data	192
Solenoid Operated Cartridge Valves	131	Sun Model Code System	193
Pilot Control Cartridge Valves	141	Sun Model Code Index	194
		Warranty	199
		International Distribution	200

Specifications, descriptions and illustrative material contained herein were accurate as known at the time this publication was approved for printing.

Sun Hydraulics reserves the right to discontinue models at any time, or change prices, specifications or designs without notice or incurring obligation.

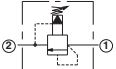
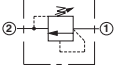
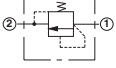
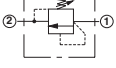
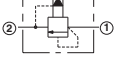
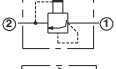
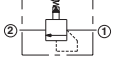
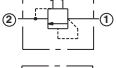
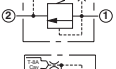
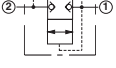
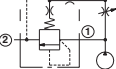
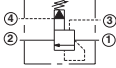
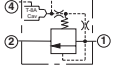
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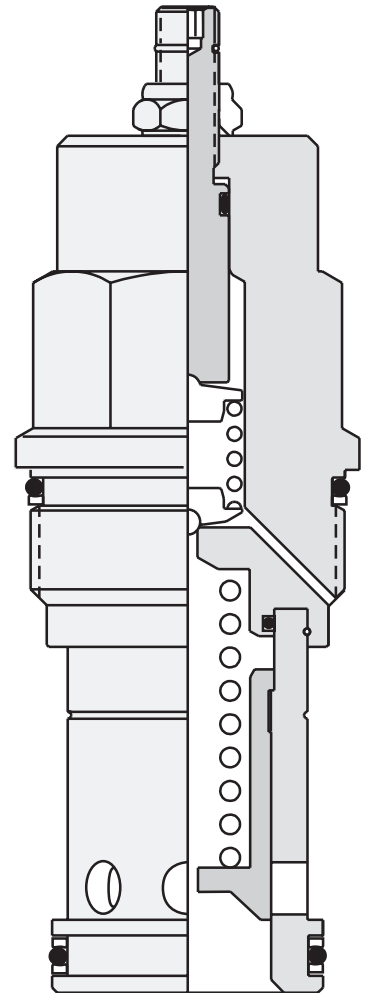
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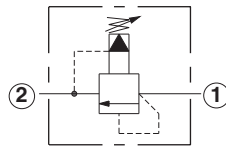
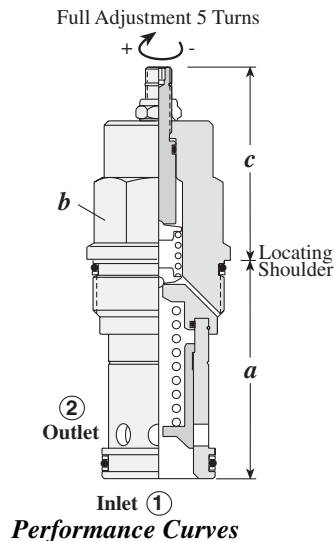


Relief Cartridge Valves

	<i>Cartridge Type</i>	<i>Page</i>
	Pilot Operated, Balanced Piston	6
	Direct Acting and Direct Acting, Non-Adjustable	7
	Direct Acting, CE Marked	8
	Direct Acting, Pilot Capacity	9
	Pilot Operated, Balanced Poppet	10
	Pilot Operated, Balanced Poppet, Soft	11
	Pilot Operated, Kick-down, Balanced Piston	12
	Pilot Operated, Balanced Piston, Air Controlled	13
	Electro-Proportional, Pilot Capacity	14
	Electro-Proportional, Pilot Capacity, High Pressure Setting with No Command, Inverse Function	15
	Pilot Operated, Balanced Piston, Main Stage with Integral T-8A Control Cavity	16
	Pilot Operated, Balanced Poppet, Main Stage with Integral T-8A Control Cavity	17
	Pilot Operated, Balanced Piston, Ventable	18
	Pilot Operated, Balanced Poppet, Ventable	19
	Pilot Operated, Balanced Poppet, Ventable, Soft	20
	Bypass Compensator with Relief Function, Normally Closed	21
	Pilot Operated, Balanced Piston, Ventable with External Drain	22
	Electro-Proportional, Pilot Operated, Balanced Piston, Ventable, Drain to Port 4, Main Stage with Integral T-8A Control Cavity	23

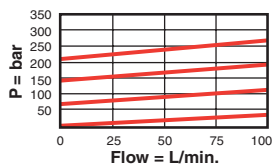


PILOT OPERATED, BALANCED PISTON

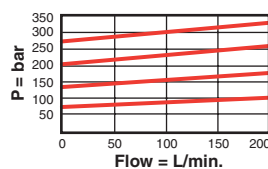


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
45 L/min.	RPCC – LAN	T - 162A	31,0	19,1	53,6	55,1	60,7	35 - 40
95 L/min.	RPEC – LAN	T - 10A	39,6	22,2	50,8	54,6	57,2	45 - 50
200 L/min.	RPGC – LAN	T - 3A	47,8	28,6	53,8	55,4	60,5	60 - 70
380 L/min.	RPIC – LAN	T - 16A	62,0	31,8	62,0	62,7	68,3	200 - 215
760 L/min.	RPKC – LAN	T - 18A	79,5	41,3	71,4	74,7	77,7	465 - 500

RPCC

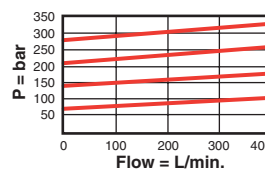


RPEC

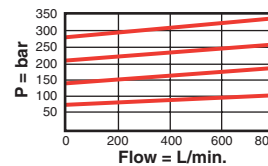


RPGC

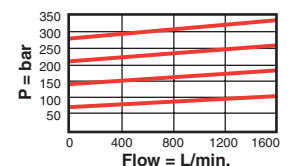
Typical Pressure Rise



RPIC



RPKC



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = RPCC, RPEC: 30 cc/min. at 70 bar; RPGC: 50 cc/min. at 70 bar; RPIC: 65,5 cc/min. at 70 bar; RPKC: 80 cc/min. at 70 bar.
- Typical response time 10 ms.
- Factory pressure settings established at 15 L/min.
- Will accept maximum pressure at Port 2.
- Back pressure on the tank port (port 2) is directly additive at a 1:1 ratio to the valve setting.

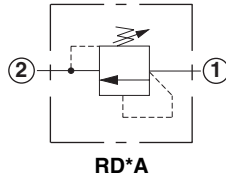
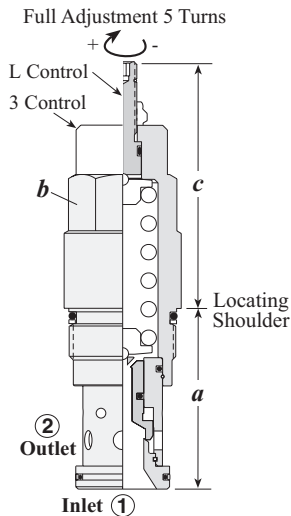
OPTION ORDERING INFORMATION

RP * C - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 45 L/min.	L Standard Screw Adjustment	RPCC only:	N Buna-N
E 95 L/min.	C* Tamper Resistant Factory Set	A 5 - 210 bar Standard set at 70 bar	V Viton
G 200 L/min.	K Handknob with Lock Knob	B 5 - 105 bar Standard set at 70 bar	
I 380 L/min.	RPEC, RPGC only:	C 5 - 420 bar Standard set at 70 bar	
K 760 L/min.	O Handknob with Panel Mount	N 5 - 55 bar Standard set at 30 bar	
	* Special setting required. Specify at time of order.	Q 5 - 25 bar Standard set at 14 bar	
	** See page 178 for information on Control Options	W 5 - 315 bar Standard set at 70 bar	
	Customer specified special setting stamped on hex.	RPEC, RPGC, RPIC, RPKC only:	
		A 7 - 210 bar Standard set at 70 bar	
		B 3,5 - 105 bar Standard set at 70 bar	
		C 10,5 - 420 bar Standard set at 70 bar	
		N 4 - 55 bar Standard set at 28 bar	
		Q 4 - 25 bar Standard set at 14 bar	
		W 10,5 - 315 bar Standard set at 70 bar	

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

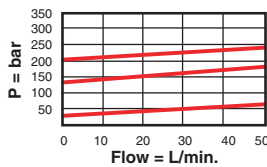
DIRECT ACTING AND DIRECT ACTING, NON-ADJUSTABLE



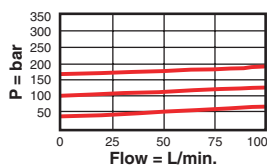
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	L	C	
45 L/min.	RDBA – LAN	T - 162A	31,0	19,1	53,6	56,4	35 - 40
95 L/min.	RDDA – LAN	T - 10A	39,6	22,2	59,2	63,2	45 - 50
200 L/min.	RDFA – LAN	T - 3A	47,8	28,6	63,5	65,0	60 - 70
380 L/min.	RDHA – LAN	T - 16A	62,0	31,8	82,6	84,1	200 - 215
760 L/min.	RDJA – LAN	T - 18A	79,5	41,3	100,0	103,4	465 - 500

Performance Curves

RDBA

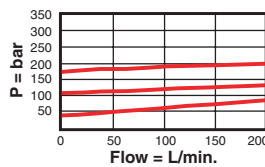


RDDA

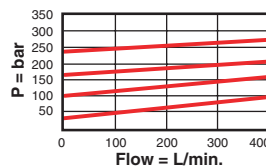


RDFA

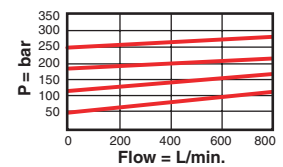
Typical Pressure Rise



RDHA



RDJA



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = 0,7 cc/min.
- Typical response time 2 ms.
- Factory pressure settings established at 15 L/min.
- Will accept maximum pressure at Port 2.
- Back pressure on the tank port (port 2) is directly additive at a 1:1 ratio to the valve setting.
- The seals on the adjust screw are exposed to system pressure which means this valve can only be adjusted when the pressure is removed. The setting procedure is; check the setting, remove the pressure, adjust the valve, check the new setting.
- Reseat exceeds 90% of cracking pressure.
- Select a spring range where the desired relief setting is approximately mid-range between the minimum and maximum pressure to ensure maximum valve repeatability.

OPTION ORDERING INFORMATION

RD * A - * * *

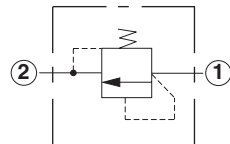
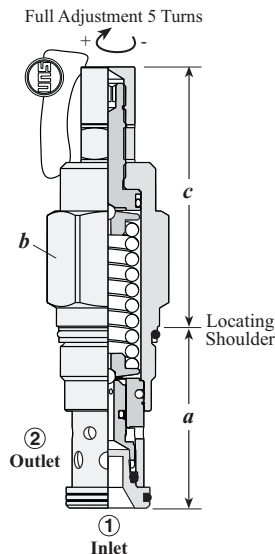
Nominal Capacity	Control**	Adjustment Range	Seal Material
B 45 L/min.	L Standard Screw Adjustment	A 35 - 210 bar Standard set at 70 bar	N Buna-N
D 95 L/min.	C* Tamper Resistant Factory Set	B 20 - 105 bar Standard set at 70 bar	V Viton
F 200 L/min.	RDDA, RDFA only:	C 70 - 420 bar Standard set at 70 bar	
H 380 L/min.	3* Non-Adjustable	D 14 - 55 bar Standard set at 28 bar	
J 760 L/min.	* Special setting required. Specify at time of order.	E 10 - 28 bar Standard set at 14 bar	
	** See page 178 for information on Control Options	S 3,5 - 14 bar Standard set at 7 bar	
	Customer specified special setting stamped on hex.	W 55 - 315 bar Standard set at 70 bar	
		RDDA-3, RDFA-3 only available with A, C, D ranges.	

U.S. Patent #4,742,846
European Patent Pending

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

DIRECT ACTING, CE MARKED



The CE marked valve is a safety valve that meets the requirements of the European Directive for Pressurized Devices (PED) 97/23/EC.

Each delivery contains a TÜV approval, which is a certification of the excess operating pressure and the approved flow, an EC declaration of conformity, and an instructional manual. See Sun website for further information.

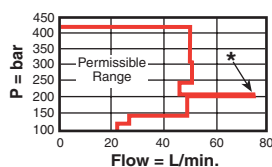
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
75 L/min.	RDDT – QAN	T - 10A	40,0 mm	22,2 mm	65,0 mm	45 - 50
79 L/min.	RDFT – QAN	T - 3A	47,8 mm	28,6 mm	70,4 mm	60 - 70

Performance Curves

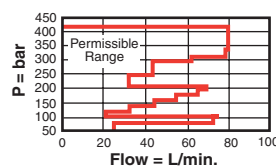
RDDT

RDFT

Permissible Operating Range



*Approved flow at 210 bar is 75 L/min.



- Maximum valve leakage at reseal = 0,7 cc/min.
- Reseat = > 90% of set pressure.
- Typical response time 2 ms.
- Standard settings for preset valves: 100, 140, 160, 210, 250, and 330 bar.
- Pressure setting from 100 bar up to 422 bar are approved and certified by TÜV.
- Will accept maximum pressure at port 2; suitable for use in cross-port relief circuits.
- Back pressure on the tank port (port 2) is additive to the valve setting at a 1:1 ratio.

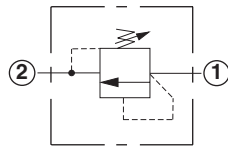
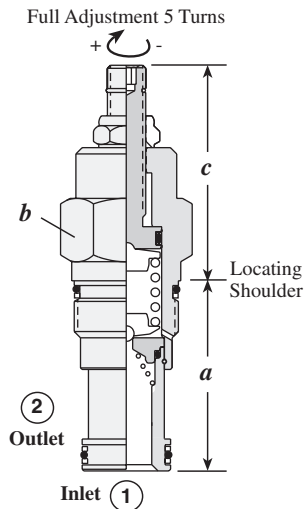
OPTION ORDERING INFORMATION

RD * T - * * *			
Nominal Capacity	Control	Adjustment Range	Seal Material
D 75 L/min.	Q* Capped and Lockwire	RDDT: A 100 - 210 bar	N Buna-N
F 79 L/min.	* Special setting required. Specify at time of order.	C 315 - 422 bar W 211 - 314 bar	V Viton
		RDFT: A 106 - 209 bar B 60 - 105 bar C 210 - 420 bar	

U.S. Patent #4,742,846

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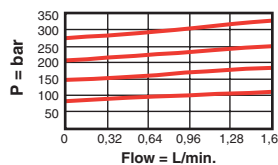
DIRECT ACTING, PILOT CAPACITY



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions						Installation Torque (Nm)
			a	b	c				
					L	C	K	O	
1 L/min.	RBAC – LAN	T - 10A	39,6	22,2	50,8	54,6	57,2	58,0	45 - 50
2 L/min.	RBAA – LAN	T - 3A	47,8	28,6	53,8	55,4	60,5	61,0	60 - 70
10 L/min.	RBAE – LAN	T - 8A	19,0	22,2	60,5	62,7	67,6	67,6	35 - 40

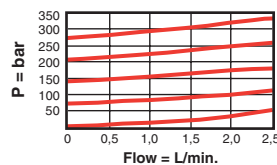
Performance Curves

RBAC

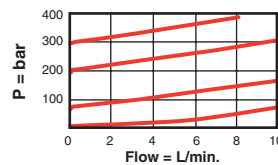


RBAA

Typical Pressure Rise



RBAE



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal at 24 cSt = RBAC, RBAA: 0,4 cc/min.; RBAE: 1 cc/min.
- Typical response time 2 ms.
- Back pressure on the tank port (port 2) is directly additive to the pressure setting at port 1 (inlet) at a 1:1 ratio to the valve setting.
- RBAE: Utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2-position, 2-way pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

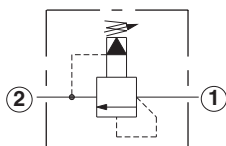
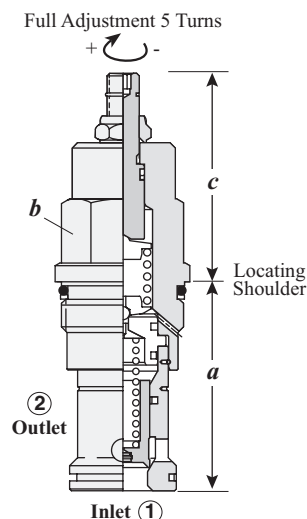
OPTION ORDERING INFORMATION

RB A * - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
AC 1 L/min.	L Standard Screw Adjustment	A 1,7 - 210 bar Standard set at 70 bar	N Buna-N
AA 2 L/min.	C* Tamper Resistant with Lock Knob	B 1,7 - 105 bar Standard set at 70 bar	V Viton
AE 10 L/min.	K Handknob Factory Set	C 1,7 - 420 bar Standard set at 70 bar	
	O Handknob with Panel Mount	D 1,7 - 55 bar Standard set at 25 bar	
	* Special setting required. Specify at time of order.	E 1,7 - 25 bar Standard set at 14 bar	
	** See page 178 for information on Control Options	W 1,7 - 315 bar Standard set at 70 bar	
	Customer specified special setting stamped on hex.		

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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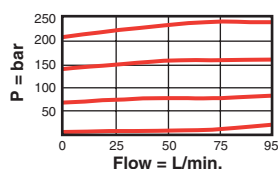
PILOT OPERATED, BALANCED POPPET



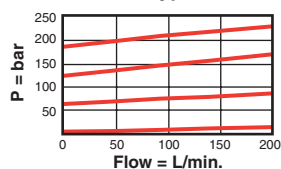
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
95 L/min.	RPES – LAN	T - 10A	39,6	22,2	50,8	54,6	57,2	40 - 50
200 L/min.	RPGS – LAN	T - 3A	47,8	28,6	53,8	55,4	60,5	60 - 70
380 L/min.	RPIS – LAN	T - 16A	62,0	31,8	62,0	62,7	68,3	200 - 215
760 L/min.	RPKS – LAN	T - 18A	79,5	41,3	71,4	74,7	77,7	465 - 500

Performance Curves

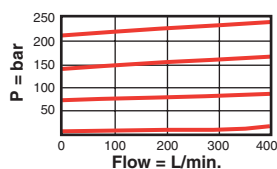
RPES



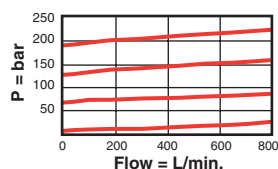
RPGS



RPIS



RPKS



Typical Pressure Rise

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = RPES: 0,7 cc/min.; RPGS, RPIS, RPKS: 2,1 cc/min.
- Typical response time 2 ms.
- Factory pressure settings established at 15 L/min.
- Will accept maximum pressure at port 2; suitable for use in cross-port relief circuits.
- Back pressure on the tank port (port 2) is directly additive at a 1:1 ratio to the valve setting.

OPTION ORDERING INFORMATION

RP * S - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
E 95 L/min.	C* Tamper Resistant Factory Set	A 7 - 210 bar Standard set at 70 bar	N Buna-N
G 200 L/min.	K Handknob with Lock Knob	B 3,5 - 105 bar Standard set at 70 bar	V Viton
I 380 L/min.	L Standard Screw Adjustment	C 10,5 - 420 bar Standard set at 70 bar	
K 760 L/min.		N 4 - 55 bar Standard set at 30 bar	
		Q 4 - 25 bar Standard set at 14 bar	
		RPES, RPGS only:	
		W 7 - 315 bar Standard set at 70 bar	
		RPIS, RPKS only:	
		W 10,5 - 315 bar Standard set at 70 bar	

** See page 178 for information on Control Options

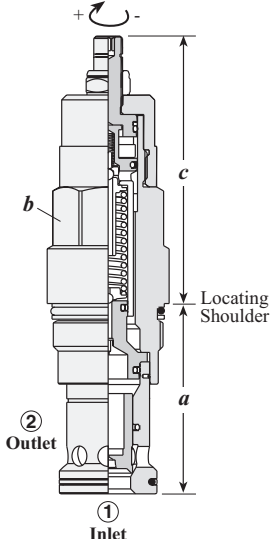
Customer specified special setting stamped on hex.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

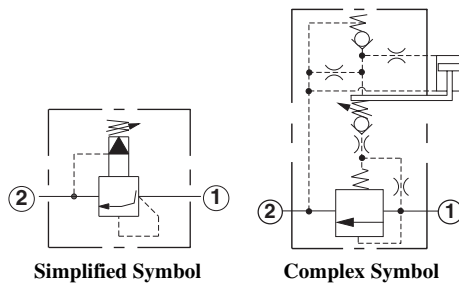
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PILOT OPERATED, BALANCED POPPET, SOFT

Full Adjustment 4.5 Turns



Performance Curves



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
95 L/min.	RPET - LAN	T - 10A	39,6	22,8	79,5	85,1	40 - 50
200 L/min.	RPGT - LAN	T - 3A	47,8	28,6	85,9	88,1	60 - 70
380 L/min.	RPIT - LAN	T - 16A	61,7	31,8	86,9	89,2	200 - 215
760 L/min.	RPKT - LAN	T - 18A	79,2	41,3	88,4	85,3	465 - 500

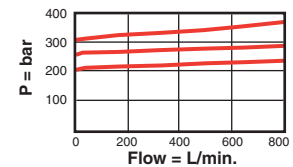
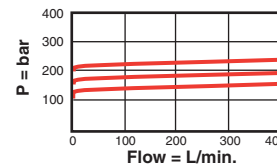
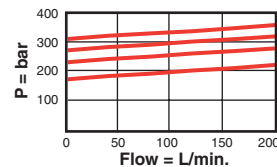
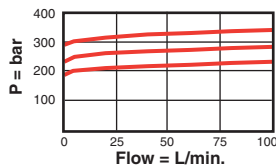
RPET

RPGT

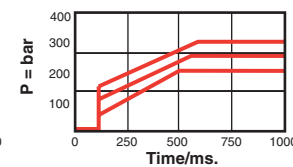
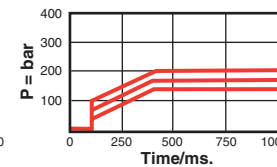
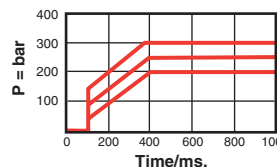
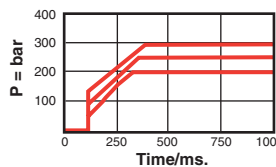
RPIT

RPKT

Pressure Differential vs. Flow



Time vs. Pressure



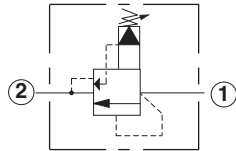
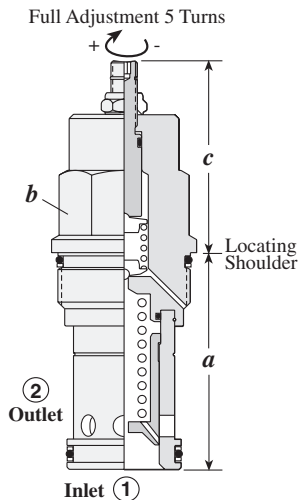
- Maximum operating pressure = 350 bar.
- Control pilot flow = 0,16 to 0,41 L/min.
- Pressure Ramp Up Time = RPET: 200 ms., RPGT: 300 ms., RPIT: 400 ms., RPKT: 500 ms.
- Factory pressure settings established at 15 L/min.
- Will accept maximum pressure at Port 2.
- When pressure at the inlet (port 1) exceeds the threshold setting, the valve opens to tank (port 2). The pilot section moves forward at a steady rate, increasing the setting by compressing the pilot spring. Maximum setting is achieved when the pilot section reaches a mechanical stop.

OPTION ORDERING INFORMATION

RP * T - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
E 95 L/min.	C* Tamper Resistant Factory Set	A 140 - 210 bar Standard set at 140 bar	N Buna-N
G 200 L/min.	L Standard Screw Adjustment	C 315 - 420 bar Standard set at 315 bar	V Viton
I 380 L/min.			
K 760 L/min.			
	* Special setting required. Specify at time of order.	W 210-315 bar Standard set at 210 bar	
	** See page 178 for information on Control Options		
Patent: U.S. #6,039,070.	Customer specified special setting stamped on hex.		

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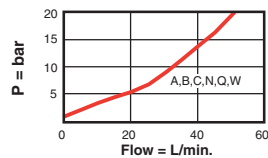
PILOT OPERATED, KICK-DOWN, BALANCED PISTON



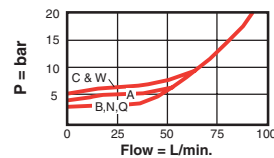
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
45 L/min.	RQCB – LAN	T - 162A	31,0	19,1	53,6	55,1	58,7	35 - 40
95 L/min.	RQEB – LAN	T - 10A	39,6	22,2	50,8	54,6	57,2	45 - 50
200 L/min.	RQGB – LAN	T - 3A	47,8	28,6	53,8	55,4	60,5	60 - 70
380 L/min.	RQIB – LAN	T - 16A	62,0	31,8	62,0	62,7	68,3	200 - 215
760 L/min.	RQKB – LAN	T - 18A	79,5	41,3	71,4	74,7	77,7	465 - 500

Performance Curves

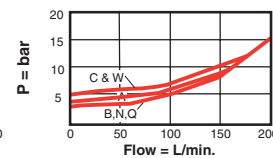
RQCB



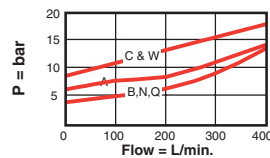
RQEB



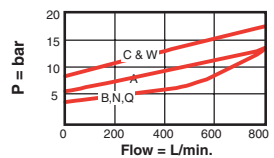
RQGB



RQIB



RQKB



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = RQCB, RQEB: 30 cc/min. at 70 bar; RQGB: 49,2 cc/min. at 70 bar; RQIB: 65,5 cc/min. at 70 bar; RQKB: 81,9 cc/min. at 70 bar.
- Typical response time 25 ms.
- Factory pressure settings established at kick down point.
- Flow through cartridge must cease to reset valve.
- Back pressure on the tank port (port 2) is directly additive to the valve setting at a 1:1 ratio.

OPTION ORDERING INFORMATION

RQ * B - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 45 L/min.	L Standard Screw Adjustment	RQCB only:	N Buna-N
E 95 L/min.	C* Tamper Resistant Factory Set	A 5 - 210 bar	V Viton
G 200 L/min.	K Handknob with Lock Knob	Standard set at 70 bar	
I 380 L/min.		B 5 - 105 bar	
K 760 L/min.		Standard set at 70 bar	
		C 5 - 420 bar	
		Standard set at 70 bar	
		N 5 - 55 bar	
		Standard set at 25 bar	
		Q 5 - 25 bar	
		Standard set at 14 bar	
		W 5 - 315 bar	
		Standard set at 70 bar	
		RQEB, RQGB, RQIB, RQKB only:	
		A 7 - 210 bar	
		Standard set at 70 bar	
		B 3,5 - 105 bar	
		Standard set at 70 bar	
		C 10,5 - 420 bar	
		Standard set at 70 bar	
		Q 4 - 25 bar	
		Standard set at 14 bar	
		W 10,5 - 315 bar	
		Standard set at 70 bar	
		RQEB, RQGB, only:	
		N 4 - 55 bar	
		Standard set at 25 bar	

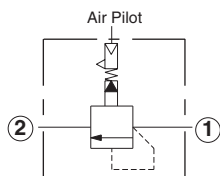
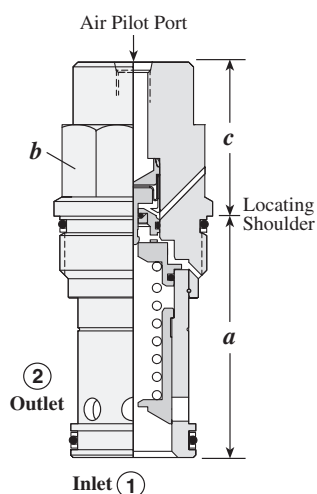
** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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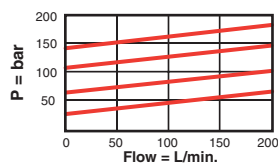
PILOT OPERATED, BALANCED PISTON, AIR CONTROLLED



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					A	B	
200 L/min.	RPGD – ABN	T - 3A	47,8	28,6	33,3	—	60 - 70
380 L/min.	RPID – BBN	T - 16A	62,0	31,8	—	41,1	200 - 215
760 L/min.	RPKD – BBN	T - 18A	79,5	41,3	—	50,8	465 - 500

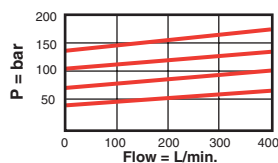
Performance Curves

RPGD

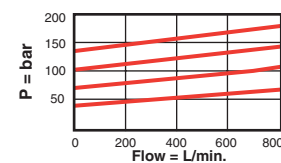


RPID

Typical Pressure Rise



RPKD



- Pilot ratio, air to hydraulic = 20:1.
- Maximum air pressure = 10,5 bar.
- Maximum operating pressure = 140 bar.
- Maximum valve leakage at 24 cSt = RPGD: 50 cc/min. at 70 bar; RPID: 65 cc/min. at 70 bar; RPKD: 80 cc/min. at 70 bar.
- Typical response time 10 ms.
- Will accept maximum pressure at Port 2; suitable for use in cross-port relief circuits.

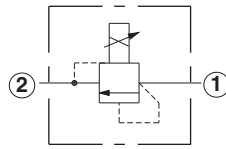
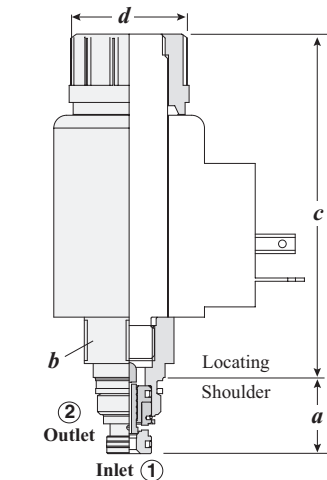
OPTION ORDERING INFORMATION

RP * D – * * *			
Nominal Capacity	Control	Adjustment Range	Seal Material
G 200 L/min.	RPGD only: A External 1/4" NPTF Pilot Port at end of Cartridge*	RPGD only: B 3,5 - 105 bar	N Buna-N
I 380 L/min.		I 1 - 70 bar	V Viton
K 760 L/min.	RPID, RPKD only: B External SAE-4 Pilot Port at end of Cartridge*	RPID, RPKD only: B 3,5 - 105 bar	
		RPKD only: J 2 - 105 bar	

* Maximum air pilot pressure should not exceed 10 bar.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

ELECTRO-PROPORTIONAL, PILOT CAPACITY

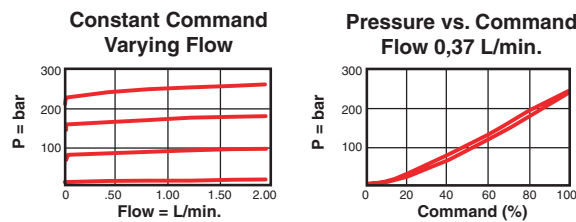


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
1 L/min.	RBAP - X**	T - 8A	18,8	22,2	130,0	85,1	35 - 40

***An additional 50,8 mm clearance is needed for coil installation and removal.

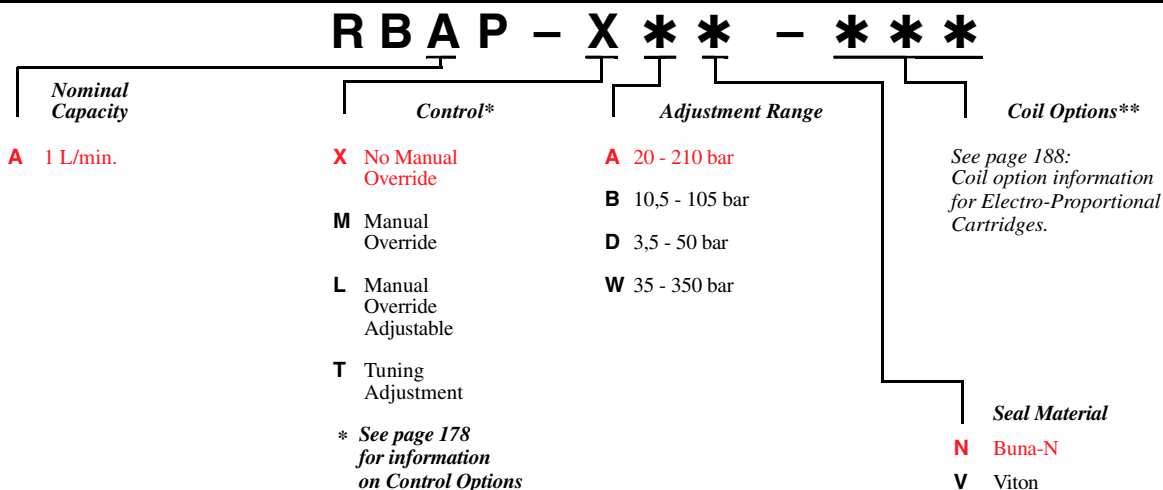
Performance Curves

RBAP



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = 25 cc/min.
- Hysteresis with dither <4% and with DC input <8%.
- Linearity with dither <2% and repeatability with dither <2%.
- Recommended dither frequency = 140 Hz.
- Low leakage at levels in the closed position. Reseat occurs at 85% of cracking pressure.
- For optimum performance, an amplifier with current sensing and adjustable dither should be used. Dither should be adjustable between 100 - 250 Hz.
- The L control allows one to manually adjust the valve in case of an electrical failure. The L control also allows one to offset the pressure range. For instance, if an A range valve is mechanically offset to a setting of 105 bar, the new maximum will be 310 bar.
- This electro-proportional cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2 port pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.
- A wide variety of coil termination and voltage options are available. See the Sun website: Products: Accessories: Coils.

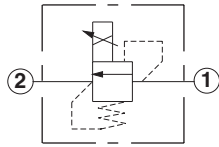
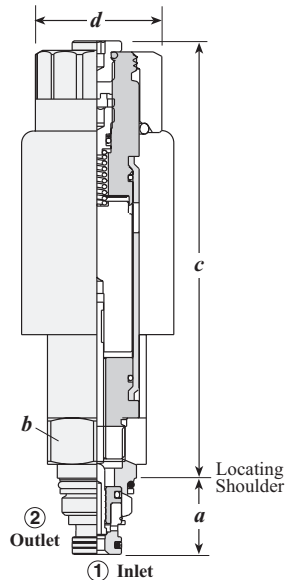
OPTION ORDERING INFORMATION



** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

ELECTRO-PROPORTIONAL, PILOT CAPACITY, HIGH PRESSURE SETTING WITH NO COMMAND, INVERSE FUNCTION

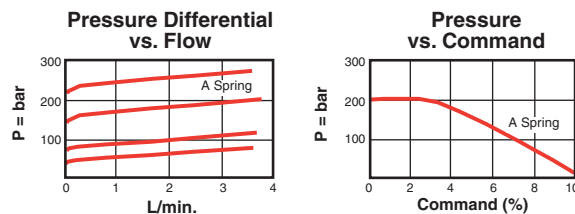


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
1 L/min.	RBAN - XAN	T - 8A	18,8	22,2	108,2	37,3	35 - 40

*** An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

RBAN



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = 25 cc/min.
- Hysteresis with dither <4% and with DC input <8%.
- Linearity with dither <2% and repeatability with dither <2%.
- Recommended dither frequency = 140 Hz.
- Low leakage at levels in the closed position. Reseat occurs at 85% of cracking pressure.
- For optimum performance, an amplifier with current sensing and adjustable dither should be used. Dither should be adjustable between 100 - 250 Hz.
- This electro-proportional cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2 port pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.
- Desired de-energized pressure, within the adjustment range must be specified when ordered.
- A wide variety of coil termination and voltage options are available. See the Sun website: Products: Accessories: Coils.

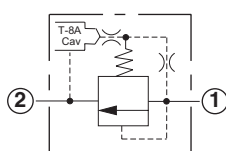
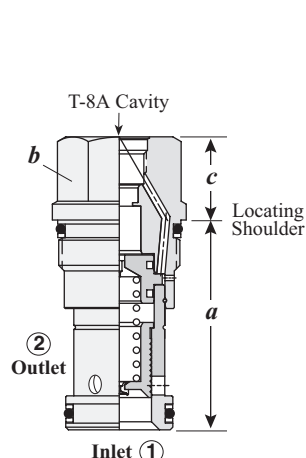
OPTION ORDERING INFORMATION

R B A N - X * * - * * *				
Nominal Capacity	Control	Adjustment Range*	Seal Material	Coil Options**
A 1 L/min.	X* No Manual Override * Special setting required. Specify at time of order. Customer specified special setting stamped on hex.	A 210 - 105 bar B 105 - 55 bar D 55 - 20 bar W 315- 210 bar * Customer is required to specify setting within the selected spring range.	N Buna-N V Viton	See page 188: Coil option information for Electro-Proportional Cartridges.

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

PILOT OPERATED, BALANCED PISTON, MAIN STAGE WITH INTEGRAL T-8A CONTROL CAVITY

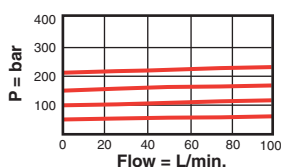


The -8 control option allows a pilot control valve to be incorporated directly into the end of the relief cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

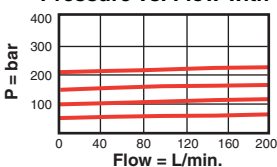
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
95 L/min.	RPEC - 8WN	T - 10A	39,6	22,2	19,0	45 - 50
200 L/min.	RPGC - 8WN	T - 3A	47,8	28,6	17,5	60 - 70
380 L/min.	RPIC - 8WN	T - 16A	62,0	31,8	24,6	200 - 215
760 L/min.	RPKC - 8WN	T - 18A	79,5	41,3	30,2	465 - 500

Performance Curves

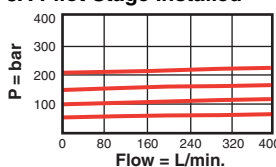
RPEC-8



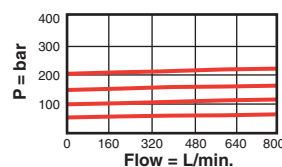
RPGC-8



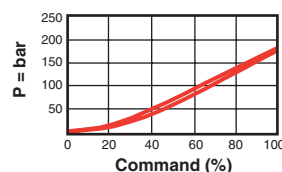
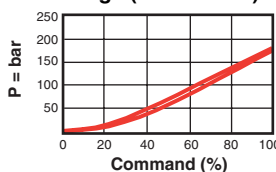
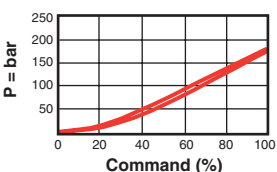
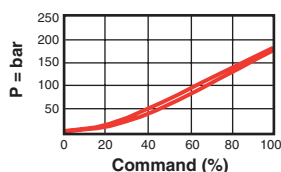
RPIC-8



RPKC-8



Pressure vs. Command with T-8A Pilot Stage (RBAP-MAN) Installed



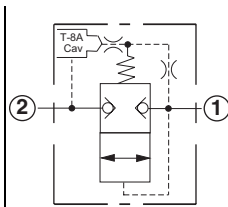
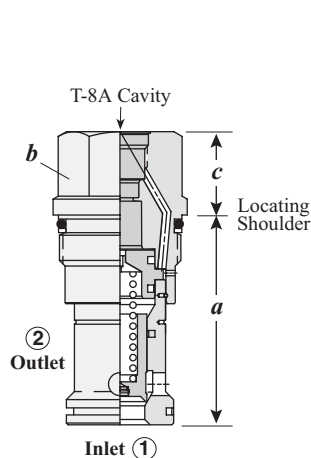
- Maximum operating pressure = 350 bar.
- Control pilot flow = RPEC-8: 0,11 to 0,16 L/min.; RPGC-8: 0,16 to 0,25 L/min.; RPIC-8, RPKC-8: 0,25 to 0,33 L/min.
- Main stage leakage at 24 cSt = RPEC-8: 50 cc/min. at 70 bar; RPGC-8: 50 cc/min. at 70 bar; RPIC-8: 65 cc/min. at 70 bar; RPKC-8: 80 cc/min. at 70 bar.
- Will accept maximum pressure at Port 2; suitable for use in cross-port relief circuits.
- Back pressure on the tank port (port 2) is directly additive to the valve setting at a 1:1 ratio.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

RP * C - 8 * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
E 95 L/min.	8 T-8A Cavity in hex body for pilot operation Pilot valve to be ordered separately	D 1,7 bar	N Buna-N
G 200 L/min.		W 7 bar	V Viton
I 380 L/min.			
K 760 L/min.			

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PILOT OPERATED, BALANCED POPPET, MAIN STAGE WITH INTEGRAL T-8A CONTROL CAVITY

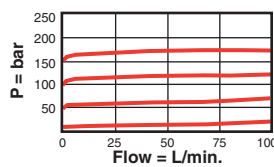


The -8 control option allows a pilot control valve to be incorporated directly into the end of the relief cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

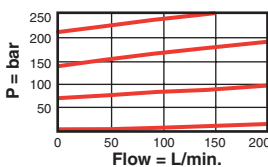
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
95 L/min.	RPES - 8WN	T - 10A	39,6	22,2	19,0	40 - 50
200 L/min.	RPGS - 8WN	T - 3A	47,8	28,6	17,5	60 - 70
380 L/min.	RPIS - 8WN	T - 16A	62,0	31,8	24,6	200 - 215
760 L/min.	RPKS - 8WN	T - 18A	79,2	41,3	30,0	465 - 500

Performance Curves

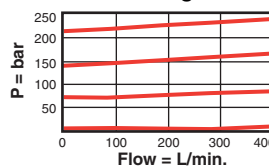
RPES-8



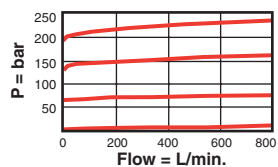
RPGS-8



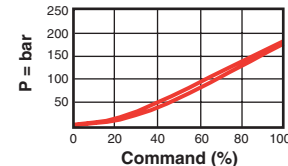
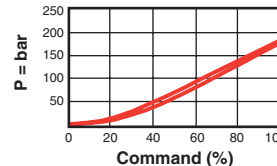
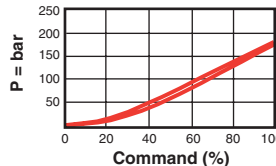
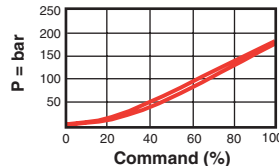
RPIS-8



RPKS-8



Pressure vs. Command with T-8A Pilot Stage (RBAP-MAN) Installed



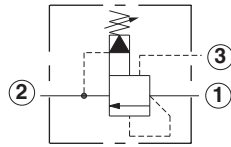
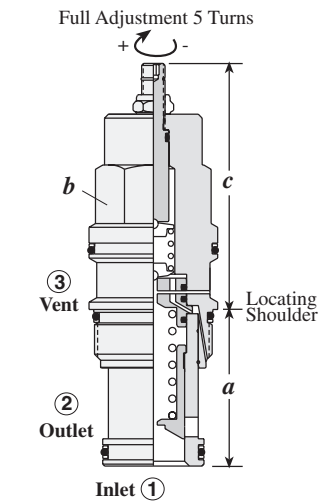
- Maximum operating pressure = 350 bar.
- Control pilot flow = RPES-8: 0,16 to 0,41 L/min.; RPGS-8: 0,16 to 0,25 L/min.; RPIS-8, RPKS-8: 0,25 to 0,33 L/min.
- Main stage leakage at 10% reseat = 0,7 cc/min.
- Typical response time 2 ms.
- Will accept maximum pressure at Port 2; suitable for use in cross-port relief circuits.
- Back pressure on the tank port (port 2) is directly additive to the valve setting at a 1:1 ratio.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

RP * S - 8 * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
E 95 L/min.	8 T-8A Cavity in hex body for pilot operation Pilot valve to be ordered separately	B 3,5 bar	N Buna-N
G 200 L/min.		W 7 bar	V Viton
I 380 L/min.		RPES-8 only: D 1,7 bar	
K 760 L/min.			

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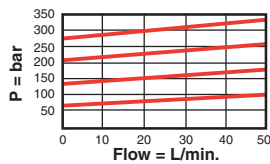
PILOT OPERATED, BALANCED PISTON, VENTABLE



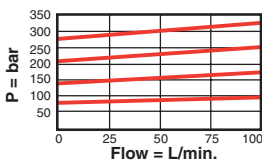
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions						Installation Torque (Nm)
			a	b	c				
					L	C	K	O	
30 L/min.	RVBA – LAN	T - 163A	31,0	19,1	64,8	66,8	70,4	71,0	35 - 40
60 L/min.	RVCA – LAN	T - 11A	35,1	22,2	63,5	67,3	70,0	70,0	45 - 50
120 L/min.	RVEA – LAN	T - 2A	34,8	28,6	71,4	73,2	77,7	—	60 - 70
240 L/min.	RVGA – LAN	T - 17A	46,0	31,8	83,3	84,1	89,7	—	200 - 215
480 L/min.	RVIA – LAN	T - 19A	63,5	41,3	100,0	103,9	106,4	—	465 - 500

Performance Curves

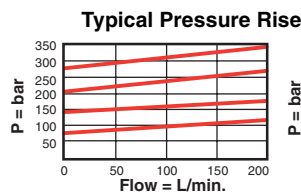
RVBA



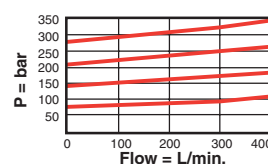
RVCA



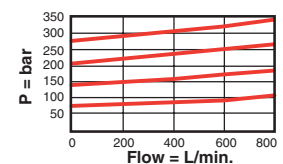
RVEA



RVGA



RVIA



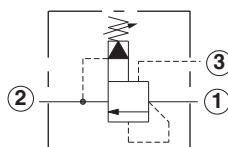
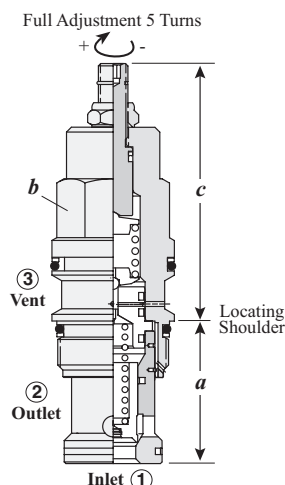
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = RVBA, RVCA: 30 cc/min. at 70 bar; RVEA: 50 cc/min. at 70 bar; RVGA: 65 cc/min. at 70 bar; RVIA: 80 cc/min. at 70 bar.
- Typical response time 10 ms.
- Control pilot flow = RVBA, RVCA: 0,11 to 0,16 L/min.; RVEA: 0,16 to 0,25 L/min.; RVGA, RVIA: 0,25 to 0,33 L/min.
- Factory pressure setting established at 15 L/min.
- A remote pilot relief on port 3 (vent) will control the valve below its own setting.
- Will accept maximum pressure at port 2; suitable for use in cross-port relief circuits. If used in cross-port relief circuits, consider spool leakage.
- Back pressure on the tank port (port 2) is directly additive to the valve setting at a 1:1 ratio.

OPTION ORDERING INFORMATION

RV * A - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
B 30 L/min.	L Standard Screw Adjustment	RVBA only: A 5 - 210 bar Standard set at 70 bar	N Buna-N
C 60 L/min.	C* Tamper Resistant Factory Set	B 5 - 105 bar Standard set at 70 bar	V Viton
E 120 L/min.	K Handknob with Lock Knob	C 5 - 420 bar Standard set at 70 bar	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.
G 240 L/min.	O Handknob with Panel Mount	N 5 - 55 bar Standard set at 28 bar	
I 480 L/min.	RVCA, RVEA only: O Handknob with Panel Mount	Q 5 - 25 bar Standard set at 14 bar	
	*Special setting required. Specify at time of order.	W 5 - 315 bar Standard set at 70 bar	
	** See page 178 for information on Control Options	RVCA, RVEA, RVGA, RVIA only: A 7 - 210 bar Standard set at 70 bar	Adjustment Ranges (Continued) RVEA, RVIA only: N 4 - 55 bar Standard set at 28 bar
	Customer specified special setting stamped on hex.	B 3,5 - 105 bar Standard set at 70 bar	
		C 10 - 420 bar Standard set at 70 bar	
		D 1,7 - 55 bar Standard set at 28 bar	
		E 1,7 - 28 bar Standard set at 14 bar	RVEA only: Q 4 - 28 bar Standard set at 14 bar
		W 10 - 315 bar Standard set at 70 bar	

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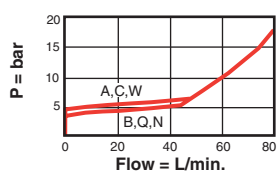
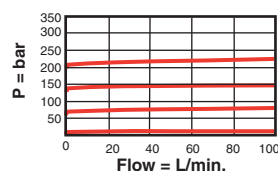
PILOT OPERATED, BALANCED POPPET, VENTABLE



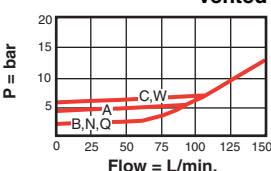
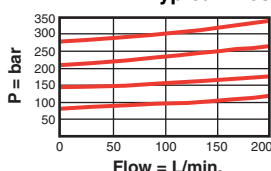
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
60 L/min.	RVCS – LAN	T - 11A	34,8	22,2	63,2	67,3	70,0	45 - 50
95 L/min.	RVES – LAN	T - 2A	34,8	28,6	71,4	73,2	77,7	60 - 70
200 L/min.	RVGS – LAN	T - 17A	46,0	31,8	83,3	84,1	89,7	200 - 215
480 L/min.	RVIS – LAN	T - 19A	63,5	41,3	99,8	103,1	106,4	465 - 500

Performance Curves

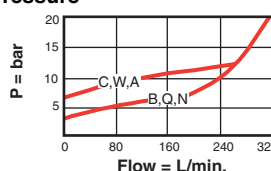
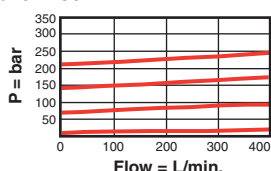
RVCS



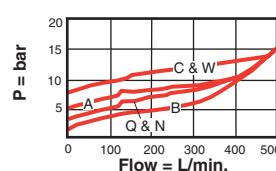
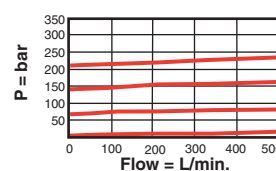
RVES



RVGS



RVIS



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 90% reseal = RVCS: 2 cc/min at 70 bar.; RVES, RVGS, RVIS: 0,7 cc/min at 70 bar.
- Typical response 2 ms.
- Control pilot flow = RVCS: 0,11 to 0,16 L/min.; RVES, RVIS, RVGS: 0,25 to 0,33 L/min.
- Factory pressure setting established at 15 L/min.
- Will accept maximum pressure at port 2; suitable for use in cross-port relief circuits.
- A remote pilot relief on port 3 (vent) will control the valve below its own setting.
- Back pressure on the tank port (port 2) is directly additive to the valve setting at a 1:1 ratio.

OPTION ORDERING INFORMATION

RV * S - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 60 L/min.	C* Tamper Resistant Factory Set	A 7 - 210 bar Standard set at 70 bar	N Buna-N
E 95 L/min.	K Handknob with Lock Knob	B 3,5 - 105 bar Standard set at 70 bar	V Viton
G 200 L/min.	L Standard Screw Adjustment	C 10,5 - 420 bar Standard set at 70 bar	
I 480 L/min.		N 4 - 55 bar Standard set at 25 bar	
		Q 4 - 25 bar Standard set at 14 bar	
		W 10,5 - 315 bar Standard set at 70 bar	

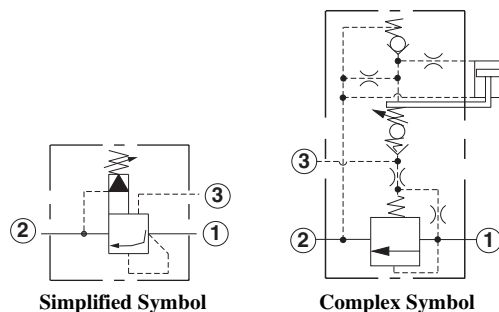
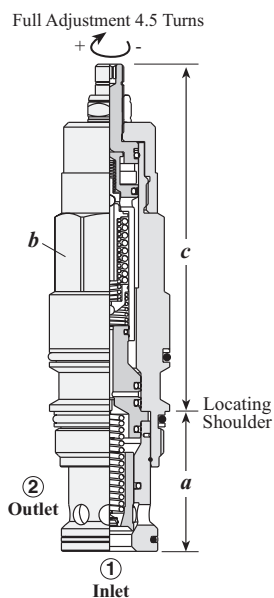
* Special setting required. Specify at time of order.

** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

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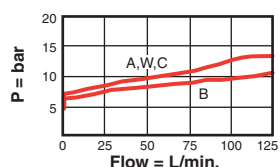
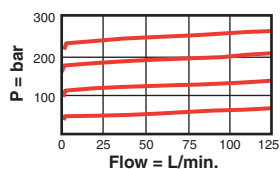
PILOT OPERATED, BALANCED POPPET, VENTABLE, SOFT



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
120 L/min.	RVET – LAN	T - 2A	35,1	28,6	110,2	113,5	60 - 70
240 L/min.	RVGT – LAN	T - 17A	46,0	31,8	114,3	116,8	200 - 215
480 L/min.	RVIT – LAN	T - 19A	63,5	35,1	115,6	120,1	465 - 500

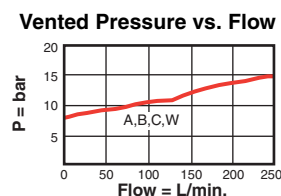
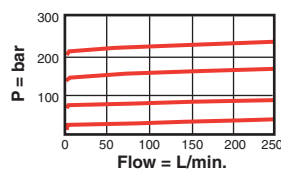
Performance Curves

RVET

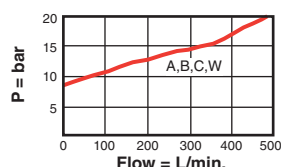
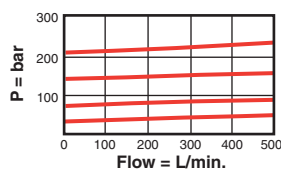


RVGT

Pressure vs. Flow - A Spring Range Shown



RVIT



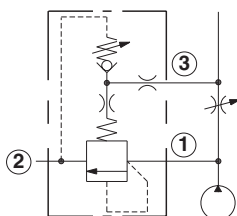
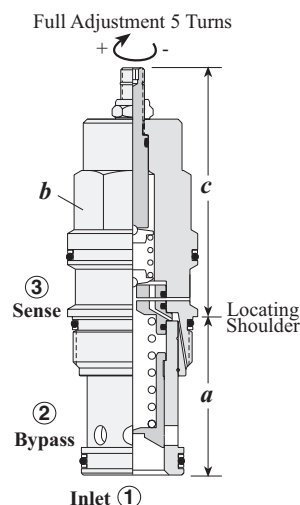
- Maximum operating pressure = 350 bar.
- Control pilot flow = RVET: 0,16 to 0,41 L/min.; RVGT, RVIT: 0,25 to 0,33 L/min.
- Pressure ramp up time = RVET: 300 ms.; RVGT: 400 ms.; RVIT: 500 ms.
- Typical response time 2 ms.
- Factory pressure setting established at 15 L/min.
- Will accept maximum pressure at port 2; suitable for use in cross-port relief circuits.
- A remote pilot relief on port 3 (vent) will control the valve below its own setting.

OPTION ORDERING INFORMATION

RV * T - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
E 120 L/min.	C* Tamper Resistant Factory Set	A 35 - 210 bar Standard set at 70 bar	N Buna-N
G 240 L/min.	L Standard Screw Adjustment	B 35 - 105 bar Standard set at 70 bar	V Viton
I 480 L/min.	* Special setting required. Specify at time of order.	C 70 - 420 bar Standard set at 70 bar	
	** See page 178 for information on Control Options	W 70 - 315 bar Standard set at 70 bar	
	Customer specified special setting stamped on hex.		

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BYPASS COMPENSATOR WITH RELIEF FUNCTION, NORMALLY CLOSED



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
20 L/min.	RVBB - LAN	T - 163A	30,7	19,1	64,5	66,8	70,4	35 - 40
40 L/min.	RVCB - LAN	T - 11A	35,1	22,2	63,5	65,3	69,3	45 - 50
80 L/min.	RVEB - LAN	T - 2A	35,1	28,6	71,4	73,2	77,7	60 - 70
160 L/min.	RVGB - LAN	T - 17A	46,0	31,8	83,3	84,1	89,7	200 - 215
320 L/min.	RVIB - LAN	T - 19A	63,8	41,3	100,0	103,1	105,9	465 - 500

Performance Curves

RVBB

RVCB

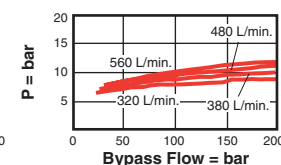
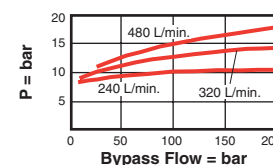
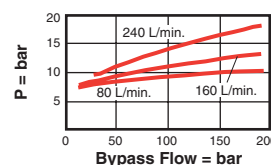
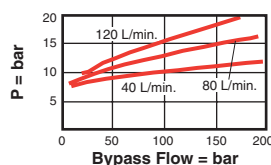
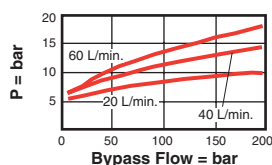
RVEB

RVGB

RVIB

Typical Compensator Differentials

The X axis of the performance curves shown indicates the system pressure. The Y axis of the performance curves indicates the pressure differential that the valve creates across the control orifice. The curves represent various bypass flows (pump flow minus control flow). The capacities listed and performance of these valves are determined by the bypass flow. The control flow is not a factor.



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = RVBB, RVCB: 30 cc/min. at 70 bar; RVEB: 50 cc/min. at 70 bar; RVGB: 65 cc/min. at 70 bar; RVIB: 80 cc/min. at 70 bar.
- Typical response time 10 ms.
- Factory pressure setting established at 15 L/min.
- Back pressure on the tank port (port 2) is directly additive to the valve setting at a 1:1 ratio.
- Compensating pressure for all ranges is 8 bar.

OPTION ORDERING INFORMATION

RV * B - * * *

Nominal Capacity	Control**	Adjustment Range	Seal Material
B 20 L/min.	L Standard Screw Adjustment	RVBB only: A 5 - 210 bar Standard set at 70 bar	N Buna-N
C 40 L/min.	C* Tamper Resistant Factory Set	B 5 - 105 bar Standard set at 70 bar	V Viton
E 80 L/min.	K Handknob with Lock Knob	C 5 - 420 bar Standard set at 70 bar	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.
G 160 L/min.		N 5 - 55 bar Standard set at 30 bar	
I 320 L/min.		Q 5 - 25 bar Standard set at 14 bar	
		W 5 - 315 bar Standard set at 70 bar	
		RVCB, RVEB, RVGB, RVIB only: A 7 - 210 bar Standard set at 70 bar	Adjustment Ranges (Continued) RVCB, RVGB, RVIB only: B 3,5 - 105 bar Standard set at 70 bar RVCB, bias pressure is 4 bar.
		C 10,5 - 420 bar Standard set at 70 bar	RVCB, RVEB only: W 7 - 315 bar Standard set at 70 bar
		D 2 - 55 bar Standard set at 30 bar	

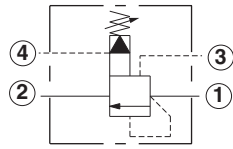
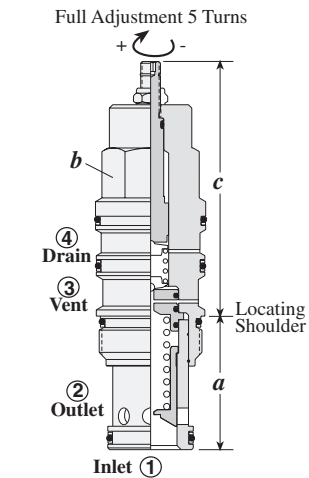
* Special setting required. Specify at time of order.

** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

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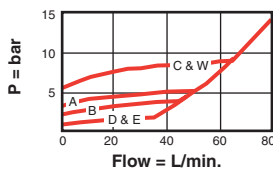
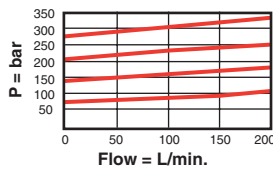
PILOT OPERATED, BALANCED PISTON, VENTABLE WITH EXTERNAL DRAIN



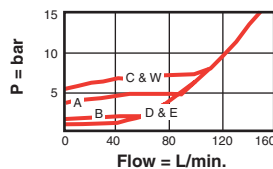
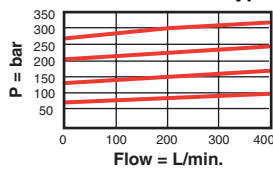
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
60 L/min.	RVCD – LAN	T - 21A	35,1	22,2	78,5	82,6	84,8	45 - 50
120 L/min.	RVED – LAN	T - 22A	35,1	28,6	87,4	89,0	93,7	60 - 70
240 L/min.	RVGD – LAN	T - 23A	46,0	31,8	99,8	101,3	106,4	200 - 215
480 L/min.	RVID – LAN	T - 24A	63,5	41,8	121,4	126,7	127,8	465 - 500

Performance Curves

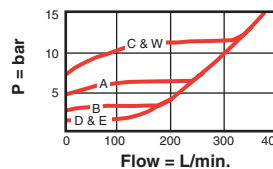
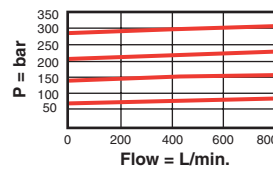
RVCD



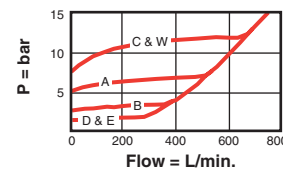
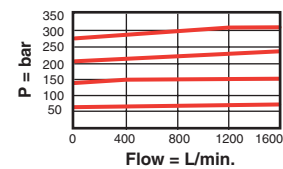
RVED



RVGD



RVID



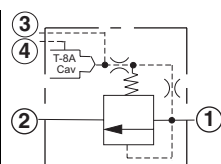
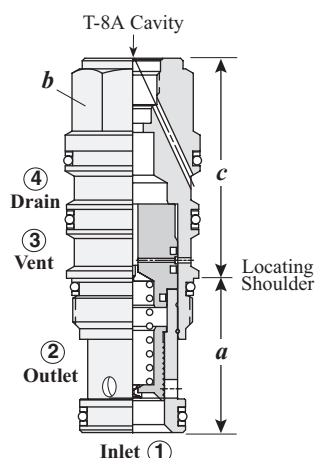
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = RVCD: 30 cc/min. at 70 bar; RVED: 50 cc/min. at 70 bar; RVGD: 65 cc/min. at 70 bar; RVID: 80 cc/min. at 70 bar.
- Control pilot flow = RVCD: 0,11 to 0,16 L/min.; RVED: 0,16 to 0,25 L/min.; RVGD, RVID: 0,25 to 0,33 L/min.
- Typical response time 10 ms.
- Factory pressure setting established at 15 L/min.
- Pressure at port 4 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.
- Will accept maximum pressure at port 2; suitable for use in cross-port relief circuits.

OPTION ORDERING INFORMATION

RV * D - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 60 L/min.	L Standard Screw Adjustment	A 7 - 210 bar Standard set at 70 bar	N Buna-N
E 120 L/min.	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Standard set at 70 bar	V Viton
G 240 L/min.	K Handknob with Lock Knob	C 10,5 - 420 bar Standard set at 70 bar	
I 480 L/min.	* Special setting required. Specify at time of order.	D 1,7 - 55 bar Standard set at 30 bar	
	** See page 178 for information on Control Options	E 1,7 - 28 bar Standard set at 14 bar	
	Customer specified special setting stamped on hex.	W 10,5 - 315 bar Standard set at 70 bar	

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

PILOT OPERATED, BALANCED PISTON, VENTABLE, DRAIN TO PORT 4, MAIN STAGE WITH INTEGRAL T-8A CONTROL CAVITY

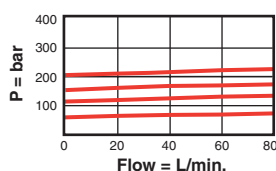


The -8 control option allows a pilot control valve to be incorporated directly into the end of the relief cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

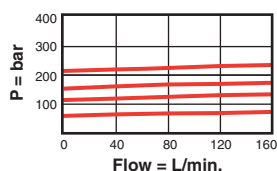
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	RVCD – 8WN	T - 21A	35,1	22,2	45,2	45 - 50
120 L/min.	RVED – 8WN	T - 22A	35,1	28,6	50,8	60 - 70
240 L/min.	RVGD – 8WN	T - 23A	46,0	31,8	65,8	200 - 215
480 L/min.	RVID – 8WN	T - 24A	63,5	41,3	80,3	465 - 500

Performance Curves

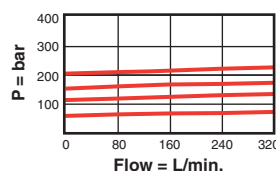
RVCD-8



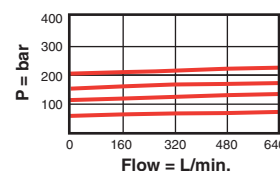
RVED-8



RVGD-8

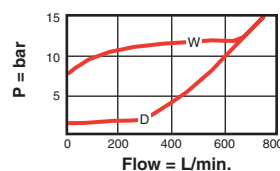
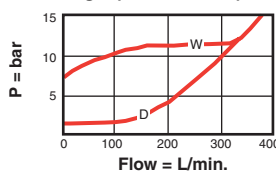
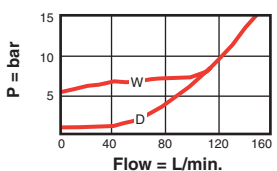
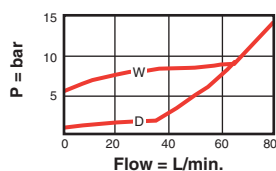


RVID-8



Pressure vs. Flow

Pressure vs. Command with T-8A Pilot Stage (RBAP-MAN) Installed



- Maximum operating pressure = 350 bar.
- Main stage leakage at 24 cSt = RVCD-8: 30 cc/min. at 70 bar; RVED-8: 50 cc/min. at 70 bar; RVGD-8: 65 cc/min. at 70 bar; RVID-8: 80 cc/min. at 70 bar.
- Control pilot flow = RVCD-8: 0,11 to 0,16 L/min.; RVED-8: 0,16 to 0,25 L/min.; RVGD-8, RVID-8: 0,25 to 0,33 L/min.
- Typical response time 10 ms.
- Will accept maximum pressure at port 2; suitable for use in cross-port relief circuits.
- Pressure at port 4 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.

OPTION ORDERING INFORMATION

RV * D - 8 * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
C 60 L/min.	8 T-8A Cavity in hex body for pilot operation	D 1,7 bar	N Buna-N
E 120 L/min.		W 7 bar	V Viton
G 240 L/min.	Pilot valve to be ordered separately		
I 480 L/min.			

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Protection against pressure spikes. . .

NEW SOFT SHIFT OPTION FOR SUN RELIEF CARTRIDGE VALVES

Using these newly designed pressure relief valves, pressures can be ramped up and ramped down. These relief valves work purely mechanically, and protect hydraulic components against pressure spikes that could damage machinery. Soft shift relief valves are available as pure pressure relief valves and as ventable relief valves in different frame sizes. As cartridge valves they can be used in many different types of assemblies such as sandwich, line mount, gasket mount, and custom.

Benefits of Sun's Soft Relief

- ***Controlled rate of pressure rise means less dynamic stress for components.***
 - No pressure transients above setting.
 - Limited rate of force change.
 - Increases the life expectancy of hoses and other critical components in the circuit.
- ***Uses a normally open pilot section to maintain a minimum threshold setting.***
 - A minimum threshold setting allows the valve to begin controlling the rate of pressure rise immediately from the vent pressure setting.
 - Incorporates a return spring to ensure a reliable reset.

*See catalogue pages 11 (RP*T) and 20 (RV*T) for detailed information on relief cartridges with soft shift options.*



Soft Shift option extended to Sun Solenoid Operated Directional Valves...

Sun's small pilot solenoid valves are used to unload larger main-stage elements remotely, or by directly integrating the pilot valve into the main-stage element. In this latter approach, unique to Sun, 12 different pilot valves (proportional, solenoid, hydraulic and pneumatic) can be integrated into a variety of main-stage elements.

Most 2-position, 2-way screw-in cartridge pilot solenoid valves utilize a poppet style construction to satisfy low leakage requirements. Sun Hydraulics has adopted a different approach that utilizes a precision spool/sleeve design. Available in both 2-position, 2- and 3-way pilot solenoid cartridges, this approach produces leakage characteristics equivalent to poppet style designs.

Since control volumes in pilot circuits are typically small, the lower gain characteristics of spool valves produce a softer unload. To further extend the operating rate, Sun offers a soft shift option that adds an orifice in the valve's armature to gain greater control of fluid displacement. Combining the benefits of a spool valve with the soft shift option extends shift times, which can reduce the hydraulic shock generated when unloading main-stage elements. Sun's Soft Shift option is offered on all of its spool-type solenoid valves.

You will find additional information about the DTDA-S, DAAL-S, DLDA-S, DBAL-S, DMDA-S, DNDA-S on pages 132 through 138 in the Solenoid section of this catalogue.

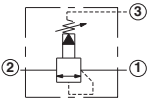
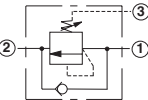
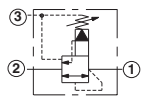
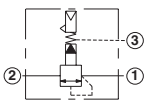
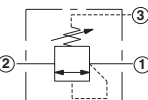
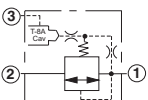
**Consult the Sun website
www.sunhydraulics.com**

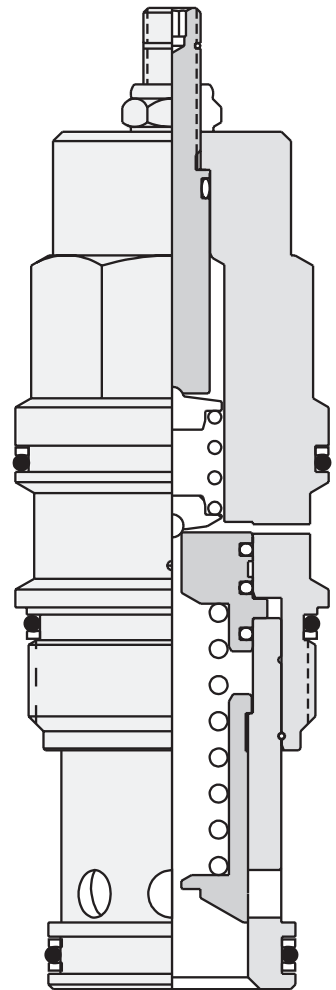
for detailed and complete information on Sun soft shift options.

**Products: Cartridges: Relief: View All Relief Cartridges and Products: Cartridges: Solenoids: View all Solenoid Operated Cartridges.
Products: Cartridges: Solenoid Operated: View All Solenoid Operated Cartridges**

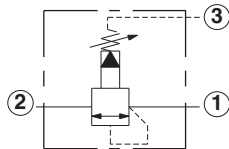
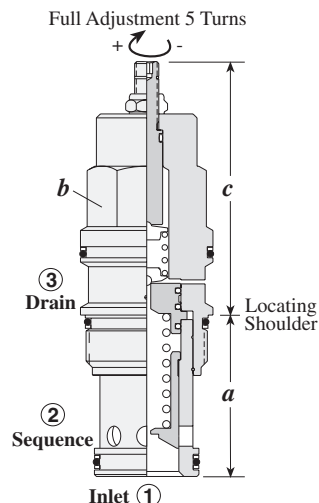


Sequence Cartridge Valves

	<i>Cartridge Type</i>	<i>Page</i>
	Pilot Operated, Balanced Piston	26
	Direct Acting with Reverse Flow Check	27
	Kick-down, Pilot Operated, Balanced Piston	28
	Air Controlled, Pilot Operated, Balanced Piston	29
	Direct Acting without Reverse Flow Check	30
	Electro-Proportional, Pilot Operated, Balanced Piston, Main Stage with Integral T-8A Control Cavity	31



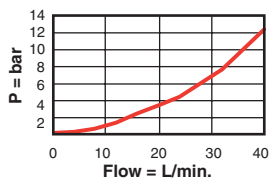
PILOT OPERATED, BALANCED PISTON



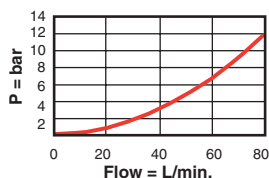
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
30 L/min.	RSBC – LAN	T - 163A	31,0	19,1	64,8	66,8	70,4	35 - 40
60 L/min.	RSDC – LAN	T - 11A	35,1	22,2	63,5	67,3	70,0	45 - 50
120 L/min.	RSFC – LAN	T - 2A	35,1	28,6	71,4	73,2	77,7	60 - 70
240 L/min.	RSHC – LAN	T - 17A	46,0	31,8	83,3	84,1	89,7	200 - 215
480 L/min.	RSJC – LAN	T - 19A	63,5	41,3	100,0	103,9	106,4	465 - 500

Performance Curves

RSBC

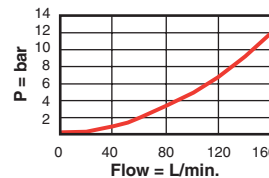


RSDC

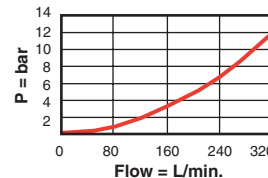


RSFC

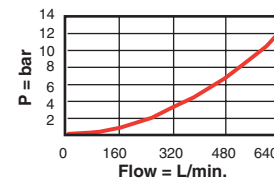
Pressure Drop Fully Sequenced



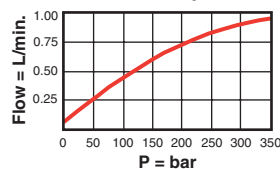
RSHC



RSJC



Pilot Flow after Valve Sequence for RS*C



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = RSBC, RSDC: 30 cc/min. at 70 bar; RSFC: 50 cc/min. at 70 bar; RSHC: 65 cc/min. at 70 bar; RSJC: 80 cc/min. at 70 bar.
- Typical response time 10 ms.

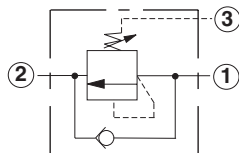
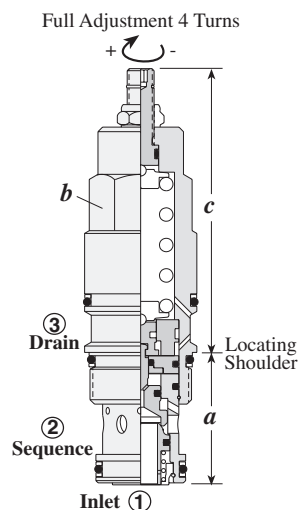
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.
- Pilot flow continues to increase as the pressure at port 1 (inlet), relative to the pressure at port 3 (drain), rises above the valve setting.

OPTION ORDERING INFORMATION

RS * C - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
B 30 L/min.	L Standard Screw Adjustment	RSBC only: A 5 - 210 bar Standard set at 70 bar	N Buna-N
D 60 L/min.	C* Tamper Resistant Factory Set	B 5 - 105 bar Standard set at 70 bar	V Viton
F 120 L/min.	K Handknob with Lock Knob	C 5 - 420 bar Standard set at 70 bar	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.
H 240 L/min.	* Special setting required. Specify at time of order.	N 5 - 55 bar Standard set at 28 bar	
J 480 L/min.		Q 5 - 28 bar Standard set at 14 bar	
		W 5 - 315 bar Standard set at 70 bar	
		RSDC, RSFC, RSHC, RSJC only: A 7 - 210 bar Standard set at 70 bar	Adjustment Ranges (Continued)
	** See page 178 for information on Control Options	B 3.5 - 105 bar Standard set at 70 bar	RSDC, RSFC, RSHC only: N 4 - 55 bar Standard set at 28 bar
	Customer specified special setting stamped on hex.	C 10 - 420 bar Standard set at 70 bar	RSDC, RSFC, RSJC only: Q 4 - 28 bar Standard set at 14 bar
		W 10 - 315 bar Standard set at 70 bar	

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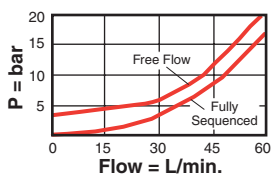
DIRECT ACTING WITH REVERSE FLOW CHECK



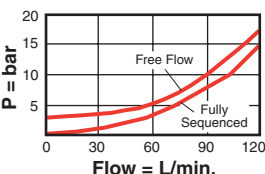
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
60 L/min.	SCCA – LAN	T - 11A	35,1	22,2	78,5	80,0	45 - 50
120 L/min.	SCEA – LAN	T - 2A	35,1	28,6	88,1	89,7	60 - 70
240 L/min.	SCGA – LAN	T - 17A	46,0	31,8	100,0	101,6	200 - 215
480 L/min.	SCIA – LAN	T - 19A	63,5	41,3	122,9	128,5	465 - 500

Performance Curves

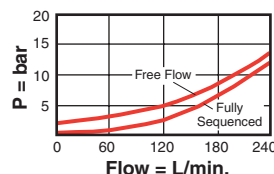
SCCA



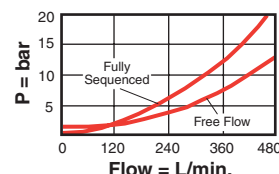
SCEA



SCGA



SCIA



Free Flow to Pressure Drop Fully Sequenced

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = 0,7 cc/min.
- Reverse flow check cracking pressure = SCCA: 2,8 bar; SCEA: 1,7 bar; SCGA, SCIA: 1,5 bar.
- Typical response time 2 ms.
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.
- Although this is a zero pilot flow valve, port 3 (drain) must be connected to maintain a pressure reference in the control chamber. If port 3 is blocked, reciprocating seal weepage will cause the valve to malfunction.

OPTION ORDERING INFORMATION

SC * A - * * *

Nominal Capacity	Control**	Adjustment Range	Seal Material
C 60 L/min.	L Standard Screw Adjustment	A 35 - 210 bar Standard set at 70 bar	N Buna-N
E 120 L/min.	C* Tamper Resistant Factory Set	B 20 - 105 bar Standard set at 70 bar	V Viton
G 240 L/min.	* Special setting required. Specify at time of order.	C 140 - 420 bar Standard set at 140 bar	
I 480 L/min.		D 14 - 55 bar Standard set at 28 bar	
		W 55 - 315 bar Standard set at 70 bar	
		SCCA only: E 7 - 28 bar Standard set at 14 bar	

U.S. Patent #4,834,135

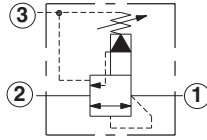
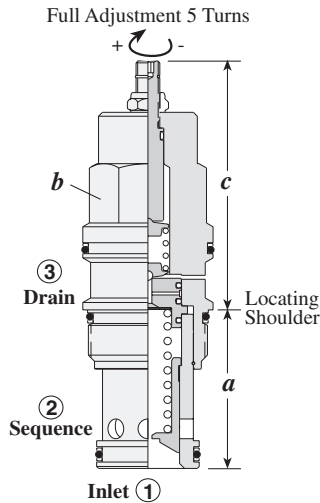
** See page 178
for information
on Control Options

Customer specified special
setting stamped on hex.

Consult the Sun website for
our most recent and complete
information on the full Corrosion
Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

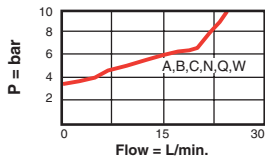
KICK-DOWN, PILOT OPERATED, BALANCED PISTON



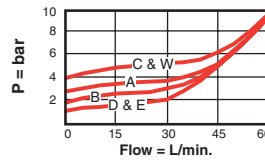
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
30 L/min.	SQBB – LAN	T - 163A	31,0	19,1	64,8	67,8	70,0	35 - 40
60 L/min.	SQDB – LAN	T - 11A	35,1	22,2	63,5	65,0	70,0	40 - 50
120 L/min.	SQFB – LAN	T - 2A	35,1	28,6	71,4	73,2	77,7	60 - 70
240 L/min.	SQHB – LAN	T - 17A	46,0	31,8	83,3	84,1	89,7	200 - 215
480 L/min.	SQJB – LAN	T - 19A	63,5	41,3	100,0	103,9	106,4	465 - 500

Performance Curves

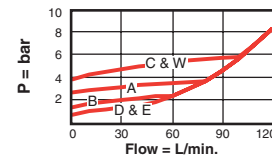
SQBB



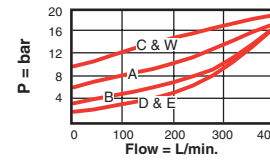
SQDB



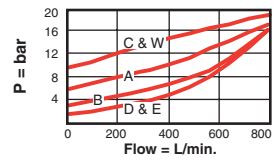
SQFB



SQHB



SQJB



Pressure Drop After Opening

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = SQBB, SQDB: = 30 cc/min. at 70 bar; SQFB: 50 cc/min. at 70 bar; SQHB: 65 cc/min. at 70 bar; SQJB: 80 cc/min. at 70 bar.
- Typical response time 25 ms.
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.

OPTION ORDERING INFORMATION

SQ * B - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
B 30 L/min.	L Standard Screw Adjustment	SQBB only: A 5 - 210 bar Standard set at 70 bar	N Buna-N
D 60 L/min.	C* Tamper Resistant Factory Set	B 5 - 105 bar Standard set at 70 bar	V Viton
F 120 L/min.	K Handknob with Lock Knob	C 5 - 420 bar Standard set at 70 bar	
H 240 L/min.		N 5 - 55 bar Standard set at 28 bar	
J 480 L/min.		Q 5 - 28 bar Standard set at 14 bar	
		W 5 - 315 bar Standard set at 70 bar	
		SQDB, SQFB, SQHB, SQJB only: A 7 - 210 bar Standard set at 70 bar	
		B 3,5 - 105 bar Standard set at 70 bar	
		C 10,5 - 420 bar Standard set at 70 bar	
		D 1,7 - 55 bar Standard set at 28 bar	
		E 1,7 - 28 bar Standard set at 14 bar	
		W 10,5 - 315 bar Standard set at 70 bar	

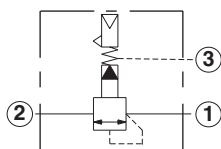
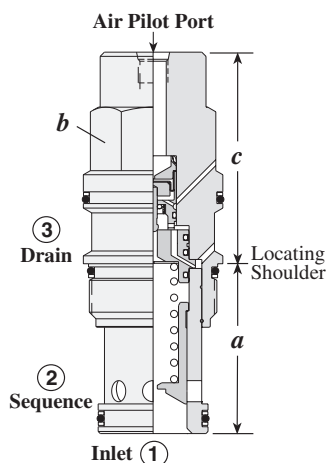
** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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AIR CONTROLLED, PILOT OPERATED, BALANCED PISTON



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					A	B	
120 L/min.	RSFE – ABN	T - 2A	35,1	28,6	50,8	-	60 - 70
240 L/min.	RSHE – BBN	T - 17A	46,0	31,8	-	62,7	200 - 215
480 L/min.	RSJE – BBN	T - 19A	63,5	41,3	-	79,2	465 - 500

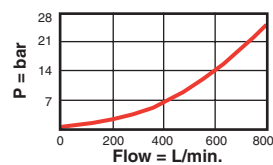
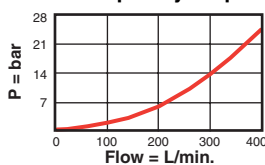
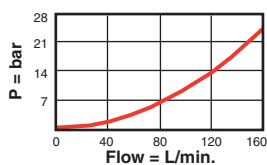
Performance Curves

RSFE

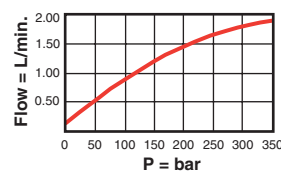
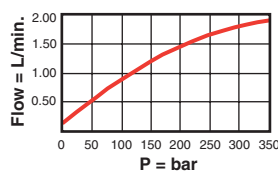
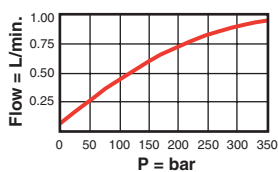
RSHE

RSJE

Pressure Drop Fully Sequenced



Pilot Flow after Valve Sequence



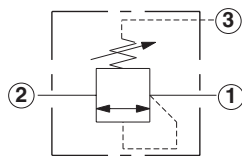
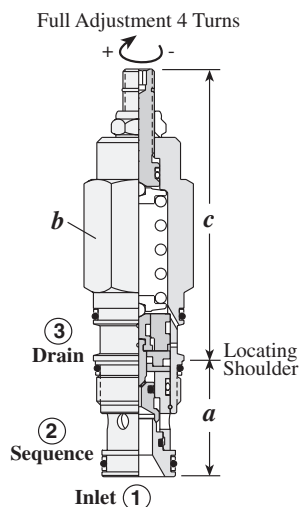
- Pilot ratio, air to hydraulic = 20:1.
- Maximum operating pressure = 140 bar.
- Maximum air pressure = 10 bar.
- Maximum valve leakage at 24 cSt = RSFE: 50 cc/min. at 70 bar; RSHE: 65 cc/min. at 70 bar; RSJE: 80 cc/min. at 70 bar.
- Typical response time 10 ms.

OPTION ORDERING INFORMATION

RS * E - * B *			
Nominal Capacity	Control	Adjustment Range	Seal Material
F 120 L/min.	Available for RSFE only	B 3,5 - 105 bar	N Buna-N
H 240 L/min.	A External 1/4" NPTF Pilot Port at end of Cartridge		V Viton
J 480 L/min.			
RSHE, RSJE only			
	B External SAE-4 Pilot Port at end of Cartridge		

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DIRECT ACTING WITHOUT REVERSE FLOW CHECK



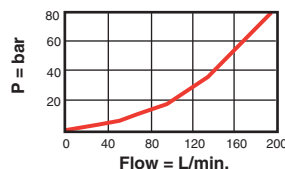
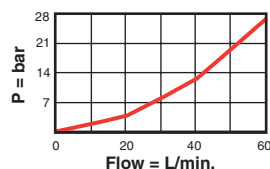
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
60 L/min.	SXCA – LAN	T - 11A	35,1	22,2	78,5	80,3	45 - 50
120 L/min.	SXEA – LAN	T - 2A	35,1	28,6	88,1	89,9	60 - 70

Performance Curves

SXCA

SXEA

Pressure Drop Fully Sequenced



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = 0,7 cc/min. Reseat exceeds 85% of cracking pressure.
- Typical response time 2 ms.
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.
- Although this is a zero pilot flow valve, port 3 (drain) must be connected to maintain a pressure reference in the control chamber. If port 3 is blocked, reciprocating seal weepage will cause the valve to malfunction.

OPTION ORDERING INFORMATION

SX * A - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 60 L/min.	L Standard Screw Adjustment	A 35 - 210 bar Standard set at 70 bar	N Buna-N
E 120 L/min.	C* Tamper Resistant Factory Set	B 20 - 105 bar Standard set at 70 bar	V Viton
	* Special setting required. Specify at time of order.	C 140 - 420 bar Standard set at 140 bar	
		D 14 - 55 bar Standard set at 28 bar	
		W 55 - 315 bar Standard set at 70 bar	

** See page 178 for information on Control Options

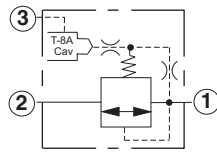
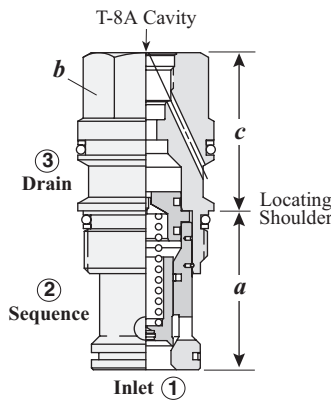
U.S. Patent #4,834,135.

Customer specified special setting stamped on hex.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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PILOT OPERATED, BALANCED PISTON, MAIN STAGE WITH INTEGRAL T-8A CONTROL CAVITY

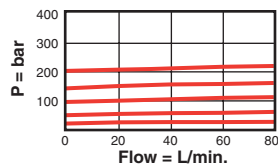


The -8 control option allows a pilot control valve to be incorporated directly into the end of the modulating element via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

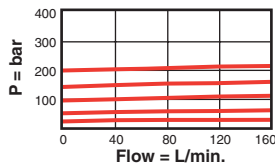
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	RSDC - 8WN	T - 11A	35,1	22,2	30,2	45 - 50
120 L/min.	RSFC - 8WN	T - 2A	35,1	28,6	35,1	60 - 70
240 L/min.	RSHC - 8WN	T - 17A	46,0	31,8	46,0	200 - 215
480 L/min.	RSJC - 8WN	T - 19A	63,5	41,3	58,7	465 - 500

Performance Curves

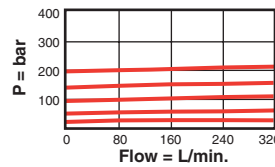
RSDC-8



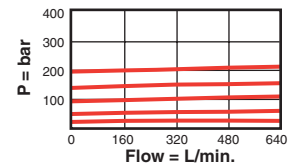
RSFC-8



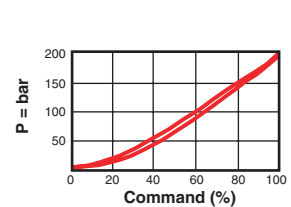
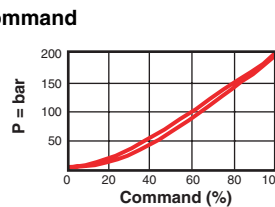
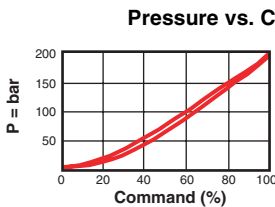
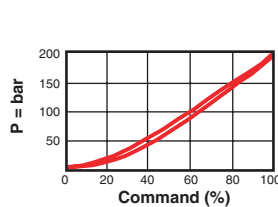
RSHC-8



RSJC-8



Typical Pressure vs. Flow with T-8A Pilot Stage (RBAP-MAN) Installed



Pressure vs. Command

- Maximum operating pressure = 350 bar.
- Main stage leakage at 24 cSt = RSDC-8: 30 cc/min. at 70 bar; RSFC-8: 50 cc/min. at 70 bar; RSHC-8: 65 cc/min. at 70 bar; RSJC-8: 80 cc/min. at 70 bar.
- Control pilot flow = RSDC-8: 0,11 to 0,16 L/min.; RSFC-8: 0,16 to 0,25 L/min.; RSHC-8, RSJC-8: 0,25 to 0,33 L/min.
- Will accept maximum pressure at Port 2; suitable for use in cross-port relief circuits. If used in cross-port relief circuits, consider spool leakage.
- Pressure at port 3 is directly additive at a 1:1 ratio to the valve setting and should not exceed 350 bar.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

RS * C - 8 * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
D 60 L/min.	8 T-8A Cavity in hex body for pilot operation	D 1,7 bar	N Buna-N
F 120 L/min.		W 7 bar	V Viton
H 240 L/min.	Pilot valve to be ordered separately		
J 480 L/min.			

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CUSTOM VALVE PACKAGES

Sun Hydraulics manufactures custom engineered valve packages or “valvepaks” at all of its locations around the world. Valvepaks are comprised of standard screw-in cartridge valves housed in a custom manifold. Once a customer’s hydraulic circuit has been developed, it is incorporated into a single, custom manifold designed to fit into a defined location.

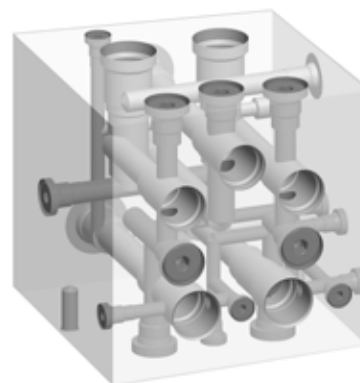
Benefits to customers:

- Creative and innovative manifold design using solid modeling.
- Rapid response for prototypes.
- Utilizing Sun cartridges with our unique floating style cartridge construction.
- Compound angle drill for extremely compact designs.
- Construction plugs are eliminated or dramatically reduced.
- Larger and more efficient flow paths.
- Manifolds available in T-6061 (210 bar) aluminium and 65-45-12 high-strength (350 bar) SG iron.

Let Sun design your manifold.

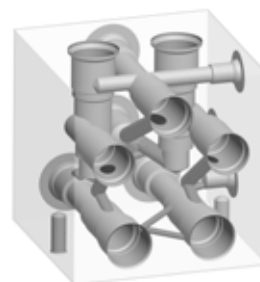
Classic Three-Axis Straight Hole Drilling

125 cubic inches (5 x 5 x 5)
2,048 cubic centimetres (12,7 x 12,7 x 12,7)
17 construction plugs.



Sun's Five-Axis Compound Angle Drilling

64 cubic inches (4 x 4 x 4)
1,049 cubic centimetres (10,2 x 10,2 x 10,2)
0 construction plugs.



View our full range of cartridge and manifold products on the Sun website:

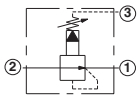
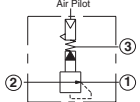
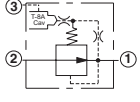
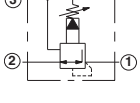
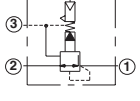
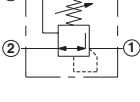
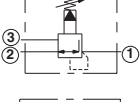
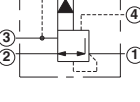
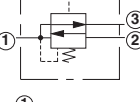
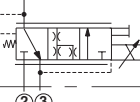
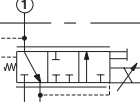
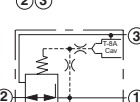
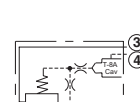
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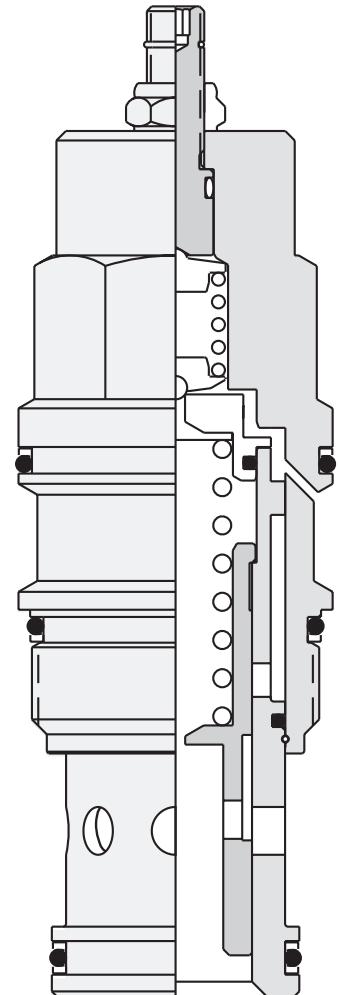
Products: Manifolds: Manifold Selector

Products: Product Selector

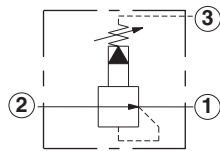
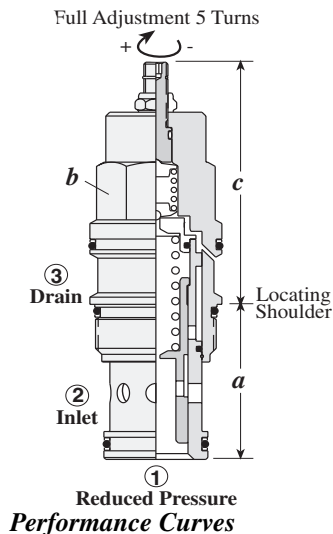
Or select your cartridge first, then select a matching manifold from menu at the top of cartridge page

Reducing and Reducing/Relieving Cartridge Valves

Cartridge Type	Page
	Pilot Operated Reducing 34
	Pilot Operated Reducing, Air Controlled 35
	Pilot Operated Reducing, Main Stage with Integral T-8A Control Cavity 36
	Pilot Operated Reducing/Relieving 37
	Pilot Operated, Reducing/Relieving, Air Controlled 38
	Direct Acting Reducing/Relieving 39
	Pilot Operated Reducing/Relieving, Externally Drained to Port 4 40
	Pilot Operated Reducing/Relieving, Ventable 41
	Direct Acting Reducing/Relieving, Main Stage, Piloted from Port 4 42
	Electro-Proportional, Direct Acting Reducing/Relieving, Open Transition, Improved Dynamic Response 43
	Electro-Proportional, Direct Acting Reducing/Relieving, Low Leakage 44
	Pilot Operated Reducing/Relieving, Main Stage, with Integral T-8A Control Cavity 45
	Pilot Operated Reducing/Relieving, Main Stage, with Integral T-8A Control Cavity, Drain to Port 4, Externally Drained 46



PILOT OPERATED



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
20 L/min.	PBBB – LAN	T - 163A	31,0	19,1	65,0	67,0	70,0	35 - 40
40 L/min.	PBDB – LAN	T - 11A	35,0	22,2	63,5	67,3	70,0	45 - 50
80 L/min.	PBFB – LAN	T - 2A	35,0	28,6	71,4	73,2	77,7	60 - 70
160 L/min.	PBHB – LAN	T - 17A	46,0	31,8	83,3	84,1	90,0	200 - 215
320 L/min.	PBJB – LAN	T - 19A	63,8	41,3	100,1	103,9	106,4	465 - 500

PBBB

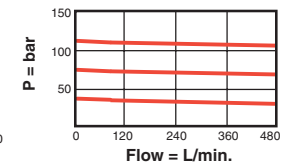
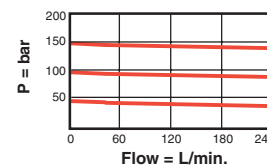
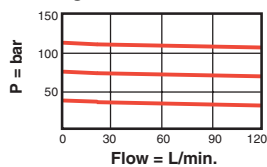
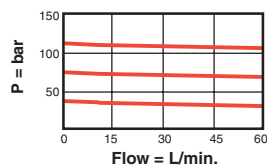
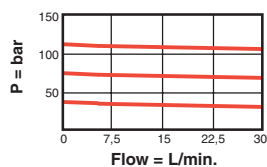
PBDB

PBFB

PBHB

PBJB

Regulated Pressure



- Maximum operating pressure = 350 bar.
- Control pilot flow = PBBB, PBDB: 0,11 to 0,16 L/min.; PBFB: 0,16 to 0,25 L/min.; PBHB, PBJB: 0,25 to 0,33 L/min.
- Factory pressure setting established at blocked control port (deadhead).
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.

OPTION ORDERING INFORMATION

PB * B - * * *

Nominal Capacity	Control**	Adjustment Range	Seal Material
B 20 L/min.	L Standard Screw Adjustment	PBBB only: A 5 - 210 bar Max. Pressure Differential 210 bar	N Buna-N
D 40 L/min.	C* Tamper Resistant Factory Set	B 5 - 105 bar Max. Pressure Differential 210 bar	V Viton
F 80 L/min.	K Handknob with Lock Knob	N 5 - 55 bar Max. Pressure Differential 210 bar	
H 160 L/min.	* Special setting required. Specify at time of order.	Q 5 - 25 bar Max. Pressure Differential 140 bar	
J 320 L/min.		W 5 - 315 bar Max. Inlet Pressure 350 bar	
		PBDB, PBFB, PBHB, PBJB only: A 7 - 210 bar Max. Pressure Differential 210 bar	
		B 3,5 - 105 bar Max. Pressure Differential 210 bar	
		N 4 - 55 bar Max. Pressure Differential 140 bar	
		Q 4 - 25 bar Max. Pressure Differential 140 bar	
		W 10,5 - 315 bar Max. Inlet Pressure 350 bar	
		Adjustment Ranges are all standard set at 14 bar.	

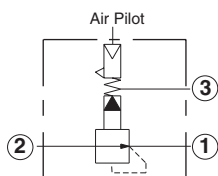
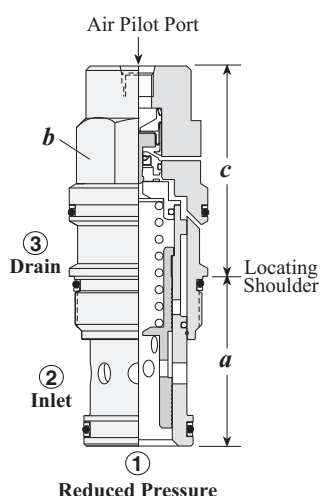
** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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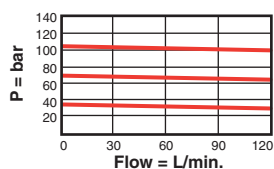
PILOT OPERATED, AIR CONTROLLED



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					A	B	
80 L/min.	PBFC – ABN	T - 2A	35,0	28,6	51,1	-	60 - 70
160 L/min.	PBHC – BBN	T - 17A	46,0	31,8	-	63,0	200 - 215
320 L/min.	PBJC – BBN	T - 19A	63,8	41,3	-	79,0	465 - 500

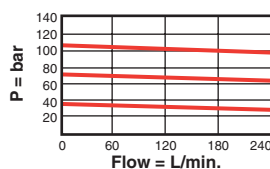
Performance Curves

PBFC

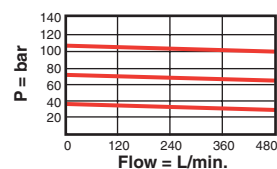


PBHC

Regulated Pressure



PBJC



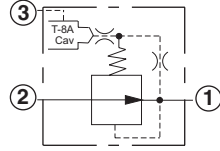
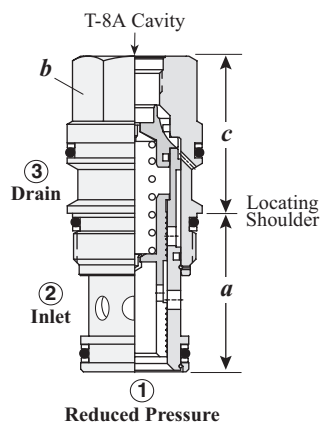
- Pilot ratio, air to hydraulic = 20:1.
- Maximum operating pressure 140 bar.
- Maximum air pressure = 10,5 bar.
- Control pilot flow = PBFC: 0,16 to 0,25 L/min.; PBHC, PBJC: 0,25 to 0,33 L/min.
- Maximum pressure differential, inlet to outlet should not exceed 210 bar.
- The pressure at port 3 determines the minimum valve setting and should not exceed 70 bar.

OPTION ORDERING INFORMATION

PB * C – * * *			
Nominal Capacity	Control	Adjustment Range	Seal Material
F 80 L/min.	Available in PBFC only:	B 3,5 - 105 bar	N Buna-N
H 160 L/min.	A External 1/4" NPTF Pilot Port at end of Cartridge		V Viton
J 320 L/min.			
PBHC, PBJC only:			
	B External SAE-4 Pilot Port at end of Cartridge		

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PILOT OPERATED, MAIN STAGE WITH INTEGRAL T-8A CONTROL CAVITY

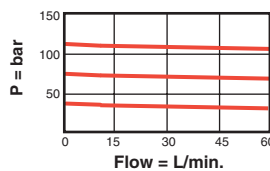


The -8 control option allows a pilot control valve to be incorporated directly into the end of the modulating element via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

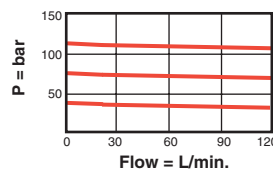
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	PBDB – 8WN	T - 11A	35,1	22,2	30,2	45 - 50
80 L/min.	PBFB – 8WN	T - 2A	35,1	28,6	35,1	60 - 70
160 L/min.	PBHB – 8WN	T - 17A	46,0	31,8	46,0	200 - 215
320 L/min.	PBJB – 8WN	T - 19A	63,5	41,3	58,7	465 - 500

Performance Curves

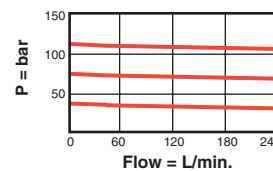
PBDB-8



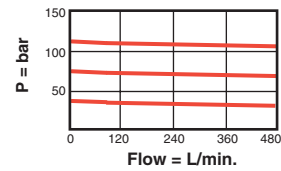
PBFB-8



PBHB-8



PBJB-8



Regulated Pressure with T-8A Pilot Stage Installed

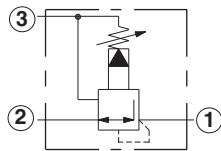
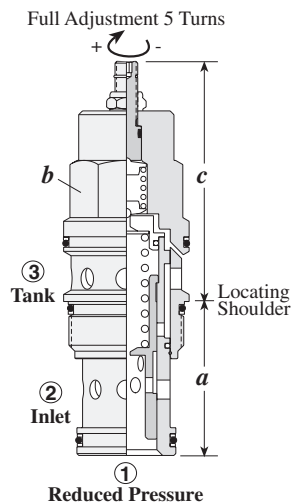
- Maximum operating pressure = 350 bar.
- Control pilot flow = PBDB-8: 0,11 to 0,16 L/min.; PBFB-8: 0,16 to 0,25 L/min.; PBHB-8, PBJB-8: 0,25 to 0,33 L/min.
- Pilot operated valves exhibit very low dead band transition between reducing and relieving modes.
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

PB * B - 8 * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
D 40 L/min.	8 T-8A Cavity in hex body for pilot operation	D 1,7 bar Max. Pressure Differential 140 bar	N Buna-N
F 80 L/min.			V Viton
H 160 L/min.	Pilot valve to be ordered separately	W 7 bar Max. Inlet Pressure 350 bar	
J 320 L/min.			

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PILOT OPERATED



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
40 L/min.	PPDB – LAN	T - 11A	35,0	22,2	63,5	67,3	70,0	45 - 50
80 L/min.	PPFB – LAN	T - 2A	35,0	28,6	71,4	73,2	77,7	60 - 70
160 L/min.	PPHB – LAN	T - 17A	46,0	31,8	83,3	84,1	90,0	200 - 215
320 L/min.	PPJB – LAN	T - 19A	63,5	41,3	100,1	103,9	106,4	465 - 500

Performance Curves

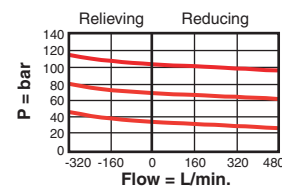
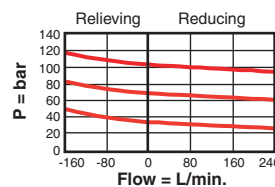
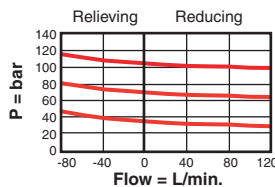
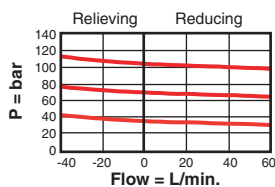
PPDB

PPFB

PPHB

PPJB

Regulated Pressure



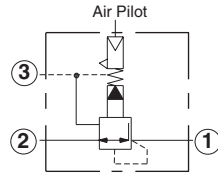
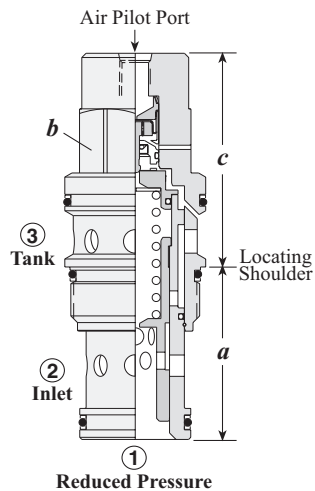
- Maximum operating pressure = 350 bar.
- Control pilot flow = PPDB: 0,11 to 0,16 L/min.; PPFB: 0,16 to 0,25 L/min.; PPHB, PPJB: 0,25 to 0,33 L/min.
- Factory pressure setting established at blocked control port (deadhead).
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 210 bar.
- Maximum pressure at port 3 should be limited to 210 bar.

OPTION ORDERING INFORMATION

PP * B - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
D 40 L/min.	L Standard Screw Adjustment	A 7 - 210 bar Max. Pressure Differential 210 bar	N Buna-N
F 80 L/min.	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Max. Pressure Differential 210 bar	V Viton
H 160 L/min.	K Handknob with Lock Knob	N 4 - 55 bar Max. Pressure Differential 140 bar	
J 320 L/min.	* Special setting is required. Specify at time of order.	Q 4 - 25 bar Max. Pressure Differential 140 bar	
	** See page 178 for information on Control Options	W 10,5 - 315 bar Max. Inlet Pressure 350 bar	
	Customer specified special setting stamped on hex.	Adjustment Ranges are all standard set at 14 bar.	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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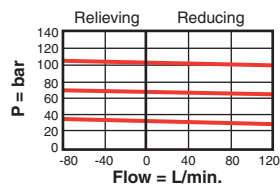
PILOT OPERATED, AIR CONTROLLED



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					A	B	
80 L/min.	PPFC – ABN	T - 2A	35,0	28,6	50,8	-	60 - 70
160 L/min.	PPHC – BBN	T - 17A	46,0	31,8	-	63,0	200 - 215
320 L/min.	PPJC – BBN	T - 19A	63,8	41,3	-	79,0	465 - 500

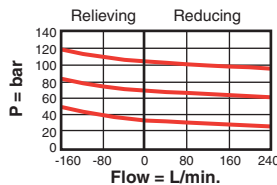
Performance Curves

PPFC

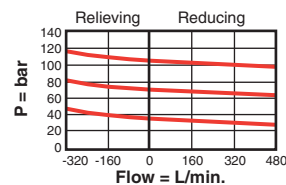


PPHC

Regulated Pressure



PPJC



- Pilot ratio, air to hydraulic = 20:1.
- Maximum operating pressure = 140 bar.
- Maximum air pressure = 10,5 bar.
- Control pilot flow = PPFC: 0,16 to 0,25 L/min.; PPHC, PPJC: 0,25 to 0,33 L/min.
- Maximum pressure differential, inlet to outlet should not exceed 210 bar.
- The pressure at port 3 determines the minimum valve setting and should not exceed 70 bar.

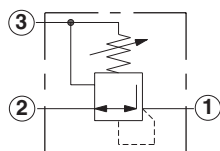
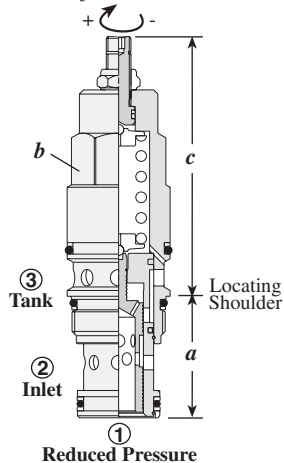
OPTION ORDERING INFORMATION

PP * C - * * *			
Nominal Capacity	Control	Adjustment Range	Seal Material
F 80 L/min.	Available in PPFC only	B 3,5 - 105 bar	N Buna-N
H 160 L/min.	A External 1/4" NPTF Pilot Port at end of Cartridge		V Viton
J 320 L/min.	PPHC, PPJC only		
	B External SAE-4 Pilot Port at end of Cartridge		

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DIRECT ACTING

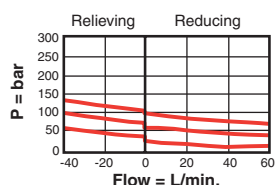
Full Adjustment 5 Turns



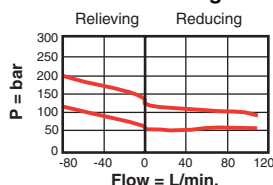
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
40 L/min.	PRDB – LAN	T - 11A	35,0	22,2	78,5	80,3	84,8	45 - 50
80 L/min.	PRFB – LAN	T - 2A	35,0	28,6	88,1	90,0	94,0	60 - 70
160 L/min.	PRHB – LAN	T - 17A	46,0	31,8	100,1	101,6	106,4	200 - 215
320 L/min.	PRJB – LAN	T - 19A	63,5	41,3	123,8	127,8	130,2	465 - 500

Performance Curves

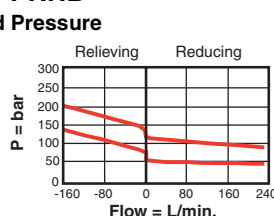
PRDB



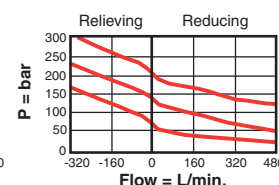
PRFB



PRHB



PRJB



- Maximum operating pressure = 350 bar.
- Maximum leakage at 24 cSt = PRDB: 30 cc/min.; PRFB: 50 cc/min.; PRHB: 65 cc/min.; PRJB: 80 cc/min. Leakage specified is out of port 3 with a supply pressure of 140 bar and the valve set at mid-range. This leakage is directly proportional to pressure differential and inversely proportional to viscosity expressed in centistokes.
- Factory pressure setting established at blocked control port (deadhead).
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 210 bar.

OPTION ORDERING INFORMATION

PR * B - * * *

Nominal Capacity	Control**	Adjustment Range	Seal Material
D 40 L/min.	L Standard Screw Adjustment	PRDB only:	N Buna-N
F 80 L/min.		A 35 - 210 bar Standard set at 50 bar	V Viton
H 160 L/min.	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Standard set at 14 bar	
J 320 L/min.	K Handknob with Lock Knob	D 1,7 - 55 bar Standard set at 14 bar	
		E 1,7 - 28 bar Standard set at 14 bar	
		S 1,7 - 14 bar Standard set at 14 bar	
		W 50 - 315 bar Standard set at 70 bar	
		PRFB, PRHB, PRJB only:	
		A 50 - 210 bar Standard set at 70 bar	
		B 20 - 105 bar Standard set at 35 bar	
		D 14 - 55 bar Standard set at 28 bar	
		E 7 - 28 bar Standard set at 14 bar	
		S 3,5 - 14 bar Standard set at 7 bar	
		PRJB only:	
		W 76 - 315 bar Standard set at 76 bar	

* Special setting required. Specify at time of order.

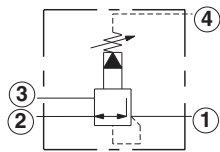
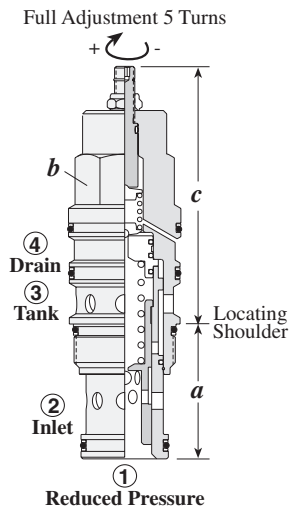
** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

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PILOT OPERATED, EXTERNALLY DRAINED TO PORT 4



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
40 L/min.	PVDA – LAN	T - 21A	35,0	22,2	78,5	82,6	84,8	45 - 50
80 L/min.	PVFA – LAN	T - 22A	35,0	28,6	87,9	90,0	94,0	60 - 70
160 L/min.	PVHA – LAN	T - 23A	46,2	31,8	100,1	101,1	105,9	200 - 215
320 L/min.	PVJA – LAN	T - 24A	63,5	41,3	121,5	125,0	128,0	465 - 500

Performance Curves

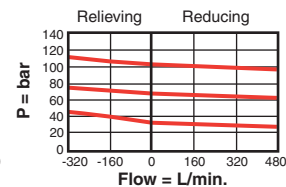
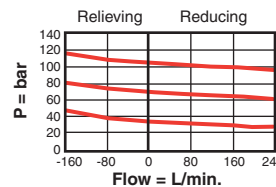
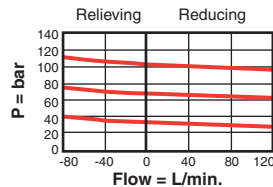
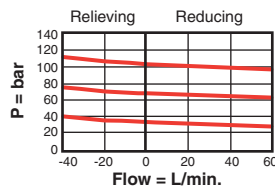
PVDA

PVFA

PVHA

PVJA

Regulated Pressure



- Maximum operating pressure = 350 bar.
- Control pilot flow = PVDA: 0,11 to 0,16 L/min.; PVFA: 0,16 to 0,25 L/min.; PVHA, PVJA: 0,25 to 0,33 L/min.
- Factory pressure settings established at blocked control port (deadhead).
- Maximum pressure at port 3 should be limited to 210 bar.
- Pilot operated valves exhibit very low dead band transition between reducing and relieving modes.
- Pressure on the drain (port 4) is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.

OPTION ORDERING INFORMATION

PV * A - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
D 40 L/min.	L Standard Screw Adjustment	A 7 - 210 bar Max. Pressure Differential 210 bar	N Buna-N
F 80 L/min.	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Max. Pressure Differential 210 bar	V Viton
H 160 L/min.	K Handknob with Lock Knob	D 1,7 - 55 bar Max. Pressure Differential 140 bar	
J 320 L/min.		E 1,7 - 28 bar Max. Pressure Differential 140 bar	
		W 10,5 - 315 bar Max. Inlet Pressure 350 bar	
	Adjustment Ranges are all standard set at 14 bar.		

* Special setting is required. Specify at time of order.

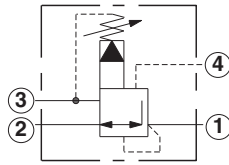
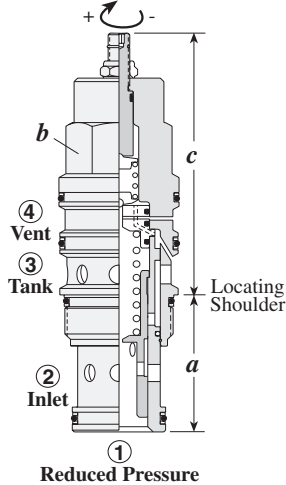
** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

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PILOT OPERATED, VENTABLE

Full Adjustment 5 Turns



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
40 L/min.	PVDB – LAN	T - 21A	35,0	22,2	78,5	82,6	84,8	45 - 50
80 L/min.	PVFB – LAN	T - 22A	35,0	28,6	87,9	90,0	94,0	60 - 70
160 L/min.	PVHB – LAN	T - 23A	46,2	31,8	100,0	101,1	105,9	200 - 215
320 L/min.	PVJB – LAN	T - 24A	63,5	41,3	121,5	125,0	128,0	465 - 500

Performance Curves

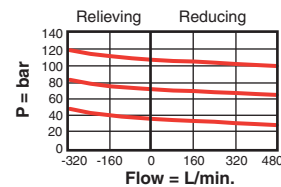
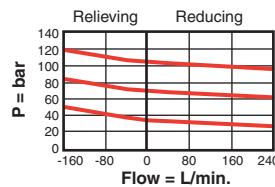
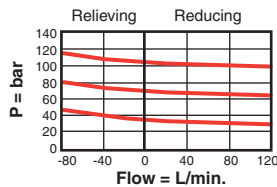
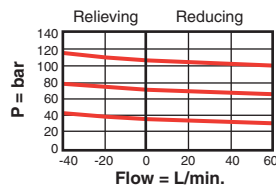
PVDB

PVFB

PVHB

PVJB

Regulated Pressure



- Maximum operating pressure = 350 bar.
- Control pilot flow = PVDB: 0,11 to 0,16 L/min.; PVFB: 0,16 to 0,25 L/min.; PVHB, PVJB: 0,25 to 0,33 L/min.
- Factory pressure setting established at blocked control port (deadhead).
- Pilot operated valves exhibit very low dead band transition between reducing and relieving modes.
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 210 bar.
- By controlling the pressure at the vent (port 4), the effective setting of the valve can be controlled below the nominal valve setting.

OPTION ORDERING INFORMATION

PV * B - * * *

Nominal Capacity	Control**	Adjustment Range	Seal Material
D 40 L/min.	L Standard Screw Adjustment	A 7 - 210 bar Max. Pressure Differential 210 bar	N Buna-N
F 80 L/min.	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Max. Pressure Differential 210 bar	V Viton
H 160 L/min.	K Handknob with Lock Knob	D 1,7 - 55 bar Max. Pressure Differential 140 bar	
J 320 L/min.		E 1,7 - 28 bar Max. Pressure Differential 140 bar	
		W 10,5 - 315 bar Max. Inlet Pressure 350 bar	

* Special setting is required. Specify at time of order.

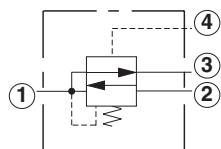
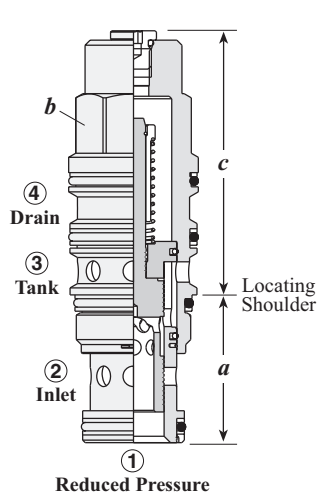
** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

Adjustment Ranges are all standard set at 14 bar.

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DIRECT ACTING, MAIN STAGE, PILOTED FROM PORT 4



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	PSDT – XFN	T - 21A	35,1	22,2	60,7	45 - 50
80 L/min.	PSFT – XFN	T - 22A	34,8	28,6	70,3	60 - 70
160 L/min.	PSHT – XFN	T - 23A	46,0	31,8	82,0	200 - 215
320 L/min.	PSJT – XFN	T - 24A	63,5	41,0	104,0	475 - 510

Performance Curves

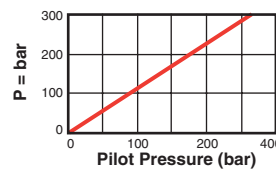
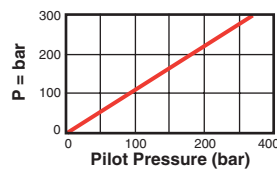
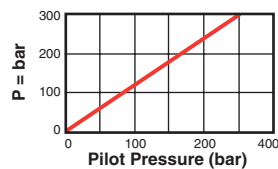
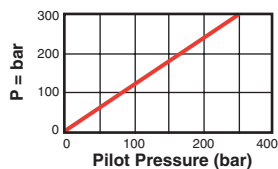
PSDT

PSFT

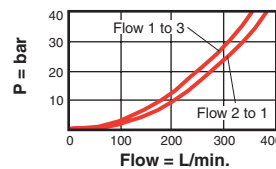
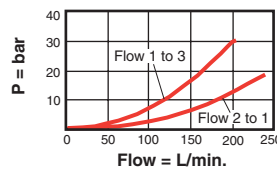
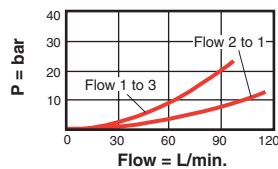
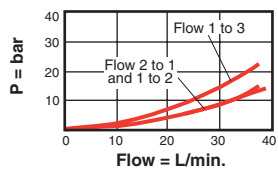
PSHT

PSJT

Reduced Pressure vs. Pilot Pressure



Pressure Differential vs. Flow

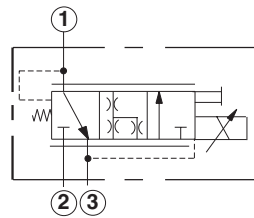
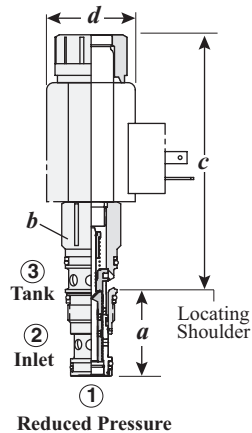


- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = PSDT: 41 cc/min. at 70 bar; PSFT: 50 cc/min. at 70 bar; PSHT: 65 cc/min. at 70 bar; PSJT: 80 cc/min. at 70 bar. Leakage specified is out of port 3 with a supply pressure of 140 bar and the valve set at mid-range. This leakage is directly proportional to pressure differential and inversely proportional to viscosity expressed in centistokes.
- The valve is biased to the relieving mode with a 7 bar spring. Pressure at port 4 is directly added to the setting of the valve once this threshold is exceeded. For example, 70 bar at port 4 will result in a setting of 63 bar at port 1.
- Maximum pressure at port 3 should be limited to 210 bar.
- Pressure on the drain (port 4) is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.

OPTION ORDERING INFORMATION

PS * T - X F *			
Nominal Capacity	Control	Bias Pressure	Seal Material
D 40 L/min.	X Not Adjustable	F 7 bar	N Buna-N
F 80 L/min.			V Viton
H 160 L/min.			
J 320 L/min.			

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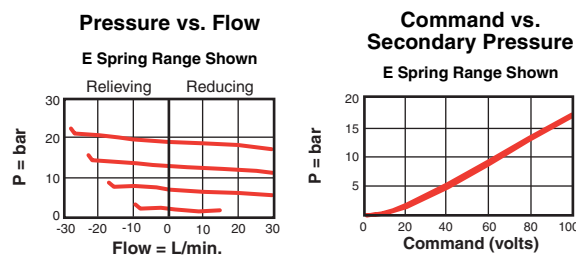


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
20 L/min.	PRDL - MDN	T-11A	35,1	22,2	108,2	37,3	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

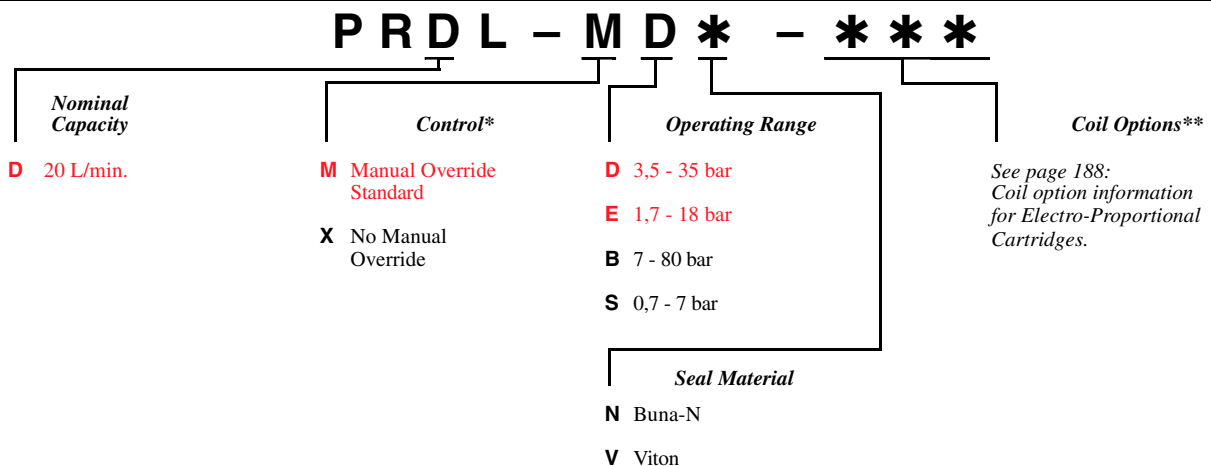
PRDL



See www.sunhydraulics.com for additional performance curves.

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,33 cc/min.
- Hysteresis with dither = <4% and with DC input = <8%.
- Linearity with dither = <2% and repeatability with dither = <2%.
- Recommended dither frequency = 140 Hz.
- Maximum pressure at port 3 should be limited to 210 bar.
- Pressure at port 3 is directly additive to the valve setting at 1:1 ratio and should not exceed 210 bar.
- The transition from reducing to relieving is slightly open. The result is very good pressure control with oil consumption of about 0,4 L/min.
- For optimum performance, an amplifier with current sensing and adjustable dither should be used. Dither should be adjustable between 100-250 Hz.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

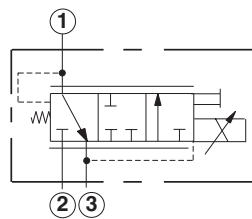
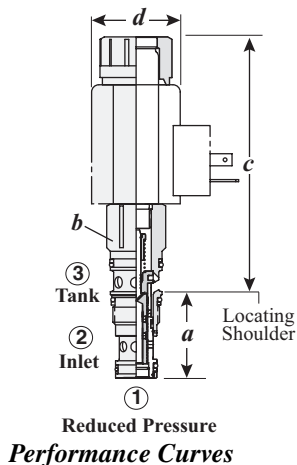


* See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

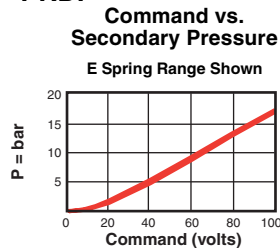
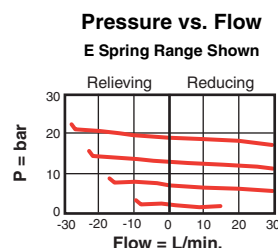
DIRECT ACTING, LOW LEAKAGE



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
20 L/min.	PRDP - MDN	T-11A	35,1	22,2	108,2	37,3	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

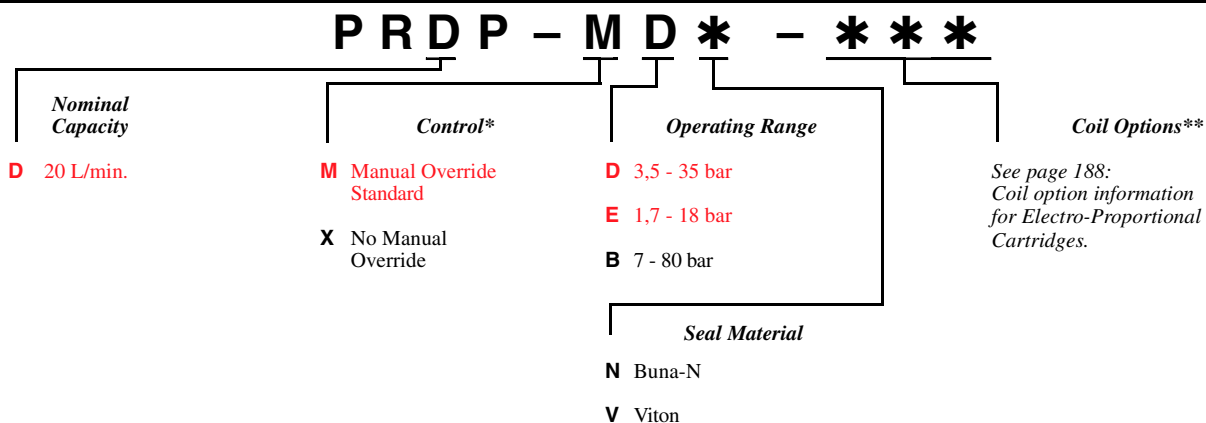
PRDP



See www.sunhydraulics.com for additional performance curves.

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 41 cc/min. Leakage specified is out of port 3 with a supply pressure of 140 bar and the valve set at mid-range. This leakage is directly proportional to pressure differential and inversely proportional to viscosity expressed in centistokes.
- The transition from reducing to relieving is closed. The result is very low leakage. However, there is a transitional step increase in pressure between reducing and relieving modes. The step equals about 5% of the high end of the adjustment range, independent of the valve setting.
- Hysteresis with dither = <4% and with DC input = <8%.
- Linearity with dither = <2% and repeatability with dither = <2%.
- Recommended dither frequency = 140 Hz.
- Maximum pressure at port 3 should be limited to 210 bar.
- Pressure at port 3 is directly additive to the valve setting at 1:1 ratio and should not exceed 210 bar.
- There is no upper limit to the pressure setting when using the M control. The more force you exert on the manual override, the higher the resulting pressure.
- For optimum performance, an amplifier with current sensing and adjustable dither should be used. Dither should be adjustable between 100-250 Hz.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

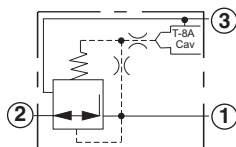
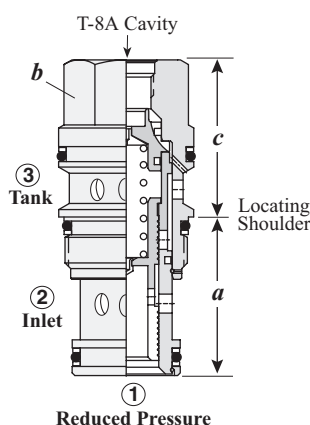


* See page 178
for information
on Control Options

** Consult the Sun website for complete information on Spool Configurations,
the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

PILOT OPERATED, MAIN STAGE WITH INTEGRAL T-8A CONTROL CAVITY

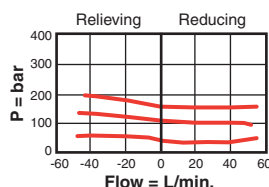


The -8 control option allows a pilot control valve to be incorporated directly into the end of the modulating element via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	PPDB - 8WN	T - 11A	35,1	22,2	30,2	45 - 50
80 L/min.	PPFB - 8WN	T - 2A	35,1	28,6	35,1	60 - 70
160 L/min.	PPHB - 8WN	T - 17A	46,0	31,8	46,0	200 - 215
320 L/min.	PPJB - 8WN	T - 19A	63,5	41,3	58,7	465 - 500

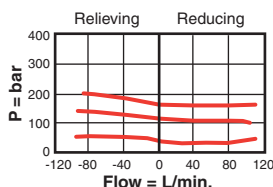
Performance Curves

PPDB-8

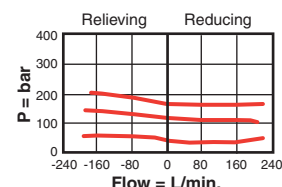


PPFB-8

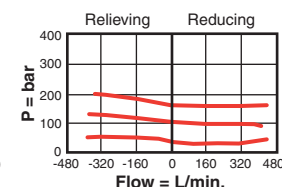
Regulated Pressure with T-8A Pilot Stage Installed



PPHB-8



PPJB-8



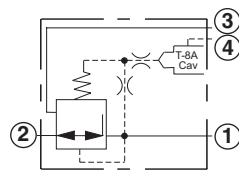
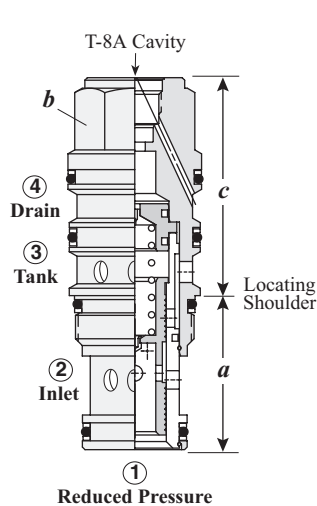
- Maximum operating pressure = 350 bar.
- Control pilot flow = PPDB-8: 0,11 to 0,16 L/min.; PPFB-8: 0,16 to 0,25 L/min.; PPHB-8, PPJB-8: 0,25 to 0,33 L/min.
- Maximum pressure at port 3 should be limited to 210 bar.
- Pressure at port 3 is directly additive to the valve setting at a 1:1 ratio and should not exceed 210 bar.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

PP * B - 8 * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
D 40 L/min.	8 T-8A Cavity in hex body for pilot operation	D 1,7 bar Max. Pressure Differential 140 bar	N Buna-N
F 80 L/min.	Pilot valve to be ordered separately	W 7 bar Max. Inlet Pressure 350 bar	V Viton
H 160 L/min.			
J 320 L/min.			

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PILOT OPERATED, MAIN STAGE WITH INTEGRAL T-8A CONTROL CAVITY, DRAIN TO PORT 4, EXTERNALLY DRAINED

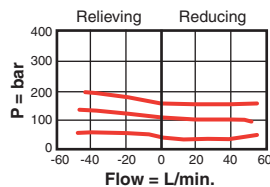


The -8 control option allows a pilot control valve to be incorporated directly into the end of the modulating element via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	PVDA - 8WN	T - 21A	35,1	22,2	45,2	45 - 50
80 L/min.	PVFA - 8WN	T - 22A	35,1	28,6	50,8	60 - 70
160 L/min.	PVHA - 8WN	T - 23A	46,0	31,8	65,8	200 - 215
320 L/min.	PVJA - 8WN	T - 24A	63,5	41,3	80,3	465 - 500

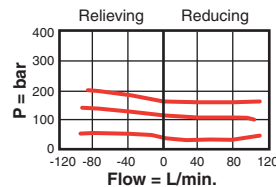
Performance Curves

PVDA-8

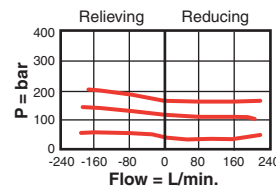


PVFA-8

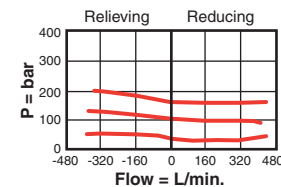
Regulated Pressure with T-8A Pilot Stage Installed



PVHA-8



PVJA-8



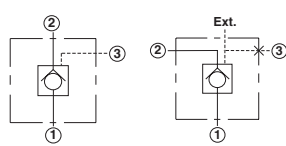
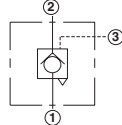
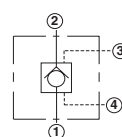
- Maximum operating pressure = 350 bar.
- Control pilot flow = PVDA-8: 0,11 to 0,16 L/min.; PVFA-8: 0,16 to 0,25 L/min.; PVHA-8, PVJA-8: 0,25 to 0,33 L/min.
- Maximum pressure at port 3 should be limited to 210 bar.
- Pilot operated valves exhibit very low dead band transition between reducing and relieving modes.
- Pressure on the drain (port 4) is directly additive to the valve setting at a 1:1 ratio and should not exceed 350 bar.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.

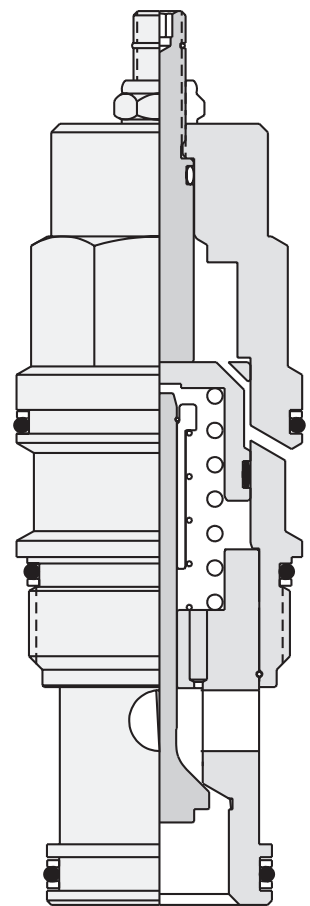
OPTION ORDERING INFORMATION

PV * A - 8 * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
D 40 L/min.	8 T-8A Cavity in hex body for pilot operation Pilot valve to be ordered separately	D 1,7 bar Max. Pressure Differential 140 bar	N Buna-N
F 80 L/min.			V Viton
H 160 L/min.			
J 320 L/min.		W 7 bar Max. Inlet Pressure 350 bar	

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

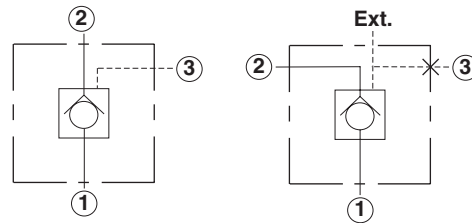
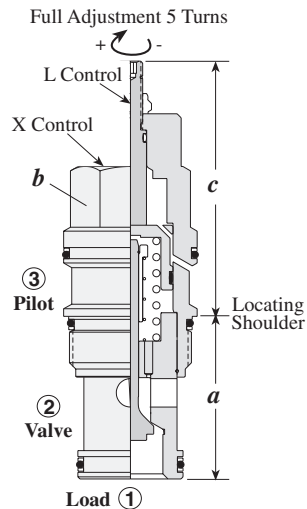
Pilot-to-Open Check Cartridge Valves

	<i>Cartridge Type</i>	<i>Page</i>
	Non-Vented, Standard Pilot and Sealed Pilot, Steel Seat	48
	Atmospherically Referenced, Vented, Sealed Pilot, Steel Seat	49
	Vented, Sealed Pilot, Steel Seat	50



Pilot-to-Open Check Valves

NON-VENTED, STANDARD PILOT (CK*B), SEALED PILOT (CK*D), STEEL SEAT



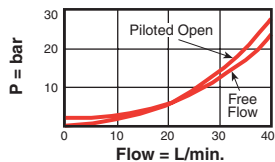
X, L Controls

B, E, P Controls

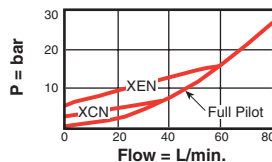
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	L	
30 L/min.	CKBB – XCN	T - 163A	31,0	19,1	31,8	42,5	35 - 40
60 L/min.	CKCB – XCN	T - 11A	35,1	22,2	30,2	63,5	45 - 50
120 L/min.	CKEB – XCN	T - 2A	35,1	28,6	35,1	71,4	60 - 70
240 L/min.	CKGB – XCN	T - 17A	46,0	31,8	46,0	83,3	200 - 215
480 L/min.	CKIB – XCN	T - 19A	63,5	41,3	58,7	100,1	465 - 500

Performance Curves

CKB*

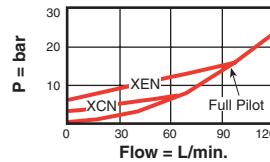


CKC*

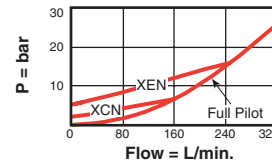


CKE*

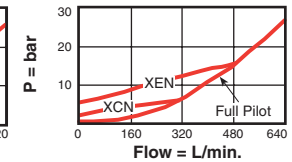
Typical Pressure Drop



CKG*



CKI*



- Pilot Ratio = 3:1.
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- CKBB, CKBD available only with 2 bar or 5 bar check valve cracking pressures.
- CK*B has standard unsealed pilot to allow air trapped in the pilot line to be purged from the circuit.
- CK*D has sealed pilot for use in circuits where cross-port leakage is undesirable.

OPTION ORDERING INFORMATION

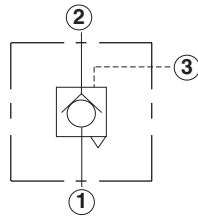
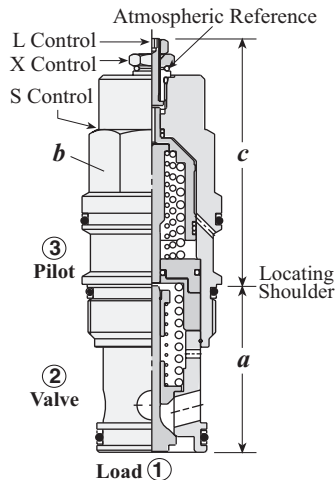
CK * * - * * *				
Nominal Capacity	Version	Control**	Cracking Pressure	Seal Material
B 30 L/min.	B Bleed through Pilot	Available for all CK*B, CK*D	A 0,3 bar	N Buna-N
C 60 L/min.	D Sealed Pilot	X Standard Pilot	B 1,0 bar	V Viton
E 120 L/min.		L Manual Load Release	C* 2,0 bar	
G 240 L/min.		E External SAE-4 Pilot, Port 3 blocked	D 3,5 bar	
I 480 L/min.		P External 1/4" NPTF Pilot, Port 3 blocked	E* 5,0 bar	
		CKCB, CKEB, CKGB, CKCD only:	F 7,0 bar	
		B External 1/4" BSPP Pilot Port 3 blocked		

* CKBB, CKBD available with C and E cracking pressures only.

** See page 178 for information on Control Options

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

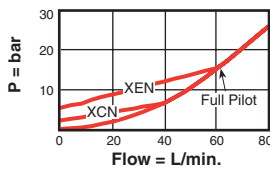
Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.



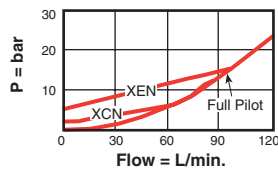
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					X	L	S	
60 L/min.	CKCV – SCN	T - 11A	35,1	22,2	51,0	56,9	42,7	40 - 50
120 L/min.	CKEV – SCN	T - 2A	35,1	28,6	59,0	65,0	50,8	60 - 70
240 L/min.	CKGV – SCN	T - 17A	46,0	31,8	71,0	76,7	62,7	200 - 215
480 L/min.	CKIV – SCN	T - 19A	63,5	41,3	84,0	95,8	—	465 - 500

Performance Curves

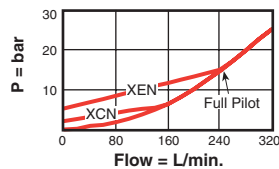
CKCV



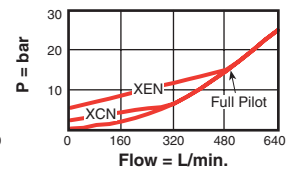
CKEV



CKGV



CKIV



Typical Pressure Drop

- Pilot Ratio = 3:1.
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Approximately 0,07 cc of fluid will pass from the pilot area to the vented spring chamber every 4000 cycles.
- For models with manual load release control option, turn load release clockwise to release load.
- Atmospherically referenced pilot-to-open check valves are considered problem solvers for existing circuits using non-vented valves. However, the atmospherically referenced valve will eventually leak externally or allow moisture into the spring chamber. Four-port vented pilot-to-open check cartridges are recommended for new applications.

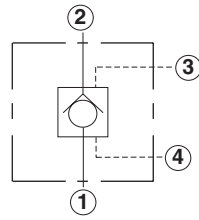
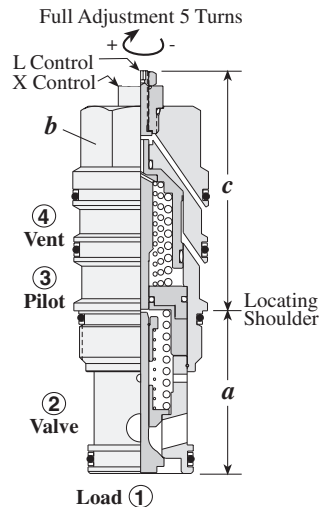
OPTION ORDERING INFORMATION

CK * V - * * *			
Nominal Capacity	Control**	Cracking Pressure	Seal Material
C 60 L/min.	L Manual Load Release, External Vent	A 0,3 bar	N Buna-N
E 120 L/min.		B 1,0 bar	V Viton
G 240 L/min.	S External SAE-4 Vent Port	C 2,0 bar	
I 480 L/min.	X Standard Pilot Atmospheric Vent	D 3,5 bar	
		E 5,0 bar	
		F 7,0 bar	

** See page 178 for information on Control Options

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

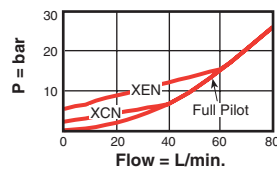
VENTED, SEALED PILOT, STEEL SEAT



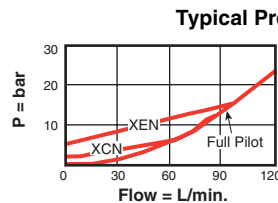
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	L	
60 L/min.	CVCV – XCN	T - 21A	35,1	22,2	53,3	59,4	45 - 50
120 L/min.	CVEV – XCN	T - 22A	35,1	28,6	59,4	65,0	60 - 70
240 L/min.	CVGV – XCN	T - 23A	46,0	31,8	71,4	77,0	200 - 215
480 L/min.	CVIV – XCN	T - 24A	63,5	41,3	88,9	95,8	465 - 500

Performance Curves

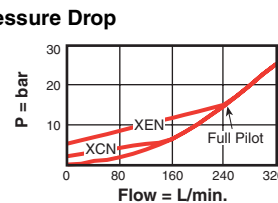
CVCV



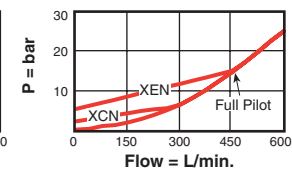
CVEV



CVGV



CVIV



Typical Pressure Drop

- Pilot Ratio = 3:1.
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Port 4 (vent) should never be blocked as seal weepage will eventually cause valve to malfunction.
- Will accept pressure at port 4 (vent) up to 350 bar maximum but back pressure will increase by 1 + pilot ratio times back pressure.

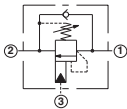
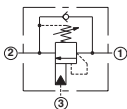
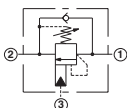
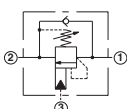
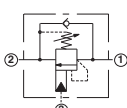
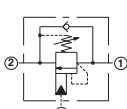
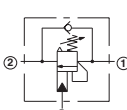
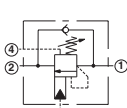
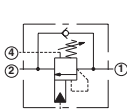
OPTION ORDERING INFORMATION

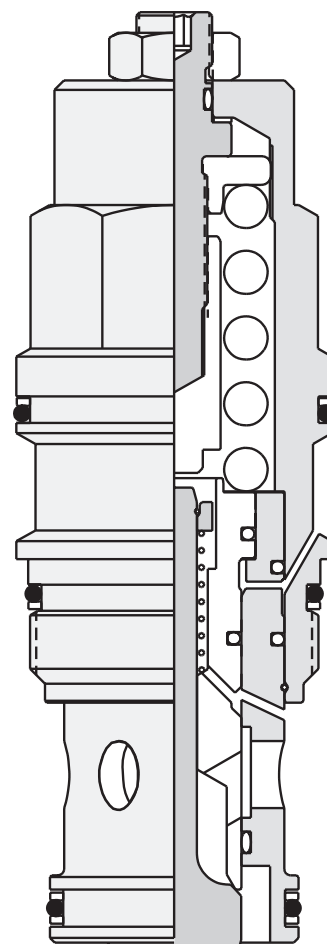
CV * V - * * *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 60 L/min.	X Standard Pilot	A 0,3 bar	N Buna-N
E 120 L/min.	L Manual Load Release	B 1,0 bar	V Viton
G 240 L/min.		C 2,0 bar	
I 480 L/min.		D 3,5 bar	
		E 5,0 bar	
		F 7,0 bar	

** See page 178
for information
on Control Options

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Counterbalance Cartridge Valves

<i>Cartridge Type</i>	<i>Page</i>
Counterbalance Technical Information	52
 Non-Vented, Standard, 280 bar Maximum Setting, 3:1, 1.5:1, 2:1 Pilot Ratios	54
 Non-Vented, Standard, 350 bar Maximum Setting, 4.5:1, 10:1, 2.3:1 Pilot Ratios	55
 Non-Vented, Semi-Restrictive, 280 bar Maximum Setting, 1.5:1, 3:1 Pilot Ratios	56
 Non-Vented, Semi-Restrictive, 350 bar Maximum Setting, 4.5:1, 2.3:1 Pilot Ratios	57
 Non-Vented, Restrictive, 280 bar Maximum Setting, 3:1, 2:1 Pilot Ratios	58
 Non-Vented, Restrictive, 350 bar Maximum Setting, 4.5:1 Pilot Ratio	59
 Vented, Atmospherically Referenced, 3:1, 5:1, 1:1, 2:1 Pilot Ratios	60
 Vented, 280 bar Maximum Setting, 3:1, 1:1 Pilot Ratios	61
 Vented, 420 bar Maximum Setting, 5:1, 2:1 Pilot Ratios	62



COUNTERBALANCE CARTRIDGE VALVE TECHNICAL INFORMATION

Adjustment Range

A, H:	70-280 bar	– Standard Setting 210 bar
B, I:	30-105 bar	– Standard Setting 70 bar
C, J:	140-350 bar	– Standard Setting 210 bar
D, K:	70-175 bar	– Standard Setting 140 bar
F:	70-175 bar	– Standard Setting 140 bar
G:	140-420 bar	– Standard Setting 280 bar

Cracking Pressure of Reverse Free Flow Check

Valves with pressure range A, B, C, D have a .3 bar cracking pressure for the reverse free flow check. All others are 1.5 to 3 bar cracking pressure. In applications with loads that change quickly, higher cracking pressures are recommended.

Influence of Back Pressure

Pressure downstream of the counterbalance valve (port 2) is additive to the setting with the given factor (influence of back pressure). The setting is the load pressure (on port 1) that opens the valve with no pilot pressure (on port 3).

In applications with proportional valves that throttle the return flow, Sun recommends using vented counterbalance valves (CW** or CA**). CW** counterbalance valves have a spring chamber drained to port 4. CA** valves have an atmospherically vented spring chamber. CA** valves can be used when some external leakage (drops) is acceptable. The spring chamber cannot corrode due to splash water.

Stability

Circuits with counterbalance valves can be unstable. In most cases the circuit will be more stable after replacing the counterbalance valve with a valve that has a lower pilot ratio or is restrictive or smaller. Pilot ratio 3:1 is very common and works in most cases.

Notes (see numbers within table at right)

(1) Fully restrictive valves have a very limited flow capacity as relief valves. Counterbalance restrictive valves can be used to limit the pressure due to thermal expansion.

(2) These counterbalance valves have an internal bleed-off orifice between port 3 and 2 to reduce the effective pilot ratio. The pilot flow between port 3 and 2 is about .6 L/min. at 70 bar pilot pressure.

(3) These valves have no sealed pilot piston. The leakage from port 3 to port 2 is .93 L/min. at 70 bar pilot pressure.

(4) These are valves with no sealed pilot piston. Leakage between port 3 and port 2 is between .03 and .3 L/min. The high leakage occurs when the pilot pressure is half the load pressure or higher.

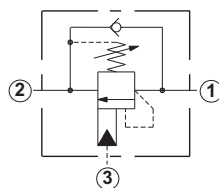
CBCA and CBEA are available with sealed pilot piston (these would be custom numbered valves).

All Model Codes shown in **boldface type** are in the counterbalance section of this catalogue. Consult www.sunhydraulics.com for our complete line of counterbalance cartridge products.

Cavity Adapters

T-17A to T-2A:	XHOC-BXN
T-17A to T-11A:	XHOC-EXN
T-19A to T-17A:	XJOC-GXN
T-23A to T-22A:	XPOC-NXN
T-24A to T-23A:	XQOC-PXN

COUNTERBALANCE CARTRIDGE VALVES / NON-VENTED



Fully Restrictive

Series 1	
Cavity	T-11A
Nominal Capacity	10 L/min.
Model Code	Adjustment Range
CBAB	H; I; A; B
CBAA	H; I; A; B
CBAG	J; K; C; D

Restrictive (1)

Series 1	
Cavity	T-11A
Nominal Capacity	20 L/min.
Model Code	Adjustment Range
CBBY (2)	H; I; A; B
CBBA	H; I; A; B
CBBG	J; K; C; D
CBBH (3)	J; K; C; D

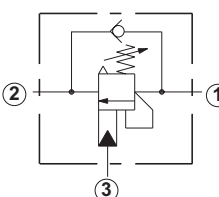
Semi-restrictive

Series 1	
Cavity	T-11A
Nominal Capacity	40 L/min.
Model Code	Adjustment Range
CBBB	H; I; A; B
CBBL	J; K; C; D
CBBC	H; I; A; B
CBBD	J; K; C; D

Standard

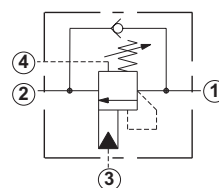
Series 1	
Cavity	T-11A
Nominal Capacity	60 L/min.
Model Code	Adjustment Range
CBCB	H; I; A; B
CBCY (2)	H; I; A; B
CBCL	J; K; C; D
CBCA (3)	H; I; A; B
CBCG (3)	J; K; C; D
CBCH (4)	J; K; C; D

COUNTERBALANCE CARTRIDGE VALVES / VENTED



Standard

Series 1	
Cavity	T-11A
Nominal Capacity	60 L/min.
Model Code	Adjustment Range
CACK	H; I
CACL	F; G
CACA	H; I
CACG	F; G



Standard

Series 1	
Cavity	T-21A
Nominal Capacity	60 L/min.
Model Code	Adjustment Range
CWCK	H; I
CWCL	F; G
CWCA	H; I
CWCG	F; G

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Series 2	Series 3	Series 4			

Series 2		Series 3		Series 4		Pilot Ratio	Max. Setting Depends on Pressure Range	Influence of Back Pressure
T-2A		T-17A		T-19A				
20 L/min.		40 L/min.		80 L/min.				
Model Code	Adjustment Range	Model Code	Adjustment Range	Model Code	Adjustment Range			
CBDA	H; I; A; B	CBFA	H; I; A; B	CBHA	H; I; A; B	2:1	280 bar	3
CBDG	J; K; C; D	CBFG	J; K; C; D	CBHG	J; K; C; D	3:1	280 bar	4
CBDH	J; K; C; D	CBFH	J; K; C; D			4.5:1	350 bar	5.5
						10:1	350 bar	11

Series 2		Series 3		Series 4		
T-2A		T-2A				
80 L/min.		160 L/min.				
Model Code	Adjustment Range	Model Code	Adjustment Range			
CBDB	H; I; A; B	CBFB	H; I; A; B			
CBDL	I; J; K; B; C; D	CBFL	J; K; C; D	Pilot Ratio	Max. Setting Depends on Pressure Range	Influence of Back Pressure
CBDC	H; I; A; B	CBFC	H; I; A; B	1.5:1	280 bar	2.5
CBDD	J; C; K; D	CBFD	J; K; C; D	2.3:1	350 bar	3.3
				3:1	280 bar	4
				4.5:1	350 bar	5.5

Series 2		Series 3		Series 4		Pilot Ratio	Max. Setting Depends on Pressure Range	Influence of Back Pressure
T-2A		T-17A		T-19A				
120 L/min.		240 L/min.		480 L/min.				
Model Code	Adjustment Range	Model Code	Adjustment Range	Model Code	Adjustment Range			
CBEB	H; I; A; B	CBGB	H; I; A; B	CBIB	H; I; A; B	1.5:1	280 bar	2.5
CBEY (2)	H; A; B	CBGY (2)	H; A; B; I	CBYI (2)	H; I; A; B	2:1	280 bar	3
CBEL	I; J; K; B; C; D	CBGL	J; K; C; D	CBIL	J; K; C; D	2.3:1	350 bar	3.3
CBEA(3)	H; I; A; B	CBGA	H; I; A; B	CBIA	H; I; A; B	3:1	280 bar	4
CBEG (3)	I; J; K; B; C; D	CBGG	J; K; C; D	CBIG	J; K; C; D	4.5:1	350 bar	5.5
CBEH (4)	I; J; K; B; C; D	CBGH	J; K; C; D	CBIH	J; K; C; D	10:1	350 bar	11



Series 2		Series 3		Series 4		Pilot Ratio	Max. Setting Depends on Pressure Range	Influence of Back Pressure
T-2A		T-17A		T-19A				
120 L/min.		240 L/min.		480 L/min.				
Model Code	Adjustment Range	Model Code	Adjustment Range	Model Code	Adjustment Range			
CAEK	H; I	CAGK	H; I	CAIK	H; I	1:1	280 bar	0
CAEL	F; G	CAGL	F; G	CAIL	F; G	2:1	420 bar	0
CAEA	H; I	CAGA	H; I	CAIA	H; I	3:1	280 bar	0
CAEG	F; G	CAGG	F; G	CAIG	F; G	5:1	420 bar	0

Series 1		Series 3		Series 4		Pilot Ratio	Max. Setting Depends on Pressure Range	Influence of Back Pressure
T-22A		T-23A		T-24A				
120 L/min.		240 L/min.		480 L/min.				
Model Code	Adjustment Range	Model Code	Adjustment Range	Model Code	Adjustment Range			
CWEK	H; I	CW GK	H; I	CWIK	H; I	1:1	280 bar	0
CWEL	F; G	CWGL	F; G	CWIL	F; G	2:1	420 bar	0
CWEA	H; I	CWGA	H; I	CWIA	H; I	3:1	280 bar	0
CWEG	F; G	CWGG	F; G	CWIG	F; G	5:1	420 bar	0

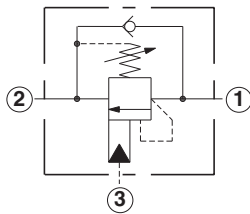
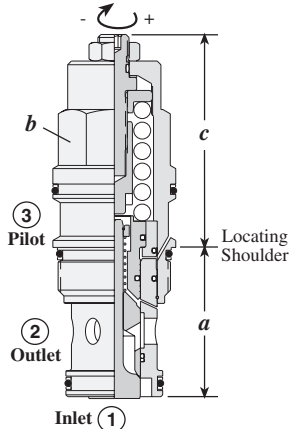
Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.



Counterbalance Valves

NON-VENTED, STANDARD, 280 BAR MAXIMUM SETTING, 3:1, 1.5:1, 2:1 PILOT RATIOS

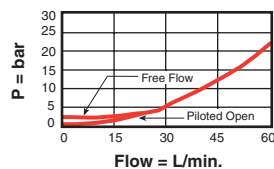
Turn screw clockwise to reduce setting and release load.
Complete Adjustment 3 3/4 Turns



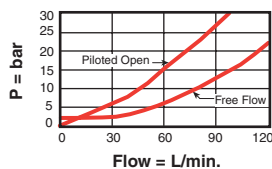
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	L	C	
60 L/min.	CBCA – LHN	T - 11A	35,1	22,2	49,8	58,2	45 - 50
120 L/min.	CBEA – LHN	T - 2A	35,1	28,6	60,5	63,5	60 - 70
240 L/min.	CBGA – LHN	T - 17A	46,0	31,8	69,9	84,1	200 - 215
480 L/min.	CBIA – LHN	T - 19A	63,5	41,3	89,9	103,9	465 - 500

Performance Curves

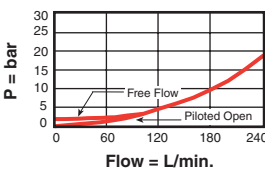
CBC*



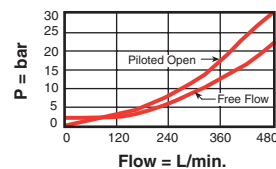
CBE*



CBG*



CBi*



Free Flow and Piloted Open Pressure Drop

- Maximum recommended load pressure at maximum setting = 215 bar.
- Maximum setting = 280 bar.
- Maximum valve leakage at reseal = 0,4 cc/mm.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when valve is standard set. Settings lower than the standard pressure may result in lower reseat percentage.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Two check valve cracking pressures are available. Use the 1,7 bar check unless actuator cavitation is a concern.

OPTION ORDERING INFORMATION

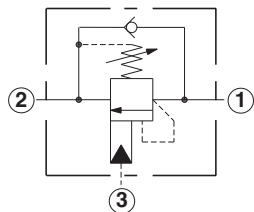
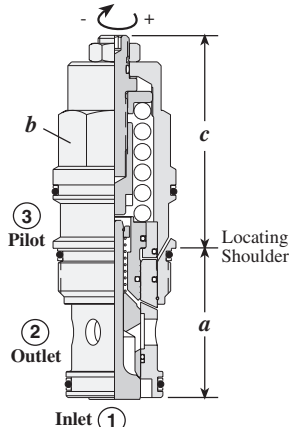
CB** – ***				
Nominal Capacity	Version	Control**	Functional Setting Range	Seal Material
C 60 L/min.	A 3:1 Pilot Ratio	L Standard Screw Adjustment	H 70 - 280 bar with 1,7 bar check Standard set at 210 bar	N Buna-N
E 120 L/min.	B 1.5:1 Pilot Ratio (Sealed Pilot)	C* Tamper Resistant Factory Set	I 28 - 105 bar with 1,7 bar check Standard set at 70 bar	V Viton
G 240 L/min.	Y 2:1 Pilot Ratio (Bleed through Pilot)	*Special setting required. Specify at time of order.	A 70 - 280 bar with 0,3 bar check Standard set at 210 bar	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.
I 480 L/min.		** See page 178 for information on Control Options Customer specified special setting stamped on hex.	B 28 - 105 bar with 0,3 bar check Standard set at 70 bar	

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NON-VENTED, STANDARD, 350 BAR MAXIMUM SETTING, 4.5:1, 10:1, 2.3:1 PILOT RATIOS

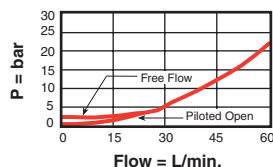
Turn screw clockwise to reduce setting and release load.
Complete Adjustment 3 3/4 Turns



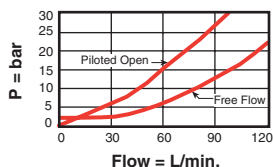
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	L	C	
60 L/min.	CBCG – LNJ	T - 11A	35,1	22,2	50,0	58,2	45 - 50
120 L/min.	CBEG – LNJ	T - 2A	35,1	28,6	60,5	63,5	60 - 70
240 L/min.	CBGG – LNJ	T - 17A	46,0	31,8	69,9	84,1	200 - 215
480 L/min.	CBIG – LNJ	T - 19A	63,5	41,3	89,9	103,9	465 - 500

Performance Curves

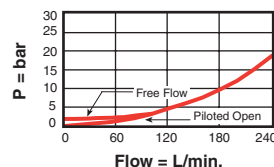
CBC*



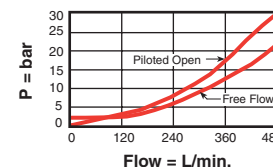
CBE*



CBG*



CBi*



Free Flow and Piloted Open Pressure Drop

- Maximum recommended load pressure at maximum setting = 270 bar.
- Maximum setting = 350 bar.
- Maximum valve leakage at reseal = 0,4 cc/mm.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when valve is standard set. Settings lower than the standard pressure may result in lower reseal percentage.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Two check valve cracking pressures are available. Use the 1,7 bar check unless actuator cavitation is a concern.

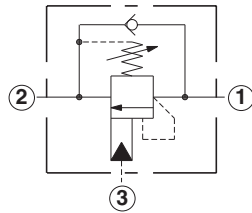
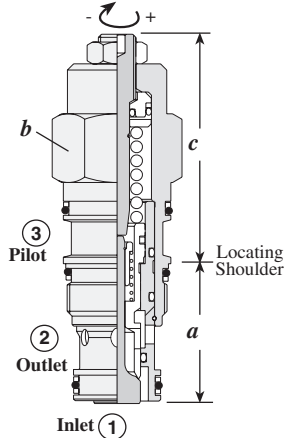
OPTION ORDERING INFORMATION

CB ** - ***				
Nominal Capacity	Version	Control**	Functional Setting Range	Seal Material
C 60 L/min.	G 4.5:1 Pilot Ratio	L Standard Screw Adjustment	J 140 - 350 bar with 1,7 bar check Standard set at 210 bar	N Buna-N
E 120 L/min.	H 10:1 Pilot Ratio	C* Tamper Resistant Factory Set	K 70 - 175 bar with 1,7 bar check Standard set at 140 bar	V Viton
G 240 L/min.	L 2.3:1 Pilot Ratio (Sealed Pilot)	<i>* Special setting required. Specify at time of order.</i>	C 140 - 350 bar with 0,3 bar check Standard set at 210 bar	
I 480 L/min.		<i>** See page 178 for information on Control Options</i>	D 70 - 175 bar with 0,3 bar check Standard set at 140 bar	
		<i>Customer specified special setting stamped on hex.</i>		<i>Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.</i>

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

NON-VENTED, SEMI-RESTRICTIVE, 280 BAR MAXIMUM SETTING, 1.5:1, 3:1 PILOT RATIOS

Turn screw clockwise to reduce setting and release load.
Complete Adjustment 3 3/4 Turns



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	L	C	
40 L/min.	CBBC – LHN	T - 11A	35,1	22,2	50,0	58,2	45 - 50
80 L/min.	CBDC – LHN	T - 2A	35,1	28,6	60,5	63,5	60 - 70
160 L/min.	CBFC – LHN	T - 17A	46,0	31,8	69,9	84,1	200 - 215

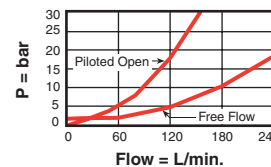
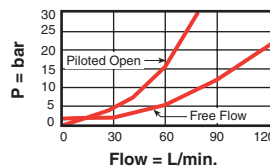
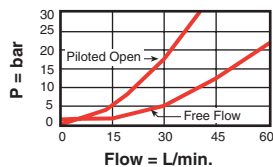
Performance Curves

CBB*

CBD*

CBF*

Free Flow and Piloted Open Pressure Drop



- Maximum recommended load pressure at maximum setting = 215 bar.
- Maximum setting = 280 bar.
- Maximum valve leakage at reseal = 0,4 cc/min.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when the valve is standard set. Settings lower than the standard sets pressure may result in lower reseal percentages.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Two check valve cracking pressures are available. Use the 1,7 bar check unless actuator cavitation is a concern.

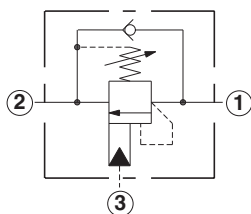
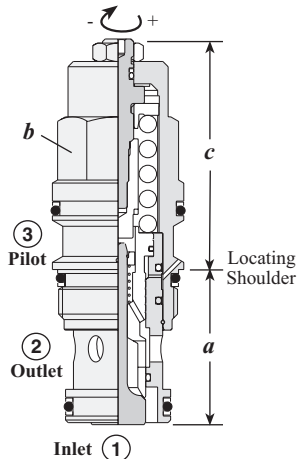
OPTION ORDERING INFORMATION

CB ** - ***				
Nominal Capacity	Version	Control**	Functional Setting Range	Seal Material
B 40 L/min.	C 3:1 Pilot Ratio (Sealed Pilot)	L Standard Screw Adjustment	H 70 - 280 bar with 1,7 bar check Standard set at 210 bar	N Buna-N
D 80 L/min.	B 1.5:1 Pilot Ratio (Sealed Pilot)	C* Tamper Resistant Factory Set	I 28 - 105 bar with 1,7 bar check Standard set at 70 bar	V Viton
F 160 L/min.		* Special setting required. Specify at time of order.	A 70 - 280 bar with 0,3 bar check Standard set at 210 bar	
		** See page 178 for information on Control Options	B 28 - 105 bar with 0,3 bar check Standard set at 70 bar	
		Customer specified special setting stamped on hex.		Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

NON-VENTED, SEMI-RESTRICTIVE, 350 BAR MAXIMUM SETTING, 4.5:1, 2.3:1 PILOT RATIOS

Turn screw clockwise to reduce setting and release load.
Complete Adjustment 3 3/4 Turns



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	L	C	
40 L/min.	CBBD – LNJ	T - 11A	35,1	22,2	49,8	58,2	45 - 50
80 L/min.	CBDD – LNJ	T - 2A	35,1	28,6	60,5	63,5	60 - 70
160 L/min.	CBFD – LNJ	T - 17A	46,0	31,8	69,9	84,1	200 - 215

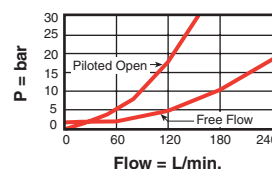
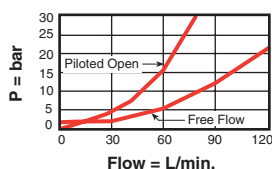
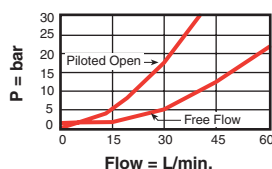
Performance Curves

CBB*

CBD*

CBF*

Free Flow and Piloted Open Pressure Drop



- Maximum recommended load pressure at maximum setting = 270 bar.
- Maximum setting = 350 bar.
- Maximum valve leakage at reseal = 0,4 cc/min.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when valve is standard set. Settings lower than the standard pressure may result in lower reseal percentage.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Two check valve cracking pressures are available. Use the 1,7 bar check unless actuator cavitation is a concern.

OPTION ORDERING INFORMATION

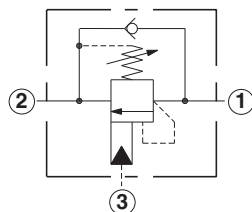
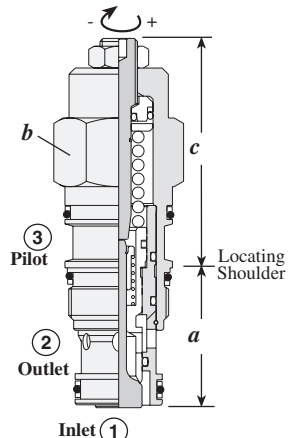
CB **		- ***		Seal Material
Nominal Capacity	Version	Control**	Functional Setting Range	
B 40 L/min.	D 4.5:1 Pilot Ratio (Sealed Pilot)	L Standard Screw Adjustment	J 140 - 350 bar with 1,7 bar check Standard set at 210 bar	N Buna-N
D 80 L/min.		C* Tamper Resistant Factory Set	K 70 - 175 bar with 1,7 bar check Standard set at 140 bar	V Viton
F 160 L/min.	L 2.3:1 Pilot Ratio (Sealed Pilot)	* Special setting required. Specify at time of order.		
		** See page 178 for information on Control Options		
		Customer specified special setting stamped on hex.		
			C 140 - 350 bar with 0,3 bar check Standard set at 210 bar	
			D 70 - 175 bar with 0,3 bar check Standard set at 140 bar	

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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NON-VENTED, RESTRICTIVE, 280 BAR MAXIMUM SETTING, 3:1, 2:1 PILOT RATIOS

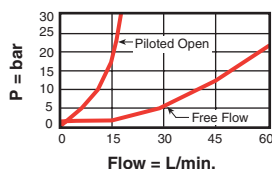
Turn screw clockwise to reduce setting and release load.
Complete Adjustment 3 3/4 Turns



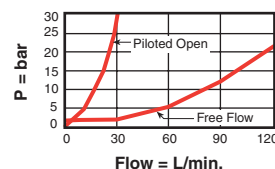
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	L	C	
15 L/min.	CBBA – LHN	T - 11A	35,1	22,2	50,0	58,2	45 - 50
30 L/min.	CBDA – LHN	T - 2A	35,1	28,6	60,5	63,5	60 - 70
60 L/min.	CBFA – LHN	T - 17A	46,0	31,8	69,9	84,1	200 - 215
80 L/min.	CBHA – LHN	T - 19A	63,5	41,3	89,9	103,9	465 - 500

Performance Curves

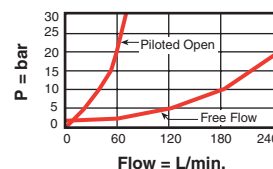
CBB*



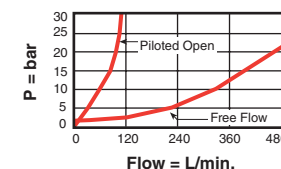
CBD*



CBF*



CBH*



Free Flow and Piloted Open Pressure Drop

- Maximum recommended load pressure at maximum setting = 215 bar.
- Maximum setting = 280 bar.
- Maximum valve leakage at reseal = 0,4 cc/min.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when valve is standard set. Settings lower than the standard pressure may result in lower reseal percentage.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Restrictive valves have no relief capacity other than as a thermal relief.
- Two check valve cracking pressures are available. Use the 1,7 bar check unless actuator cavitation is a concern.

OPTION ORDERING INFORMATION

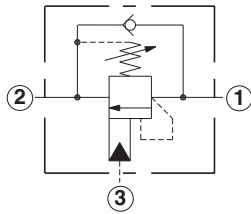
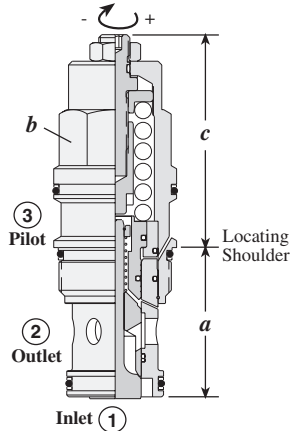
CB ** - ***				
Nominal Capacity	Version	Control**	Functional Setting Range	Seal Material
B 15 L/min.	A 3:1 Pilot Ratio (Sealed Pilot)	L Standard Screw Adjustment	H 70 - 280 bar with 1,7 bar check Standard set at 210 bar	N Buna-N
D 30 L/min.		C* Tamper Resistant Factory Set	I 28 - 105 bar with 1,7 bar check Standard set at 70 bar	V Viton
F 60 L/min.	CBBY only:	* <i>Special setting required. Specify at time of order.</i>	A 70 - 280 bar with 0,3 bar check Standard set at 210 bar	
H 80 L/min.	Y 2:1 Pilot Ratio (Bleed through Pilot)	** <i>See page 178 for information on Control Options</i>	B 28 - 105 bar with 0,3 bar check Standard set at 70 bar	
		<i>Customer specified special setting stamped on hex.</i>		

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

NON-VENTED, RESTRICTIVE, 350 BAR MAXIMUM SETTING, 4.5:1 PILOT RATIO

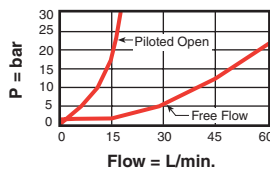
Turn screw clockwise to reduce setting and release load.
Complete Adjustment 3 3/4 Turns



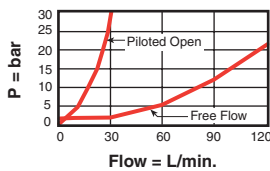
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
15 L/min.	CBBG – L JN	T - 11A	35,1	22,2	50,0	58,2	45 - 50
30 L/min.	CBDG – L JN	T - 2A	35,1	28,6	60,5	63,5	60 - 70
60 L/min.	CBFG – L JN	T - 17A	46,0	31,8	69,9	84,1	200 - 215
80 L/min.	CBHG – L JN	T - 19A	63,5	41,3	89,9	103,9	465 - 500

Performance Curves

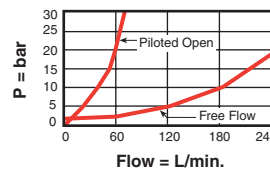
CBBG



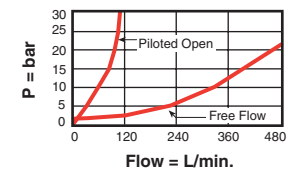
CBDG



CBFG



CBHG



- Maximum recommended load pressure at maximum setting = 270 bar.
- Maximum setting = 350 bar.
- Maximum valve leakage at reseal = 0,4 cc/min.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when valve is standard set. Settings lower than the standard pressure may result in lower reseal percentage.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Restrictive valves have no relief capacity other than as a thermal relief.
- Two check valve cracking pressures are available. Use the 1,7 bar check unless actuator cavitation is a concern.

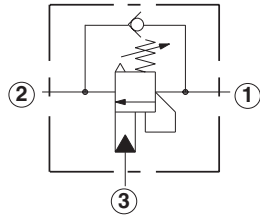
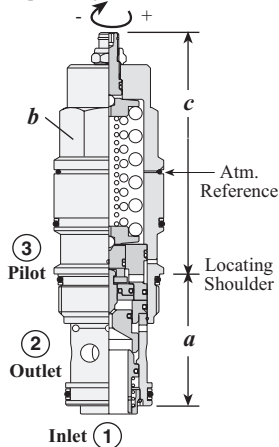
OPTION ORDERING INFORMATION

CB * G		- * * *		Seal Material
Nominal Capacity	Version	Control**	Functional Setting Range	
B 15 L/min.	G 4.5:1 Pilot Ratio (Sealed Pilot)	L Standard Screw Adjustment	J 140 - 350 bar with 1,7 bar check Standard set at 210 bar	N Buna-N
D 30 L/min.		C* Tamper Resistant Factory Set	K 70 - 175 bar with 1,7 bar check Standard set at 140 bar	V Viton
F 60 L/min.		* Special setting required. Specify at time of order.	C 140 - 350 bar with 0,3 bar check Standard set at 210 bar	
H 80 L/min.		** See page 178 for information on Control Options Customer specified special setting stamped on hex.	D 70 - 175 bar with 0,3 bar check Standard set at 140 bar	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

VENTED, ATMOSPHERICALLY REFERENCED, 3:1, 5:1, 1:1, 2:1 PILOT RATIOS

Turn screw clockwise to reduce setting and release load.
Complete Adjustment 4 Turns



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
60 L/min.	CACA – LHN	T - 11A	35,1	22,2	73,4	82,6	45 - 50
120 L/min.	CAEA – LHN	T - 2A	35,1	28,6	83,6	89,9	60 - 70
240 L/min.	CAGA – LHN	T - 17A	46,0	31,8	95,0	100,8	200 - 215
480 L/min.	CAIA – LHN	T - 19A	63,5	41,3	116,3	126,0	465 - 500

Performance Curves

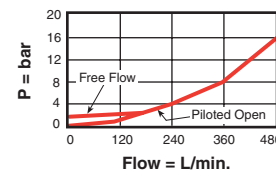
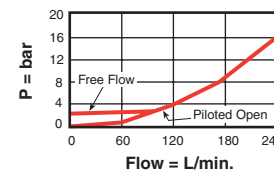
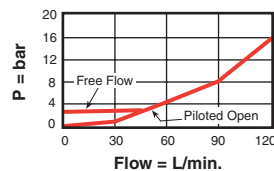
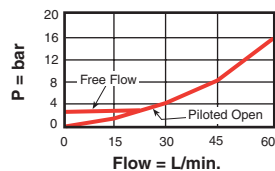
CAC*

CAE*

CAG*

CAI*

Free Flow and Piloted Open Pressure Drop



- Maximum recommended load pressure at maximum setting = CA*A, CA*K: 215 bar, CA*G, CA*L: 320 bar.
- Maximum setting = CA*A, CA*K: 280 bar, CA*G, CA*L: 420 bar.
- Maximum valve leakage at reseal = 0,4 cc/min.
- Reverse flow check cracking pressure = CAC*: 2,8 bar, CAE*, CAG*: 1,7 bar, CAI*: 1,5 bar.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when the valve is standard set. Settings lower than the standards set pressure may result in lower reseats percentages.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.
- Approximately 1 drop of fluid will pass from the pilot area to the vented spring chamber every 4000 cycles.

OPTION ORDERING INFORMATION

CA**		***		Seal Material
Nominal Capacity	Version	Control**	Functional Setting Range	
C 60 L/min.	A 3:1 Pilot Ratio	L Standard Screw Adjustment	CA*A, CA*K, only:	N Buna-N
E 120 L/min.	G 5:1 Pilot Ratio	C* Tamper Resistant Factory Set	H 70 - 280 bar Standard set at 210 bar	V Viton
G 240 L/min.	K 1:1 Pilot Ratio	* Special setting required. Specify at time of order.	I 28 - 105 bar Standard set at 70 bar	
I 480 L/min.	L 2:1 Pilot Ratio		CA*G, CA*L only:	
			F 70 - 175 bar Standard set at 140 bar	
			G 140 - 420 bar Standard set at 280 bar	

CA*A, CA*K, CA*G, CA*L:
Patent: U.S. #4,834,135

** See page 178
for information
on Control Options

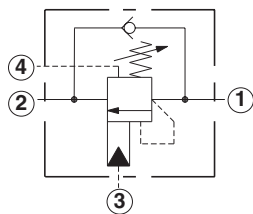
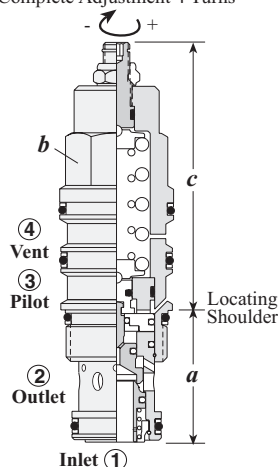
Customer specified
special setting
stamped on hex.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Counterbalance Valves

VENTED, 280 BAR MAXIMUM SETTING, 3:1, 1:1 PILOT RATIOS

Turn screw clockwise to reduce setting and release load.
Complete Adjustment 4 Turns



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
60 L/min.	CWCA– LHN	T - 21A	34,9	22,2	74,0	82,6	40 - 50
120 L/min.	CWEA– LHN	T - 22A	34,9	28,6	84,0	90,0	60 - 70
240 L/min.	CWGA– LHN	T - 23A	46,0	31,8	95,3	101,0	200 - 215
480 L/min.	CWIA – LHN	T - 24A	63,5	41,3	117,0	126,0	465 - 500

Performance Curves

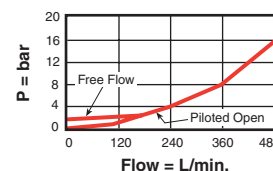
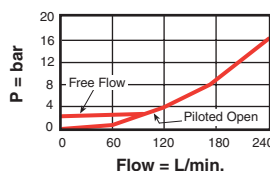
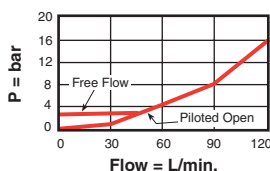
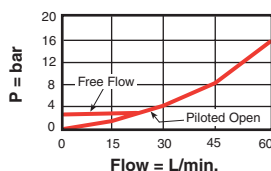
CWC*

CWE*

CWG*

CWI*

Free Flow and Piloted Open Pressure Drop



- Maximum recommended load pressure at maximum setting = 215 bar.
- Maximum setting = 280 bar.
- Maximum valve leakage at reseal = 0,4 cc/min.
- Reverse flow check cracking pressure = CWC*: 2,8 bar, CWE*, CWG*: 1,7 bar, CWI*: 1,5 bar.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when the valve is standard set. Settings lower than the standards set pressure may result in lower reseats percentages.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.

OPTION ORDERING INFORMATION

CW**		***		Seal Material
Nominal Capacity	Version	Control**	Functional Setting Range	
C 60 L/min.	A 3:1 Pilot Ratio	L Standard Screw Adjustment	H 70 - 280 bar Standard set at 210 bar	N Buna-N
E 120 L/min.	K 1:1 Pilot Ratio	C* Tamper Resistant Factory Set	I 28 - 105 bar Standard set at 70 bar	V Viton

* Special setting required.
Specify at time of order.

** See page 178
for information
on Control Options

Customer specified
special setting
stamped on hex.

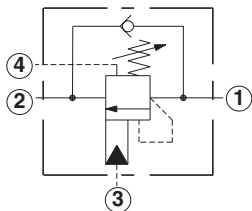
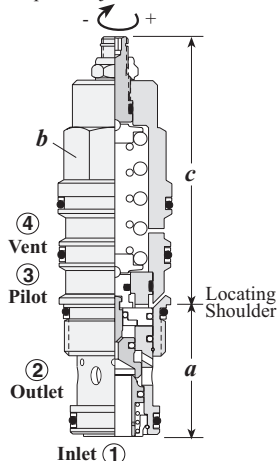
CW*A, CW*K:
Patent: U.S. #4,834,135

Consult the Sun website
for our most recent and
complete information
on the full Corrosion
Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

VENTED, 420 BAR MAXIMUM SETTING, 5:1, 2:1 PILOT RATIOS

Turn screw clockwise to reduce setting and release load.
Complete Adjustment 4 Turns



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					L	C	
60 L/min.	CWCG– LFN	T - 21A	35,0	22,2	74,0	82,6	40 - 50
120 L/min.	CWEG– LFN	T - 22A	35,0	28,6	83,6	90,0	60 - 70
240 L/min.	CWGG– LFN	T - 23A	46,0	31,8	93,3	101,0	200 - 215
480 L/min.	CWIG – LFN	T - 24A	63,5	41,3	117,0	126,0	465 - 500

Performance Curves

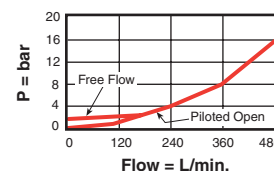
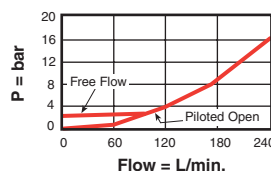
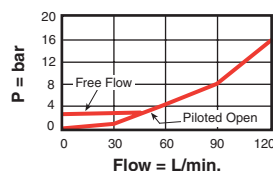
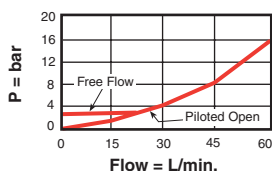
CWC*

CWE*

CWG*

CWI*

Free Flow and Piloted Open Pressure Drop



- Maximum recommended load pressure at maximum setting = 320 bar.
- Maximum setting = 420 bar.
- Maximum valve leakage at reseal = 0,4 cc/min.
- Reverse flow check cracking pressure = CWC*: 2,8 bar, CWE*, CWG*: 1,7 bar, CWI*: 1,5 bar.
- Factory pressure setting established at 30 cc/min.
- Reseat exceeds 85% of set pressure when the valve is standard set. Settings lower than the standards set pressure may result in lower reseats percentages.
- Counterbalance valves should be set at least 1.3 times the maximum load induced pressure.

OPTION ORDERING INFORMATION

Nominal Capacity	Version	Control**	Functional Setting Range	Seal Material
C 60 L/min.	G 5:1 Pilot Ratio	L Standard Screw Adjustment	F 70 - 175 bar Standard set at 140 bar	N Buna-N
E 120 L/min.	L 2:1 Pilot Ratio	C* Tamper Resistant Factory Set	G 140 - 420 bar Standard set at 280 bar	V Viton
G 240 L/min.				
I 480 L/min.				

* Special setting required.
Specify at time of order.

** See page 178
for information
on Control Options

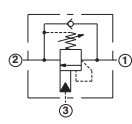
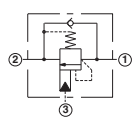
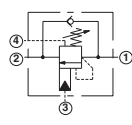
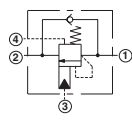
Customer specified
special setting
stamped on hex.

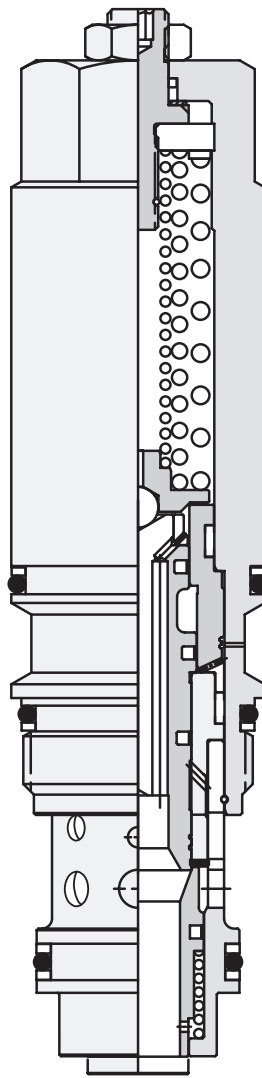
Consult the Sun website
for our most recent and
complete information
on the full Corrosion
Resistant line of products.

CW*G, CW*L:
Patent: U.S. #4,834,135

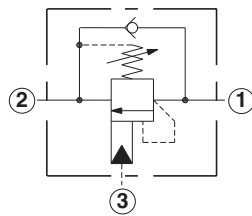
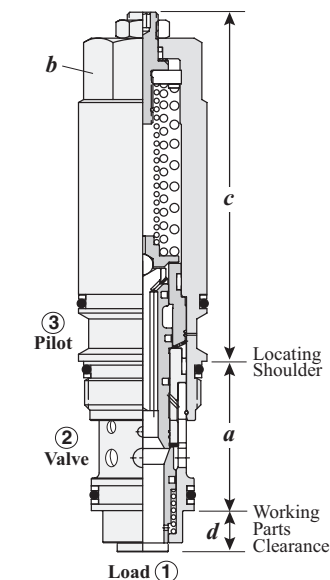
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Load Control: Load Reactive Cartridge Valves

	Cartridge Type	Page
	Non-vented, 3:1, 1.5:1, 4.5:1 Pilot Ratios	64
	Non-vented, Fixed Setting, 3:1, 1.5:1, 4.5:1 Pilot Ratios	65
	Vented, 3:1, 1.5:1, 4.5:1 Pilot Ratios	66
	Vented, Fixed Setting, 3:1, 1.5:1, 4.5:1 Pilot Ratios	67



NON-VENTED, 3:1, 1.5:1, 4.5:1 PILOT RATIOS



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
120 L/min.	MBEA – LHN	T-2A	35,1	28,6	92,7	7,1	60 - 70
240 L/min.	MBGA – LHN	T-17A	46,2	31,8	107,5	9,4	200 - 215
480 L/min.	MBIA – LHN	T-19A	63,5	41,3	124,0	5,8	465 - 500

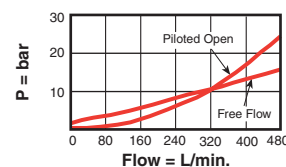
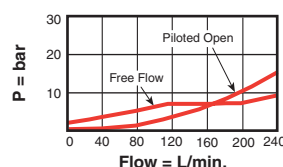
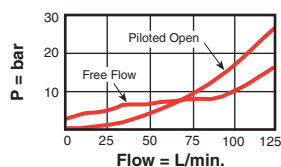
Performance Curves

MBE*-L

MBG*-L

MBI*-L

Free Flow and Piloted Open Pressure Drop



- Maximum recommended load pressure at maximum setting = 260 bar.
- Maximum setting = 350 bar.
- Factory pressure setting established at 30 cc/min.
- Maximum valve leakage at reseal = 0,3 cc/min.
- Reseat = >85% of set pressure.
- Reverse flow check cracking pressure = 2 bar.
- Load reactive load control valves should be set at least 1.3 times the maximum load induced pressure.
- Full clockwise lowest setting is 70 bar for the H range and 140 bar for the J range.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- This valve is functionally a 3 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.

OPTION ORDERING INFORMATION

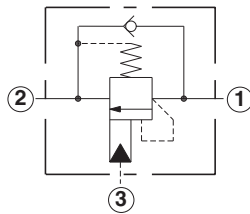
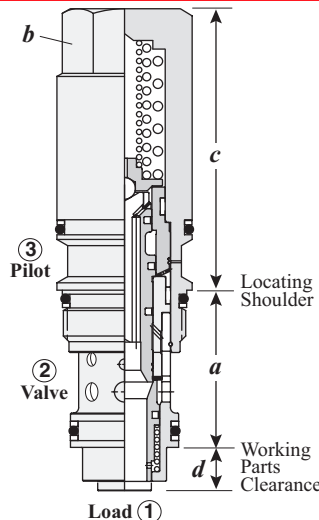
M B * * - L * *				
Nominal Capacity	Version	Control	Functional Setting Range	Seal Material
E 120 L/min.	A 3:1 Pilot Ratio	L Standard Screw Adjustment	H 70 - 280 bar Standard set at 210 bar	N Buna-N
G 240 L/min.	B 1.5:1 Pilot Ratio	MBEA, MBEB, MBEG only:	J 140 - 350 bar Standard set at 210 bar	V Viton
I 480 L/min.	G 4.5:1 Pilot Ratio	C* Tamper Resistant Factory Set		

* Special setting required.
Specify at time of order.

Customer specified
special setting
stamped on hex.

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NON-VENTED, FIXED SETTING, 3:1, 1.5:1, 4.5:1 PILOT RATIOS



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
120 L/min.	MBEA – XLN	T-2A	35,1	28,6	67,6	7,1	60 - 70
240 L/min.	MBGA – XLN	T-17A	46,2	31,8	82,6	9,4	200 - 215
480 L/min.	MBIA – XLN	T-19A	63,5	41,3	124,0	5,8	465 - 500

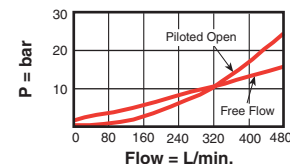
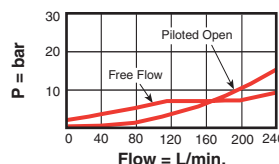
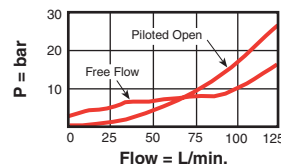
Performance Curves

MBE*-X

MBG*-X

MBI*-X

Free Flow and Piloted Open Pressure Drop



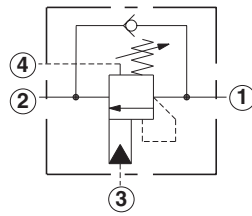
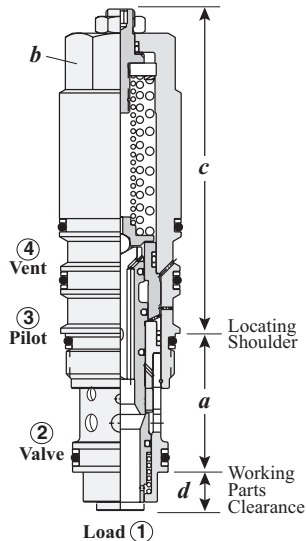
- Factory pressure setting established at 30 cc/min.
- Maximum valve leakage at reseal = 0,3 cc/min.
- Reseat = >85% of set pressure.
- Reverse flow check cracking pressure = 2 bar.
- Load reactive load control valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Fixed setting valves have much wider cracking pressure ranges than adjustable setting valves, which can be set to within +/- 3,5 bar. The valve-to-valve cracking pressure for fixed setting valves can be large either side of the mean pressure, as indicated in the range selected.
 - 210 bar fixed setting: +20/-35 bar
 - 280 bar fixed setting: +20/-60 bar
 - 350 bar fixed setting: +20/-70 bar
- This valve is functionally a 3 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.

OPTION ORDERING INFORMATION

MB**		- X**		Factory Set		Seal Material
Nominal Capacity	Version	Control				
E 120 L/min.	A 3:1 Pilot Ratio	X Fixed		K 210 bar Max. Recommended Load Pressure 160 bar Highest Cracking Pressure 210 bar		N Buna-N
G 240 L/min.	B 1.5:1 Pilot Ratio			L 280 bar Max. Recommended Load Pressure 215 bar Highest Cracking Pressure 300 bar		V Viton
I 480 L/min.	G 4.5:1 Pilot Ratio			M 350 bar Max. Recommended Load Pressure 270 bar Highest Cracking Pressure 370 bar		

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VENTED, 3:1, 1.5:1, 4.5:1 PILOT RATIOS



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
120 L/min.	MWEA-LHN	T-22A	35,1	28,6	92,7	7,1	60 - 70
240 L/min.	MWGA-LHN	T-23A	46,2	31,8	107,5	9,4	200 - 215
480 L/min.	MWIA-LHN	T-24A	63,5	41,3	124,0	5,8	465 - 500

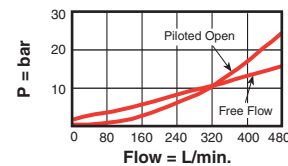
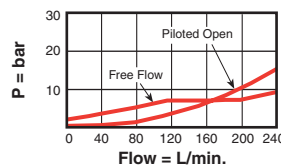
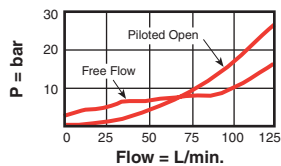
Performance Curves

MWE*-L

MWG*-L

MWI*-L

Free Flow and Piloted Open Pressure Drop



- Maximum recommended load pressure at maximum setting = 260 bar.
- Maximum setting = 350 bar.
- Factory pressure setting established at 30 cc/min.
- Maximum valve leakage at reseal = 0,3 cc/min.
- Reseat = >85% of set pressure.
- Reverse flow check cracking pressure = 2 bar.
- Load reactive load control valves should be set at least 1.3 times the maximum load induced pressure.
- This valve is functionally a 4 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.
- Full clockwise lowest setting is 70 bar for H range and 140 bar for J range.

OPTION ORDERING INFORMATION

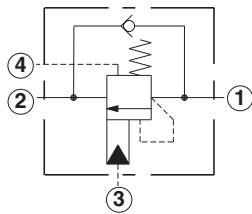
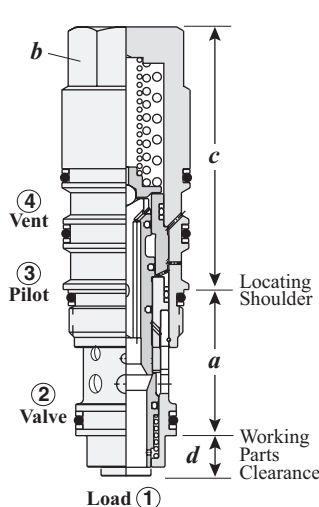
MW**		- L**		Seal Material
Nominal Capacity	Version	Control	Functional Setting Range	
E 120 L/min.	A 3:1 Pilot Ratio	L Standard Screw Adjustment	H 70 - 280 bar Standard set at 210 bar	N Buna-N
G 240 L/min.	B 1.5:1 Pilot Ratio	MWEA only: C* Tamper Resistant Factory Set	J 140 - 350 bar Standard set at 210 bar	V Viton
I 480 L/min.	G 4.5:1 Pilot Ratio			

* Special setting required.
Specify at time of order.

Customer specified
special setting
stamped on hex.

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VENTED, FIXED SETTING, 3:1, 1.5:1, 4.5:1 PILOT RATIOS



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
120 L/min.	MWEA-XLN	T-22A	35,1	28,6	67,6	7,1	60 - 70
240 L/min.	MWGA-XLN	T-23A	46,2	31,8	82,6	9,4	200 - 215
480 L/min.	MWIA-XLN	T-24A	63,5	41,3	114,3	5,8	465 - 500

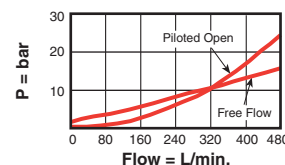
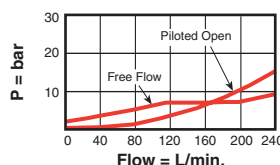
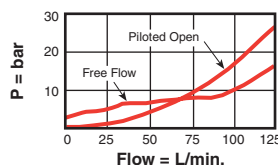
Performance Curves

MWE*-X

MWG*-X

MWI*-X

Free Flow and Piloted Open Pressure Drop



- Factory pressure setting established at 30 cc/min.
- Maximum valve leakage at reseal = 0,3 cc/min.
- Reseat = >85% of set pressure.
- Reverse flow check cracking pressure = 2 bar.
- Load reactive load control valves should be set at least 1.3 times the maximum load induced pressure.
- Back pressure at port 2 adds to the effective relief setting at a ratio of 1 plus the pilot ratio times the back pressure.
- Fixed setting valves have much wider cracking pressure ranges than adjustable setting valves, which can be set to within +/- 3,5 bar. The valve-to-valve cracking pressure for fixed setting valves can be large either side of the mean pressure, as indicated in the range selected.
 - 210 bar fixed setting: +20/-35 bar
 - 280 bar fixed setting: +20/-60 bar
 - 350 bar fixed setting: +20/-70 bar
- This valve is functionally a 4 port counterbalance valve. It seats as a poppet valve and modulates as a spool valve.

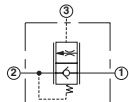
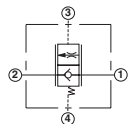
OPTION ORDERING INFORMATION

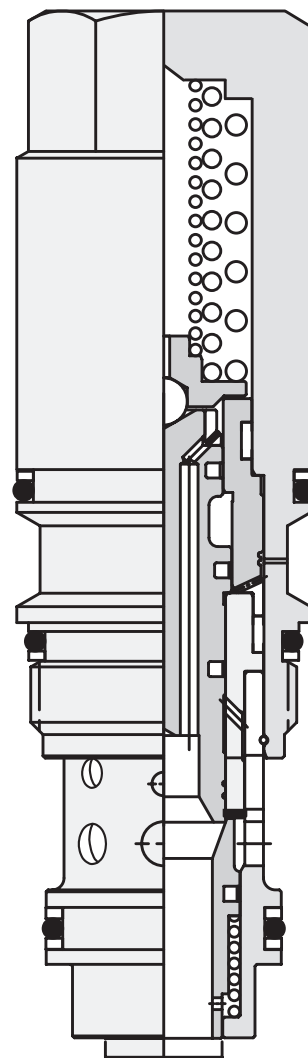
MW** - X**						
Nominal Capacity	Version	Control	Factory Set	Seal Material		
E 120 L/min.	A 3:1 Pilot Ratio	X Fixed	K 210 bar Max. Recommended Load Pressure 160 bar Highest Cracking Pressure 210 bar	N Buna-N		
G 240 L/min.	B 1.5:1 Pilot Ratio		L 280 bar Max. Recommended Load Pressure 215 bar Highest Cracking Pressure 300 bar	V Viton		
I 480 L/min.	G 4.5:1 Pilot Ratio		M 350 bar Max. Recommended Load Pressure 270 bar Highest Cracking Pressure 370 bar			

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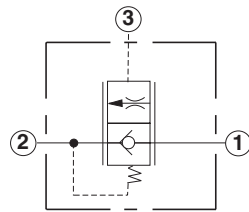
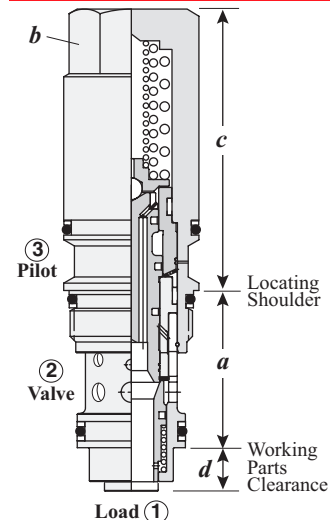
NOTES

Load Control: Balanced Cartridge Valves

	<i>Cartridge Type</i>	<i>Page</i>
	Non-vented, Non-relieving	70
	Vented, Non-relieving	71



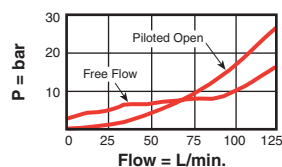
NON-VENTED, NON-RELIEVING



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
120 L/min.	MBEM- XIN	T-2A	35,1	28,6	92,7	7,1	60 - 70
240 L/min.	MBGM- XIN	T-17A	46,2	31,8	107,5	12,7	200 - 215
480 L/min.	MBIM - XIN	T-19A	63,5	41,3	114,3	5,8	465 - 500

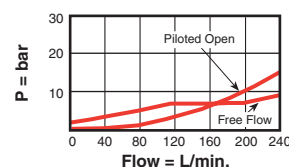
Performance Curves

MBEM-X

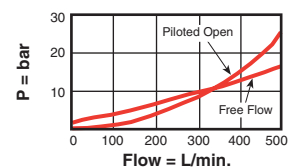


MBGM-X

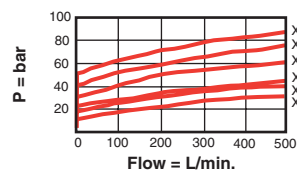
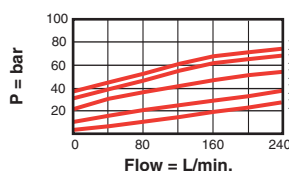
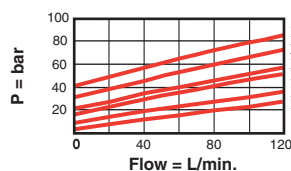
Free Flow and Piloted Open Pressure Drop



MBIM-X



Pilot Pressure vs. Flow (70 bar Load Pressure)



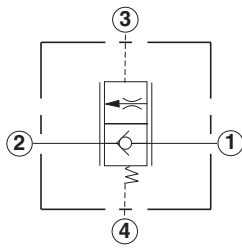
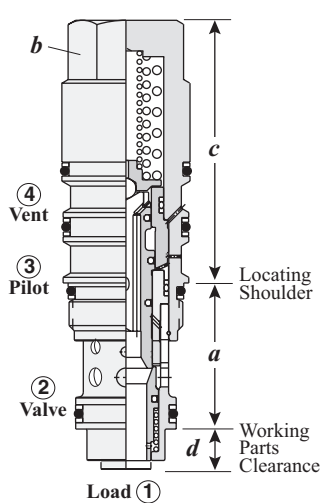
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = I, K, M ranges: 0,4 cc/min. at 14 bar below cracking pressure; E, G, H ranges: 50 cc/min. at 3,5 bar below cracking pressure.
- Reverse flow check cracking pressure = 2 bar.
- Back pressure at port 2 directly opposes pilot pressure at port 3.
- This valve has no relief function, not even thermal expansion relief.
- This valve is balanced against load pressures and therefore exhibits self-compensation. Flow is controlled by the pilot pressure. Because of dynamic seals, performance is best in the meter-out mode with port 1 being the load and port 2 being tank.

OPTION ORDERING INFORMATION

M B * M		- X * *		Seal Material
Nominal Capacity	Version	Control	Minimum Control Pressure	
E 120 L/min.	M Non-vented, Sealed Pilot	X Not Adjustable	E 5 bar	N Buna-N
G 240 L/min.			G 10,5 bar	V Viton
I 480 L/min.			I 20 bar	
			K 33 bar	
			M 36,7 bar	
			Available with MBEM-X, MBIM-X only:	
			H 14 bar	

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VENTED, NON-RELIEVING



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
120 L/min.	MWEM-XIN	T-22A	35,1	28,6	92,7	7,1	60 - 70
240 L/min.	MWGM-XIN	T-23A	46,2	31,8	107,5	9,4	200 - 215
480 L/min.	MWIM-XIN	T-24A	63,5	41,3	114,3	5,8	465 - 500

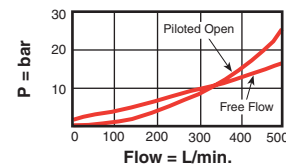
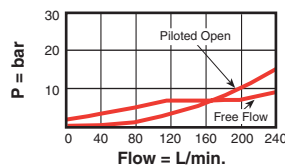
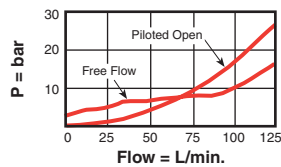
Performance Curves

MWEM-X

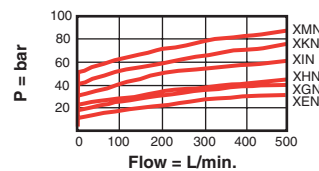
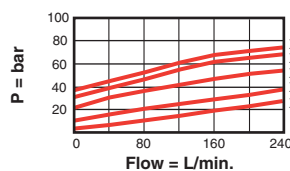
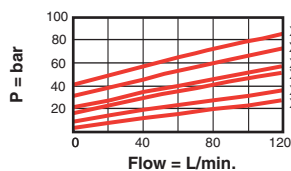
MWGM-X

MWIM-X

Free Flow and Piloted Open Pressure Drop



Pilot Pressure vs. Flow (70 bar Load Pressure)



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseal = I, K, M ranges: 0,4 cc/min. at 14 bar below cracking pressure; E, G, H ranges: 50 cc/min. at 3,5 bar below cracking pressure.
- Reverse flow check cracking pressure = 2 bar.
- This valve has no relief function, not even thermal expansion relief.
- This valve is balanced against load pressures and therefore exhibits self-compensation. Flow is controlled by the pilot pressure. Because of dynamic seals, performance is best in the meter-out mode with port 1 being the load and port 2 being tank.

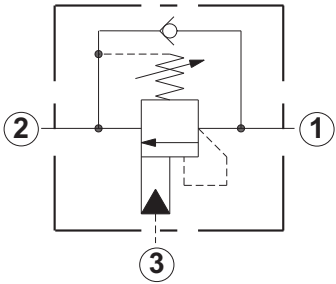
OPTION ORDERING INFORMATION

M W * M		- X * *		Seal Material
Nominal Capacity	Version	Control	Minimum Control Pressure	
E 120 L/min.	M Vented, Sealed Pilot	X Not Adjustable	E 5 bar	N Buna-N
G 240 L/min.			G 10,5 bar	V Viton
I 480 L/min.			I 20 bar	
			K 33 bar	
			M 36,7 bar	
			<i>Available with MWEM-X, MWIM-X only:</i>	
			H 14 bar	

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SUN FIXED SETTING COUNTERBALANCE VALVES FEATURE LOWER PROFILE

Sun recently introduced four new, standard fixed setting counterbalance valves in the series 1 frame size (T-11A cavity). These valves are pre-set to a nominal value at the factory and are offered with a 1,7 bar integral check. Because there is no adjustment mechanism in these cartridges, they are approximately 40% shorter than adjustable versions (dimension from locating shoulder of cartridge to end of hex body).

COUNTERBALANCE CARTRIDGE VALVES, NON-VENTED, FIXED SETTING		
	Model Code	Pilot Ratio
		T-11A
		40 L/min.
	Semi-restrictive	CBBL-X** 2.3:1
		CBBC-X** 3:1
		CBBD-X** 4.5:1
		10 L/min.
	Restrictive	CBAB-X** 1.5:1
		CBAA-X** 3:1
		20 L/min.
	Restrictive	CBBA-X** 3:1
		CBBG-X** 4.5:1
		60 L/min.
	Standard	CBCL-X** 2.3:1
		CBCA-X** 3:1
		CBCG-X** 4.5:1
		CBCH-X** 10:1

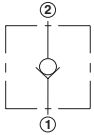
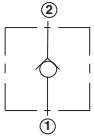
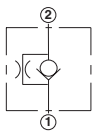
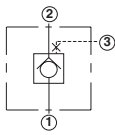
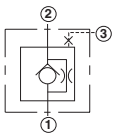
Other alternatives are available as custom part numbers. Contact your Sun Distributor for more information.

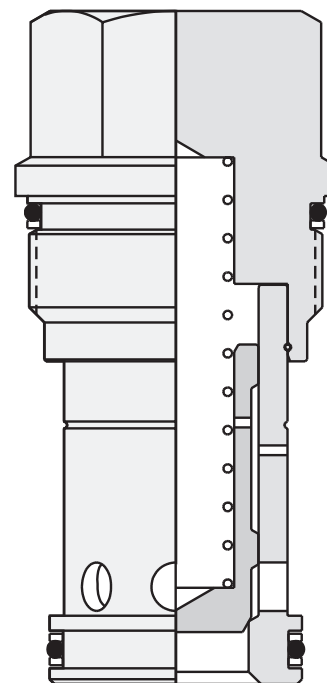
For detailed information on these new fixed setting counterbalance cartridges consult

www.sunhydraulics.com

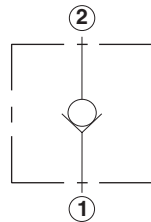
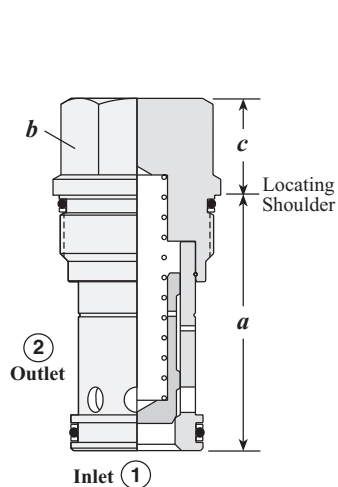
Products: Cartridges: Counterbalance: View All Counterbalance Cartridges

Check Cartridge Valves

	<i>Cartridge Type</i>	<i>Page</i>
	Free Flow, Nose-to-Side	74
	Free Flow, Side-to-Nose	75
	Free Flow, Nose-to-Side with Bypass Orifice	76
	Free Flow, Side-to-Nose, Port 3 Blocked	77
	Free Flow, Side-to-Nose with Bypass Orifice, Port 3 Blocked	78



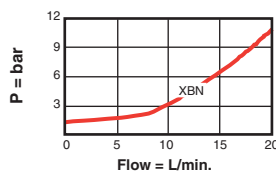
FREE FLOW, NOSE-TO-SIDE



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
20 L/min.	CXAA – XBN	T - 8A	19,1	22,2	11,4	35 - 40
40 L/min.	CXBA – XCN	T - 162A	31,0	19,1	20,8	35 - 40
80 L/min.	CXDA – XCN	T - 13A	35,1	22,2	19,1	45 - 50
160 L/min.	CXFA – XCN	T - 5A	41,1	28,6	17,5	60 - 70
320 L/min.	CXHA – XCN	T - 16A	62,0	31,8	24,6	200 - 215
640 L/min.	CXJA – XCN	T - 18A	79,5	41,3	30,2	465 - 500

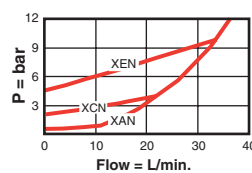
Performance Curves

CXAA

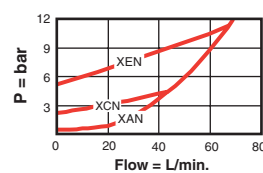


CXBA

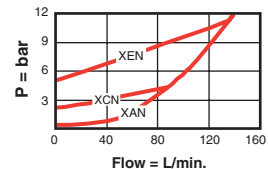
Typical Pressure Drop



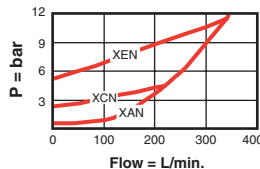
CXDA



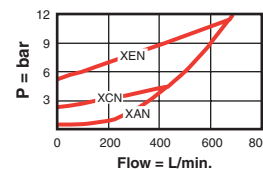
CXFA



CXHA



CXJA



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Will accept 350 bar at ports 1 and 2.
- Caution:** CX*A two port nose-to-side check valves and CX*D side-to-nose valves (shown in this catalogue section) share the same cavities and are mechanically interchangeable, but have opposite flow paths.

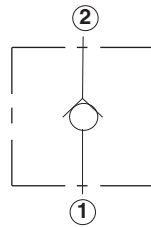
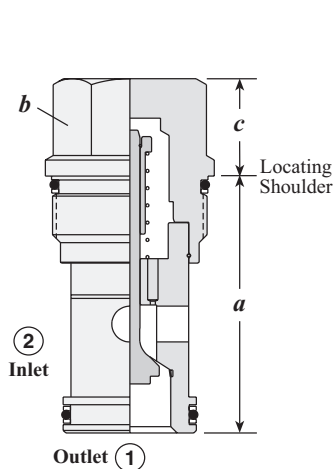
OPTION ORDERING INFORMATION

CX * A - * * *			
Nominal Capacity	Control	Cracking Pressure	Seal Material
A 20 L/min.	X Not Adjustable	A 0,3 bar	N Buna-N
B 40 L/min.		B 1 bar	V Viton
D 80 L/min.		C 2 bar	
F 160 L/min.		D 3,5 bar	
H 320 L/min.		E 5 bar	
J 640 L/min.		F 7 bar	
		Only Available	
		Cracking Pressure	
		for CXAA:	
		B 1 bar	

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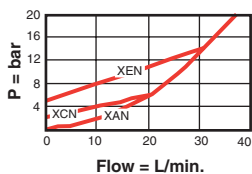
FREE FLOW, SIDE-TO-NOSE



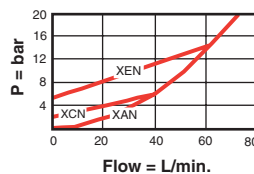
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
30 L/min.	CXAD – XCN	T - 162A	31,0	19,1	20,8	35 - 40
60 L/min.	CXCD – XCN	T - 13A	35,1	22,2	19,1	45 - 50
120 L/min.	CXED – XCN	T - 5A	41,1	28,6	17,5	60 - 70
240 L/min.	CXGD – XCN	T - 16A	62,0	31,8	24,6	200 - 215
480 L/min.	CXID – XCN	T - 18A	79,5	41,3	30,2	465 - 500

Performance Curves

CXAD

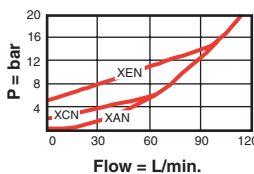


CXCD

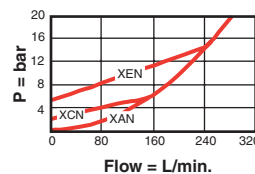


CXED

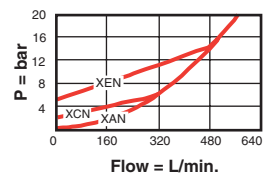
Typical Pressure Drop



CXGD



CXID



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Will accept 350 bar at ports 1 and 2.
- Caution:** CX*A two port nose-to-side check valves and CX*D side-to-nose valves (shown in this catalogue section) share the same cavities and are mechanically interchangeable, but have opposite flow paths.

OPTION ORDERING INFORMATION

CX * D - * * *			
Nominal Capacity	Control**	Cracking Pressure	Seal Material
A 30 L/min.	X Not Adjustable	A* 0,3 bar	N Buna-N
C 60 L/min.		B 1 bar	V Viton
E 120 L/min.		C* 2 bar	
G 240 L/min.		D* 3,5 bar	
I 480 L/min.		E* 5 bar	
		F 7 bar	

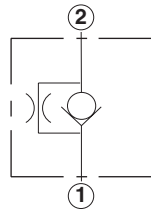
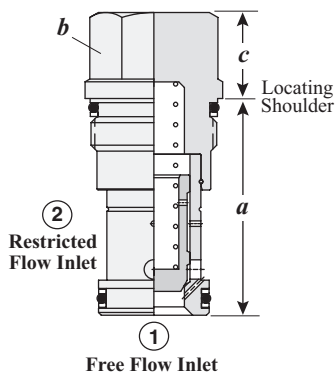
* CXAD available with A, C, D, E Cracking Pressures Only.

** See page 178 for information on Control Options

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FREE FLOW, NOSE-TO-SIDE WITH BYPASS ORIFICE



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
30 L/min.	CNBC – XCN	T - 162A	31,0	19,1	20,8	35 - 40
60 L/min.	CNDC – XCN	T - 13A	35,1	22,2	19,1	45 - 50
120 L/min.	CNFC – XCN	T - 5A	41,4	28,6	17,5	60 - 70
240 L/min.	CNHC – XCN	T - 16A	61,7	31,8	24,6	200 - 215
480 L/min.	CNJC – XCN	T - 18A	79,5	41,3	30,2	465 - 500

Performance Curves

CNBC

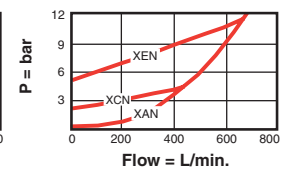
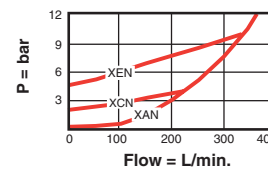
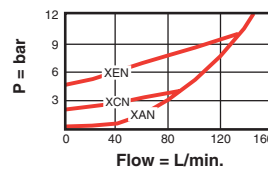
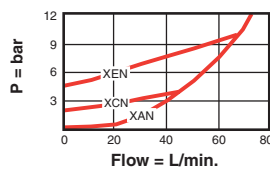
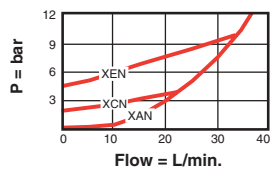
CNDC

CNFC

CNHC

CNJC

Typical Pressure Drop
Performance Data Shown Reflects Blocked Orifice



- Maximum operating pressure = 350 bar.
- Will accept 350 bar at ports 1 and 2.
- Two port check valves share the same cavity for a given frame size; however, pay close attention as flow paths maybe in opposite directions.

OPTION ORDERING INFORMATION

CN * C - * * *			
Nominal Capacity	Control**	Cracking Pressure*	Seal Material
B 30 L/min.	X Not Adjustable	A 0,3 bar	N Buna-N
D 60 L/min.		B 1 bar	V Viton
F 120 L/min.		C 2 bar	
H 240 L/min.		D 3,5 bar	
J 480 L/min.		E 5 bar	
		F 7 bar	

* Customer specified orifice setting stamped on hex:

Orifice Setting:

CNBC: 0,4 - 1,6 mm.

CNDC: 0,4 - 2,7 mm.

CNFC: 0,4 - 3,2 mm.

CNHC: 0,4 - 6,4 mm.

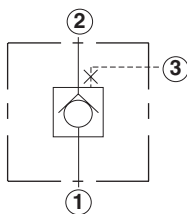
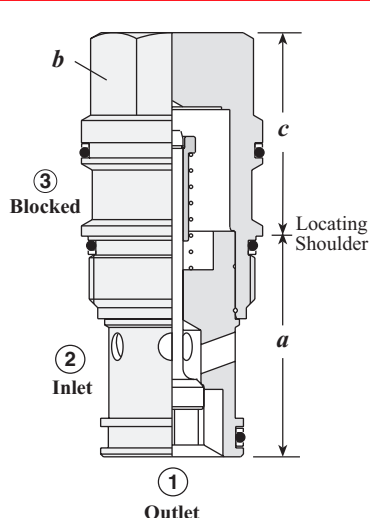
CNJC: 0,4 - 9,0 mm.

** See page 178 for information on Control Options

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FREE FLOW, SIDE-TO-NOSE, PORT 3 BLOCKED



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	CXCE – XCN	T - 11A	35,1	22,2	30,2	45 - 50
120 L/min.	CXEE – XCN	T - 2A	35,1	28,6	35,1	60 - 70
240 L/min.	CXGE – XCN	T - 17A	46,0	31,8	46,0	200 - 215
480 L/min.	CXIE – XCN	T - 19A	63,5	41,3	58,7	465 - 500

Performance Curves

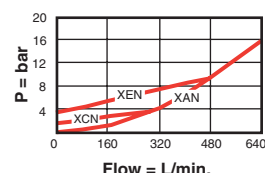
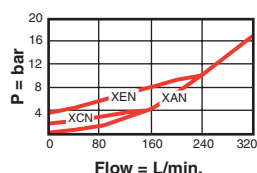
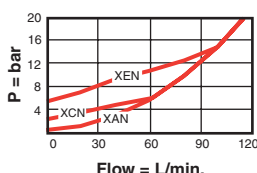
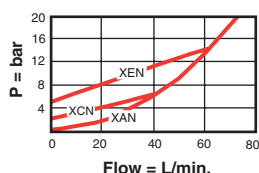
CXCE

CXEE

CXGE

CXIE

Typical Pressure Drop



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Will accept 350 bar at ports 1 and 2.
- Caution:** CX*A two port nose-to-side check valves and CX*D side-to-nose valves (shown in this catalogue section) share the same cavities and are mechanically interchangeable, but have opposite flow paths.

OPTION ORDERING INFORMATION

CX * E - * * *

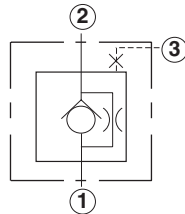
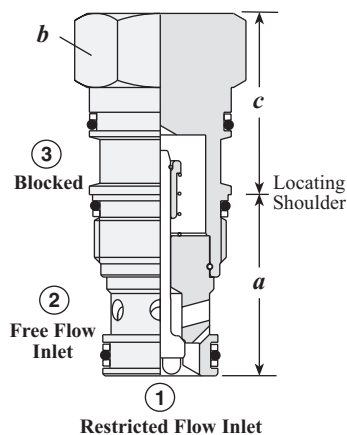
Nominal Capacity	Control**	Cracking Pressure	Seal Material
C 60 L/min.	X Not Adjustable	A 0,3 bar	N Buna-N
E 120 L/min.		B 1 bar	V Viton
G 240 L/min.		C 2 bar	
I 480 L/min.		D 3,5 bar	
		E 5 bar	
		F 7 bar	

** See page 178
for information
on Control Options

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our most recent and complete
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Resistant line of products.

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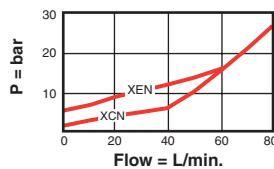
FREE FLOW, SIDE-TO-NOSE, WITH BYPASS ORIFICE, PORT 3 BLOCKED



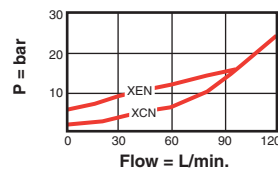
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	CNCD – XCN	T - 11A	35,1	22,2	30,2	45 - 50
120 L/min.	CNED – XCN	T - 2A	35,1	28,6	35,1	60 - 70
240 L/min.	CNGD – XCN	T - 17A	46,0	31,8	46,0	200 - 215
480 L/min.	CNID – XCN	T - 19A	63,5	41,3	58,7	465 - 500

Performance Curves

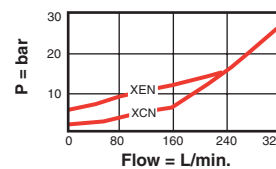
CNCD



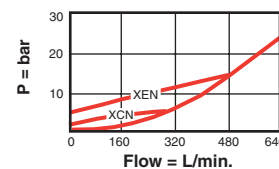
CNED



CNGD



CNID



Typical Pressure Drop

- Maximum operating pressure = 350 bar.
- Will accept 350 bar at ports 1 and 2.
- When used in a full time regeneration circuit, these valves allow full force to be developed by the cylinder when it comes to a stop. The bypass orifice drops the rod end pressure to zero when flow out of the rod stops.

OPTION ORDERING INFORMATION

CN * D – * * *			
Nominal Capacity	Control**	Cracking Pressure*	Seal Material
C 60 L/min.	X Not Adjustable	A 0,3 bar	N Buna-N
E 120 L/min.		B 1 bar	V Viton
G 240 L/min.		C 2 bar	
I 480 L/min.		D 3,5 bar	
		E 5 bar	
		F 7 bar	

* Customer specified orifice effective diameter stamped on hex:

Orifice Diameter Range:

CNCD: 0,4 - 3,9 mm

CNED: 0,4 - 3,4 mm

CNGD: 0,4 - 5,5 mm

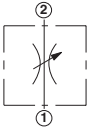
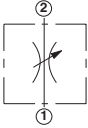
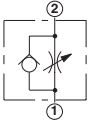
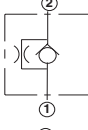
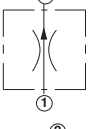
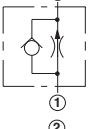
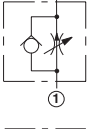
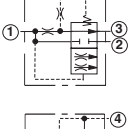
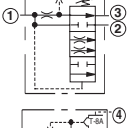
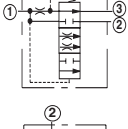
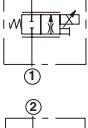
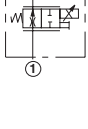
CNID: 0,4 - 5,5 mm

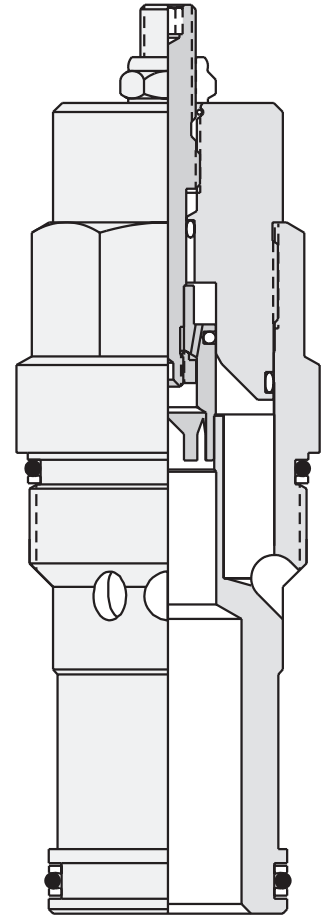
** See page 178 for information on Control Options

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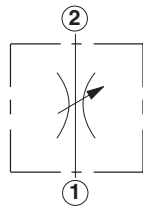
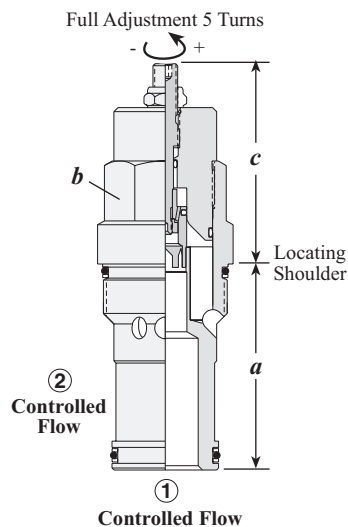
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Flow Control Valves

<i>Cartridge Type</i>	<i>Page</i>
	Fully Adjustable Needle 80
	Fully Adjustable Needle, High Capacity 81
	Fully Adjustable Needle with Reverse Flow Check, High Capacity 82
	Fixed Orifice, Non-pressure Compensated, with Reverse Flow Check 83
	Fixed Orifice, Pressure Compensated 84
	Fixed Orifice, Pressure Compensated, with Reverse Flow Check 85
	Fully Adjustable, Pressure Compensated, with Reverse Flow Check 86
	Fixed Orifice, Bypass/Restrictive, Priority Flow 87
	Ventable, Fixed Orifice, Bypass/Restrictive, Priority Flow 88
	Ventable, Fixed Orifice, Bypass/Restrictive, Priority Flow, with Integral T-8A Control Cavity 89
	Electro-Proportional, Normally Closed Throttle 90
	Electro-Proportional, Normally Open Throttle 91



FULLY ADJUSTABLE NEEDLE



Maximum Nominal Orifice	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	H	K	
4,0 mm dia.	NFBC – LCN	T - 162A	31,0	19,1	40,4	-	43,9	35 - 40
4,8 mm dia.	NFCC – LCN	T - 13A	35,0	22,2	57,7	63,2	63,5	45 - 50
6,4 mm dia.	NFDC – LAN	T - 5A	41,4	28,6	59,7	71,6	69,3	60 - 70
9,7 mm dia.	NFEC – LEN	T - 16A	62,0	31,8	67,6	77,7	74,7	200 - 215
14,2 mm dia.	NFFC – LGN	T - 18A	79,5	41,3	84,1	88,9	88,1	465 - 500

Performance Curves

NFBC

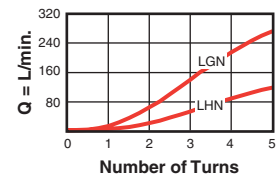
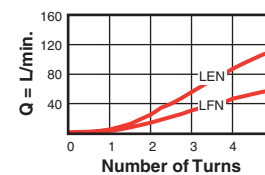
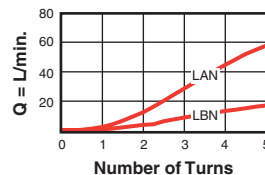
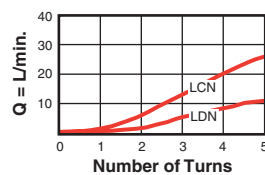
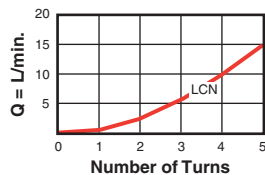
NFCC

NFDC

NFEC

NFFC

Adjustment Sensitivity at 7 bar Differential



- Maximum operating pressure = 350 bar.
- Because needle valves are non-compensating devices, the fixed orifice size will regulate flow through the valve in proportion to the square root of the pressure differential across ports 1 and 2.
- The sharp edged orifice design minimizes flow variations due to viscosity changes.
- There is no leakage when the adjustment mechanism is turned to the shut-off position.

OPTION ORDERING INFORMATION

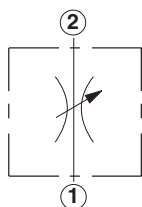
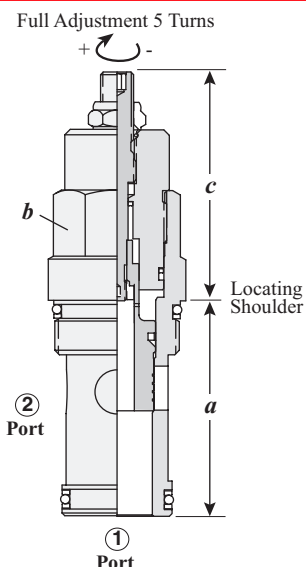
NF * C - * * *			
Maximum Nominal Orifice	Control**	Maximum Orifice Diameter	Seal Material
B 4,0 mm dia.	L Standard Screw Adjustment	NFBC	N Buna-N
C 4,8 mm dia.		C 4 mm	
D 6,3 mm dia.	H* Calibrated Handknob with Detent Lock	NFCC	V Viton
E 9,6 mm dia.		C 4,8 mm	
F 14,2 mm dia.	K Handknob with Lock Knob	D 2,3 mm	
	* Not Available on NFBC	NFDC	
		A 6,4 mm	
		B 3,0 mm	
		NFEC	
		E 9,7 mm	
		F 7,1 mm	
		NFFC	
		G 14,2 mm	
		H 9,6 mm	

** See page 178 for information on Control Options

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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FULLY ADJUSTABLE NEEDLE, HIGH CAPACITY



Nominal Orifice	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	H	K	
8,4 mm dia.	NFCD – LFN	T - 13A	35,0	22,2	57,4	62,5	63,2	45 - 50
12,7 mm dia.	NFDD – LGN	T - 5A	41,4	28,6	59,7	71,4	69,1	60 - 70
17,5 mm dia.	NFED – LHN	T - 16A	62,0	31,8	67,6	77,7	74,7	200 - 215
21,6 mm dia.	NFFD – LIN	T - 18A	79,5	41,3	84,1	88,9	88,1	465 - 500

- Maximum operating pressure = 350 bar.
- Because needle valves are non-compensating devices, the fixed orifice size will regulate flow through the valve in proportion to the square root of the pressure differential across ports 1 and 2.
- A balanced adjustment mechanism allows for easy adjustment even at high pressures.
- The sharp edged orifice design minimizes flow variations due to viscosity changes.
- The flow path through this valve is bi-directional. The preferred path is port 1 to 2, to allow interchangeability with other flow controls.
- There is no leakage when the adjustment mechanism is turned to the shut-off position.

OPTION ORDERING INFORMATION

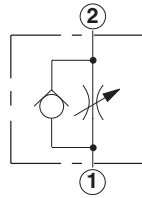
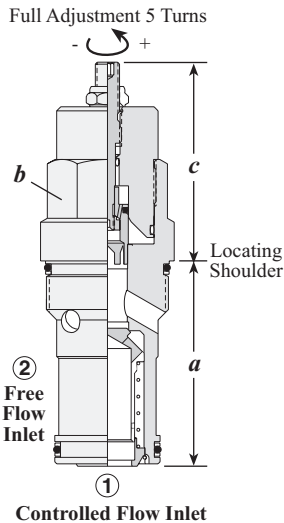
NF * D - * * *			
Nominal Orifice	Control**	Maximum Orifice Diameter	Seal Material
C 8,4 mm dia.	L Standard Screw Adjustment	NFCD	N Buna-N
D 12,7 mm dia.	H Calibrated Detent Lock Handknob with	F 8,4 mm	V Viton
E 17,5 mm dia.	K Handknob with Lock Knob	NFDD	
F 21,6 mm dia.		G 12,7 mm	
		NFED	
		H 17,5 mm	
		NFFD	
		I 21,6 mm	

** See page 178
for information
on Control Options

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our most recent and complete
information on the full Corrosion
Resistant line of products.

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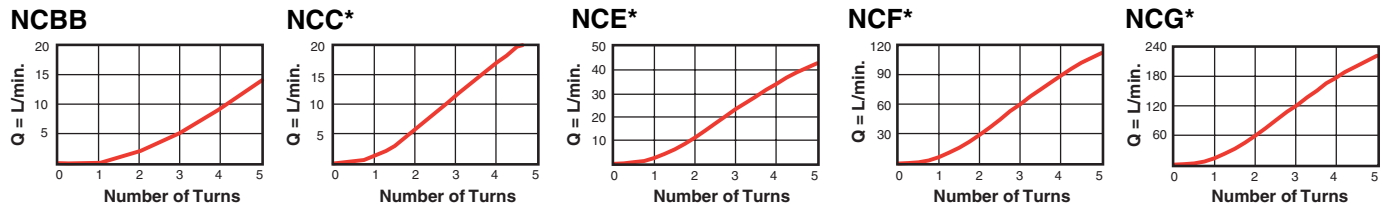
FULLY ADJUSTABLE NEEDLE WITH REVERSE FLOW CHECK, HIGH CAPACITY



Maximum Nominal Orifice	Typical Cartridge Model Code	Cavity	a	b	Cartridge Dimensions			Installation Torque (Nm)
					L	H	K	
4,0 mm dia.	NCBB – LCN	T - 162A	31,0	19,1	40,4	-	43,9	35 - 40
1,5 mm dia.	NCCD – LCN	T - 13A	35,0	22,2	57,7	63,2	63,5	45 - 50
4,8 mm dia.	NCCB – LCN	T - 13A	35,0	22,2	57,7	63,2	63,5	45 - 50
6,3 mm dia.	NCEB – LCN	T - 5A	41,4	28,6	59,7	71,6	69,3	60 - 70
9,7 mm dia.	NCFB – LCN	T - 16A	62,0	31,8	67,6	77,7	74,7	200 - 215
14,2 mm dia.	NCGB – LCN	T - 18A	79,5	41,3	84,1	88,9	88,1	465 - 500

Performance Curves

Adjustment Sensitivity at 7 bar Differential



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,4 cc/min.
- Because needle valves are non-compensating devices, the fixed orifice size will regulate flow through the valve in proportion to the square root of the pressure differential across ports 1 and 2.
- The sharp edged orifice design minimizes flow variations due to viscosity changes.

OPTION ORDERING INFORMATION

NC **		- * C *		Seal Material
Maximum Nominal Orifice	Version	Control**	Cracking Pressure Reverse Flow Check	
NCBB* 4,0 mm dia.	B High Capacity	L Standard Screw Adjustment	A* 0,3 bar	N Buna-N
NCCB 4,8 mm dia.	C Low Capacity	H Calibrated Handknob with Detent Lock	B* 1,0 bar	V Viton
NCCC 2,3 mm dia.	D Low Capacity	K Handknob with Lock Knob	C 2,0 bar	
NCCD 1,5 mm dia.			D* 3,5 bar	
NCEB 6,3 mm dia.			E* 5,0 bar	
NCEC 3,2 mm dia.				
NCFB 9,7 mm dia.				
NCFC 7,1 mm dia.				
NCGB 14,2 mm dia.				
NCGC 9,6 mm dia.				

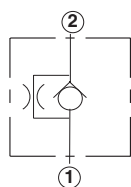
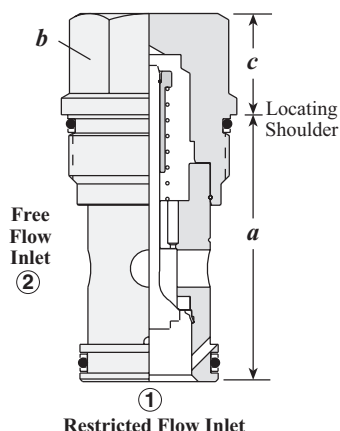
* Cracking Pressure Ranges A, B, D, and E are not available for NCBB, T-162A cavity.

** See page 178 for information on Control Options

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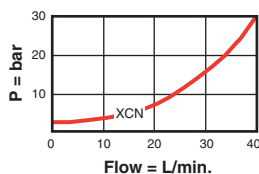
FIXED ORIFICE, NON-PRESSURE COMPENSATED, WITH REVERSE FLOW CHECK



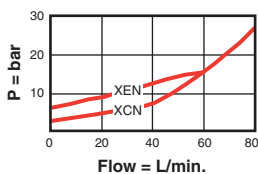
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
30 L/min.	CNAC – XCN	T - 162A	31,0	19,1	20,8	35 - 40
60 L/min.	CNCC – XCN	T - 13A	35,1	22,2	19,1	45 - 50
120 L/min.	CNEC – XCN	T - 5A	41,1	28,6	17,5	60 - 70
240 L/min.	CNGC – XCN	T - 16A	62,0	31,8	24,6	200 - 215
480 L/min.	CNIC – XCN	T - 18A	79,5	41,3	30,2	465 - 500

Performance Curves

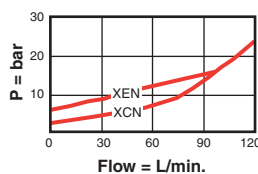
CNAC



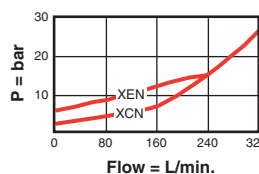
CNCC



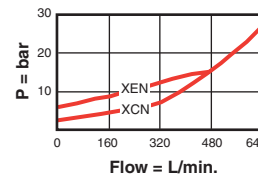
CNEC



CNGC



CNIC



- Maximum operating pressure = 350 bar.
- There are essentially check valves with bypass orifices. The flow path matches Sun's flow controls and can be used in any flow control manifolds. Valves with the opposite direction of flow can be found under check valves with bypass orifice.
- Because needle valves are non-compensating devices, the fixed orifice size will regulate flow through the valve in proportion to the square root of the pressure differential across ports 1 and 2.

OPTION ORDERING INFORMATION

CN * C - X * *			
Nominal Capacity	Control	Cracking Pressure	Seal Material
A 30 L/min.	X Not Adjustable	A* 0,3 bar	N Buna-N
C 60 L/min.		B* 1,0 bar	V Viton
E 120 L/min.		C* 2,0 bar	
G 240 L/min.		D* 3,5 bar	
I 480 L/min.		E* 5,0 bar	
		F* 7,0 bar	
		Z* 0,7 bar	

* Customer specified effective orifice diameter stamped on hex.

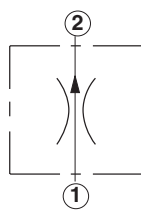
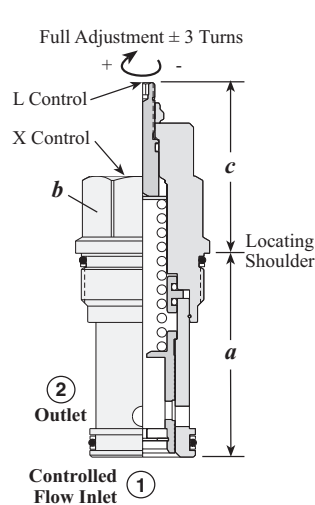
Orifice Ranges:

CNAC: 0,4 - 1,6 mm.
CNCC: 0,4 - 3,89 mm.
CNEC: 0,4 - 3,42 mm.
CNGC: 0,4 - 5,54 mm.
CNIC: 0,4 - 5,54 mm.

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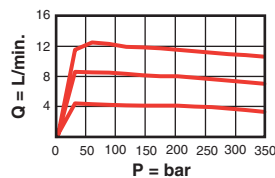
FIXED ORIFICE, PRESSURE COMPENSATED



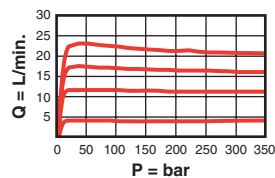
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					X	L	K	
11 L/min.	FXBA – XAN	T - 162A	31,0	19,1	20,8	53,6	64,8	35 - 40
23 L/min.	FXCA – XAN	T - 13A	35,1	22,2	19,1	50,8	57,2	45 - 50
45 L/min.	FXDA – XAN	T - 5A	41,1	28,6	17,5	53,8	60,5	60 - 70
95 L/min.	FXEA – XAN	T - 16A	62,0	31,8	24,6	62,0	68,3	200 - 215
200 L/min.	FXFA – XAN	T - 18A	79,5	41,3	30,2	71,4	77,7	465 - 500

Performance Curves

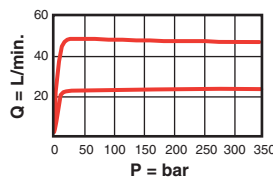
FXBA



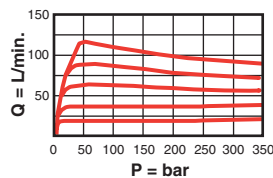
FXCA



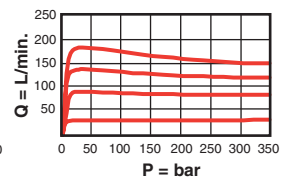
FXDA



FXEA



FXFA



Flow vs. Pressure Differential

- Maximum operating pressure = 350 bar.
- Customer must specify a flow setting. The factory set flow ratings for FXCA, FXDA, FXEA, FXFA, are within +/- 10% of the required setting. The factory set flow rating for FXBA is within +/- 15% of the required setting.
- Accurate pressure compensated control requires that a 14 bar minimum pressure differential be maintained across the valve.
- The tuneable control option provides +/- 25% variation from the nominal factory pre-set flow. Turn the adjustment clockwise to increase.
- The sharp edged orifice design minimizes flow variations due to viscosity changes.

OPTION ORDERING INFORMATION

FX * A – X A *			
Nominal Capacity	Control**	Setting Range	Seal Material
B 11 L/min.	X Not Adjustable	FXBA: A* Orifice Not Replaceable	N Buna-N
C 23 L/min.	L+ Tuning Adjustment ±25% of customer specified flow	FXCA, FXDA, FXEA, FXFA: A* Replaceable Orifice	V Viton
D 45 L/min.			
E 95 L/min.	K Handknob with Lock Knob		
F 200 L/min.			

+ Special setting is required.
Specify at time of order.

* Customer specified
flow setting stamped
on hex.

Flow Settings:

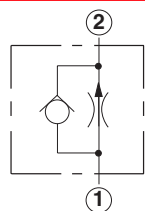
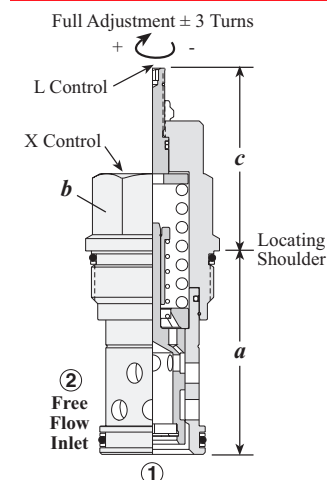
FXBA: 0,4 - 11 L/min.
FXCA: 0,4 - 23 L/min.
FXDA: 0,4 - 45 L/min.
FXEA: 0,8 - 95 L/min.
FXFA: 0,8 - 200 L/min.

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our most recent and complete
information on the full Corrosion
Resistant line of products.

** See page 178
for information
on Control Options

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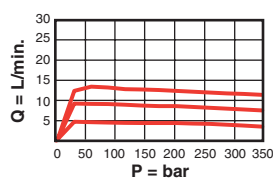
FIXED ORIFICE, PRESSURE COMPENSATED, WITH REVERSE FLOW CHECK



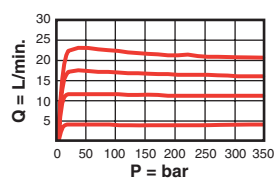
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	X	L	K	
11 L/min.	FCBB – XAN	T - 162A	31,0	19,1	20,8	53,6	58,0	35 - 40
23 L/min.	FCCB – XAN	T - 13A	35,1	22,2	19,1	50,8	57,2	45 - 50
45 L/min.	FCDB – XAN	T - 5A	41,1	28,6	17,5	53,8	60,5	60 - 70
95 L/min.	FCEB – XAN	T - 16A	62,0	31,8	24,6	62,0	68,3	200 - 215
200 L/min.	FCFB – XAN	T - 18A	79,5	41,3	30,2	71,4	77,7	465 - 500

Controlled Flow Inlet
Performance Curves

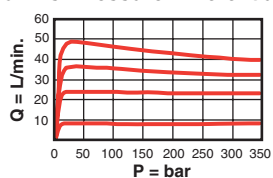
FCBB



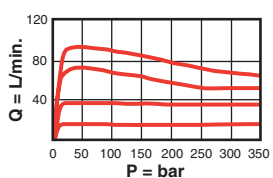
FCCB



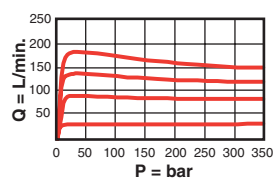
FCDB



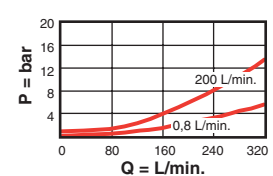
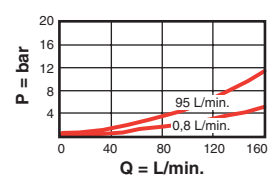
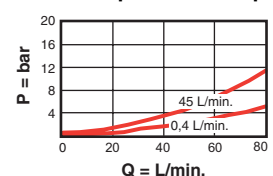
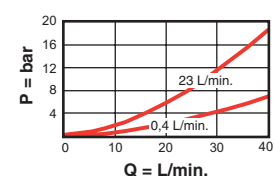
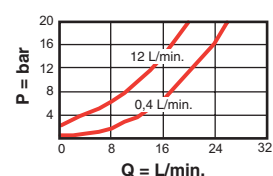
FCEB



FCFB



Reverse Free Flow Pressure Drop Based on Specified Flow Extremes



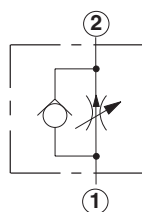
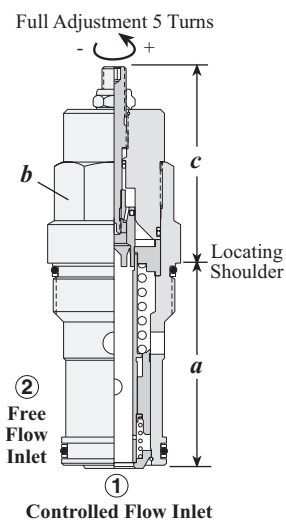
- Maximum operating pressure = 350 bar.
- Customer must specify a flow setting. The factory set flow ratings for FCCB, FCDB, FCEB, FCFB, are within +/- 10% of the required setting. The factory set flow rating for FCBB is within +/- 15% of the required setting.
- Accurate pressure compensated control requires that a 14 bar minimum pressure differential be maintained across the valve.
- The tuneable control option provides +/- 25% variation from the nominal factory pre-set flow. Turn the adjustment clockwise to increase.
- The sharp edged orifice design minimizes flow variations due to viscosity changes.

OPTION ORDERING INFORMATION

FC * B - * A *			
Nominal Capacity	Control**	Setting Range	Seal Material
B 11 L/min.	X Not Adjustable	FCBB: A* Orifice Not Replaceable	N Buna-N
C 23 L/min.	L+ Tuning Adjustment ±25% of customer specified flow	FCCB, FCDB, FCEB, FCFB: A* Replaceable Orifice	V Viton
D 45 L/min.	K Handknob with Lock Knob		
E 95 L/min.			
F 200 L/min.			
	+ Special setting is required. Specify at time of order.	* Customer specified flow setting stamped on hex.	
	** See page 178 for information on Control Options	Flow Settings: FCBB: 0,4 - 11 L/min. FCCB: 0,4 - 23 L/min. FCDB: 0,4 - 45 L/min. FCEB: 0,8 - 95 L/min. FCFB: 0,8 - 200 L/min.	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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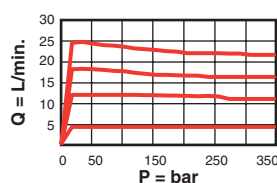
FULLY ADJUSTABLE, PRESSURE COMPENSATED, WITH REVERSE FLOW CHECK



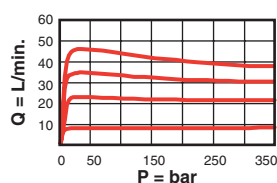
Nominal Flow Range	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	H	K	
23 L/min.	FDBA – LAN	T - 13A	35,1	22,2	57,7	62,0	58,7	45 - 50
45 L/min.	FDCB – LAN	T - 5A	41,1	28,6	59,7	71,6	69,3	60 - 70
95 L/min.	FDEA – LAN	T - 16A	62,0	31,8	67,6	77,7	73,9	200 - 215
200 L/min.	FDFA – LAN	T - 18A	79,5	41,3	84,1	88,9	88,1	465 - 500

Performance Curves

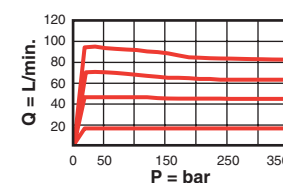
FDBA



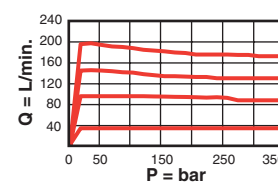
FDCB



FDEA



FDFA



Flow vs. Pressure Differential

- Maximum operating pressure = 350 bar.
- Accurate pressure compensated control requires that a 14 bar minimum pressure differential be maintained across the valve.
- A balanced adjustment mechanism allows for easy adjustment even at high pressures.
- The sharp edged orifice design minimizes flow variations due to viscosity changes.

OPTION ORDERING INFORMATION

FD ** - * A *			
Nominal Flow Range	Control**	Adjustment Range*	Seal Material
BA 23 L/min.	L Standard Screw Adjustment	FDBA	N Buna-N
CB 45 L/min.		A 0,4 - 23 L/min.	
EA 95 L/min.	H Calibrated Handknob with Detent Lock	B 0,4 - 8 L/min.	V Viton
FA 200 L/min.		FDCB	
	K Handknob with Lock Knob	A 0,4 - 45 L/min.	
		B 0,4 - 11 L/min.	
		FDEA	
		A 0,8 - 95 L/min.	
		B 0,8 - 60 L/min.	
		FDFA	
		A 0,8 - 200 L/min.	

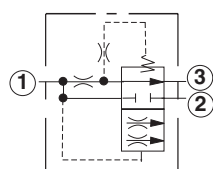
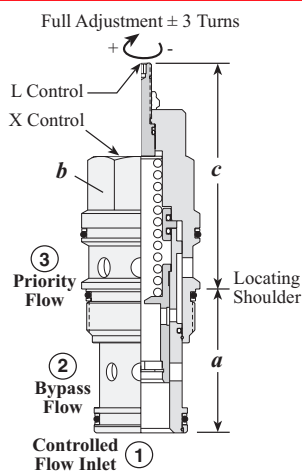
** See page 178 for information on Control Options

* Customer specified special setting stamped on hex.

U.S. Patent #4,630,640

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

FIXED ORIFICE, BYPASS / RESTRICTIVE, PRIORITY FLOW

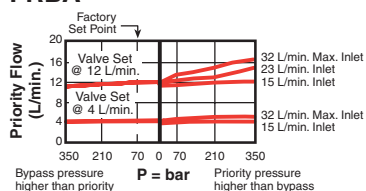


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					X	L	K	
11 L/min.	FRBA – XAN	T - 163A	31,0	19,1	32,0	64,8	70,4	35 - 40
23 L/min.	FRCA – XAN	T - 11A	35,1	22,2	30,2	63,5	69,9	45 - 50
45 L/min.	FRDA – XAN	T - 2A	35,1	28,6	35,1	71,4	77,7	60 - 70
95 L/min.	FREA – XAN	T - 17A	46,0	31,8	46,0	83,3	89,7	200 - 215
200 L/min.	FRFA – XAN	T - 19A	63,5	41,3	69,9	100,1	106,4	465 - 500

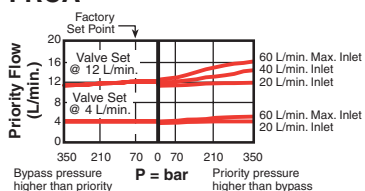
Performance Curves

Typical Performance

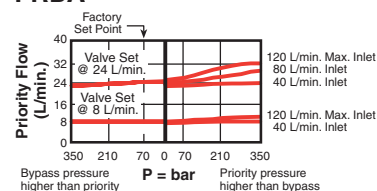
FRBA



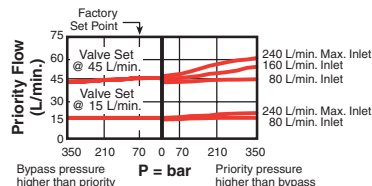
FRCA



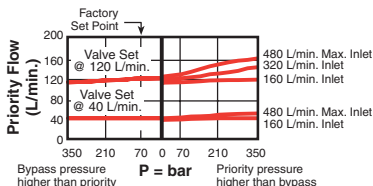
FRDA



FREA



FRFA



- Maximum operating pressure = 350 bar.
- Maximum input flow: FRBA: 30 L/min., FRCA: 60 L/min., FRDA: 120 L/min., FREA: 240 L/min., FRFA: 480 L/min.
- Customer must specify a flow rating. The factory set flow ratings for FRCA, FRDA, FREA, FRFA, are within +/- 10% of the requested setting. The factory set flow rating for FRBA is within +/- 15% of the requested setting.
- Priority remains relatively constant regardless of variation in input flow.

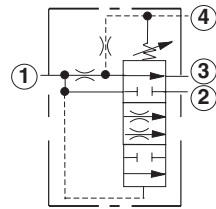
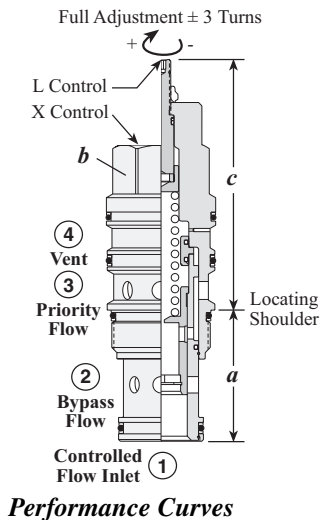
- Both priority and bypass flow are usable up to the system operating pressure.
- Bypass flow is not available until priority flow requirements are satisfied.
- Pressure at the bypass port (port 2) may exceed pressure at the priority port (port 3).

OPTION ORDERING INFORMATION

FR * A – * A *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
B 11 L/min.	X Not adjustable	FRBA: A* Orifice Not Replaceable	N Buna-N
C 23 L/min.	L+ Tuning Adjustment ±25% of customer specified flow	FRCA, FRDA, FREA, FRFA: A* Replaceable Orifice	V Viton
D 45 L/min.	K Handknob with Lock Knob		
E 95 L/min.	+ Special setting is required. Specify at time of order.	* Customer specified flow setting stamped on hex.	
F 200 L/min.		Flow Settings: FRBA: 0,4 - 11 L/min. FRCA: 0,4 - 23 L/min. FRDA: 0,4 - 45 L/min. FREA: 1 - 95 L/min. FRFA: 1 - 200 L/min.	Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.
** See page 178 for information on Control Options			

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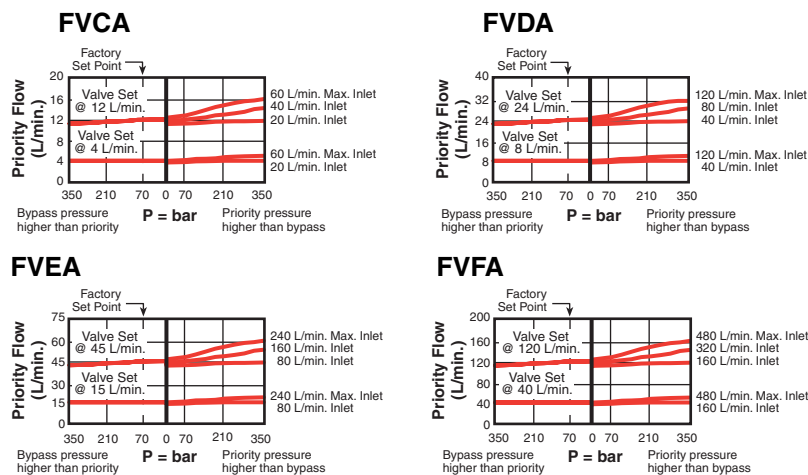
VENTABLE, FIXED ORIFICE, BYPASS / RESTRICTIVE, PRIORITY FLOW



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	X	L	K	
23 L/min.	FVCA – XAN	T - 21A	35,1	22,2	45,2	78,5	84,8	45 - 50
45 L/min.	FVDA – XAN	T - 22A	35,1	28,6	50,8	87,4	93,7	60 - 70
95 L/min.	FVEA – XAN	T - 23A	46,0	31,8	63,5	100,1	106,4	200 - 215
200 L/min.	FVFA – XAN	T - 24A	63,5	41,3	81,0	120,9	127,3	465 - 500

Performance Curves

Typical Performance



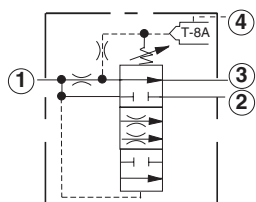
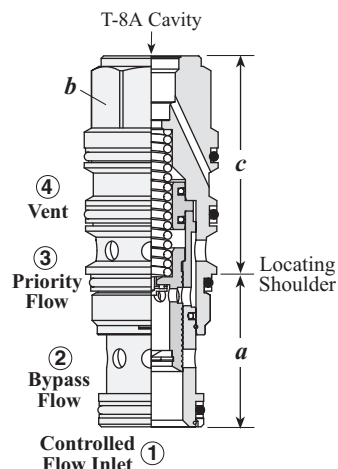
- Maximum operating pressure = 350 bar.
- Maximum input flow: FVCA: 60 L/min., FVDA: 120 L/min., FVEA: 240 L/min., FVFA: 480 L/min.
- Nominal vent flow = 0,75 L/min.
- Customer must specify a flow rating. Factory set flow ratings are within +/-10% of the requested setting.
- Pressure at the bypass port (port 2) may exceed pressure at the priority port (port 3).
- Priority remains relatively constant regardless of variation in input flow.
- A tuneable adjustment control option provides +/- 25% variation from the nominal factory pre-set flow. Adjustment is done with +/- 3 turns of the adjustment screw.

OPTION ORDERING INFORMATION

FV * A – X A *			
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 23 L/min.	X Not Adjustable	A* Replaceable Orifice	N Buna-N
D 45 L/min.	L+ Tuning Adjustment ±25% of customer specified flow		V Viton
E 95 L/min.	K Handknob with Lock Knob		
F 200 L/min.	+ Special setting is required. Specify at time of order.		
	** See page 178 for information on Control Options	* Customer specified flow setting stamped on hex.	
	Customer specified special setting stamped on hex.	Flow Settings: FVCA: 0,4 - 23 L/min. FVDA: 0,4 - 45 L/min. FVEA: 0,8 - 95 L/min. FVFA: 0,8 - 200 L/min.	

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VENTABLE, FIXED ORIFICE, BYPASS / RESTRICTIVE, PRIORITY FLOW, WITH INTEGRAL T-8A CONTROL CAVITY



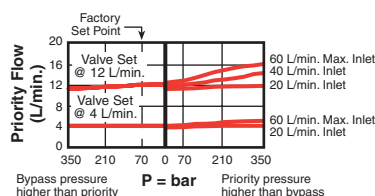
The -8 control option allows the pilot control valve to be incorporated directly into the end of the priority flow control cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
23 L/min.	FCVA - 8AN	T - 21A	34,8	22,2	45,2	45 - 50
45 L/min.	FVDA - 8AN	T - 22A	34,8	28,6	50,8	60 - 70
95 L/min.	FVEA - 8AN	T - 23A	45,9	31,8	65,7	200 - 215
200 L/min.	FVFA - 8AN	T - 24A	63,5	41,3	80,0	465 - 500

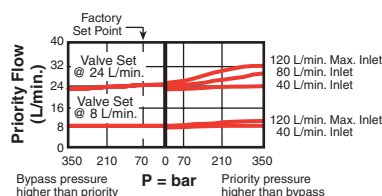
Performance Curves

Typical Performance

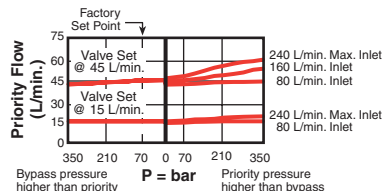
FCVA-8



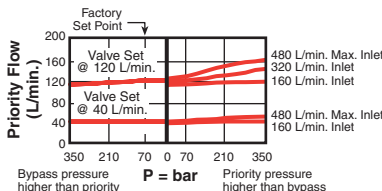
FVDA-8



FVEA-8



FVFA-8



- Maximum operating pressure = 350 bar.
- Maximum input flow: FCVA: 60 L/min., FVDA: 120 L/min., FVEA: 240 L/min., FVFA: 480 L/min.
- Nominal vent flow = 0,75 L/min.
- Customer must specify a flow rating. Factory set flow ratings are within +/-10% of the requested setting.
- Both priority and bypass flow are usable up to the system operating pressure.
- Priority remains relatively constant regardless of variation in input flow.
- Pressure at the bypass port (port 2) may exceed pressure at the priority port (port 3).

OPTION ORDERING INFORMATION

FV * A - 8 A *			
Nominal Capacity	Control	Setting Range	Seal Material
C 23 L/min.	8 T-8A cavity in hex body for pilot operation	A* Replaceable Orifice	N Buna-N
D 45 L/min.	Pilot valve to be ordered separately		V Viton
E 95 L/min.			
F 200 L/min.			

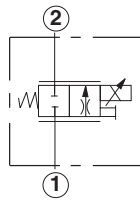
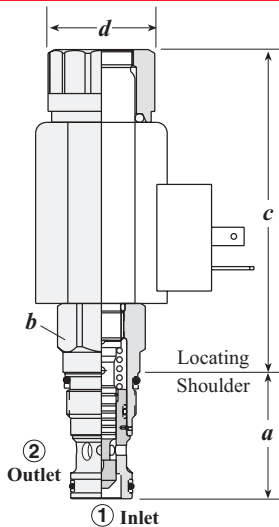
* Customer specified flow setting stamped on hex.

Flow Settings:

FCVA-8: 0,4 - 23 L/min.
FVDA-8: 0,4 - 45 L/min.
FVEA-8: 0,8 - 95 L/min.
FVFA-8: 1 - 200 L/min.

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NORMALLY CLOSED THROTTLE



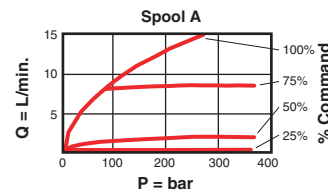
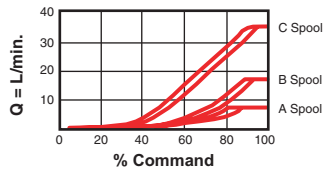
Maximum Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c***		d	
40 L/min.	FPCC – XCN	T - 13A	35,1	22,2	X,M	D,L,T	38,1	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

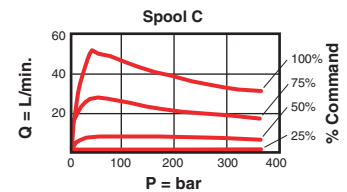
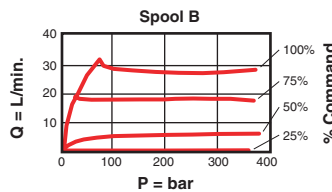
Performance Curves

FPCC

Flow vs. Command
at 14 bar Differential



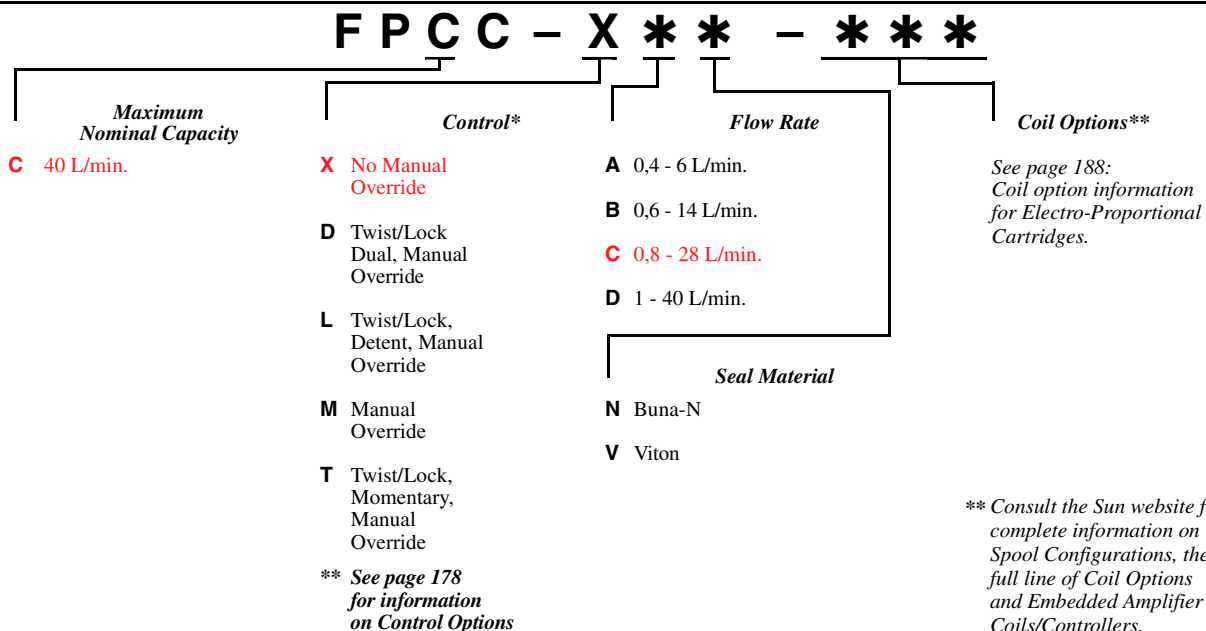
Flow vs. Pressure Differential



- Capable of operating with pressures up to 350 bar.
- Maximum valve leakage at 24 cSt = 100 cc/min. at 210 bar.
- Manual override force requirement = 10 kg at 350 bar.
- Manual override stroke = 2,5 mm.
- Hysteresis with dither = <4% and with DC input = <8%.
- Linearity with dither = <2% and repeatability with dither = <2%.
- Recommended dither frequency = 140 Hz.
- Deadband nominal (as percentage of input) = 25%.

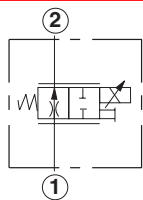
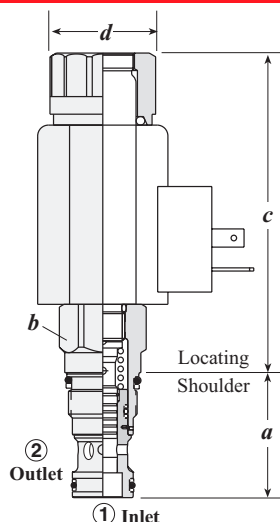
- For optimum performance, an amplifier with current sensing and adjustable dither should be used. Dither should be adjustable between 100-250 Hz.
- Available in either a normally open or normally closed configuration with three different capacity ranges.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION



Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

NORMALLY OPEN THROTTLE

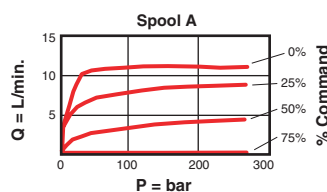
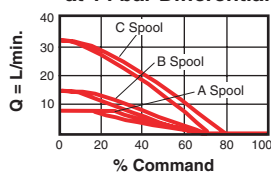


Maximum Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c***		d	
28 L/min.	FPCH - XCN	T - 13A	35,1	22,2	X,M	D,L,T	38,1	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

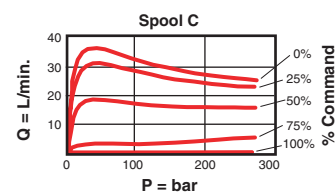
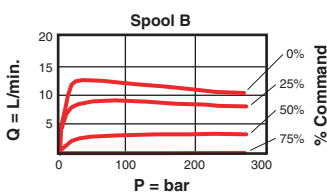
Performance Curves

Flow vs. Command at 14 bar Differential



FPCH

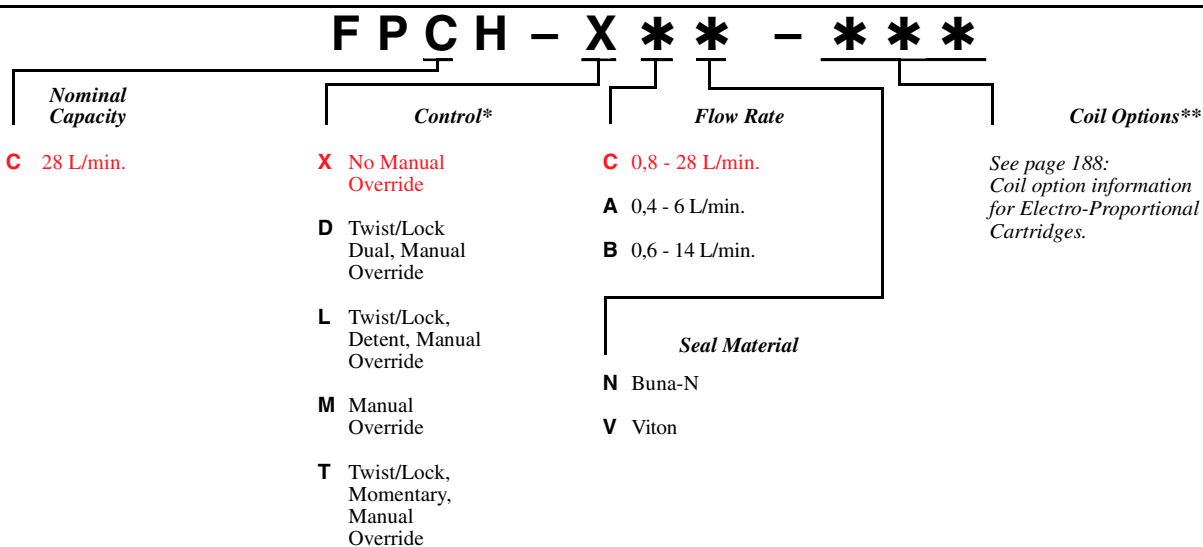
Flow vs. Pressure Differential



- Capable of operating with pressures up to 350 bar.
- Maximum valve leakage at 24 cSt = 100 cc/min. at 210 bar.
- Hysteresis with dither = <4% and with DC input = <8%.
- Linearity with dither = <2% and repeatability with dither = <2%.
- Recommended dither frequency = 140 Hz.
- Deadband nominal (as percentage of input) = 25%.
- Manual override force requirement = 10 kg at 350 bar.
- Manual override stroke = 2,5 mm.

- Available in either a normally open or normally closed configuration with three different capacity ranges.
- Low leakage levels in the closed position.
- For optimum performance, an amplifier with current sensing and adjustable dither should be used. Dither should be adjustable between 100-250 Hz.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION



** See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

A Sun Amplifier, Controlling a Sun Coil, Powering a Sun Valve:

Sun Hydraulics' Optimized Solution

Electro-Hydraulic Proportional Valves WITH ON-BOARD ELECTRONICS

Sun's proportional hydraulic cartridge valves:

- Available in a wide array of pilot, single-stage and two-stage versions.
- Affordable for mobile and industrial applications.
- Systems become more efficient and versatile.
- Circuits become less complicated hydraulically.
- System plumbing and wiring are simplified.

Proportional pilot valves incorporated as the pilot control option can mount directly into any of Sun's ventable and pilot operated cartridges which are configured to accept the pilot. This versatility allows proportional control of high pressures and high flows with the power consumption of a much smaller valve.

And Sun's electro-proportional valves with embedded electronics can be mounted close to actuators for improved performance, while minimizing system wiring and plumbing.

All Sun Proportional, Ramping and Power Saver Amplifiers offer improved efficiency, precise control, and enhanced reliability. Performance is optimized with Sun proportional valves — valve, coil, and amplifier are matched (serialized) for easy "plug and play". And, assemblies are ultrasonically welded and polyurethane potted for excellent environmental protection.



*See catalogue pages: 14 (RBAP), 15 (RBAN), 16 (RP*C-8), 17 (RP*S-8), 23 (RV*D-8), 31 (RS*C-8), 36 (PB*B-8), 43 (PRDL), 44 (PRDP), 45 (PP*B-8), 46 (PV*A-8), 90 (FPCC), and 91 (FPCH).*

View our full range of Electronic Products, Cartridges and Manifolds,
call your Sun Distributor or consult the Sun web site:

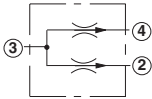
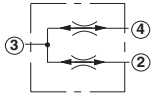
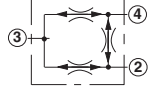
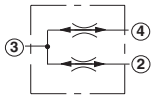
www.sunhydraulics.com

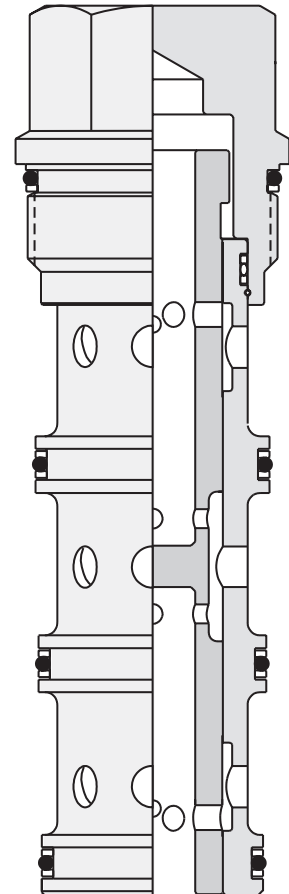
Products: Cartridges: Electro-Proportional: View All Electro-Proportional Cartridges.

Products: Cartridges: Coils or Coil Search.

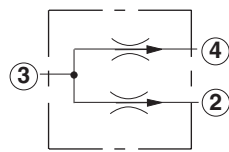
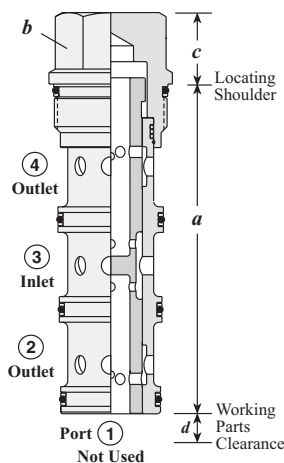
Standard and Embedded Coil Options are listed at the bottom of each cartridge web page.

Flow Divider / Combiner Cartridge Valves

	<i>Cartridge Type</i>	<i>Page</i>
	Divide Only	94
	Divider / Combiner, Closed Centre	95
	Synchronizing Divider / Combiner	96
	Divider / Combiner, Closed Centre, High Capacity	97



DIVIDE ONLY



Capacity Min/Max	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
6-30 L/min.	FSCD – XAN	T - 31A	85,1	22,2	19,1	3,6	45 - 50
12-60 L/min.	FSDD – XAN	T - 32A	92,2	28,6	17,1	3,8	60 - 70
23-115 L/min.	FSED – XAN	T - 33A	114,3	31,8	24,6	5,3	200 - 215
45-230 L/min.	FSFD – XAN	T - 34A	139,7	41,3	30,2	6,9	465 - 500

Operating Characteristics

Split	Divisional Accuracy			Maximum Possible Flow Variation	
	Input Flow L/min.		Rated Accuracy	High Flow Leg L/min.	Low Flow Leg L/min.
FSCD					
50:50	Max. Rated	30	+/-3.5%	14,0-16,0	—
	Min. Rated	6	+/-6.5%	2,6-3,4	—
40:60	Max. Rated	26,5	+/-3.5%	15,0-16,8	9,7-11,6
	Min. Rated	5,3	+/-6.5%	2,8-3,5	1,8-2,5
33:67	Max. Rated	22,7	+/-3.5%	14,4-16	6,7-8,3
	Min. Rated	4,5	+/-6.5%	2,7-3,3	1,2-1,8
FSDD					
50:50	Max. Rated	60	+/-3.5%	28-32	—
	Min. Rated	12	+/-6.5%	5,2-6,7	—
40:60	Max. Rated	47	+/-3.5%	26,6-29,8	17,2-20-4
	Min. Rated	9,4	+/-6.5%	5,0-6,2	3,2-4,4
33:67	Max. Rated	42	+/-3.5%	26,5-29,5	12,5-15,5
	Min. Rated	8,4	+/-6.5%	5,1-6,2	2,2-3,3

Split	Divisional Accuracy			Maximum Possible Flow Variation	
	Input Flow L/min.		Rated Accuracy	High Flow Leg L/min.	Low Flow Leg L/min.
FSED					
50:50	Max. Rated	115	+/-3.5%	53,5-61,5	—
	Min. Rated	23	+/-6.5%	10-13	—
40:60	Max. Rated	95	+/-3.5%	54-60	35-41
	Min. Rated	19	+/-6.5%	10,2-12,6	6,4-8,8
33:67	Max. Rated	85	+/-3.5%	54-60	25-31
	Min. Rated	17	+/-6.5%	10,3-12,5	4,5-6,7
FSFD					
50:50	Max. Rated	230	+/-3.5%	10-123	—
	Min. Rated	45	+/-6.5%	19,6-25,4	—
40:60	Max. Rated	200	+/-3.5%	113-127	73-87
	Min. Rated	38	+/-6.5%	20,3-25,3	12,7-17,7
33:67	Max. Rated	180	+/-3.5%	114-126	54-66
	Min. Rated	36	+/-6.5%	22-26	10-14

The maximum variation is at 350 bar differential between legs with the high pressure leg being the higher flow.

- Maximum operating pressure = 350 bar.
- Pressure drop at maximum input flow = 18 bar; at minimum input flow = 0,7 bar.
- This valve is a divider; any attempt to flow backwards through the valve is not advised.

OPTION ORDERING INFORMATION

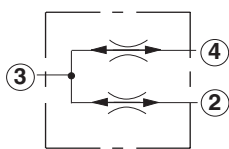
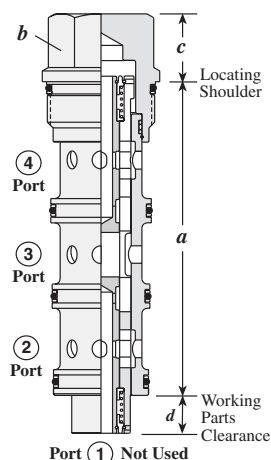
FS * D - X * *			
Nominal Capacity	Control	Flow Split	Seal Material
C 6-30 L/min.	X Not Adjustable	A 50/50	N Buna-N
D 12-60 L/min.		B 40/60	V Viton
E 23-115 L/min.		C 33/67	
F 45-230 L/min.			

* Port 4 is always high percentage flow.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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DIVIDER / COMBINER, CLOSED CENTRE



Note: Closed centre valves have spring centred internal spools that provide blocked flow paths when centred. Centring occurs when the Port 3 flow is also blocked. This internal blocking isolates Port 2 and 4 from cross flow.

Capacity Min/Max	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
6-30 L/min.	FSCA – XAN	T - 31A	85,1	22,2	19,1	16,5	45 - 50
12-60 L/min.	FSDA – XAN	T - 32A	92,2	28,6	17,5	19,6	60 - 70
23-115 L/min.	FSEA – XAN	T - 33A	114,3	31,8	24,6	25,1	200 - 215
45-230 L/min.	FSFA – XAN	T - 34A	139,7	41,3	30,2	23,1	465 - 500

Operating Characteristics

Split	Divisional Accuracy			Maximum Possible Flow Variation L/min.
	Input Flow L/min.	Rated Accuracy		
FSCA				
50:50	Max. Rated	30	+/-2.5%	14,3-15,8
	Min. Rated	6	+/-4.5%	2,73-3,27
FSDA				
50:50	Max. Rated	60	+/-2.5%	28,5-31,5
	Min. Rated	12	+/-4.5%	5,5-6,5

Split	Divisional Accuracy			Maximum Possible Flow Variation L/min.
	Input Flow L/min.	Rated Accuracy		
FSEA				
50:50	Max. Rated	115	+/-2.5%	54,6-60,4
	Min. Rated	23	+/-4.5%	10,5-12,5
FSFA				
50:50	Max. Rated	230	+/-2.5%	109-120
	Min. Rated	45	+/-4.5%	21-25

The maximum variation is at 350 bar differential between legs with the high pressure leg being the higher flow in dividing mode and the lower flow in combining mode.

- Maximum operating pressure = 350 bar.
- Pressure drop at maximum input flow = 24 bar; at minimum input flow = 1 bar.
- Operating characteristics cause the leg of the circuit with the greatest load to receive the higher percentage of the flow in dividing mode. If a rigid mechanism is used to tie actuators together, the lead actuator may pull the lagging actuator and cause it to cavitate.
- In combining mode, compensating characteristics will cause the leg of the circuit with the lowest load to receive the higher percentage of flow. If a synchronization feature is not included, an additive accuracy error will be experienced with each full stroke of the actuator.

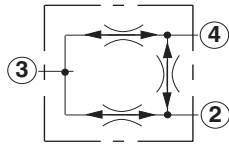
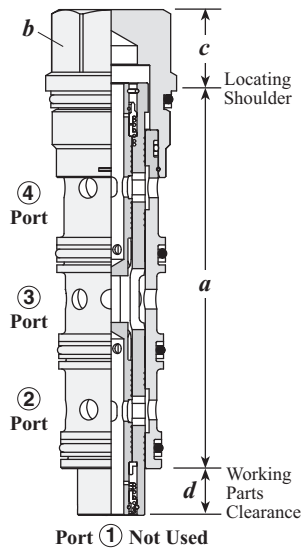
OPTION ORDERING INFORMATION

FS * A – X A *			
Nominal Capacity	Control	Flow Split	Seal Material
C 6-30 L/min.	X Not Adjustable	A 50/50	N Buna-N
D 12-60 L/min.			V Viton
E 23-115 L/min.			
F 45-230 L/min.			

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SYNCHRONIZING DIVIDER / COMBINER



Capacity Min/Max	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
6-30 L/min.	FSCS – XAN	T - 31A	85,1	22,2	19,0	16,5	45 - 50
12-60 L/min.	FSDS – XAN	T - 32A	92,2	28,6	17,5	19,6	60 - 70
23-115 L/min.	FSES – XAN	T - 33A	114,3	31,8	24,6	25,1	200 - 215
45-230 L/min.	FSFS – XAN	T - 34A	139,7	41,3	30,2	23,1	465 - 500

Operating Characteristics

Split	Divisional Accuracy			Maximum Possible Flow Variation L/min.	
	Input Flow L/min.	Rated Accuracy			
FSCS					
50:50	Max. Rated	30	+/-2.5%		14,3-15,8
	Min. Rated	6	+/-4.5%		2,73-3,27
		Synchronizing Flow:			0,94-2,46
FSDS					
50:50	Max. Rated	60	+/-2.5%		28,5-31,5
	Min. Rated	12	+/-4.5%		5,5-6,5
		Synchronizing Flow:			1,1-2,8

Split	Divisional Accuracy			Maximum Possible Flow Variation L/min.
	Input Flow L/min.	Rated Accuracy		
FSES				
50:50	Max. Rated	115	+/-2.5%	54,6-60,4
	Min. Rated	23	+/-4.5%	10,5-12,5
		Synchronizing Flow:		3,4-6,6
FSFS				
50:50	Max. Rated	230	+/-2.5%	109-120
	Min. Rated	45	+/-4.5%	21-25
		Synchronizing Flow:		6,6-13,2

The maximum possible variation is at 350 bar differential between legs with the high pressure leg being the higher flow in dividing mode and the lower flow in combining mode.

- Maximum operating pressure = 350 bar.
- Pressure drop at maximum input flow = 24 bar; at minimum input flow = 1 bar.
- Operating characteristics cause the leg of the circuit with the greatest load to receive the higher percentage of the flow in dividing mode. If a rigid mechanism is used to tie actuators together, the lead actuator may pull the lagging actuator and cause it to cavitate.
- In combining mode, compensating characteristics will cause the leg of the circuit with the lowest load to receive the higher percentage of flow. If a synchronization feature is not included, an additive accuracy error will be experienced with each full stroke of the actuator.

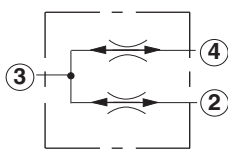
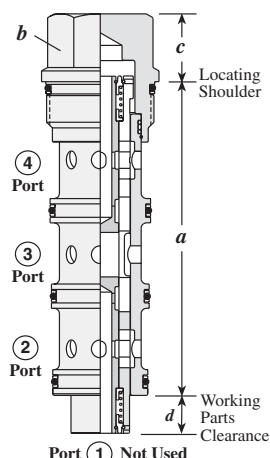
OPTION ORDERING INFORMATION

FS * S - X A *			
Nominal Capacity	Control	Flow Split	Seal Material
C 6-30 L/min.	X Not Adjustable	A 50/50	N Buna-N
D 12-60 L/min.			V Viton
E 23-115 L/min.			
F 45-230 L/min.			

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DIVIDER / COMBINER, CLOSED CENTRE, HIGH CAPACITY



Note: Closed centre valves have spring centred internal spools that provide blocked flow paths when centered. Centring occurs when the Port 3 flow is also blocked. This internal blocking isolates Port 2 and 4 from cross flow. These **high capacity** valves have approximate 30% greater capacity than standard closed-centre divider/combiners and are designed for use in tractive drive systems. Note: Accuracy on these cartridges is not equivalent to the accuracy of standard closed-centre divider/combiners.

Capacity Min/Max	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
8-38 L/min.	FSCH – XAN	T - 31A	85,1	22,2	19,1	16,5	45 - 50
15-75 L/min.	FSDH – XAN	T - 32A	92,2	28,6	17,5	19,6	60 - 70
30-150 L/min.	FSEH – XAN	T - 33A	114,4	31,8	24,6	25,1	200 - 215
60-300 L/min.	FSFH – XAN	T - 34A	139,7	41,3	30,2	23,1	465 - 500

Operating Characteristics

Split	Divisional Accuracy			Maximum Possible Flow Variation L/min.
	Input Flow L/min.	Rated Accuracy		
FSCH				
50:50	Max. Rated	38	+/-3.5%	17,7-20,3
	Min. Rated	8	+/-6.5%	3,5-4,5
FSDH				
50:50	Max. Rated	75	+/-3.5%	35-40
	Min. Rated	15	+/-6.5%	6,5-8,5

Split	Divisional Accuracy			Maximum Possible Flow Variation L/min.
	Input Flow L/min.	Rated Accuracy		
FSEH				
50:50	Max. Rated	150	+/-3.5%	70-80
	Min. Rated	30	+/-6.5%	13-17
FSFH				
50:50	Max. Rated	300	+/-3.5%	139-160
	Min. Rated	60	+/-6.5%	26-34

The maximum possible variation is at 350 bar differential between legs with the high pressure leg being the higher flow in dividing mode and the lower flow in combining mode.

- Maximum operating pressure = 350 bar.
- Pressure drop at maximum input flow = 24 bar; at minimum input flow = 1 bar.
- Operating characteristics cause the leg of the circuit with the greatest load to receive the higher percentage of the flow in dividing mode. If a rigid mechanism is used to tie actuators together, the lead actuator may pull the lagging actuator and cause it to cavitate.
- In combining mode, compensating characteristics will cause the leg of the circuit with the lowest load to receive the higher percentage of flow. If a synchronization feature is not included, an additive accuracy error will be experienced with each full stroke of the actuator.

OPTION ORDERING INFORMATION

FS * H – X A *			
Nominal Capacity	Control	Flow Split	Seal Material
C 8-38 L/min.	X Not Adjustable	A 50/50	N Buna-N
D 15-75 L/min.			V Viton
E 30-150 L/min.			
F 60-300 L/min.			

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CARTRIDGE FILTERS

*Sun Filter Cartridges are pressure rated
the same as all other Sun Cartridges*

Surface Type (Last Chance) Elements

Surface type (Last Chance) elements are 40 µm nominal range with single layer stainless steel mesh supported by a perforated sheet tube. Crush pressure is greater than 350 bar. The flow path is port 2 to port 1 only. Do not use in reverse flow mode even with a reverse free flow check valve installed. The stainless steel mesh is not externally supported and will fail through fatigue. The four sizes are rated for 38, 76, 151, and 303 L/min. with a maximum differential pressure of 2.4 bar in the clean state.

Surface type elements are designed to capture errant particles that may not be trapped in the main system filter or particles resulting from a component failure. The 40 µm surface type element will not provide system filtration but is a “last chance” element. With a correctly assembled system, these elements will be unnoticed during regular operation but will provide protection from sudden component failure. Installation directly above the subplate will protect the entire valve stack from particles.

Depth Style Elements

Depth type elements are available in 3µm, 10µm, and 25µm nominal ranges. The crush pressure is 350 bar and the flow path is port 2 to port 1 only. Do not use in reverse flow mode. Due to their physical size and the requirement for a pleated filtration material, the elements are only available in Series 3 and Series 4 sizes. The flow capacities for cartridges limit their use to flows of 30 and 90 L/min. respectively at 7 bar. They are offered as a means to install a system filter in small manifold packages using your available Sun cavity tooling. These elements provide contamination holding capability that the “last chance” 40µm elements do not. For small manifold packages with expensive proportional or servo valves installed, very fine filtration in an extremely small space is available. Filter life will depend on initial system cleanliness and the amount of dirt ingress to the system when operating.

FILTER CARTRIDGES

Sun filter cartridges are pressure rated the same as all other Sun cartridges.

Model Code	Series	Micron Rating	Nominal Flow Rating (L/min.)	Cavity	Filter Type
FLDA-XD*	1	40	10/40	T-13A	Surface
FLFA-XD*	2	40	20/80	T-5A	Surface
FLHA-XA*	3	3	8/32	T-16A	Depth
FLHA-XB*	3	10	8/32	T-16A	Depth
FLHA-XC*	3	25	8/32	T-16A	Depth
FLHA-XD*	3	40	40/160	T-16A	Surface
FLJA-XA*	4	3	24/95	T-18A	Depth
FLJA-XB*	4	10	24/95	T-18A	Depth
FLJA-XC*	4	25	24/95	T-18A	Depth
FLJA-XD*	4	40	80/320	T-18A	Surface

View our full range of filter cartridges and manifold products on the Sun website:

www.sunhydraulics.com

Products: Cartridges: Circuit Savers

or click Search on home page and key in filter model code shown above.

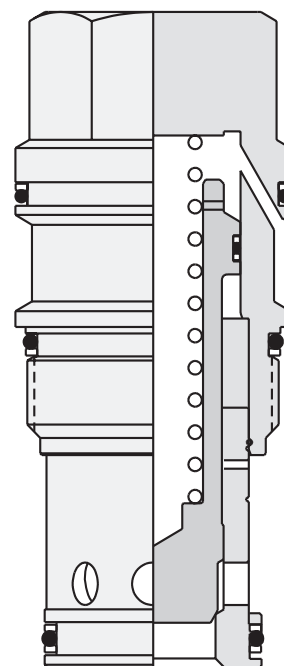
or Products: Literature: Literature Download: View Cartridge Filters Booklet



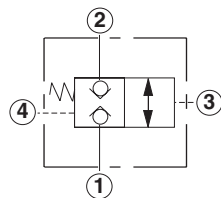
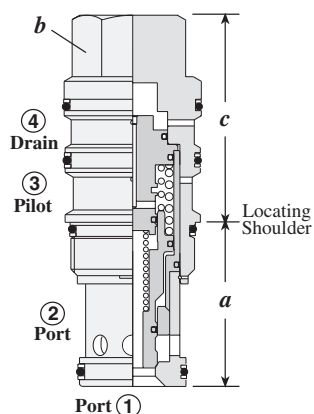
Logic Elements

Cartridge Type

	Page		Page
	100		109
	101		110
	102		111
	103		112
	104		113
	105		114
	106		115
	107		116
	108		



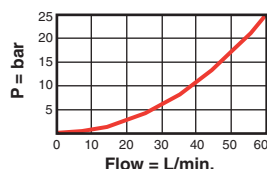
BALANCED POPPET, NORMALLY CLOSED, DIRECT OPERATED, PILOT-TO-OPEN



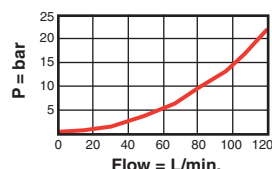
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DKDS – XHN	T - 21A	35,0	22,2	45,2	45 - 50
120 L/min.	DKFS – XHN	T - 22A	35,0	28,6	50,8	60 - 70
240 L/min.	DKHS – XHN	T - 23A	46,2	31,8	62,7	200 - 215
480 L/min.	DKJS – XHN	T - 24A	63,5	41,3	80,3	465 - 500

Performance Curves

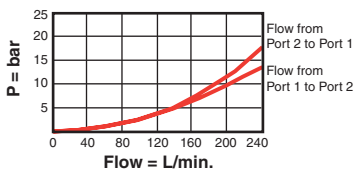
DKDS



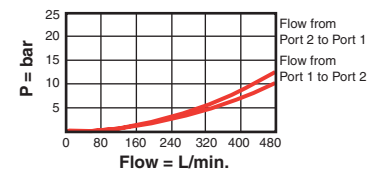
DKFS



DKHS



DKJS



Piloted Open Pressure Differential vs. Flow

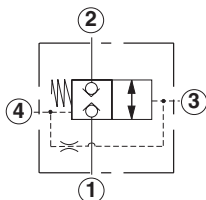
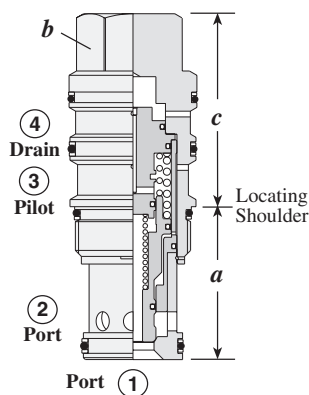
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DKDS, DKFS: 28 bar; DKHS, DKJS: 20 bar.
- Pilot passage into valve = DKDS, DKFS: 0,8 mm; DKHS, DKJS: 1,19 mm.
- Pilot volume displacement = DKDS: 0,16 cc; DKFS: 0,33 cc; DKHS: 0,82 cc; DKJS: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at both ports 1 and 2, with the external drain open and minimum pilot pressure at port 3.
- These valves are hydraulically balanced between port 1 and port 2.
- Port 1 and port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Valve will reseal when the pilot pressure falls below 10 bar.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.
- Any back pressure at the drain port is directly additive to the required pilot pressure for reliable operation.

OPTION ORDERING INFORMATION

DK * S – X H *			
Nominal Capacity	Control	Minimum Pilot Pressure	Seal Material
D 60 L/min.	X Standard Pilot	DKDS, DKFS only: 28 bar	N Buna-N
F 120 L/min.		DKHS, DKJS: 20 bar	V Viton
H 240 L/min.			
J 480 L/min.			

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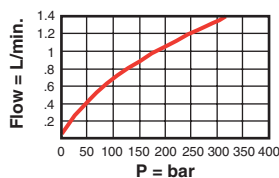
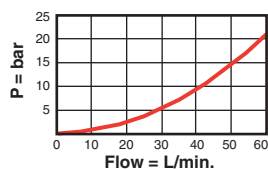
BALANCED POPPET, NORMALLY CLOSED, VENT-TO-OPERATE



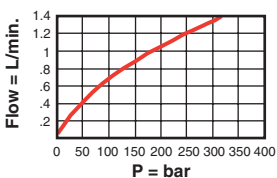
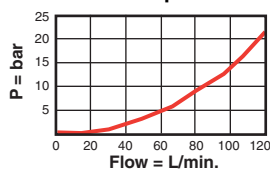
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DKDR – XHN	T - 21A	35,0	22,2	45,2	45 - 50
120 L/min.	DKFR – XHN	T - 22A	35,0	28,6	50,8	60 - 70
240 L/min.	DKHR – XHN	T - 23A	46,2	31,8	62,7	200 - 215
480 L/min.	DKJR – XHN	T - 24A	63,5	41,3	80,3	465 - 500

Performance Curves

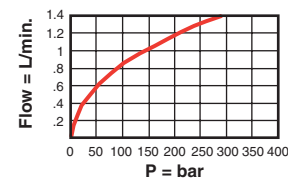
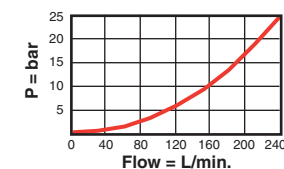
DKDR



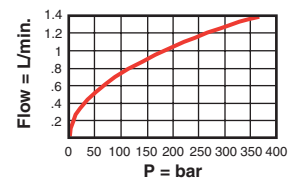
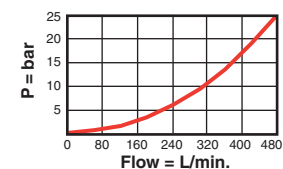
DKFR



DKHR



DKJR



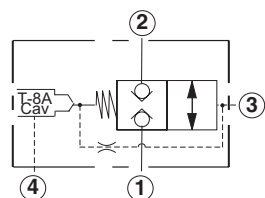
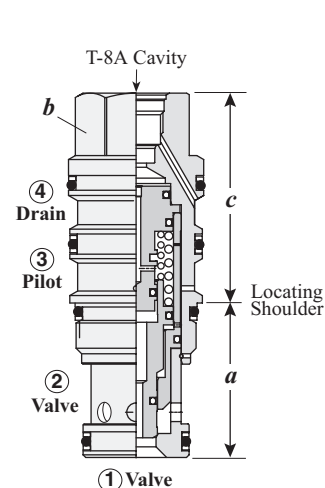
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DKDR, DKFR: 28 bar; DKHR, DKJR: 20 bar.
- Pilot passage into valve = DKDR, DKFR: 0,8 mm; DKHR, DKJR: 1,19 mm.
- Pilot volume displacement = DKDR: 0,16 cc; DKFR: 0,33 cc; DKHR: 0,82 cc; DKJR: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at both ports 1 and 2, with the vent (port 4) open and minimum pilot pressure at port 3.
- These valves are hydraulically balanced between port 1 and port 2.
- Valve will reseal when the pilot pressure falls below 10 bar.
- Port 1 and Port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Port 4 may be externally connected to a pilot switching valve. The pilot valve should have a leakage rate of less than 10 drops/min. and be able to satisfy the pilot flow requirements. Sun model DA*-*** solenoid pilot valve is ideal for this application.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.

OPTION ORDERING INFORMATION

DK * R - X * *			
Nominal Capacity	Control	Minimum Pilot Pressure	Seal Material
D 60 L/min.	X Vent-to-operate	DKDR, DKFR only:	N Buna-N
F 120 L/min.		H 28 bar	V Viton
H 240 L/min.		DKHR, DKJR:	
J 480 L/min.		20 bar	

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BALANCED POPPET, NORMALLY CLOSED, VENT-TO-OPERATE, WITH INTEGRAL T-8A CONTROL CAVITY



The -8 control option allows a pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DKDR - 8HN	T - 21A	35,0	22,2	45,2	45 - 50
120 L/min.	DKFR - 8HN	T - 22A	35,0	28,6	50,8	60 - 70
240 L/min.	DKHR - 8HN	T - 23A	46,2	31,8	62,7	200 - 215
480 L/min.	DKJR - 8HN	T - 24A	63,5	41,3	80,3	465 - 500

Performance Curves

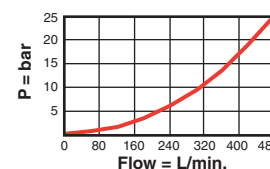
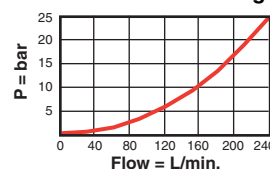
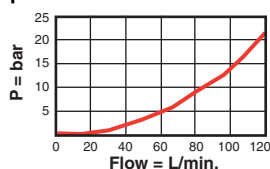
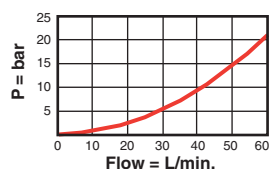
DKDR-8

DKFR-8

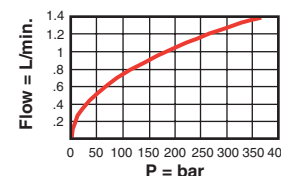
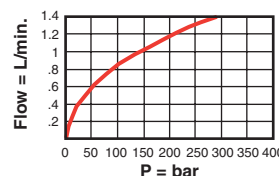
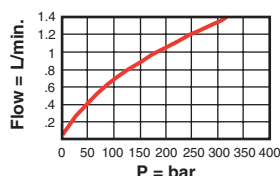
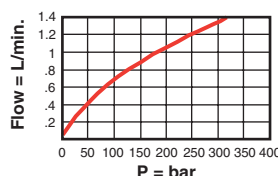
DKHR-8

DKJR-8

Piloted Open Pressure Differential vs. Flow with T-8A Pilot Stage Installed



Pilot Pressure vs. Pilot Flow



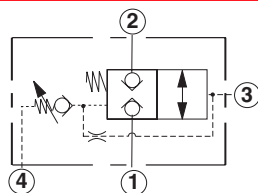
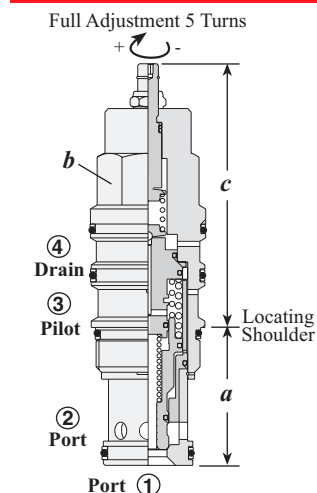
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DKDR-8, DKFR-8: 28 bar; DKHR-8, DKJR-8: 20 bar.
- Pilot passage into valve = DKDR-8, DKFR-8: 0,8 mm; DKHR-8, DKJR-8: 1,19 mm.
- Pilot volume displacement = DKDR-8: 0,16 cc; DKFR-8: 0,33 cc; DKHR-8: 0,82 cc; DKJR-8: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at port 1 and port 2. Switching will only occur when both minimum pilot pressure at port 3 is present and pilot control is open.
- The valves are hydraulically balanced between port 1 and port 2.
- Port 1 and port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.
- Valve will reseal when the pilot pressure falls below 10 bar.
- Any back pressure at the drain port is directly additive to the required pilot pressure for reliable operation.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value of 35-40 Nm.

OPTION ORDERING INFORMATION

DK * R - 8 H *			
Nominal Capacity	Control	Minimum Pilot Pressure	Seal Material
D 60 L/min.	8 with T-8A cavity in hex body for pilot operation	DKDR-8, DKFR-8: only: 28 bar	N Buna-N
F 120 L/min.		DKHR-8, DKJR-8: 20 bar	V Viton
H 240 L/min.	See pilot control section for alternate options		
J 480 L/min.			

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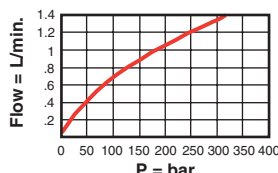
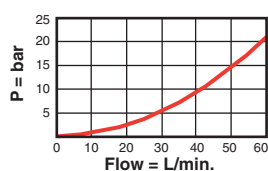
BALANCED POPPET, NORMALLY CLOSED, PRESSURE ADJUSTABLE



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
60 L/min.	DKDP – LAN	T - 21A	35,0	22,2	79,0	82,6	84,8	45 - 50
120 L/min.	DKFP – LAN	T - 22A	35,0	28,6	87,4	89,0	94,0	60 - 70
240 L/min.	DKHP – LAN	T - 23A	46,2	31,8	100,1	101,1	105,9	200 - 215
480 L/min.	DKJP – LAN	T - 24A	63,5	41,3	121,5	125,0	128,0	465 - 500

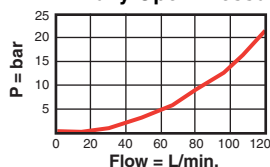
Performance Curves

DKDP

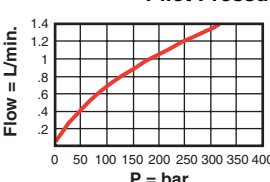


DKFP

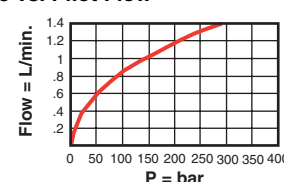
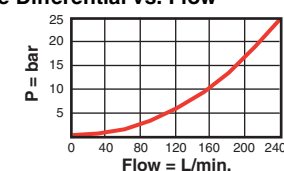
Fully Open Pressure Differential vs. Flow



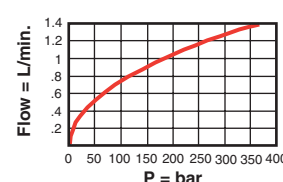
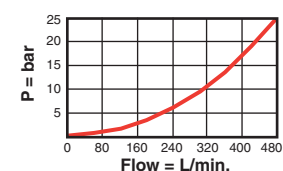
Pilot Pressure vs. Pilot Flow



DKHP



DKJP



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DKDP, DKFP: 28 bar; DKHP, DKJP: 20 bar.
- Pilot passage into valve = DKDP, DKFP: 0,8 mm; DKHP, DKJP: 1,19 mm.
- Pilot volume displacement = DKDP: 0,16 cc; DKFP: 0,33 cc; DKHP: 0,82 cc; DKJP: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at both port 1 and port 2. When the remote pressure signal at port 3 exceeds the internal valve setting, the valve shifts to the open position.
- Port 1 and port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.
- Any back pressure at the drain port is directly additive to the valve setting.
- Valve will reseal when the pilot pressure falls to 85% of the cracking value.

OPTION ORDERING INFORMATION

DK * P – * * *

Nominal Capacity	Control**	Adjustment Range	Seal Material
D 60 L/min.	L Standard Screw Adjustment	DKDP, DKFP only:	N Buna-N
F 120 L/min.	C* Tamper Resistant Factory Set	A 28 - 210 bar	V Viton
H 240 L/min.	K Handknob with Lock Knob	Standard set at 70 bar	
J 480 L/min.		B 28 - 105 bar	
		Standard set at 70 bar	
		W 28 - 315 bar	
		Standard set at 70 bar	
		DKHP, DKJP:	
		A 20 - 210 bar	
		Standard set at 70 bar	
		B 20 - 105 bar	
		Standard set at 70 bar	
		W 20 - 315 bar	
		Standard set at 70 bar	

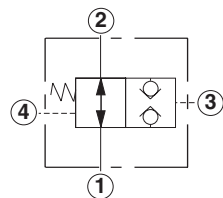
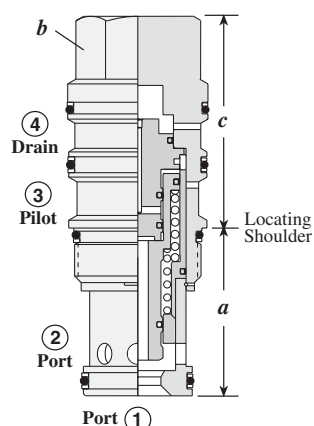
* Special setting required. Specify at time of order.

** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

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BALANCED POPPET, NORMALLY OPEN, PILOT-TO-CLOSE



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DODS – XHN	T - 21A	35,0	22,2	45,2	45 - 50
120 L/min.	DOFS – XHN	T - 22A	35,0	28,6	50,8	60 - 70
240 L/min.	DOHS – XHN	T - 23A	46,2	31,8	62,7	200 - 215
480 L/min.	DOJS – XHN	T - 24A	63,5	41,3	80,3	465 - 500

Performance Curves

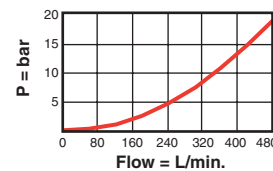
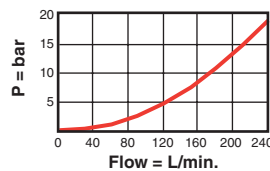
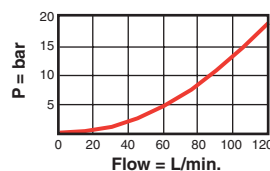
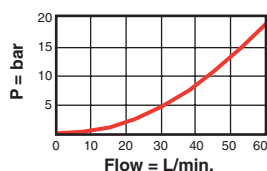
DODS

DOFS

DOHS

DOJS

Fully Open Pressure Differential vs. Flow



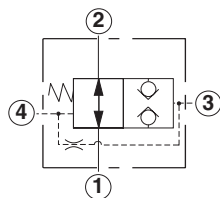
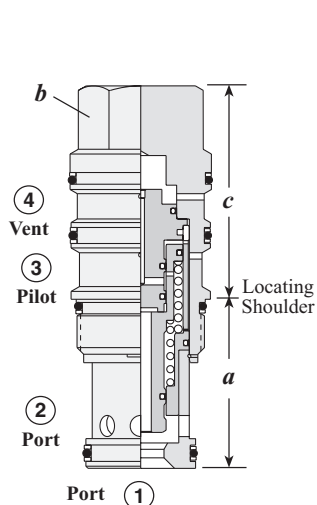
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DODS, DOFS: 28 bar; DOHS, DOJS: 20 bar.
- Pilot passage into valve = DODS, DOFS: 0,8 mm; DOHS, DOJS: 1,19 mm.
- Pilot volume displacement = DODS: 0,16 cc; DOFS: 0,33 cc; DOHS: 0,82 cc; DOJS: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at both ports 1 and 2, with the external drain open and minimum pilot pressure at port 3.
- These valves are hydraulically balanced between port 1 and port 2.
- Port 1 and Port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Valve will open when the pilot pressure falls below 10 bar.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.
- Any back pressure at the drain port is directly additive to the required pilot pressure for reliable operation.

OPTION ORDERING INFORMATION

DO * S - X H *			
Nominal Capacity	Control	Minimum Pilot Pressure	Seal Material
D 60 L/min.	X Standard Pilot	DODS, DOFS only: H 28 bar	N Buna-N
F 120 L/min.		DOHS, DOJS only: H 20 bar	V Viton
H 240 L/min.			
J 480 L/min.			

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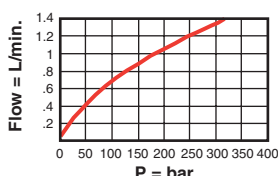
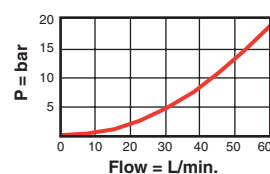
BALANCED POPPET, NORMALLY OPEN, VENT-TO-OPERATE



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DODR – XHN	T - 21A	35,0	22,2	45,2	45 - 50
120 L/min.	DOFR – XHN	T - 22A	35,0	28,6	50,8	60 - 70
240 L/min.	DOHR – XHN	T - 23A	46,2	31,8	62,7	200 - 215
480 L/min.	DOJR – XHN	T - 24A	63,5	41,3	80,3	465 - 500

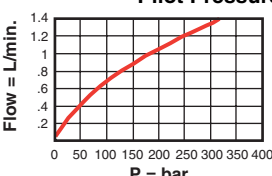
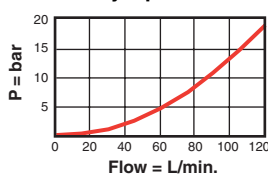
Performance Curves

DODR

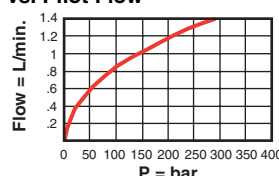
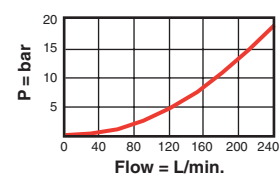


DOFR

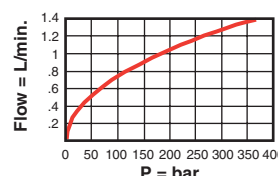
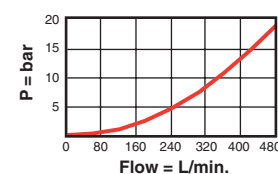
Fully Open Pressure Differential vs. Flow



DOHR



DOJR



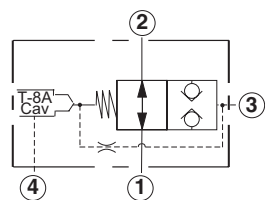
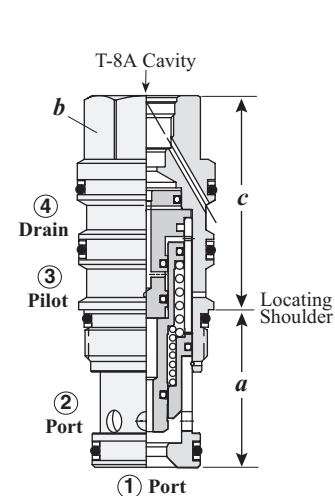
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DODR, DOFR: 28 bar; DOHR, DOJR: 20 bar.
- Pilot passage into valve = DODR, DOFR: 0,8 mm; DOHR, DOJR: 1,19 mm.
- Pilot volume displacement = DODR: 0,16 cc; DOFR: 0,33 cc; DOHR: 0,82 cc; DOJR: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at both ports 1 and 2, with the vent (port 4) open and minimum pilot pressure at port 3.
- These valves are hydraulically balanced between port 1 and port 2.
- Port 1 and Port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Valve will open when the pilot pressure falls below 10 bar or with port 4 blocked.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.
- Port 4 may be externally connected to a pilot switching valve. the pilot valve should have a leakage rate of less than 0,6 cc/min. and be able to satisfy the pilot flow requirements. Sun model DAA*-*** solenoid pilot valve is ideal for this application.

OPTION ORDERING INFORMATION

DO * R – X H *			
Nominal Capacity	Control	Minimum Pilot Pressure	Seal Material
D 60 L/min.	X Vent-to-operate	DODR, DOFR only: H 28 bar	N Buna-N
F 120 L/min.		DOHR, DOJR: 20 bar	V Viton
H 240 L/min.			
J 480 L/min.			

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BALANCED POPPET, NORMALLY OPEN, VENT-TO-OPERATE WITH INTEGRAL T-8A CONTROL CAVITY



The -8 control option allows a pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Performance Curves

Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DODR - 8HN	T - 21A	35,0	22,2	45,2	45 - 50
120 L/min.	DOFR - 8HN	T - 22A	35,0	28,6	50,8	60 - 70
240 L/min.	DOHR - 8HN	T - 23A	46,2	31,8	62,7	200 - 215
480 L/min.	DOJR - 8HN	T - 24A	63,5	41,3	80,3	465 - 500

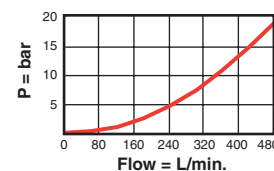
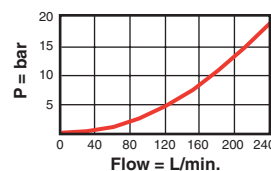
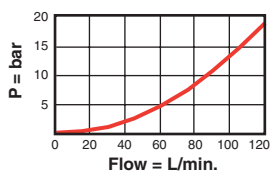
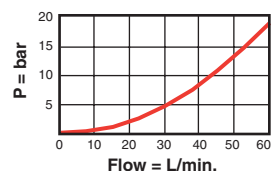
DODR-8

DOFR-8

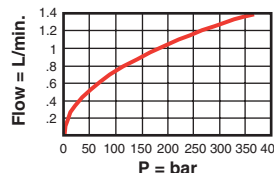
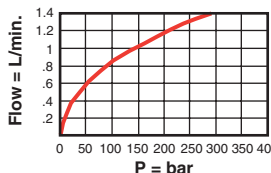
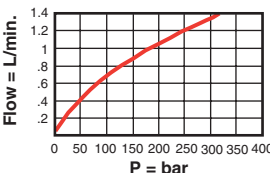
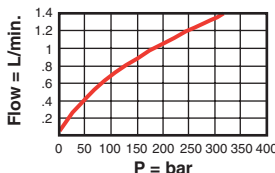
DOHR-8

DOJR-8

Fully Open Pressure Differential vs. Flow with T-8A Pilot Stage Installed



Pilot Pressure vs. Pilot Flow



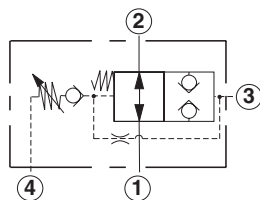
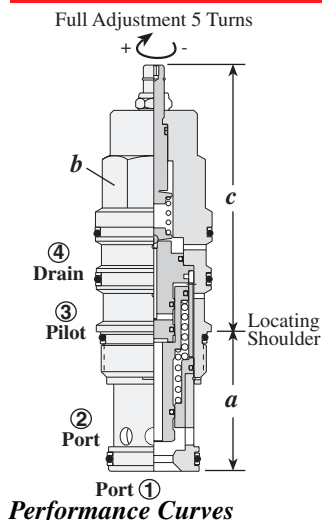
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DODR-8, DOFR-8: 28 bar; DOHR-8, DOJR-8: 20 bar.
- Pilot passage into valve = DODR-8, DOFR-8: 0,8 mm; DOHR-8, DOJR-8: 1,19 mm.
- Pilot volume displacement = DODR-8: 0,16 cc; DOFR-8: 0,33 cc; DOHR-8: 0,82 cc; DOJR-8: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at port 1 and 2. Switching will only occur when both minimum pilot pressure at port 3 is present and pilot control valve is open.
- These valves are hydraulically balanced between port 1 and port 2.
- Port 1 and Port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Valve will open when the pilot pressure falls below 10 bar.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.
- Any back pressure at the drain port is directly additive to the required pilot pressure.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value of 35-40 Nm.

OPTION ORDERING INFORMATION

DO * R - 8 H *			
Nominal Capacity	Control	Minimum Pilot Pressure	Seal Material
D 60 L/min.	8 with T-8A cavity in hex body for pilot operation	DODR-8, DOFR-8 only:	N Buna-N
F 120 L/min.		H 28 bar	V Viton
H 240 L/min.	See pilot control section for alternate options	DOHR-8, DOJR-8:	
J 480 L/min.		20 bar	

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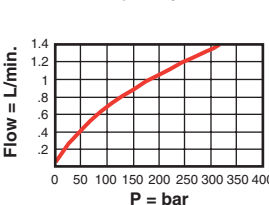
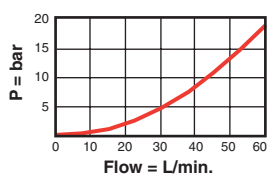
BALANCED POPPET, NORMALLY OPEN, PRESSURE ADJUSTABLE



Nominal Capacity	Typical Cartridge Model Code	Cavity	a	b	Cartridge Dimensions			Installation Torque (Nm)
					L	C	K	
60 L/min.	DODP – LAN	T - 21A	35,0	22,2	79,0	82,6	84,8	45 - 50
120 L/min.	DOFP – LAN	T - 22A	35,0	28,6	87,9	89,0	94,0	60 - 70
240 L/min.	DOHP – LAN	T - 23A	46,2	31,8	100,1	101,1	105,9	200 - 215
480 L/min.	DOJP – LAN	T - 24A	63,5	41,3	121,4	125,0	128,0	465 - 500

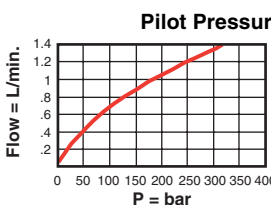
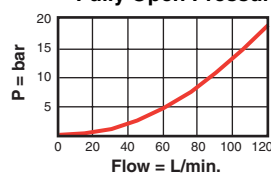
Performance Curves

DODP

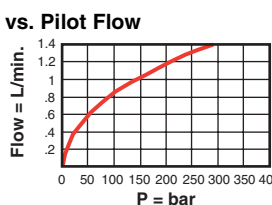
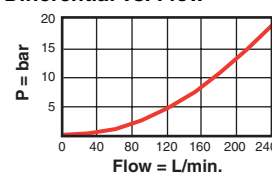


DOFP

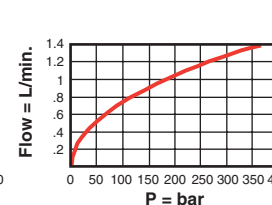
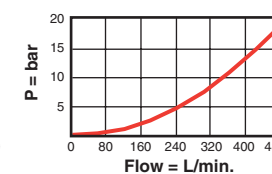
Fully Open Pressure Differential vs. Flow



DOHP



DOJP



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Minimum pilot pressure required to shift valve = DODP, DOFP: 28 bar; DOHP, DOJP: 20 bar.
- Pilot passage into valve = DODP, DOFP: 0,8 mm; DOHP, DOJP: 1,19 mm.
- Pilot volume displacement = DODP: 0,16 cc; DOFP: 0,33 cc; DOHP: 0,82 cc; DOJP: 2,8 cc.
- Unique balanced construction provides predictable switching with 350 bar at both port 1 and port 2. When the remote pressure signal at port 3 exceeds the internal valve setting, the valve shifts to the closed position.
- These valves are hydraulically balanced between port 1 and port 2.
- Port 1 and port 2 are fully sealed from port 3 and port 4. Ports 3 and 4 are positively sealed.
- Valve will open when the pilot pressure falls below 10 bar.
- Leakage rate between port 1 and port 2 is less than 0,3 cc/min. at 350 bar.
- Any back pressure at the drain port is directly additive to the valve setting.

OPTION ORDERING INFORMATION

DO * P - * * *			
Nominal Capacity	Control	Adjustment Range	Seal Material
D 60 L/min.	L Standard Screw Adjustment	DODP, DOFP only:	N Buna-N
F 120 L/min.	C* Tamper Resistant Factory Set	A 28 - 210 bar	V Viton
H 240 L/min.	K Handknob with Lock Knob	Standard set at 70 bar	
J 480 L/min.		B 28 - 105 bar	
		Standard set at 70 bar	
		W 28 - 315 bar	
		Standard set at 70 bar	
		DOHP, DOJP:	
		A 20 - 210 bar	
		Standard set at 70 bar	
		B 20 - 105 bar	
		Standard set at 70 bar	
		W 20 - 315 bar	
		Standard set at 70 bar	

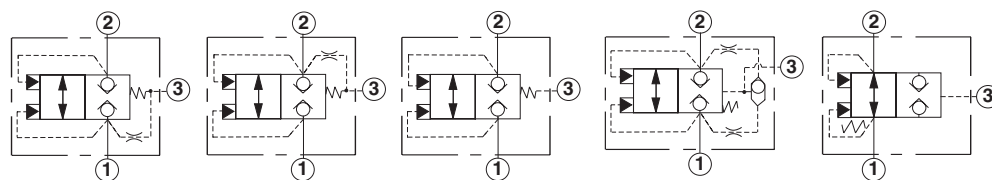
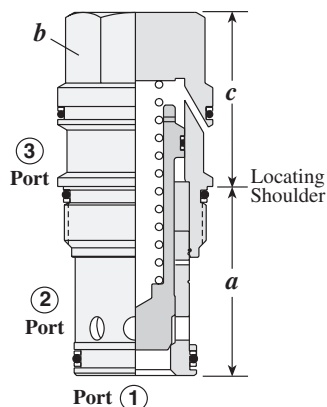
* Special setting required.
Specify at time of order.

** See page 178
for information
on Control Options

Customer specified special
setting stamped on hex.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

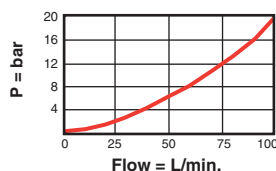
UNBALANCED POPPET, PILOT-TO-CLOSE AND VENT-TO-OPEN



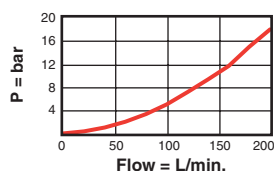
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	X	
95 L/min.	LODC – XDN	T - 11A	35,0	22,2	30,2	30,2	45 - 50
200 L/min.	LOFC – XDN	T - 2A	35,0	28,6	35,1	35,1	60 - 70
380 L/min.	LOHC – XDN	T - 17A	46,0	31,8	46,0	46,0	200 - 215
760 L/min.	LOJC – XDN	T - 19A	63,8	41,3	58,7	58,7	465 - 500

Performance Curves

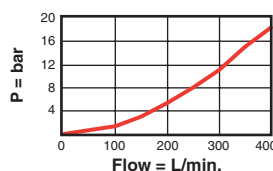
LOD*



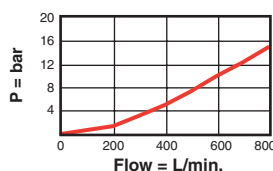
LOF*



LOH*



LOJ*



Full Open Pressure Drop

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min.
- Area ratio: A3 to A1 = 1.8:1; A3 to A2 = 2.25:1.
- Control orifice diameter = LOFA, LODB, LOFB, LODD, LOFD: 0,53 mm; LOHA, LOHB, LOHD: 0,8 mm; LOJA, LOJB, LOJD: 0,9 mm.
- Pilot passage into valve = LOD*: 0,8 mm; LOF*: 0,9 mm; LOH*: 1,50 mm; LOJ*: 2,3 mm.
- Pilot volume displacement = LOD*: 0,66 cc; LOF*: 1,1 cc; LOH*: 4,1 cc; LOJ*: 6,9 cc.
- These valves are pressure responsive at all three ports, therefore it is essential to consider all aspects of system operation through a complete cycle. Pressure changes at any one port may cause a valve to switch from a closed to an open position, or vice versa. All possible pressure changes in the complete circuit must be considered to assure a safe, functional system design.

OPTION ORDERING INFORMATION

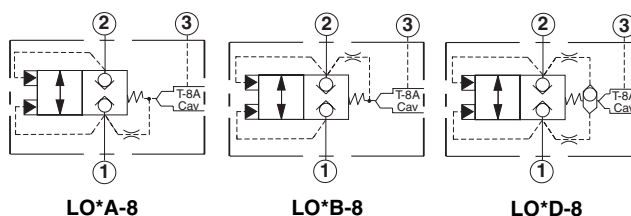
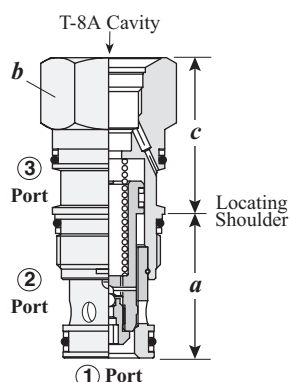
Nominal Capacity	Version	Control**	Minimum Pilot Pressure	Seal Material
D 95 L/min.	A Spring biased closed, Pilot source from Port 1, Vent-to-open	X Not Adjustable	D 3,5 bar	N Buna-N
F 200 L/min.	B Spring biased closed, Pilot source from Port 2, Vent-to-open	LODA, LOHA, LO*C, LOHD, LODD, LOHO, LOFO only:		V Viton
H 380 L/min.	C Spring biased closed, Port 3 pilot source, Pilot-to-close	E External SAE-4 Pilot, Port 3 blocked		
J 760 L/min.	D Spring biased closed, higher of Ports 1 or 2 pilot source, Vent-to-open	LODA, LOFA, LODB, LOFB, LODC, LOFC, LODD, LOFD, LOFO only:		
	O Spring biased open, Port 3 pilot source, Pilot-to-close	L Stroke Adjustment		

** See page 178 for information on Control Options

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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UNBALANCED POPPET, VENT-TO-OPEN, WITH INTEGRAL T-8A CONTROL CAVITY

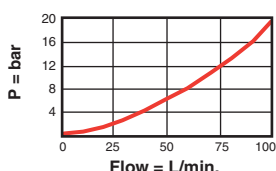


The -8 control option allows a pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include solenoid and air pilot operation. See Pilot Control Cartridges on page 141.

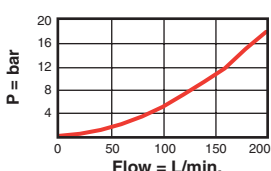
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
95 L/min.	LODA – 8DN	T - 11A	35,0	22,2	30,2	45 - 50
200 L/min.	LOFA – 8DN	T - 2A	35,0	28,6	35,1	60 - 70
380 L/min.	LOHA – 8DN	T - 17A	46,0	31,8	46,0	200 - 215
760 L/min.	LOJA – 8DN	T - 19A	63,5	41,3	58,7	465 - 500

Performance Curves

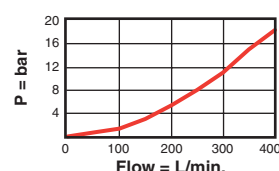
LOD*-8



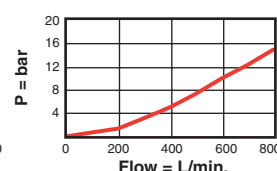
LOF*-8



LOH*-8



LOJ*-8



Full Open Pressure Drop with T-8A Pilot Stage Installed

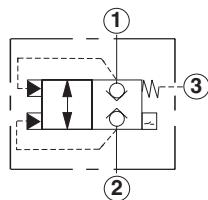
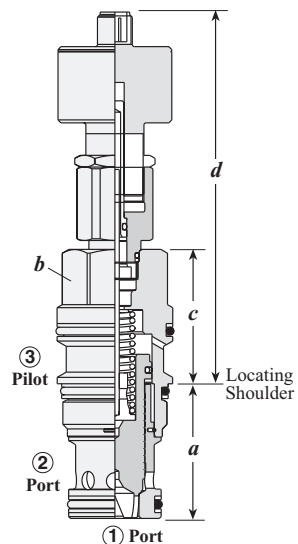
- Maximum operating pressure = 350 bar.
- Area ratio: A3 to A1 = 1.8:1; A3 to A2 = 2.25:1.
- Control orifice diameter = LOD*-8, LOF*-8: 0,53 mm, LOH*-8: 0,8 mm, LOJ*-8: 0,9 mm.
- Pilot volume displacement = LOD*-8: 0,66 cc; LOF*-8: 1,1 cc; LOH*-8: 4,1 cc.; LOJ*-8: 6,9 cc.
- These valves are pressure responsive at all three ports, therefore it is essential to consider all aspects of system operation through a complete cycle. Pressure changes at any one port may cause a valve to switch from a closed to an open position, or vice versa. All possible pressure changes in the complete circuit must be considered to assure a safe, functional system design.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

LO**		- 8 D*			
Nominal Capacity	Version	Control	Cracking Pressure	Seal Material	
D 95 L/min.	A Spring biased closed, Pilot source from Port 1	8 T-8A Cavity in hex body for pilot operation	D 3,5 bar	N	Buna-N
F 200 L/min.	B Spring biased closed, Pilot source from Port 2	Pilot valve to be ordered separately		V	Viton
H 380 L/min.					
J 760 L/min.	D Spring biased closed, with pilot source from Ports 1 or 2				

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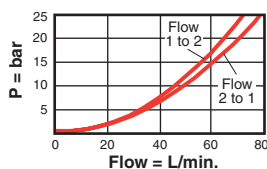
UNBALANCED POPPET, PILOT-TO-CLOSE, SPRING BIASED OPEN WITH POSITION INDICATING SWITCH



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
45 L/min.	LOEC – ZDN	T - 2A	35,1	28,6	35,1	116,8	60 - 70
200 L/min.	LOFC – ZDN	T - 2A	35,1	28,6	35,1	116,8	60 - 70
160 L/min.	LOGC – ZDN	T - 17A	45,8	31,8	45,8	127,3	200 - 215
380 L/min.	LOHC – ZDN	T - 17A	45,8	31,8	45,8	127,3	200 - 215

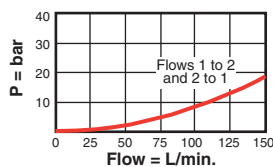
Performance Curves

LOEC-Z

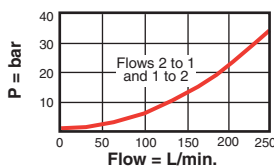


LOFC-Z

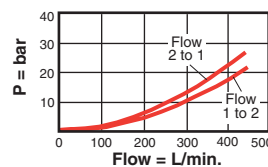
Pressure Differential vs. Flow Sequenced Open



LOGC-Z



LOHC-Z



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Area Ratio: A3 to A1 = 1.8:1; A3 to A2 = 2.25:1.
- Pilot passage into valve = LOEC-Z, LOFC-Z: 0,9 mm; LOGC-Z, LOHC-Z: 1,50 mm.
- Pilot volume displacement = LOEC-Z, LOFC-Z: 1,1 cc; LOGC-Z, LOHC-Z: 4,1 cc.
- The position switch confirms that poppet is in the spring biased closed position.
- Switch specifications: supply voltage: 20-32 V DC; Maximum output load: ≤ 400 mA, duty ratio 100%. Turn on time: ≤ 25 ms.; Operating temperature range: -25 to 80° C. See the Sun website for complete switch specifications.

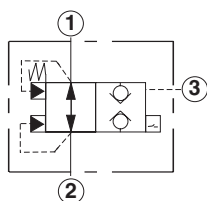
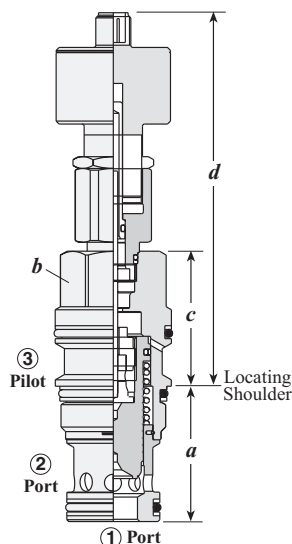
OPTION ORDERING INFORMATION

LO * C		- Z D *			
Nominal Capacity	Version	Control	Cracking Pressure	Seal Material	
E 45 L/min.	C Spring biased closed, Port 3 pilot source	Z Position switch*	D 3,5 bar	N Buna-N	
F 200 L/min.				V Viton	
G 160 L/min.					
H 380 L/min.					

* See Sun website for complete Switch Specifications.

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UNBALANCED POPPET, PILOT-TO-CLOSE, SPRING BIASED CLOSED WITH POSITION INDICATING SWITCH



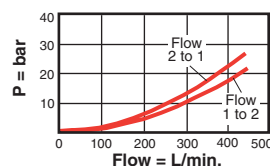
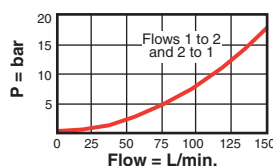
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
200 L/min.	LOFO – ZDN	T - 2A	35,0	28,6	35,1	116,8	60 - 70
380 L/min.	LOHO – ZDN	T - 17A	46,0	31,8	46,0	127,3	200 - 215

Performance Curves

LOFO-Z

LOHO-Z

Pressure Differential vs. Flow Sequenced Open



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Area Ratio: A3 to A1 = 1.8:1; A3 to A2 = 2.25:1.
- Pilot passage into valve = LOFO-Z: 0,9 mm LOHO-Z: 1,50 mm.
- Pilot volume displacement = LOFO-Z: 1,1 cc; LOHO-Z: 4,1 cc.
- The position switch confirms that the valve is in the open position.
- Switch specifications: supply voltage: 20-32 V DC; Maximum output load: ≤ 400 mA, duty ratio 100%. Turn on time: ≤ 25 ms.; operating temperature range: -25 to 80° C. See the Sun website for complete switch specifications.

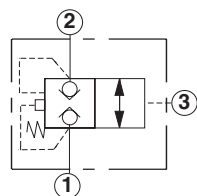
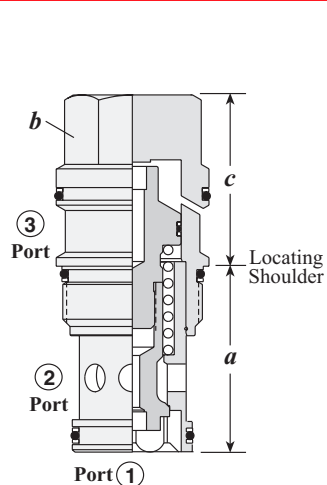
OPTION ORDERING INFORMATION

LO * O		- Z D *			
Nominal Capacity	Version	Control	Cracking Pressure	Seal Material	
F 200 L/min.	O Spring biased open, Port 3 pilot source	Z Position switch*	D 3,5 bar	N	Buna-N
H 380 L/min.				V	Viton

* See Sun website for complete Switch Specifications.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

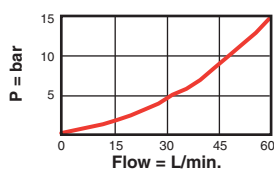
UNBALANCED POPPET, PILOT-TO-OPEN, SPRING BIASED CLOSED



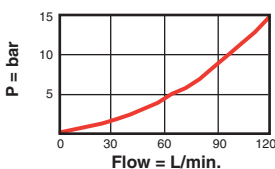
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	X L	
60 L/min.	LKDC – XDN	T - 11A	35,0	22,2	29,0	63,0	45 - 50
120 L/min.	LKFC – XDN	T - 2A	35,0	28,6	35,0	71,6	60 - 70
240 L/min.	LKHC – XDN	T - 17A	46,0	31,8	46,0	—	200 - 215
480 L/min.	LKJC – XDN	T - 19A	63,8	41,3	58,7	—	465 - 500

Performance Curves

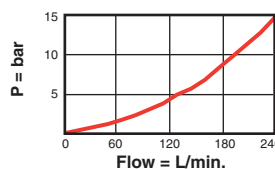
LKDC



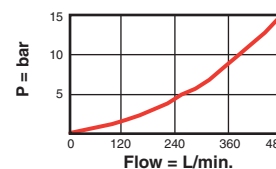
LKFC



LKHC



LKJC



Full Open Pressure Drop

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 70 bar.
- Area ratio: A3 to A1 = 1.8:1; A3 to A2 = 2.25:1.
- Pilot passage into valve = LKDC: 0,8 mm; LKFC: 0,9 mm; LKHC: 1,50 mm; LKJC: 2,3 mm.
- Pilot volume displacement = LKDC: 0,33 cc; LKFC: 0,98 cc; LKHC: 2,5 cc; LKJC: 4,9 cc.
- These valves are pressure responsive at all three ports, therefore it is essential to consider all aspects of system operation through a complete cycle. Pressure changes at any one port may cause a valve to switch from a closed to an open position, or vice versa. All possible pressure changes in the complete circuit must be considered to assure a safe, functional system design.

OPTION ORDERING INFORMATION

Nominal Capacity	Version	Control**	Minimum Pilot Pressure	Seal Material
D 60 L/min.	C Spring biased closed, Pilot source from port 3	LK*C	D 3,5 bar	N Buna-N
F 120 L/min.		X Not Adjustable		V Viton
H 240 L/min.		LKDC, LKFC only:		
J 480 L/min.		L Manual Release		

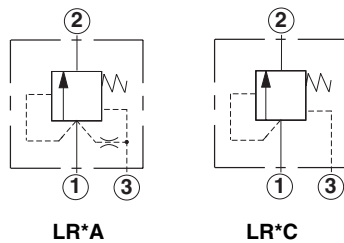
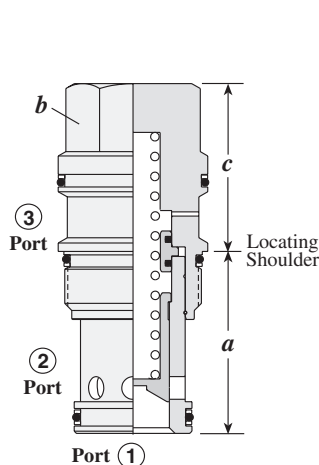
U.S. Patent # 4,795,129

** See page 178
for information
on Control Options

Consult the Sun website
for our most recent and
complete information
on the full Corrosion
Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

NORMALLY CLOSED, MODULATING ELEMENT



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					X	L	
30 L/min.	LRBC – XHN	T - 163A	31,8	19,1	31,8	64,8	35 - 40
60 L/min.	LRDC – XHN	T - 11A	35,0	22,2	30,2	63,5	45 - 50
120 L/min.	LRFC – XHN	T - 2A	35,0	28,6	35,0	83,1	60 - 70
240 L/min.	LRHC – XHN	T - 17A	46,0	31,8	46,0	84,0	200 - 215
480 L/min.	LRJC – XHN	T - 19A	63,8	41,3	58,7	100,1	465 - 500

- Maximum operating pressure = 350 bar.
- Control orifice diameter = LRBA, LRDA, LRFA: 0,4 mm; LRHA, LRJA: 0,53 mm.
- Control Pilot Flow = LRBA, LRDA, LRFA: 0,16 - 0,25 L/min.; LRHA, LRJA: 0,25 - 0,50 L/min.
- An optional tuning adjustment (L control) is offered to vary the pressure drop across the compensator to increase or decrease the flow. **This option is only available with the D differential pressure range.**

OPTION ORDERING INFORMATION

Nominal Capacity	Version	Control**	Differential Pressure	Seal Material
B 30 L/min.	A Internal pilot, Pilot source from port 1 (mainstage relief element)	X Not Adjustable	D 3,5 bar	N Buna-N
D 60 L/min.		Available in D Differential Pressure only:	F 7,0 bar	V Viton
F 120 L/min.			G* 10,0 bar	
H 240 L/min.	C External pilot (bypass compensator)	L Tuning Adjustment	H 14,0 bar	
J 480 L/min.				

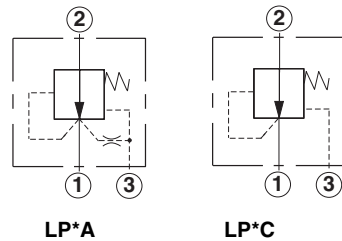
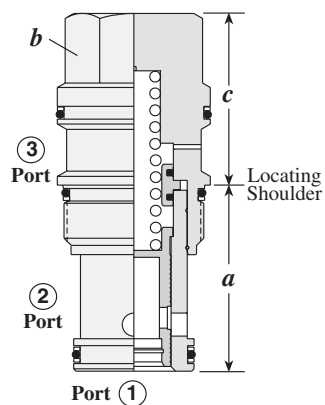
* Differential Pressure not available in LRBA, LRDA, LRHA, LRJA, and LRBC

** See page 178 for information on Control Options

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

NORMALLY OPEN, MODULATING ELEMENT



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c		
					X	L	
30 L/min.	LPBC – XHN	T - 163A	31,0	19,1	31,8	64,8	35 - 40
60 L/min.	LPDC – XHN	T - 11A	35,0	22,2	30,2	63,5	45 - 50
120 L/min.	LPFC – XHN	T - 2A	35,0	28,6	35,0	71,6	60 - 70
240 L/min.	LPHC – XHN	T - 17A	46,0	31,8	46,0	83,1	200 - 215
480 L/min.	LPJC – XHN	T - 19A	63,5	41,3	58,7	100,0	465 - 500

- Maximum operating pressure = 350 bar.
- Control Pilot Flow = LPBA, LPDA, LPFA: 0,16 - 0,25 L/min.; LPHA, LPJA: 0,25 - 0,50 L/min.
- Control Orifice Diameter = LPBA, LPDA, LPFA: 0,4 mm; LPHA, LPJA: 0,53 mm.
- An optional tuning adjustment (L control) is offered to vary the pressure drop across the compensator to increase or decrease the flow. **This option is only available with the D differential pressure range.**

OPTION ORDERING INFORMATION

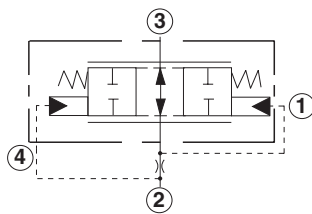
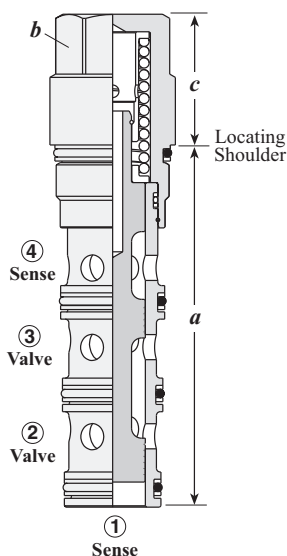
Nominal Capacity	Version	Control**	Differential Pressure	Seal Material
B 30 L/min.	A Internal pilot, Pilot source from port 1. (mainstage reducing element)	X Not Adjustable	D 3,5 bar	N Buna-N
D 60 L/min.		<i>Available in D Differential Pressure only:</i>	F 7,0 bar	V Viton
F 120 L/min.			G* 10,0 bar	
H 240 L/min.	C External pilot (restrictive compensator)	L Tuning Adjustment	H 14,0 bar	
J 480 L/min.			* Differential Pressure Range not available in LPBC, LPBA, LPDA, LPFA, and LPJA.	

** See page 178 for information on Control Options

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

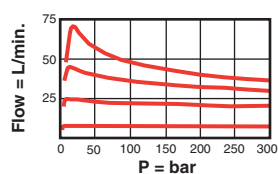
BI-DIRECTIONAL, MODULATING ELEMENT, NORMALLY OPEN



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	LHDT - XFN	T - 31A	84,8	22,2	30,2	45 - 50
120 L/min.	LHFT - XFN	T - 32A	92,2	28,6	33,3	60 - 70
240 L/min.	LHHT - XFN	T - 33A	114,3	31,8	41,3	200 - 215

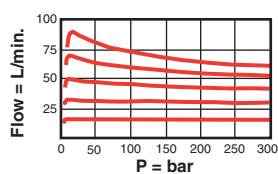
Performance Curves

LHDT

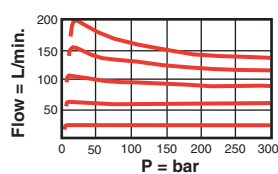


LHFT

Pressure Differential vs. Flow



LHHT



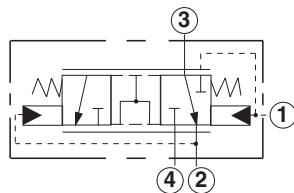
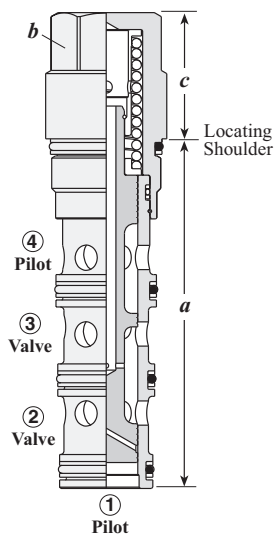
- Maximum operating pressure = 350 bar.
- All ports will accept 350 bar.
- These bi-directional, normally open, modulating elements, used with an external orifice, create a bi-directional, pressure compensated flow control.

OPTION ORDERING INFORMATION

LH * T - X * *			
Nominal Capacity	Control	Nominal Control Pressure	Seal Material
D 60 L/min.	X Not Adjustable	D 3,5 bar	N Buna-N
F 120 L/min.		E 5 bar	V Viton
H 240 L/min.		F 7 bar	

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BYPASS/RESTRICTIVE, PRIORITY MODULATING ELEMENT



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	LHDA – XFN	T - 31A	84,8	22,2	30,1	45 - 50
120 L/min.	LHFA – XFN	T - 32A	92,2	28,6	33,3	60 - 70
240 L/min.	LHHA – XFN	T - 33A	114,3	31,8	41,3	200 - 215
480 L/min.	LHJA – XFN	T - 34A	139,7	41,3	54,0	465 - 500

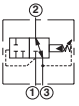
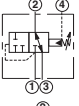
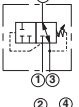
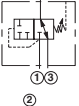
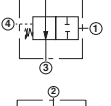
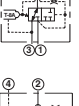
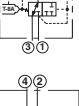
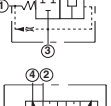
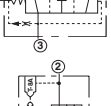
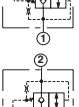
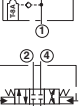
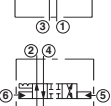
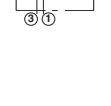
- Maximum operating pressure = 350 bar.
- Bypass flow is not available until priority flow requirements are satisfied.
- Bypass pressure at port 4 can be higher than pressure at control port 2.
- Priority flow can be turned off with a pilot sized solenoid valve on port 1.

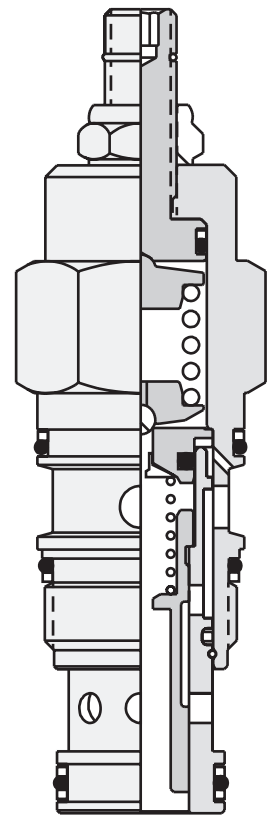
OPTION ORDERING INFORMATION

LH * A – X * *			
Nominal Capacity	Control	Differential Pressure	Seal Material
D 60 L/min.	X Not Adjustable	E 5 bar	N Buna-N
F 120 L/min.		F 7 bar	V Viton
H 240 L/min.			
J 480 L/min.			

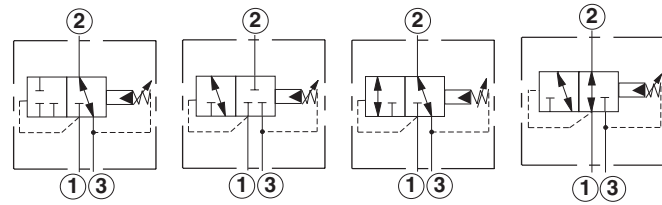
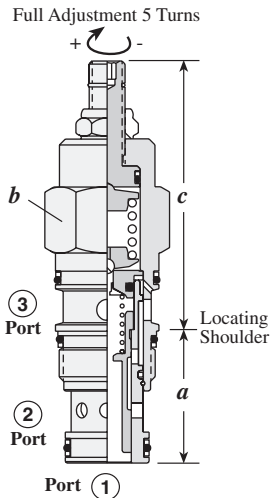
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Directional Cartridge Valves

	Cartridge Type	Page
	2-way and 3-way, with Internal Drain to Port 3	118
	2-way and 3-way, with Drain to Port 4	119
	2-way and 3-way Direct Acting, Internal Drain to Port 3	120
	2-way and 3-way, Direct Acting, Drain to Port 4	121
	2-way, Direct Acting, Sealed Pilot, Pilot-to-shift	122
	2-way and 3-way, Vent-to-Operate, with Integral T-8A Control Cavity	123
	2-way and 3-way, Vent-to-operate, with Integral T-8A Control Cavity	124
	3-way, 2-position Vent-to-shift, Diverter, Normally Closed	125
	3-way, 2-position Vent-to-shift, Diverter, Normally Open	126
	2-way Poppet, with Integral T-8A Control Cavity, Control Port 1 to Port 2	127
	2-way Poppet, with Integral T-8A Control Cavity, Control Port 2 to Port 1	128
	3-position, 4-way, Pilot-to-shift	129
	2-position, 4-way, Pilot-to-shift, Detented	130



2-WAY AND 3-WAY, WITH INTERNAL DRAIN TO PORT 3



DPBA, DPBA

DPBB, DPBB

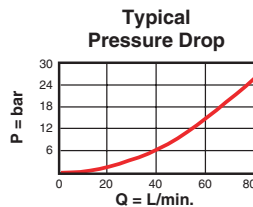
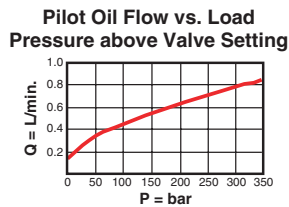
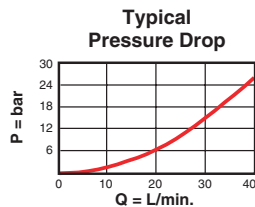
DPBC, DPBC

DPBD, DPBD

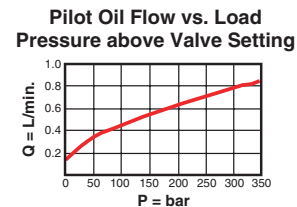
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
28 L/min.	DPBA – LAN	T - 11A	35,1	22,2	63,5	67,6	69,9	45 - 50
60 L/min.	DPCA – LAN	T - 2A	35,1	28,6	71,4	73,2	77,7	60 - 70

Performance Curves

DPB*



DPC*



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 15 cc/min. at 70 bar.
- Control pilot flow = DPBA, DPBB, DPBC, DPBD: 0,11 - 0,16 L/min.; DPCA, DPCB, DPCC, DPCD: 0,16 - 0,25 L/min.
- Maximum pressure at port 3 should be limited to 210 bar. This is due to fatigue strength limits not hydraulic operating limits.
- Pressure at port 3 is directly additive to the setting of the valve. Because of this, port 3 may not be useable as a work port in your circuit. If this is a consideration, the 4 port version of this valve may be a solution.
- Direct acting and pilot operated versions of these valves are interchangeable. They fit the same cavities and have the same flow paths.
- These valves are not bistable; it is capable of modulating between the two positions shown.

OPTION ORDERING INFORMATION

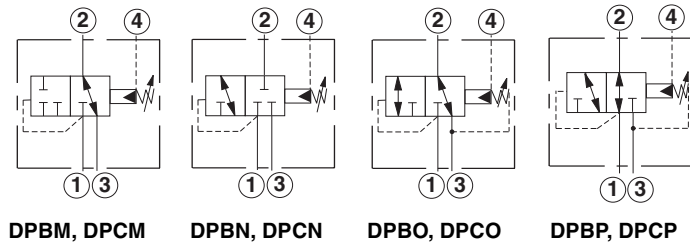
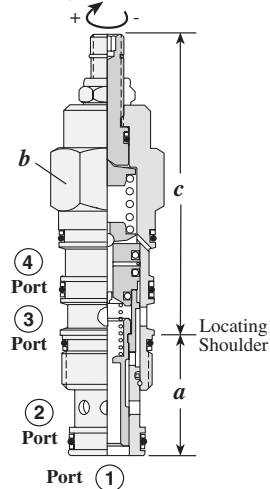
DP ** - ***				
Nominal Capacity	Version	Control**	Adjustment Range	Seal Material
B 28 L/min.	A 2-Way, Pilot Operated, with Internal Drain to Port 3, Normally Open	L Standard Screw Adjustment	A 7 - 210 bar Standard set at 70 bar	N Buna-N
C 60 L/min.	B 2-Way, Pilot Operated, with Internal Drain to Port 3, Normally Closed	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Standard set at 70 bar	V Viton
	C 3-Way, 2-Position, Pilot Operated, with Internal Drain to Port 3, Port 1 Blocked, 2 to 3 Open	K Handknob with Lock Knob	D 1,7 - 55 bar Standard set at 28 bar	
	D 3-Way, 2-Position, Pilot Operated, with Internal Drain to Port 3, Port 3 Blocked, 1 to 2 Open	* Special setting required. Specify at time of order.	E 1,7 - 28 bar Standard set at 14 bar	
		** See page 178 for information on Control Options	W 10,5 - 315 bar Standard set at 70 bar	
			C 10,5 - 420 bar Standard set at 70 bar	

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2-WAY AND 3-WAY, WITH DRAIN TO PORT 4

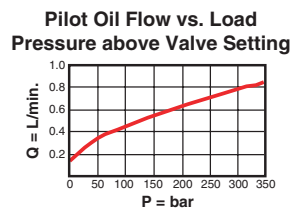
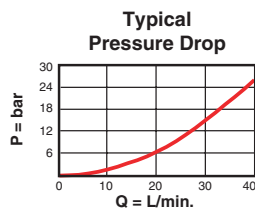
Full Adjustment 5 Turns



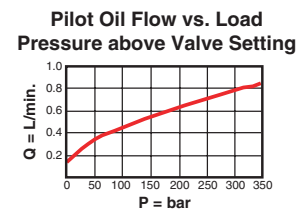
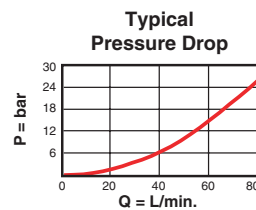
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
28 L/min.	DPBM – LAN	T - 21A	35,1	22,2	78,5	82,6	84,8	45 - 50
60 L/min.	DPCM – LAN	T - 22A	35,1	28,6	87,4	88,9	93,7	60 - 70

Performance Curves

DPB*



DPC*



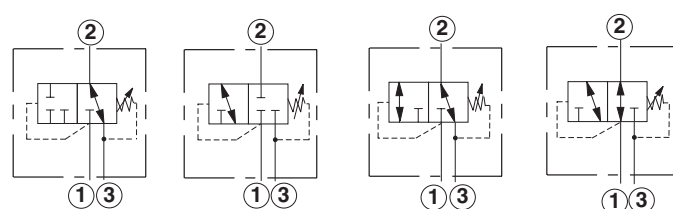
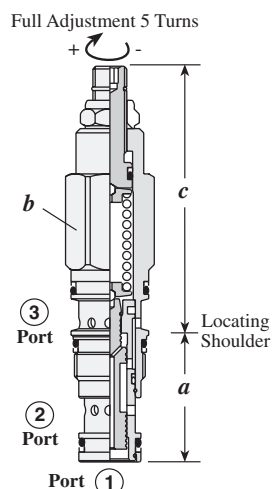
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 15 cc/min. at 70 bar.
- Control pilot flow = DPBM, DPBN, DPBO, DPBP: 0,11 - 0,16 L/min.; DPCM, DPCN, DPCO, DPCP: 0,16 - 0,25 L/min.
- Maximum pressure at port 3 should be limited to 210 bar. This is due to fatigue strength limits not hydraulic operating limits.
- Pressure at port 4 is directly additive to the setting of the valve.
- Port 3 can be used as a work port.
- Port 4 can be blocked to prevent the cartridge from shifting.
- Direct acting and pilot operated versions of these valves are interchangeable. They fit the same cavities and have the same flow paths.
- These valves are not bistable; it is capable of modulating between the two positions shown.

OPTION ORDERING INFORMATION

Nominal Capacity	Version	Control**	Adjustment Range	Seal Material
B 28 L/min.	M 2-Way, Pilot Operated, with Drain to Port 4, Normally Open	L Standard Screw Adjustment	A 7 - 210 bar Standard set at 70 bar	N Buna-N
C 60 L/min.	N 2-Way, Pilot Operated, with Drain to Port 4, Normally Closed	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Standard set at 70 bar	V Viton
	O 3-Way, 2-Position, Pilot Operated, with Drain to Port 4, 2 to 3 Open, Port 1 Blocked	K Handknob with Lock Knob	D 1,7 - 55 bar Standard set at 28 bar	
	P 3-Way, 2-Position, Pilot Operated, with Drain to Port 4, 1 to 2 Open, Port 3 Blocked	* Special setting required. Specify at time of order.	E 1,7 - 28 bar Standard set at 14 bar	
		** See page 178 for information on Control Options	W 10,5 - 315 bar Standard set at 70 bar	

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2-WAY AND 3-WAY DIRECT ACTING, INTERNAL DRAIN TO PORT 3



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
28 L/min.	DRBA – LAN	T - 11A	35,0	22,2	78,5	82,6	85,0	45 - 50
28 L/min.	DRBB – LAN	T - 11A	35,0	22,2	78,5	82,6	85,0	45 - 50
28 L/min.	DRBC – LAN	T - 11A	35,0	22,2	78,5	82,6	85,0	45 - 50
28 L/min.	DRBD – LAN	T - 11A	35,0	22,2	78,5	82,6	85,0	45 - 50

Performance Curves

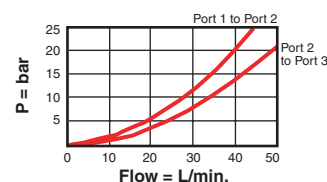
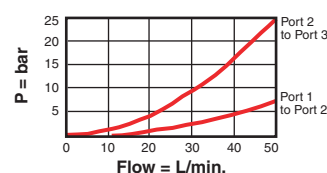
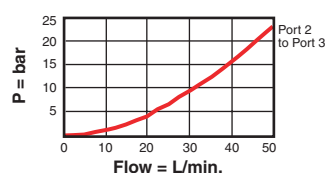
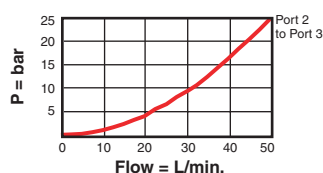
DRBA

DRBB

DRBC

DRBD

Typical Pressure Drop



- Maximum operating pressure = 350 bar.
- Maximum combined valve leakage (ports 2 and 3) = 30 cc/min. at 70 bar.
- Pressure at port 3 is directly additive to the setting of the valve. Because of this, port 3 may not be useable as a work port in your circuit. If this is a consideration, the 4 port version of this valve may be a solution.
- Pilot pressure at port 3 is limited to 210 bar.
- Direct acting and pilot operated versions of these valves are interchangeable. They fit the same cavities and have the same flow paths.
- Because of their direct acting design, these cartridges feature low internal leakage and low pilot flow consumption.
- These valves are not bistable; it is capable of modulating between the two positions shown.

OPTION ORDERING INFORMATION

DR ** - ***				
Nominal Capacity	Version	Control**	Adjustment Range	Seal Material
B 28 L/min.	A 2-Way, Direct Acting, with Internal Drain to Port 3, Normally Open	L Standard Screw Adjustment	A 35 - 210 bar Standard set at 70 bar	N Buna-N
	B 2-Way, Direct Acting, with Internal Drain to Port 3, Normally Closed	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Standard set at 14 bar	V Viton
	C 3-Way, 2-Position, Direct Acting, with Internal Drain to Port 3, Port 1 Blocked, 2 to 3 Open	K Handknob with Lock Knob	D 1,7 - 55 bar Standard set at 14 bar	
	D 3-Way, 2-Position, Direct Acting, with Internal Drain to Port 3, Port 3 Blocked, 1 to 2 Open		E 1,7 - 28 bar Standard set at 14 bar	
			S 1,7 - 14 bar Standard set at 14 bar	
			W 50 - 315 bar Standard set at 70 bar	

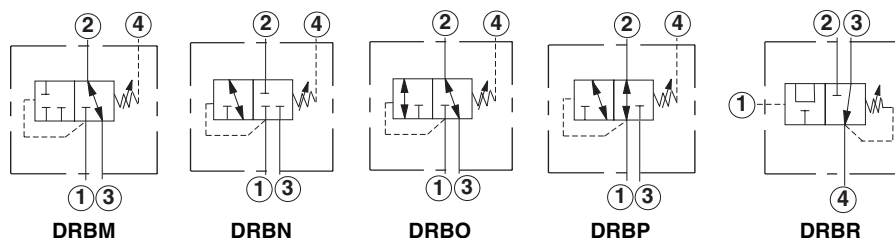
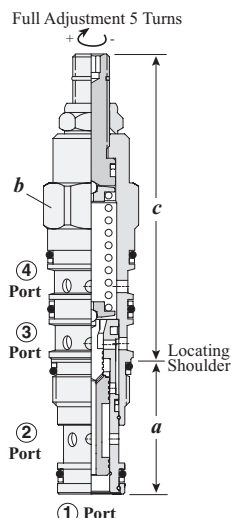
* Special setting required. Specify at time of order.

** See page 178 for information on Control Options

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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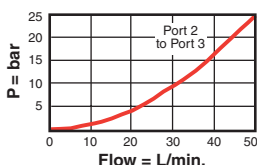
2-WAY AND 3-WAY DIRECT ACTING, DRAIN TO PORT 4



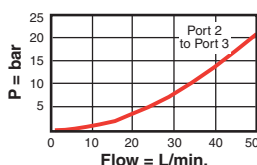
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	C	K	
28 L/min.	DRBM – LAN	T - 21A	35,1	22,2	78,7	80,3	84,8	45 - 50
28 L/min.	DRBN – LAN	T - 21A	35,1	22,2	78,7	80,3	84,8	45 - 50
28 L/min.	DRBO – LAN	T - 21A	35,1	22,2	78,7	80,3	84,8	45 - 50
28 L/min.	DRBP – LAN	T - 21A	35,1	22,2	78,7	80,3	84,8	45 - 50
28 L/min.	DRBR – LAN	T - 21A	35,1	22,2	78,7	80,3	84,8	45 - 50

Performance Curves

DRBM

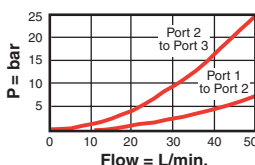


DRBN

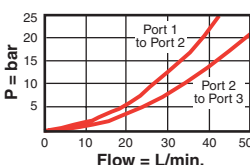


DRBO

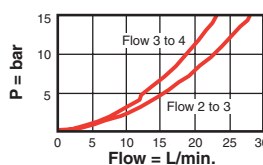
Typical Pressure Drop



DRBP



DRBR



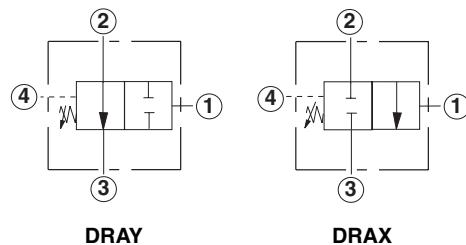
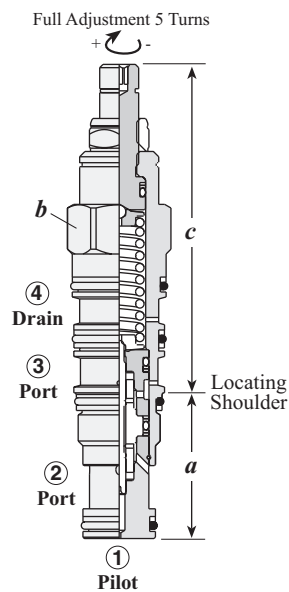
- Maximum operating pressure = 350 bar.
- Maximum combined valve leakage (ports 2, 3, and 4) = 30 cc/min. at 70 bar.
- Maximum pressure at port 3 should be limited to 210 bar. This is due to fatigue strength limits not hydraulic operating limits. Port 3 can be used as a work port.
- Pressure at port 4 is directly additive to the setting of the valve.
- Because of their direct acting design, these cartridges feature low internal leakage and low pilot flow consumption.
- Direct acting and pilot operated versions of these valves are interchangeable. They fit the same cavities and have the same flow paths.
- This valve is not bistable; it is capable of modulating between the two positions shown.
- DRBR: 55 bar is the highest setting possible for this valve. The flow path between ports 2 and 3 is bidirectional.

OPTION ORDERING INFORMATION

DR**		***		Seal Material
Nominal Capacity	Version	Control**	Adjustment Range	
B 28 L/min.	M 2-Way, Direct Acting, with Drain to Port 4, Normally Open	L Standard Screw Adjustment	A 35 - 210 bar Standard set at 70 bar	N Buna-N
DRCO only:	N 2-Way, Direct Acting, with Drain to Port 4, Normally Closed	C* Tamper Resistant Factory Set	B 3,5 - 105 bar Standard set at 14 bar	V Viton
C 60 L/min.	O 3-Way, 2-Position, Direct Acting, with Drain to Port 4, Port 2 to 3 Open, Port 1 Blocked	K Handknob with Lock Knob	D 1,7 - 55 bar Standard set at 14 bar	
	P 3-Way, 2-Position, with Drain to Port 4, Port 1 to 2 Open, Port 3 Blocked	* Special setting required. Specify at time of order.	E 1,7 - 28 bar Standard set at 14 bar	
	R 3-Way, 2-Position, Direct Acting, with Drain to Port 4, Port 3 to Port 4 Open, Port 2 Blocked	** See page 178 for information on Control Options	S 1,7 - 14 bar Standard set at 14 bar	
		Customer specified special setting stamped on hex.	W 50 - 315 bar Standard set at 70 bar	
			DRBR only:	
			N 4 - 55 bar Standard set at 14 bar	
			E 1,7 - 28 bar Standard set at 14 bar	
			S 1,7 - 14 bar Standard set at 14 bar	

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2-WAY, DIRECT ACTING, SEALED PILOT, PILOT-TO-SHIFT

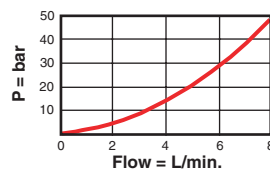


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
2 L/min.	DRAY – LAN	T - 21A	35,1	22,2	78,5	45 - 50
2 L/min.	DRAX – LAN	T - 21A	35,1	22,2	78,5	45 - 50

Performance Curves

DRAY, DRAX

Typical Pressure Drop vs. Flow
Port 2 to Port 3



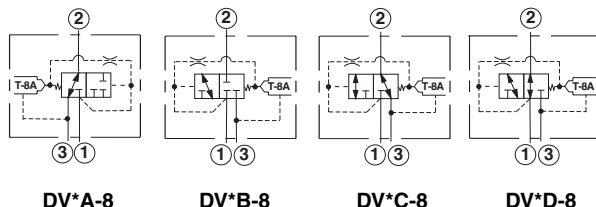
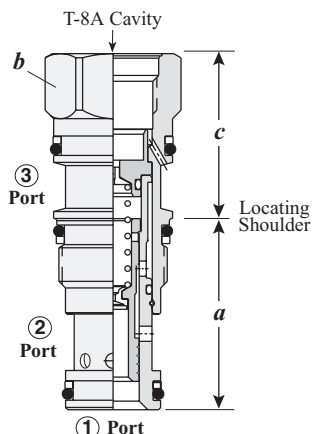
- Maximum operating pressure = 350 bar.
- Reseat = > 85% of set pressure.
- The pilot area (port 1) and the spring chamber drain (port 4) are positively sealed.
- The valve is designed not to modulate and is the equivalent of a hydraulic pressure switch.
- There is spool leakage at 0,6 cc/min. at 70 bar between work ports 2 and 3.

OPTION ORDERING INFORMATION

DR A * - L * *				
Nominal Capacity	Version	Control	Adjustment Range*	Seal Material
A 2 L/min.	Y 2-Way, Pilot-to-shift with Drain to Port 4, Normally Open	L Standard Screw Adjustment	A 70 - 210 bar Standard set at 70 bar	N Buna-N
	X 2-Way, Pilot-to-shift with Drain to Port 4, Normally Closed		C 140 - 420 bar Standard set at 140 bar	V Viton

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2-WAY AND 3-WAY, VENT-TO-OPERATE WITH INTEGRAL T-8A CONTROL CAVITY



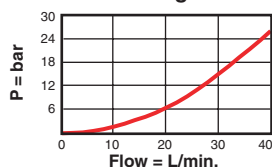
The -8 control option allows the pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
28 L/min.	DVB* - 8FN	T-11A	35,1	22,2	35,1	45 - 50
60 L/min.	DVC* - 8FN	T-2A	35,1	28,6	35,1	60 - 70

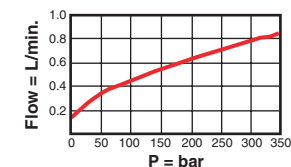
Performance Curves

DVB*-8

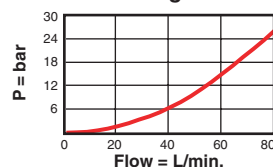
Typical Pressure Drop with T-8A Pilot Stage Installed



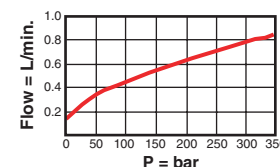
Pilot Oil Flow vs. Load Pressure above Valve Setting



Typical Pressure Drop with T-8A Pilot Stage Installed



Pilot Oil Flow vs. Load Pressure above Valve Setting



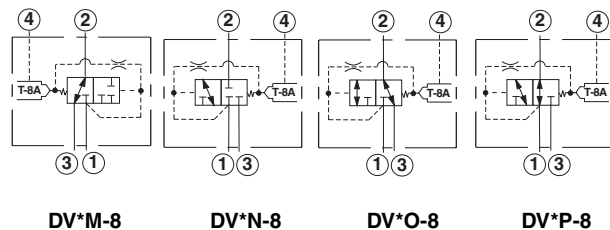
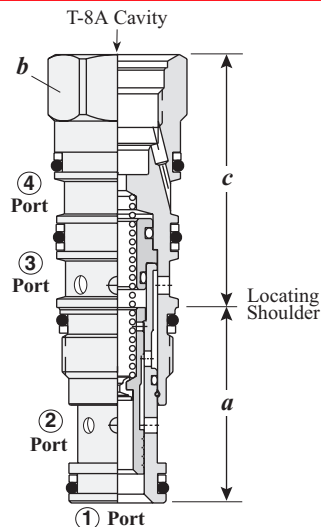
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 30 cc/min. at 70 bar.
- Control pilot flow = DVBA-8, DVBB-8, DVBC-8, DVBD-8: 0,11 - 0,16 L/min.; DVCA-8, DVCB-8, DVCC-8, DVCD-8: 0,16 - 0,25 L/min.
- There must be a pressure source at port 1, relative to port 3, to shift the valve.
- Pressure at port 3 may oppose the opening of the valve. Because of this, port 3 may not be useable as a work port in your circuit. If this is a consideration, the 4 port version of this valve may be a solution.
- Pressure at port 3 is limited to 210 bar.
- These valves are not bistable; they are capable of modulating between the two positions shown.
- The main stage valve should first be installed to the correct torque value followed by the T-8A pilot control section into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

DV ** - 8 F *				
Nominal Capacity	Version	Control	Minimum Control Pressure	Seal Material
B 28 L/min.	A 2-Way, Vent-to-operate, with Internal Drain to Port 3, Normally Open	8 T-8A Cavity in hex body for pilot operation	F 7 bar	N Buna-N
C 60 L/min.	B 2-Way, Vent-to-operate, with Internal Drain to Port 3, Normally Closed	Pilot valve to be ordered separately		V Viton
	C 3-Way, 2-Position, Vent-to-operate, with Internal Drain to Port 3, Port 2 to 3 Open, Port 1 Blocked			
	D 3-Way, 2-Position, Vent-to-operate, with Internal Drain to Port 3, Port 1 to 2 Open, Port 3 Blocked			

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2-WAY AND 3-WAY, VENT-TO-OPERATE, WITH INTEGRAL T-8A CONTROL CAVITY



The -8 control option allows the pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

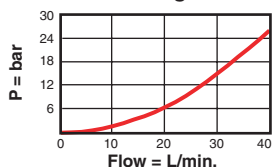
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
28 L/min.	DVB* - 8FN	T-21A	35,1	22,2	42,9	45 - 50
60 L/min.	DVC* - 8FN	T-22A	35,1	28,6	50,8	60 - 70

Performance Curves

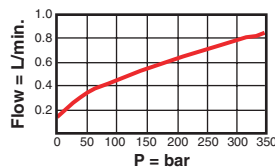
DVB*-8

DVC*-8

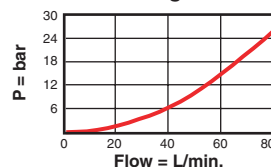
Typical Pressure Drop with T-8A Pilot Stage Installed



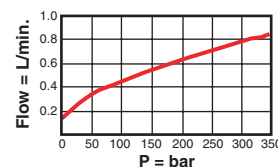
Pilot Oil Flow vs. Load Pressure above Valve Setting



Typical Pressure Drop with T-8A Pilot Stage Installed



Pilot Oil Flow vs. Load Pressure above Valve Setting



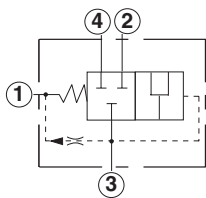
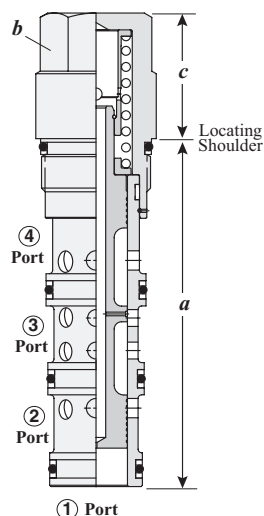
- Maximum operating pressure = 350 bar.
- Maximum leakage at 24 cSt = 30,0 cc/min. at 70 bar.
- Control pilot flow at opening = DVB*-8, DVC*-8: 0,11 - 0,16 L/min.
- Port 3 can be used as a work port.
- The flow path between port 2 and port 3 is bidirectional.
- Pressure at port 3 is limited to 210 bar.
- These valves are not bistable; it is capable of modulating between the two positions shown.
- There must be a pressure source at port 1, relative to port 4, to shift the valve.
- The main stage valve should first be installed to the correct torque value followed by the T-8A pilot control section into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

DV **		- 8 F *		Seal Material
Nominal Capacity	Version	Control	Minimum Control Pressure	
B 28 L/min.	M 2-Way, Vent-to-operate, with Drain to Port 4, Normally Open	8 T-8A Cavity in hex body for pilot operation	F 7 bar	N Buna-N
C 60 L/min.	N 2-Way, Vent-to-operate, with Drain to Port 4, Normally Closed	Pilot valve to be ordered separately		V Viton
	O 3-Way, 2-Position, Vent-to-operate, with Drain to Port 4, Port 2 to 3 Open, Port 1 Blocked			
	P 3-Way, 2-Position, Vent-to-operate, with Drain to Port 4, Port 1 to 2 Open, Port 3 Blocked			

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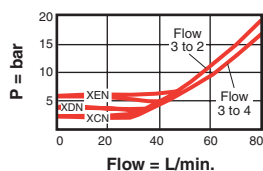
3-WAY, 2-POSITION VENT-TO-SHIFT, DIVERTER, NORMALLY CLOSED



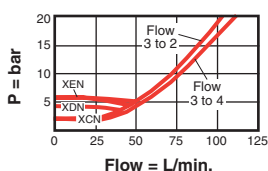
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DSCX – XEN	T - 31A	84,8	22,2	30,2	45 - 50
120 L/min.	DSEX – XEN	T - 32A	92,2	28,6	33,3	60 - 70
240 L/min.	DSGX – XEN	T - 33A	114,6	31,8	41,4	200 - 215
480 L/min.	DSIX – XEN	T - 34A	139,7	41,3	53,8	465 - 500

Performance Curves

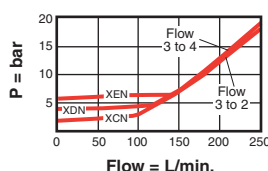
DSCX



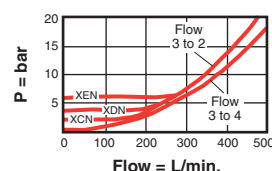
DSEX



DSGX



DSIX



Typical Pressure Drop

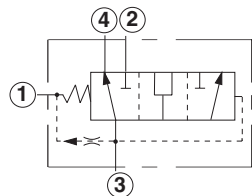
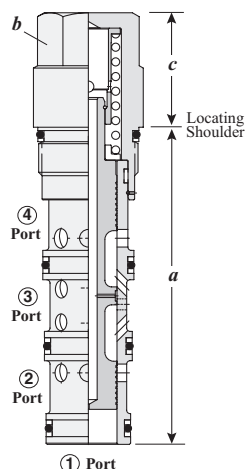
- Maximum operating pressure = 350 bar.
- Pressure compensated vent flow = DSCX, DSEX: 0,38 L/min.; DSGX, DSIX: 0,60 L/min.
- There must be a pressure source at port 3, relative to port 1, to shift the valve.
- The pressure at port 3 must be greater than port 1 and is dependant on the minimum control pressure selected.
- One application of this valve is to bypass divider/combiner valves in a limited-slip tractive circuit. Closed, the oil must go through the divider/combiner valves. Open, there is a large path around the divider/combiner valves for efficient high speed operation.
- One pilot valve may be used; to vent multiple diverter valves if blocking checks are used at port 1 of each diverter. If blocking checks are not used, there will be interaction between high and low pressure legs of the circuits.
- Hardened spool and sleeve provide consistent and low spool leakage rates and excellent wear characteristics.
- The valve is not bistable; it is capable of modulation between the two positions shown.

OPTION ORDERING INFORMATION

DS * X – X E *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
C 60 L/min.	X Not Adjustable	C 2 bar	N Buna-N
E 120 L/min.		D 3,5 bar	V Viton
G 240 L/min.		E 5 bar	
I 480 L/min.			

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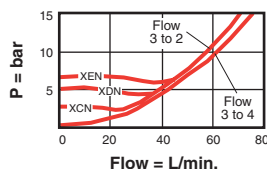
3-WAY, 2-POSITION, VENT-TO-SHIFT, DIVERTER, NORMALLY OPEN



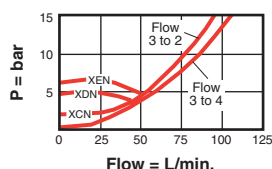
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DSCY – XEN	T - 31A	84,8	22,2	30,2	45 - 50
120 L/min.	DSEY – XEN	T - 32A	92,2	28,6	33,3	60 - 70
240 L/min.	DSGY – XEN	T - 33A	114,6	31,8	41,4	200 - 215
480 L/min.	DSIY – XEN	T - 34A	139,7	41,3	53,8	465 - 500

Performance Curves

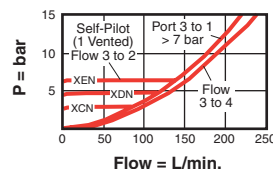
DSCY



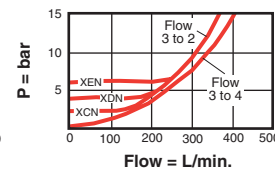
DSEY



DSGY



DSIY



Typical Pressure Drop

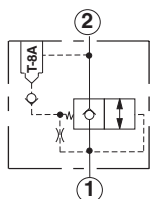
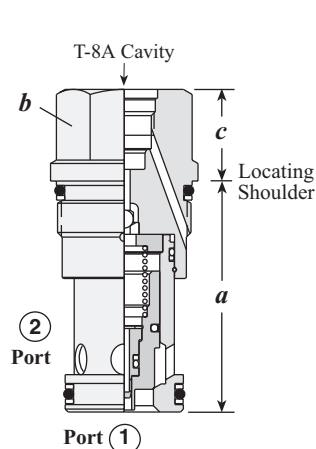
- Maximum operating pressure = 350 bar.
- Pressure compensated vent flow = DSCY, DSEY: 0,38 L/min.; DSGY, DSIY: 0,60 L/min.
- The pressure at port 3 must be greater than port 1 and is dependant on the minimum control pressure selected.
- There must be a pressure source at port 3, relative to port 1, to shift the valve.
- One application of this valve is to be used in pairs to select between 2 motors or pumps.
- Hardened spool and sleeve provide consistent and low spool leakage rates and excellent wear characteristics.
- The valve is not bistable; it is capable of modulation between the two positions shown.

OPTION ORDERING INFORMATION

DS * Y – X E *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
C 60 L/min.	X Not Adjustable	C 2 bar	N Buna-N
E 120 L/min.		D 3,5 bar	V Viton
G 240 L/min.		E 5 bar	
I 480 L/min.			

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2-WAY POPPET, WITH INTEGRAL T-8A CONTROL CAVITY, CONTROL PORT 1 TO PORT 2



The -8 control option allows the pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DFCA - 8DN	T - 13A	35,1	22,2	19,1	45 - 50
120 L/min.	DFDA - 8DN	T - 5A	41,1	28,6	17,5	60 - 70
240 L/min.	DFEA - 8DN	T - 16A	62,0	31,8	24,6	200 - 215
480 L/min.	DFFA - 8DN	T - 18A	79,5	41,3	30,2	465 - 500

Performance Curves

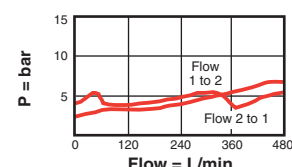
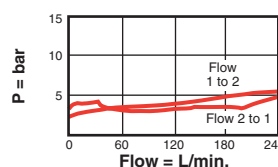
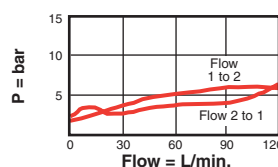
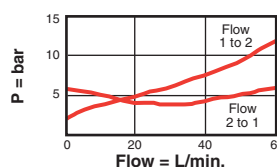
DFCA-8

DFDA-8

DFEA-8

DFFA-8

Pressure Differential vs. Flow



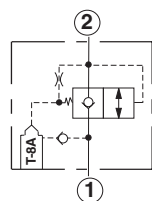
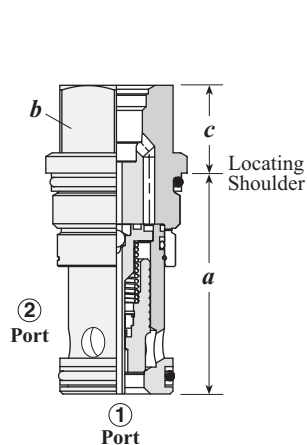
- Maximum operating pressure = 350 bar.
- Maximum main stage valve leakage at 24 cSt = 0,6 cc/min. at 350 bar (for complete assembly, port valve leakage must be considered).
- The main stage valve should first be installed to the correct torque value followed by the T-8A pilot control section into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

DF * A - 8 D *			
Nominal Capacity	Control	Cracking Pressure	Seal Material
C 60 L/min.	8 T-8A cavity in hex body for pilot operation	D 3,5 bar	N Buna-N
D 120 L/min.			V Viton
E 240 L/min.	Pilot valve to be ordered separately		
F 480 L/min.	Options are:		
	• Solenoid Pilot		
	• Air Pilot		
	• Hydraulic Pilot		
	• Manual Control		

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2-WAY POPPET, WITH INTEGRAL T-8A CONTROL CAVITY, CONTROL PORT 2 TO PORT 1



The -8 control option allows the pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DFCB – 8DN	T - 13A	35,1	22,2	19,1	45 - 50
120 L/min.	DFDB – 8DN	T - 5A	41,1	28,6	17,5	60 - 70
240 L/min.	DFEB – 8DN	T - 16A	62,0	31,8	24,6	200 - 215

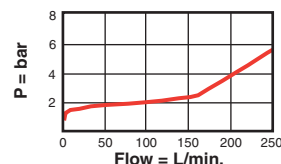
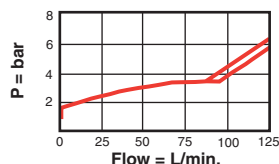
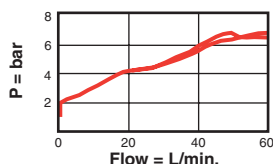
Performance Curves

DFCB-8

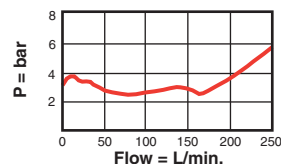
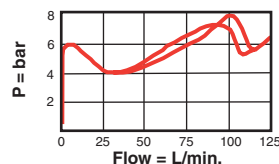
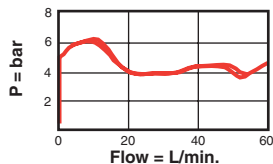
DFDB-8

DFEB-8

Pressure vs. Flow with T-8A Pilot Stage Installed, Port 1 to 2



Pressure vs. Flow with T-8A Pilot Stage Installed, Port 2 to 1



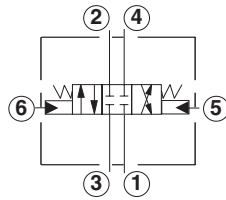
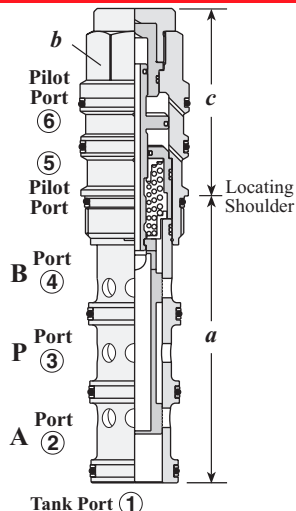
- Maximum operating pressure = 350 bar.
- Maximum main stage valve leakage at 24 cSt = 0,6 cc/min. at 350 bar (for complete assembly, port valve leakage must be considered).
- The main stage valve should first be installed to the correct torque value followed by the T-8A pilot control section into the main stage valve to its required torque value.

OPTION ORDERING INFORMATION

DF * B – 8 D *			
Nominal Capacity	Control	Cracking Pressure	Seal Material
C 60 L/min.	8 T-8A cavity in hex body for pilot operation	D 3,5 bar	N Buna-N
D 120 L/min.	Pilot valve to be ordered separately Options are: • Solenoid Pilot • Air Pilot • Hydraulic Pilot • Manual Control		V Viton
E 240 L/min.			

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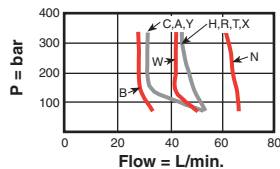
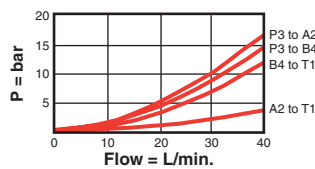
3-POSITION, 4-WAY, PILOT-TO-SHIFT



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	DCCC – XCN	T - 61A	85,1	22,2	50,0	45 - 50
80 L/min.	DCDC – XCN	T - 62A	92,2	28,6	58,7	60 - 70
160 L/min.	DCEC – XCN	T - 63A	114,6	31,8	72,1	200 - 215
320 L/min.	DCFC – XCN	T - 64A	140,0	41,3	91,2	465 - 500

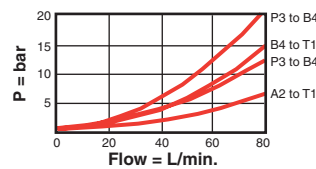
Performance Curves

DCCC

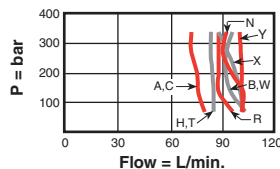


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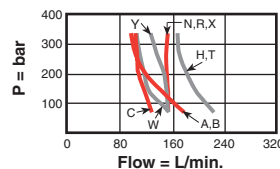
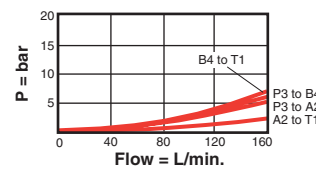
Typical Pressure Drop



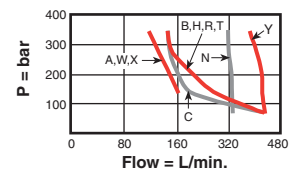
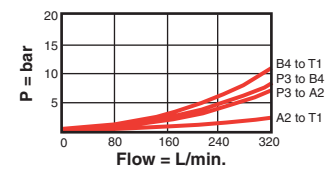
Flow Capacity vs. System Pressure with 12 bar Pilot Signal



DCEC

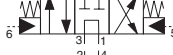
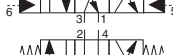


DCFC



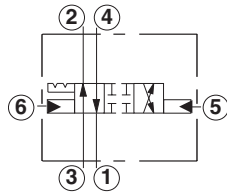
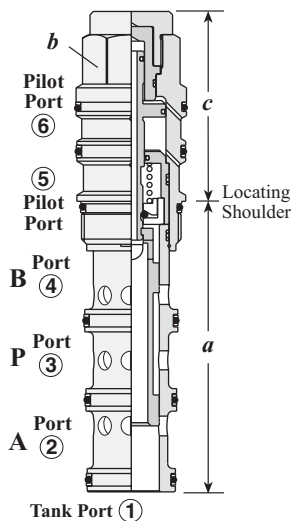
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 30 cc/min. at 70 bar.
- Minimum pilot pressure required to shift valve = DCCC: 12 bar, DCDC: 10,5 bar, DCEC, DCFC: 9 bar.
- Pilot volume displacement = DCCC: 0,33 cc.; DCDC: 0,98 cc.; DCEC: 2,8 cc.; DCFC: 6,9 cc.
- All ports will accept 350 bar, including the x and y pilot ports (port 5 and port 6).
- The pilot ports, 5 and 6 are positively sealed from the work ports.
- The reason for the different capacities, or performance limits, for the different spool configurations are flow forces. Flow forces are proportional to flow and pressure drop. Typically, they resist the opening of a passage. Spool configurations that open passages as they spring centre are the most susceptible. If the flow forces due to the flow and pressure conditions exceed the centring spring force the valve may not shift completely. Higher flows may be used at lower pressures.

OPTION ORDERING INFORMATION

DC * C – X * *							
Nominal Capacity	Control	Spool Configuration			Spool Configuration	Seal Material	
C 40 L/min.	X Standard Pilot	A A to T Centre		R Regen Centre		N Buna-N V Viton	
D 80 L/min.		B B to T Centre		T Tandem Centre			
E 160 L/min.		C Blocked Centre		W A and B Bleed to T Centre			
F 320 L/min.		H Open Centre		X P to B and A to T Centre			
		N P to A and B to T Centre		Y A and B to T Centre			

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

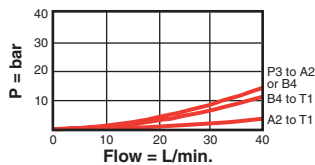
2-POSITION, 4-WAY, PILOT-TO-SHIFT, DETENTED



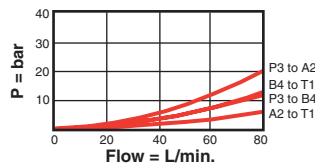
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	DCCD – XCN	T - 61A	85,1	22,2	50,0	45 - 50
80 L/min.	DCDD – XCN	T - 62A	92,2	28,6	58,7	60 - 70
160 L/min.	DCED – XCN	T - 63A	114,6	31,8	72,1	200 - 215
320 L/min.	DCFD – XCN	T - 64A	140,0	41,3	91,2	465 - 500

Performance Curves

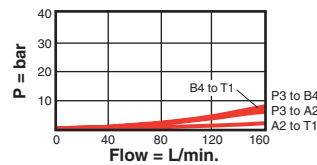
DCCD



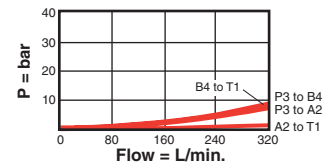
DCDD



DCED



DCFD



Typical Pressure Drop

See www.sunhydraulics.com for additional performance curves.

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 30 cc/min. at 70 bar.
- Minimum pilot pressure required to shift valve = DCCD: 12 bar, DCDD: 10,5 bar, DCED, DCFD: 9 bar.
- Pilot volume displacement = DCCD: 0,82 cc.; DCDD: 2,0 cc.; DCED: 5,6 cc.; DCFD: 14,0 cc.
- All ports will accept 350 bar, including the x and y pilot ports (port 5 and port 6).
- The pilot ports, 5 and 6, are positively sealed from the work ports.

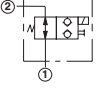
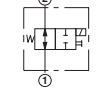
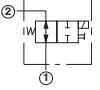
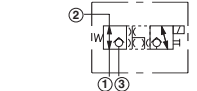
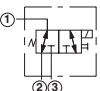
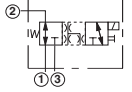
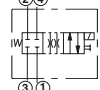
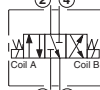
OPTION ORDERING INFORMATION

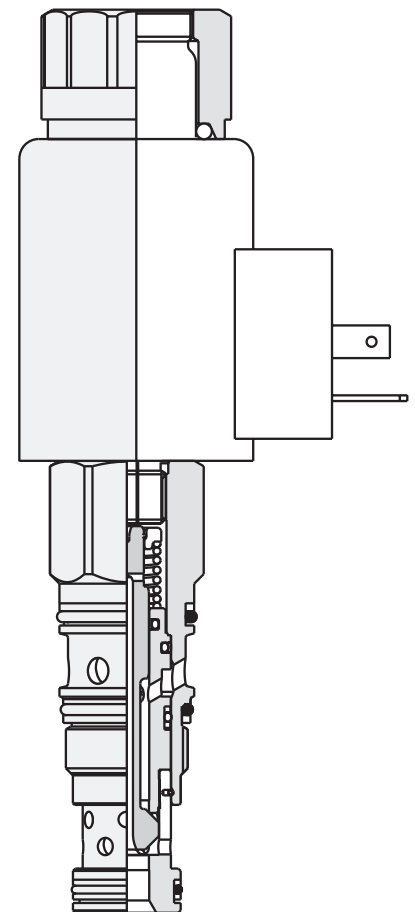
DC * D – X * *

Nominal Capacity	Control	Spool Configuration	Seal Material
C 40 L/min.	X Standard Pilot	C Blocked Crossover	N Buna-N V Viton
D 80 L/min.		H Open Crossover	
E 160 L/min.		X P to B and A to T Crossover	
F 320 L/min.		T Tandem Crossover	

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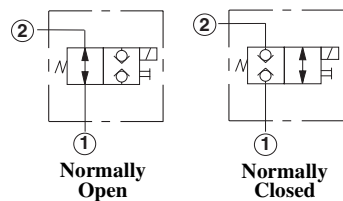
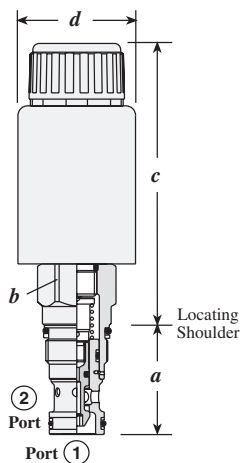
Solenoid Operated Cartridge Valves

	Cartridge Type	Page
Normally Open  Normally Closed 	2-way, Direct Acting, Poppet Directional Valve	132
Normally Open  Normally Closed 	2-way, Directional Spool Valve, Pilot Capacity	133
Normally Open  Normally Closed 	2-way, Soft Shift, Directional Spool Valve	134
Normally Open 	3-way, 2-position, Direct Acting, Directional Poppet Valve	135
Normally Open  Normally Open 	3-way, 2-position, Directional Spool Valve, Pilot Capacity	136
	3-way, 2-position, Soft Shift, Directional Spool Valve	137
	4-way, 2-position, Directional Spool Valve	138
	4-way, 3-position, Spring Centred, Directional Spool Valve	139



Solenoid Operated Cartridge Valves

2-WAY, DIRECT ACTING, POPPET DIRECTIONAL VALVE



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c***		d	
40 L/min.	DTDA -***	T - 13A	35,0	22,2	M,X,S	D,L,T	37,3	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

DTDA-MC*

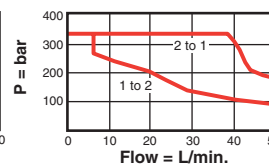
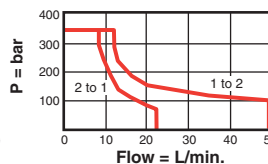
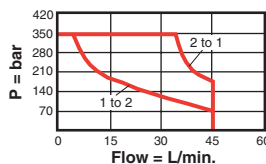
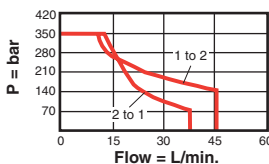
DTDA-MH*

DTDA-SC*

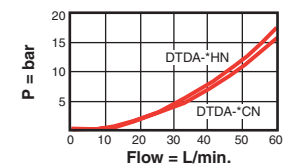
DTDA-SH*

DTDA-***

Valve Performance Limits at 10% Undervoltage and Stabilized Coil Temperature

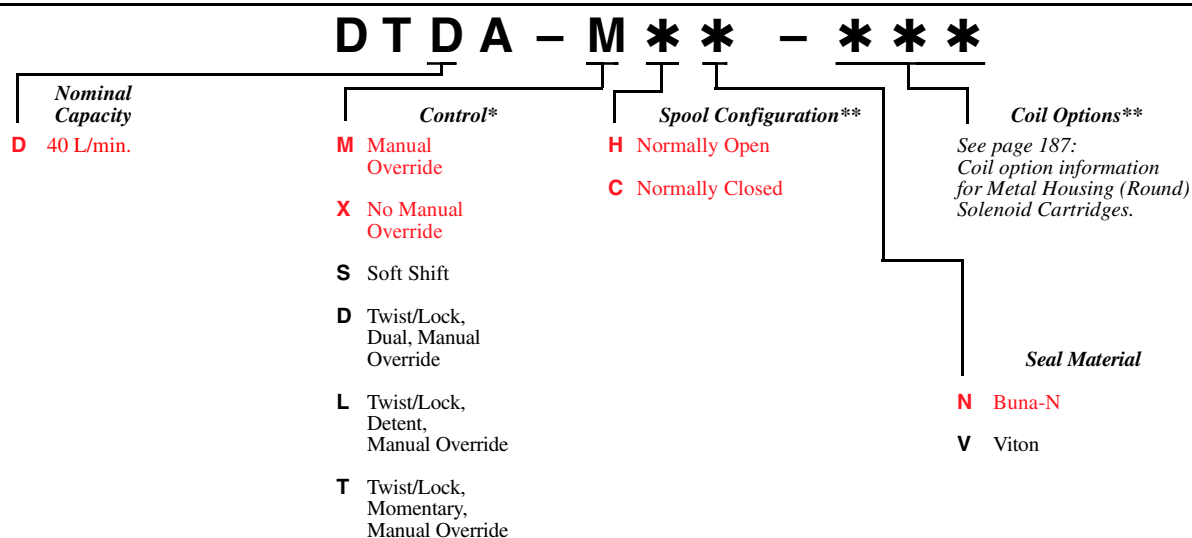


Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 10 kg at 350 bar.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

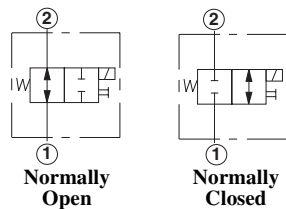
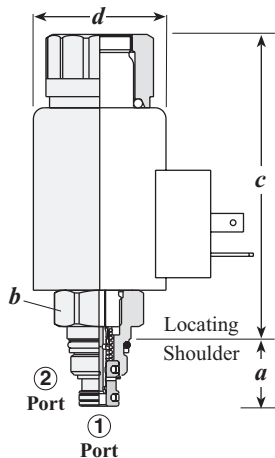


* See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

2-WAY, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY



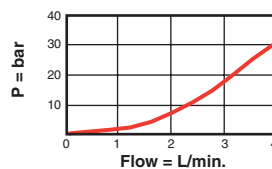
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
1 L/min.	DAAL - ***	T - 8A	18,5	22,2	M,X,S 83,6	D,L,T 108,7	37,3

***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

DAAL-X**, DAAL-S**

Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 6,6 kg at 100 bar at port 1.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

DAAL - X** - ***			
Nominal Capacity	Control*	Spool Configuration**	Coil Options**
A 1 L/min.	X No Manual Override	H Normally Open	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges.
	M Manual Override	C Normally Closed	
	S Soft Shift		
	D Twist/Lock, Dual, Manual Override		
	L Twist/Lock, Detent, Manual Override		Seal Material
	T Twist/Lock, Momentary, Manual Override		
			N Buna-N
			V Viton

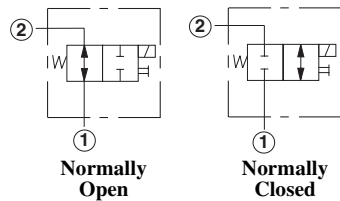
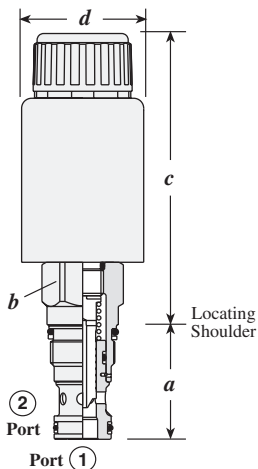
* See page 178 for information on Control Options

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Solenoid Operated Cartridge Valves

2-WAY, SOFT SHIFT, DIRECTIONAL SPOOL VALVE

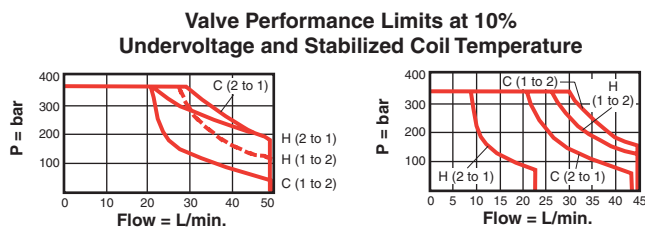


Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
45 L/min.	DLDA - ***	T - 13A	35,0	22,2	89,4	114,3	45 - 50

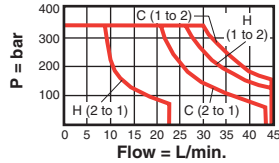
***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

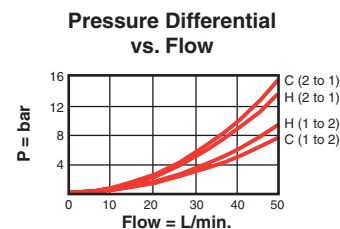
DLDA-M**



DLDA-S**

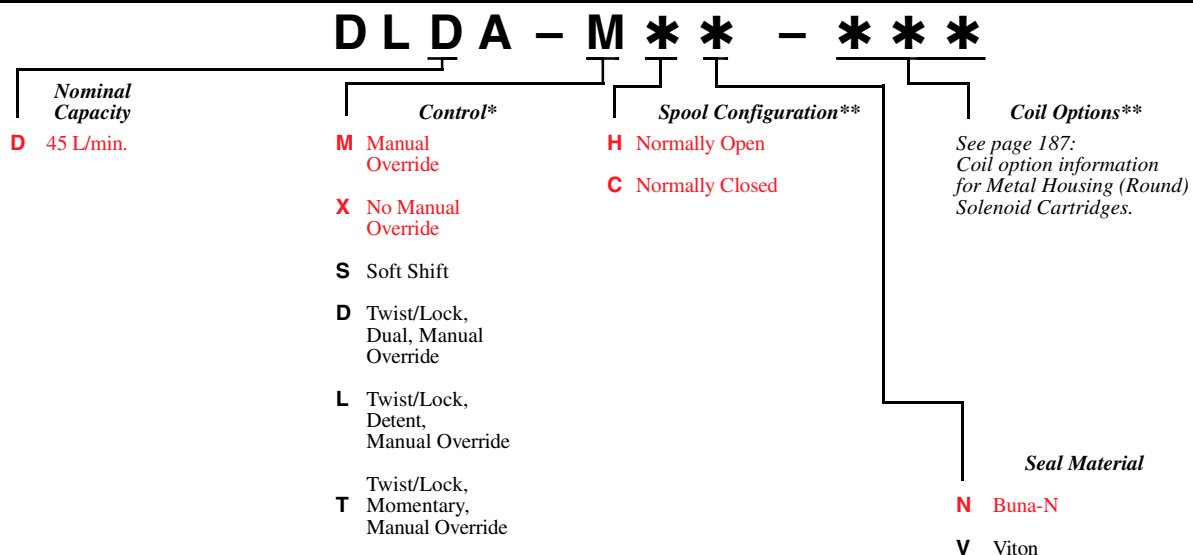


DLDA-***



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 80 cc/min. at 210 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 10 kg at 350 bar.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION



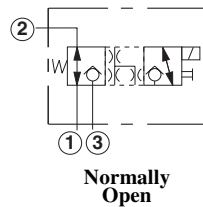
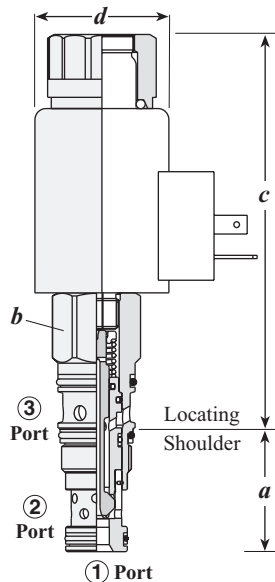
* See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Solenoid Operated Cartridge Valves

3-WAY, 2-POSITION, DIRECT ACTING, DIRECTIONAL POPPET VALVE



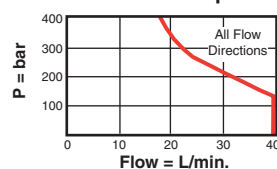
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			<i>a</i>	<i>b</i>	<i>c</i> ***	<i>d</i>	
30 L/min.	DWDA-XAN	T - 11A	34,8	22,2	108,2	133,1	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

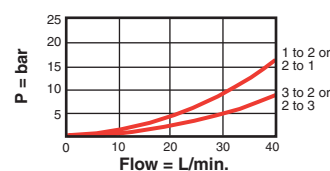
Performance Curves

DWDA-XAN

Valve Performance Limits at 10% Undervoltage and Stabilized Coil Temperature



Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 10 kg at 350 bar.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

D W D A - X A * - * * *

Nominal Capacity	Control*	Spool Configuration**	Coil Options**	Seal Material
D 30 L/min.	X No Manual Override	A Normally Open Port 1 to 2, Closed 2 to 3	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges.	N Buna-N
	M Manual Override			V Viton
	D Twist/Lock, Manual Override			
	L Twist/Lock, Detent, Manual Override			
	T Twist/Lock, Momentary, Manual Override			

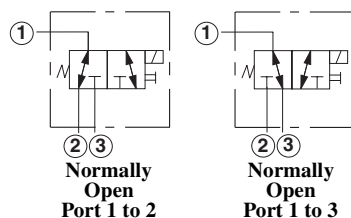
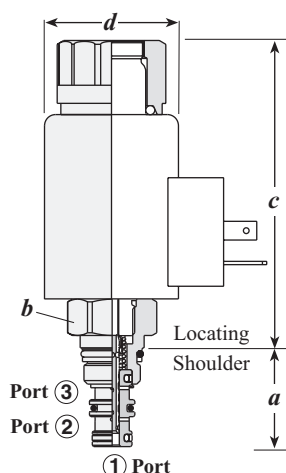
* See page 178 for information on Control Options

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Solenoid Operated Cartridge Valves

3-WAY, 2-POSITION, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY



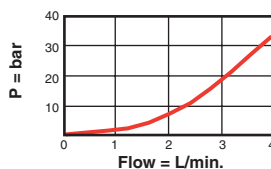
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
1 L/min.	DBAL - ***	T - 9A	27,4	22,2	83,6	108,7	35 - 40

***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

DBAL-M**, DBAL-S

Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 6,6 kg at 100 bar at port 1.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

DBAL - X** - ***			
Nominal Capacity	Control*	Spool Configuration**	Coil Options**
A 1 L/min.	X No Manual Override	H Normally Open Port 1 to 2, Closed 1 to 3	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges.
	M Manual Override	C Normally Open Port 1 to 3, Closed 1 to 2	
	S Soft Shift		Seal Material
	D Twist/Lock, Dual, Manual Override		
	L Twist/Lock, Detent, Manual Override		
	T Twist/Lock, Momentary, Manual Override		N Buna-N
			V Viton

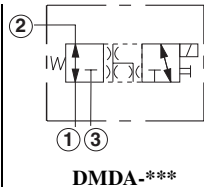
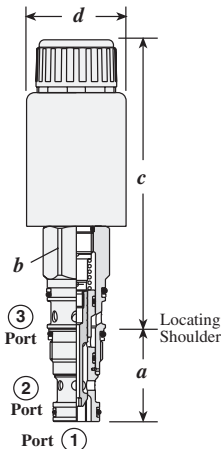
* See page 178 for information on Control Options

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Solenoid Operated Cartridge Valves

3-WAY, 2-POSITION, SOFT SHIFT, DIRECTIONAL SPOOL VALVE



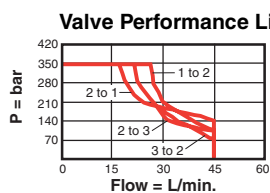
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
45 L/min.+	DMDA- ***	T - 11A	35,0	22,2	108,2	132,8	45 - 50

*** An additional 50,8 mm clearance is needed for coil installation and removal.

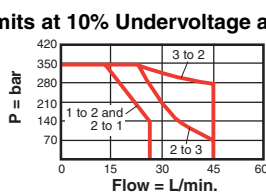
+ Only for A and N spools. View performance curves for other spool configurations.

Performance Curves

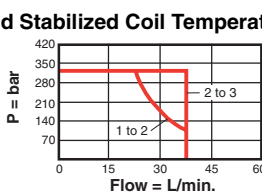
DMDA-MA*



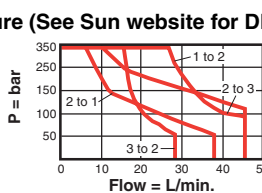
DMDA-MN*



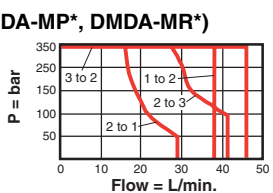
DMDA-MB*



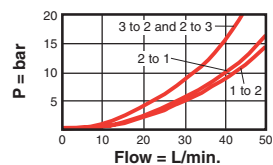
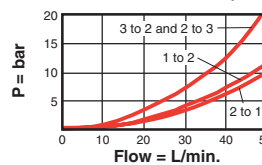
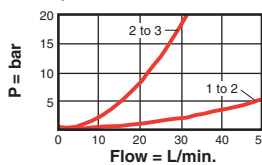
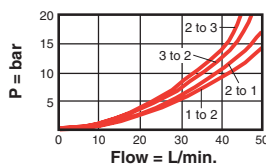
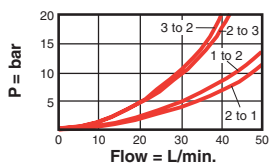
DMDA-SA*



DMDA-SN*



Valve Performance Limits at 10% Undervoltage and Stabilized Coil Temperature (See Sun website for DMDA-MP*, DMDA-MR*)



Pressure Differential vs. Flow (See Sun website for DMDA-MP*, DMDA-MR*)

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 80 cc/min. at 210 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 10 kg at 350 bar.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- Spools B and R are closed in the transition between their two positions. This results in a higher performance limit at the expense of lower capacity. When used as pilot controls, where capacity is not a factor, the closed transition will provide faster and more consistent response times.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

DMDA - M * * - * * *

Nominal Capacity	Control*	Spool Configuration**	Coil Options**
D 45 L/min.	M Manual Override X No Manual Override S Soft Shift D Twist/Lock, Dual, Manual Override L Twist/Lock, Detent, Manual Override T Twist/Lock, Momentary, Manual Override	A Normally Open Port 1 to 2, Closed 2 to 3 N Normally Open Port 2 to 3, Closed 1 to 2 B Normally Open Ports 1 to 2, Closed 2 to 3, Closed Transition P Normally Open Ports 1 to 3, Closed 1 to 2 R Normally Open Ports 2 to 3, Closed 1 to 2, Closed Transition	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges. Seal Material N Buna-N V Viton

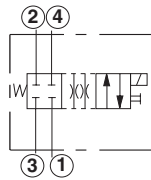
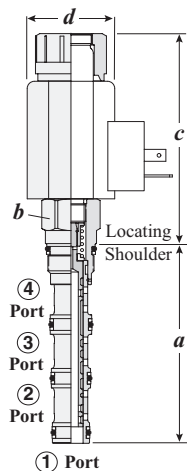
* See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Solenoid Operated Cartridge Valves

4-WAY, 2-POSITION, DIRECTIONAL SPOOL VALVE



DNDA-***

Nominal Capacity

Typical Cartridge Model Code

Cavity

Cartridge Dimensions

Installation Torque (Nm)

Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
40 L/min.	DNDA - ***	T - 31A	84,8	22,2	89,4	114,3	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

DNDA-X**

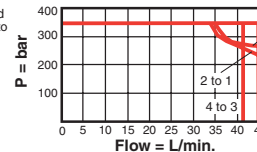
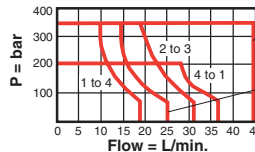
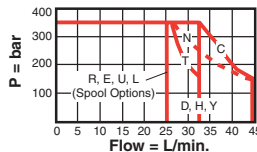
DNDA-SC*

DNDA-SN*

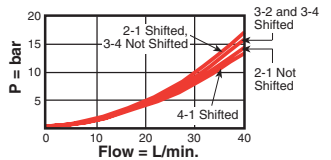
DNDA-***

Valve Performance Limits at 10% Undervoltage and Stabilized Coil Temperature

Note: Performance limits are derived with 4-way operation and symmetrical flow. For valve applications where either asymmetrical flow or 3-way operation are present, these performance limits may be reduced.



Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 160 cc/min. at 210 bar.
- Manual override force requirement = 10 kg at 350 bar.
- Manual override stroke = 2,5 mm.
- Response time - typical = 50 ms.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

DNDA - X * * - * * *

Nominal Capacity	Control*	Spool Configuration**	Spool Configuration**	Coil Options**
D 40 L/min.	X No Manual Override	C Closed, Shift to Through	N Through, Shift to Cross	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges.
	M Manual Override	D Closed, Shift to Cross	R Regen, Shift to Cross	
	S Soft Shift	E Cross, Shift to Closed	T Tandem, Shift to Through	
	D Twist/Lock Dual, Manual Override	H Open, Shift to Cross	U Through, Shift to Through	
	L Twist/Lock, Detent, Manual Override	L Cross, Shift P to A, B and T Blocked	Y Motor, Shift to Cross	Seal Material
	T Twist/Lock, Momentary, Manual Override			

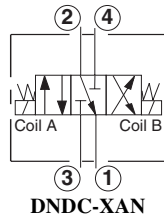
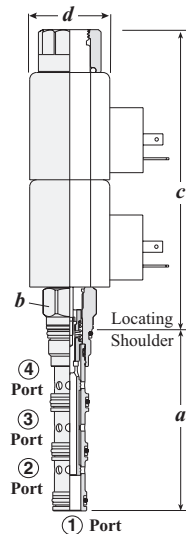
* See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Solenoid Operated Cartridge Valves

4-WAY, 3-POSITION, SPRING CENTRED, DIRECTIONAL SPOOL VALVE



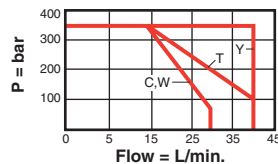
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
20 L/min.	DNDC - X**	T - 31A	84,8	22,2	139,4	37,3	45 - 50

***An additional 50,8 mm clearance is needed for coil installation and removal.

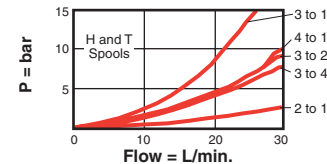
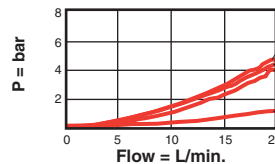
Performance Curves

DNDC-X**

Valve Performance Limits at 10% Undervoltage and Stabilized Coil Temperature



Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 160 cc/min. at 210 bar.
- Response time - typical = 50 ms.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

DNDC - X** - ***

Nominal Capacity	Control*	Spool Configuration**		Coil Options**
D 20 L/min.	X No Manual Override	A A to T Centre B B to T Centre C Blocked Centre H Open Centre	R Regen Centre T Tandem Centre W A and B, Bleed to T Centre Y A and B to T Centre	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges. Sea Material N Buna-N V Viton

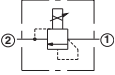
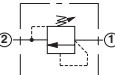
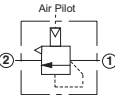
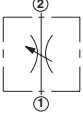
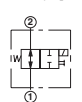
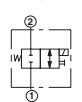
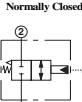
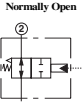
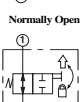
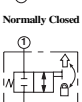
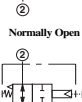
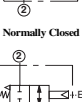
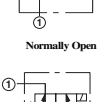
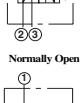
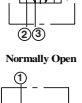
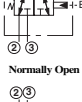
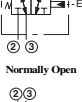
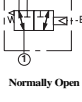
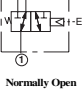
* See page 178 for information on Control Options

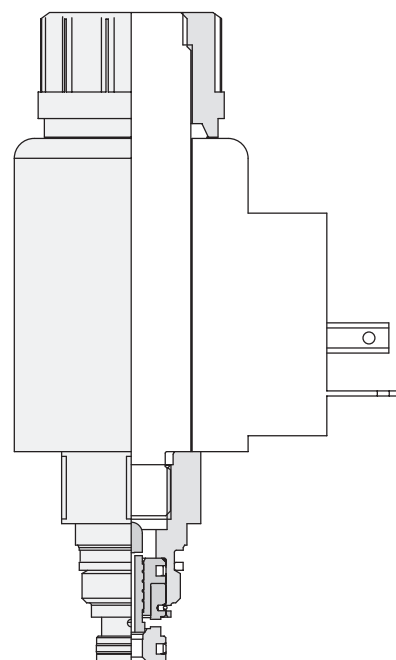
** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

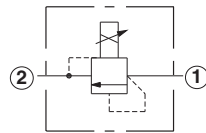
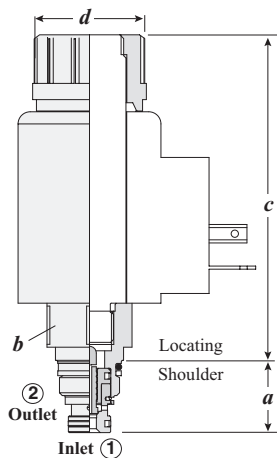
NOTES

Pilot Control Valves

Cartridge Type	Page
	142
	143
	144
	145
 	146
 	147
 	148
 	149
 	150
 	151
 	152
 	153



ELECTRO-PROPORTIONAL, RELIEF VALVE, PILOT CAPACITY



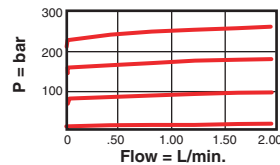
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	L	X/M	d	
1 L/min.	RBAP – XAN	T - 8A	18,8	22,2	130,0	85,1	37,3	35 - 40

***An additional 50,8 mm clearance is needed for coil installation and removal.

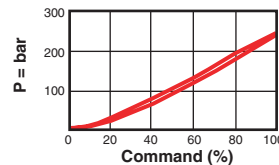
Performance Curves

RBAP

Constant Command Varying Flow



Pressure vs. Command Flow 0,37 L/min.



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at reseat = 25 cc/min.
- Low leakage levels in the closed position. Reseat > 85% of set pressure.
- Hysteresis with dither <4% and with DC input <8%.
- Linearity with dither <2% and repeatability with dither <2%.
- Recommended dither frequency = 140 Hz.
- For optimum performance, an amplifier with current sensing and adjustable dither should be used. Dither should be adjustable between 100 - 250 Hz.
- The L control allows one to manually adjust the valve in case of an electrical failure. The L control also allows offsetting the pressure range. For instance, if an A range valve is offset to a setting of 100 bar with no analog input signal, the new maximum will be 300 bar.
- This electro-proportional cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2 port pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

OPTION ORDERING INFORMATION

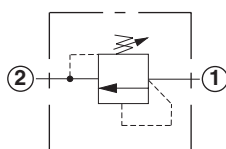
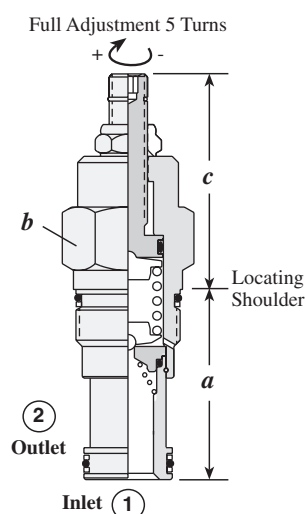
R B A P – X * * – * * *				Coil Options**
Nominal Capacity	Control*	Adjustment Range	Seal Material	
A 1 L/min.	X No Manual Override	A 20 - 210 bar	N Buna-N	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges.
	M Manual Override	B 10,5 - 105 bar	V Viton	
	L Manual Override, Adjustable	D 3,5 - 50 bar		
	T Tuning Adjustment	W 35 - 350 bar		

* See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

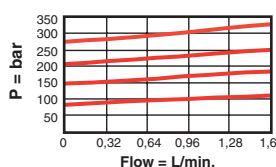
DIRECT ACTING, RELIEF VALVE, PILOT CAPACITY



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions						Installation Torque (Nm)
			a	b	c				
					L	C	K	O	
1 L/min.	RBAC – LAN	T - 10A	39,7	22,2	51,0	55,0	58,0	58,0	45 - 50
2 L/min.	RBAA – LAN	T - 3A	47,8	28,6	54,0	56,0	61,0	61,0	60 - 70
10 L/min.	RBAE – LAN	T - 8A	19,1	22,2	60,5	62,7	67,6	67,6	35 - 40

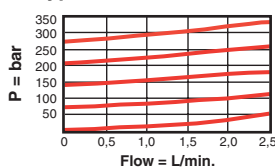
Performance Curves

RBAC

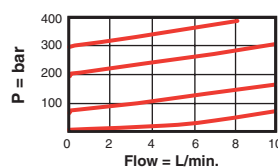


RBAA

Typical Pressure Rise



RBAE



- Maximum operating pressure = 350 bar.
- Typical response time 2 ms.
- Maximum valve leakage at reseal at 24 cSt = RBAC, RBAA, 0,3 cc/min.; RBAE: 1 cc/min.
- Back pressure on the tank port (port 2) is directly additive to the pressure setting at port 1 (inlet) at a 1:1 ratio to the valve setting.
- RBAE: This cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2-position, 2-way, pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

OPTION ORDERING INFORMATION

R B A * - * * *

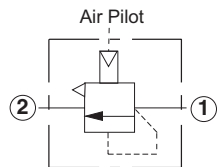
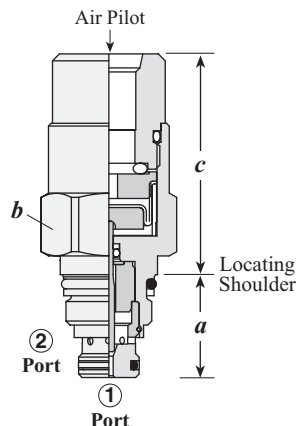
Nominal Capacity	Control**	Adjustment Range	Seal Material
C 1 L/min.	L Standard Screw Adjustment	A 1,7 - 210 bar Standard set at 70 bar	N Buna-N
A 2 L/min.	C* Tamper Resistant Factory Set	B 1,7 - 105 bar Standard set at 70 bar	V Viton
E 10 L/min.	K Handknob with Lock Knob	C 1,7 - 420 bar Standard set at 70 bar	
	O Handknob with Panel Mount	D 1,7 - 55 bar Standard set at 28 bar	
	* Special setting required. Specify at time of order.	E 1,7 - 28 bar Standard set at 14 bar	
		W 1,7 - 315 bar Standard set at 70 bar	

** See page 178 for information on Control Options

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

AIR CONTROLLED, DIRECT ACTING, RELIEF VALVE, PILOT CAPACITY

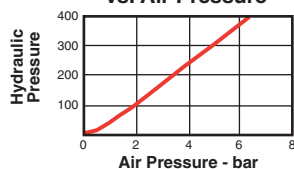


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
10 L/min.	RBAR – DWN	T - 8A	19,1	22,2	40,9	35 - 40
10 L/min.	RBAR – DYN	T - 8A	19,1	28,6	40,9	35 - 40

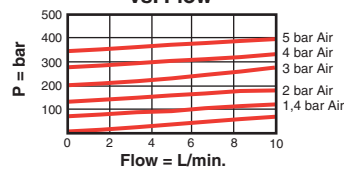
Performance Curves

RBAR

Hydraulic Pressure at 0,4 L/min. vs. Air Pressure



Pressure Differential vs. Flow



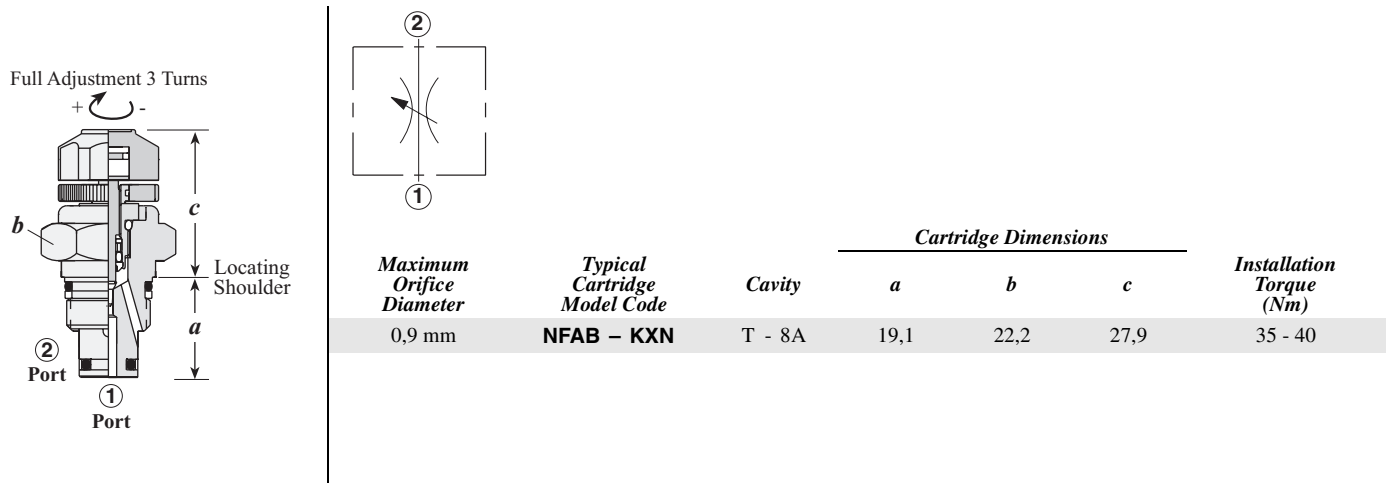
- Amplifies air pilot pressure to hydraulic by a nominal 50:1 or 75:1 ratio.
- Maximum air pilot pressure = 10,5 bar.
- Minimum operational air pressure = 1,4 bar.
- Reseat = > 90% of amplified set pressure.
- Maximum amplified operating pressure = 350 bar.
- Maximum valve leakage at reseal at 24 cSt = 1 cc/min.
- Ports 1 and 2 may be pressured to 350 bar.
- Back pressure at port 2 increases the relief setting by .43 multiplier.
- This cartridge utilizes the Sun T-8A 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2-position, 2-way, pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

OPTION ORDERING INFORMATION

R B A R - * * *			
Nominal Capacity	Pilot Control Port	Air Pilot Ratio	Seal Material
A 10 L/min.	A External 1/8 NPTF Port	W 50:1	N Buna-N
	B External SAE-4 Port	Y 75:1	V Viton
	D External 1/8 BSPP Port		

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

FLOW CONTROL, FULLY ADJUSTABLE NEEDLE VALVE, PILOT CAPACITY



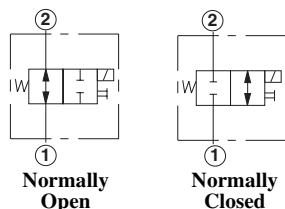
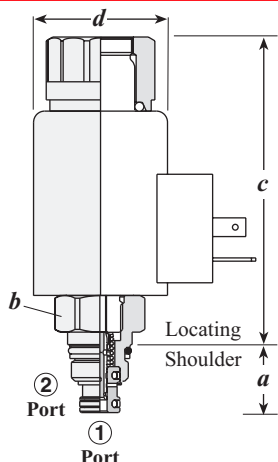
- Maximum operating pressure = 350 bar.
- Leakage rate at shutoff is less than .07 cc/min.
- Effective orifice size = 0,9 mm.
- Ports 1 and 2 may be pressured to 350 bar.
- Needle adjusts from fully closed to fully open in three complete turns resulting in extremely fine resolution.
- Adjustment mechanism equipped with locking device to maintain consistent orifice diameter/flow rate.
- This cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2-position, 2-way, pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

OPTION ORDERING INFORMATION

N F A B – K X *			
Model Code	Control*	Maximum Orifice Diameter	Seal Material
NFAB	K Handknob with Lock Knob	X 0,9 mm	N Buna-N V Viton
* See page 178 for information on Control Options			

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2-WAY, SOLENOID OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY



Normally Open

Normally Closed

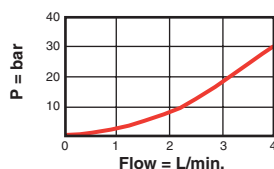
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
1 L/min.	DAAL-***	T - 8A	18,5	22,2	83,6	108,7	35 - 40

***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

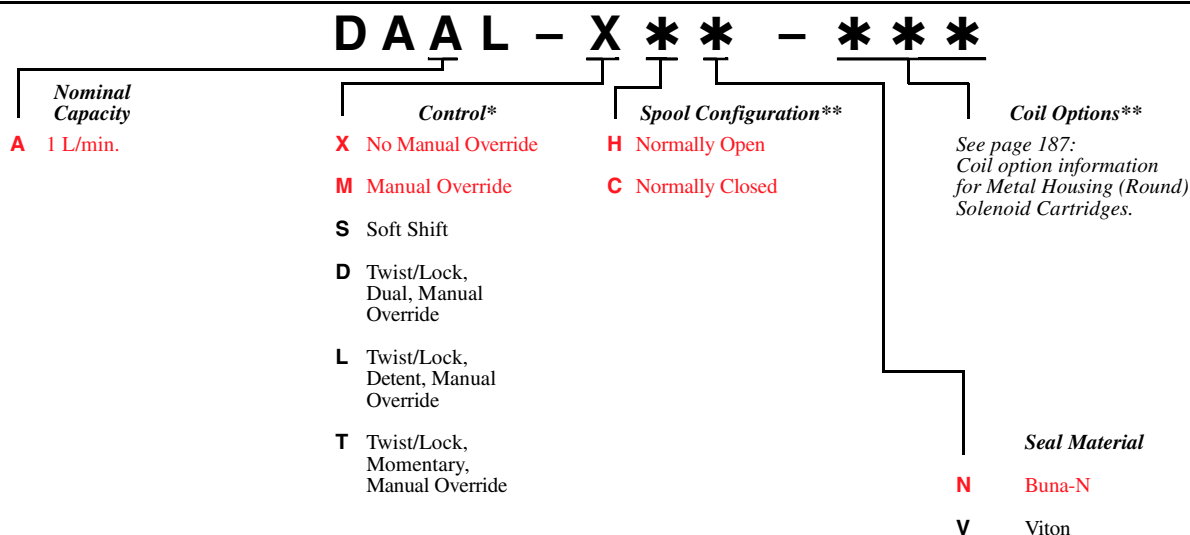
DAAL-X**, DAAL-S**

Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = < 0,6 cc/min. at 350 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 6,6 kg at 100 bar at port 1.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

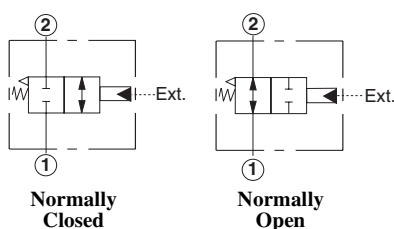
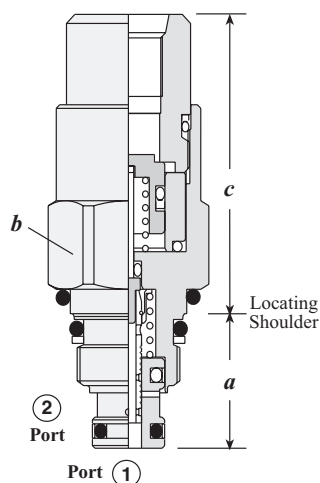


* See page 178
for information
on Control Options

** Consult the Sun website for complete information on Spool Configurations,
the full line of Coil Options and Embedded Amplifier Coils/Controllers.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

2-WAY, HYDRAULICALLY OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY

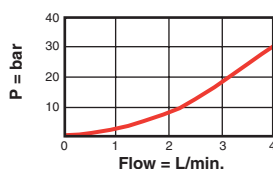


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
1 L/min.	DAH – DCN	T - 8A	19,1	22,2	52,5	35 - 40

Performance Curves

DAH

Pressure Differential vs. Flow



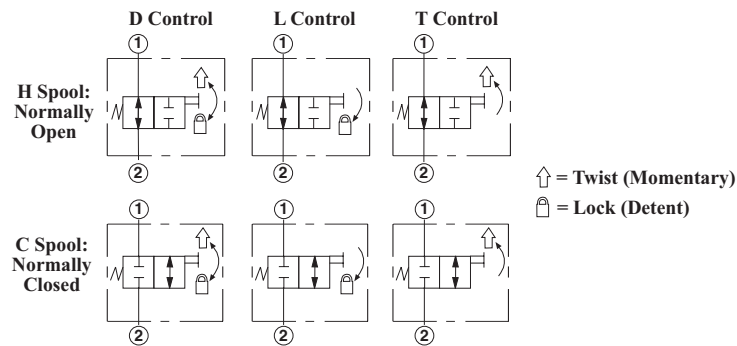
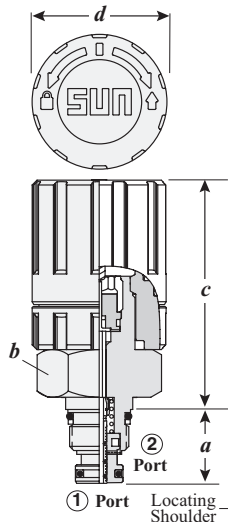
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- The minimum pilot pressure required to operate the valve is determined by the following formula: pilot pressure = 6 bar + pressure at port 1 times 0,023. This results in a pilot pressure range of 6 to 14 bar.
- All ports will accept 350 bar including the pilot control port.
- The preferred flow path through the valve is port 2 to port 1.
- This cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2-position, 2-way, pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

OPTION ORDERING INFORMATION

D A H - * * *			
Nominal Capacity	Pilot Control Port	Spool Configuration	Seal Material
A 1 L/min.	A External 1/8 NPTF Port	H Normally Open	N Buna-N
	B External SAE-4 Port	C Normally Closed	V Viton
	D External 1/8 BSPP Port		

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2-WAY, MANUALLY OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY

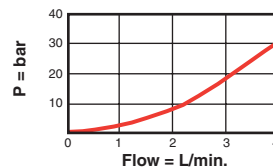


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
1 L/min.	DAAM - LCN	T-8A	18,5	28,6	61,0	48,3	35 - 40

Performance Curves

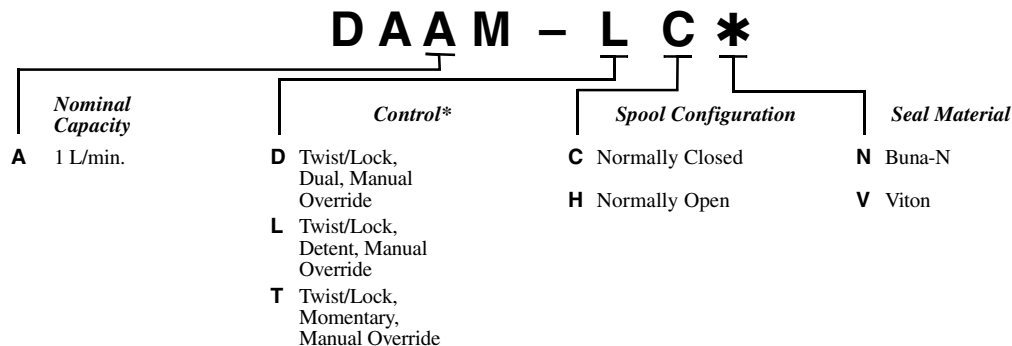
DAAM

Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- This valve is designed for intermittent use such as a manual override. The manual control assembly has a mechanical life expectancy of about 10,000 cycles.
- The preferred flow path through the valve is port 2 to port 1.
- The dual-operation control option D allows the operator to either shift the valve momentarily by twisting the knob clockwise or shift it into a mechanically detented position by twisting counter-clockwise.
- The detent/lock control option L allows the operator to shift the valve into a mechanically detented position by twisting the knob counter-clockwise. This detented position will be maintained until the operator twists the knob clockwise and allows the valve to return to its normal position.
- The momentary/twist control option T allows the operator to momentarily shift the valve by twisting the knob clockwise and releasing. Once released, the valve returns to its normal position.
- This cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2-position, 2-way, pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

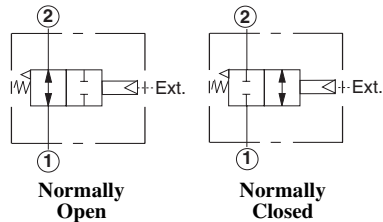
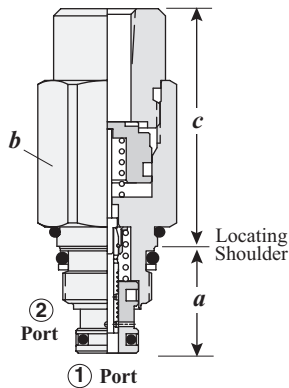
OPTION ORDERING INFORMATION



* See page 178 for information on Control Options

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

2-WAY, AIR OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY

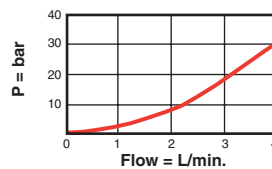


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			<i>a</i>	<i>b</i>	<i>c</i>	
1 L/min.	DAAP-PCN	T - 8A	19,1	22,2	42,2	35 - 40

Performance Curves

DAAP

Pressure Differential vs. Flow



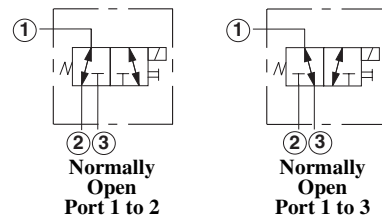
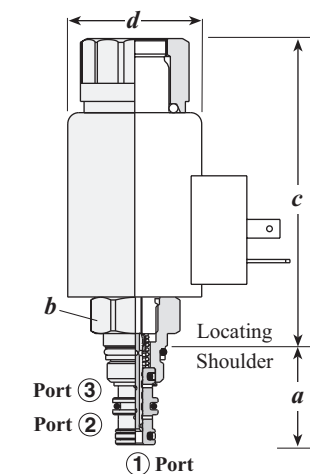
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- The minimum pilot pressure required to operate the valve is determined by the following formula: pilot pressure = 6 bar + pressure at port 1 divided by 100. This results in a pilot pressure range of 1,4 to 5 bar.
- All ports will accept 350 bar with the exception of the pilot port which accepts 35 bar maximum.
- The preferred flow path through the valve is port 2 to port 1.
- This cartridge utilizes the Sun T-8A, 2 port cavity making it the ideal choice to use in conjunction with Sun's main stage pilot or vent-to-operate cartridges. Separate pilot lines are eliminated and only one cavity needs to be machined to accommodate both the control and primary function. Note: All 2-position, 2-way, pilot stage control cartridges utilize the same cavity and are physically interchangeable. Functionality is the only consideration.

OPTION ORDERING INFORMATION

DAAP - * * *			
Nominal Capacity	Pilot Control Port	Spool Configuration	Seal Material
A 1 L/min.	E External SAE-4 Port	H Normally Open	N Buna-N
	F External 1/8 NPTF Port	C Normally Closed	V Viton
	P External 1/8 BSPP Port		

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

3-WAY, 2-POSITION, SOLENOID OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY



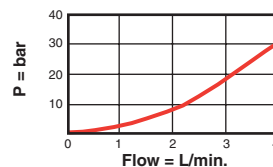
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c***	d	
1 L/min.	DBAL - ***	T - 9A	27,4	22,2	83,5	94,7	35 - 40

***An additional 50,8 mm clearance is needed for coil installation and removal.

Performance Curves

DBAL-X**, DBAL-S**

Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24cSt = 0,6 cc/min. at 350 bar.
- Response time - typical = 50 ms.
- Manual override force requirement = 6,6 kg at 100 bar at port 1.
- Manual override stroke = 2,5 mm.
- Maximum switching frequency = 15000 cycles/hr.
- Viscosity range = 10 - 600 cSt.
- This valve is direct actuated and requires no minimum hydraulic pressure for operation.
- The solenoid tube assembly is fatigue rated for 350 bar service.
- The soft shift feature results in significantly longer response time over Sun's standard solenoid. Response time is dependant on flow, pressure, coil voltage, oil viscosity and ambient temperature. Typical response time ranges from 150 ms to 300 ms.
- A wide variety of coil termination and voltage options are available. See Sun website: Products: Accessories: Coils.

OPTION ORDERING INFORMATION

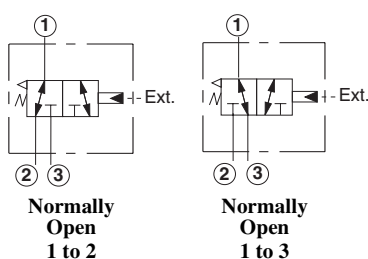
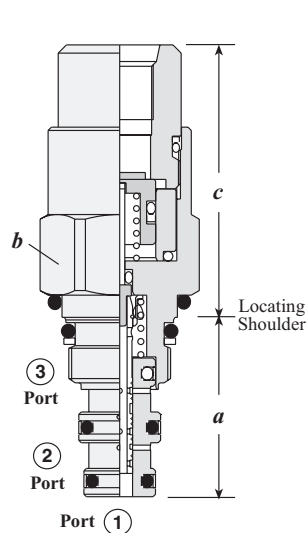
DBAL - X** - ***			
Nominal Capacity	Control*	Spool Configuration**	Coil Options**
A 1 L/min.	X No Manual Override	H Normally Open Port 1 to 2, Closed 1 to 3	See page 187: Coil option information for Metal Housing (Round) Solenoid Cartridges.
	M Manual Override	C Normally Open Port 1 to 3, Closed 1 to 2	
	S Soft Shift		
	D Twist/Lock, Dual, Manual Override		
	L Twist/Lock, Detent, Manual Override		
	T Twist/Lock, Momentary, Manual Override		
			Seal Material
			N Buna-N
			V Viton

* See page 178 for information on Control Options

** Consult the Sun website for complete information on Spool Configurations, the full line of Coil Options and Embedded Amplifier Coils/Controllers.

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3-WAY, 2-POSITION, HYDRAULICALLY OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY

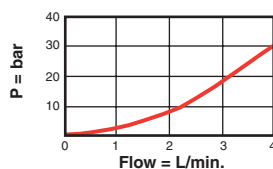


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			<i>a</i>	<i>b</i>	<i>c</i>	
1 L/min.	DBAH – DCN	T - 9A	27,7	22,2	42,1	35 - 40

Performance Curves

DBAH

Pressure Differential vs. Flow



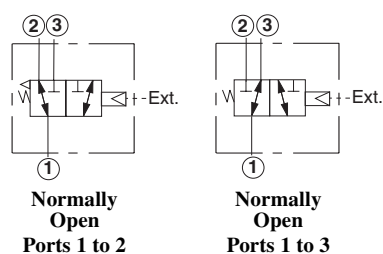
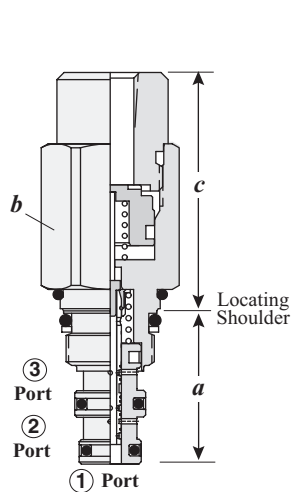
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24cSt = 0,6 cc/min. at 350 bar.
- The minimum pilot pressure required to operate the valve is determined by the following formula: pilot pressure = 6 bar + pressure at port 1 times 0,023. This results in a pilot pressure range of 6 to 14 bar.
- All ports will accept 350 bar including the pilot control port.

OPTION ORDERING INFORMATION

D B A H - * * *			
Nominal Capacity	Pilot Control Port	Spool Configuration	Seal Material
A 1 L/min.	A External 1/8 NPTF Port	H Normally Open Port 1 to 2, 1 to 3 Closed	N Buna-N
	B External SAE-4 Port	C Normally Open Port 1 to 3, 1 to 2 Closed	V Viton
	D External 1/8 BSPP Port		

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3-WAY, 2-POSITION, AIR OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY

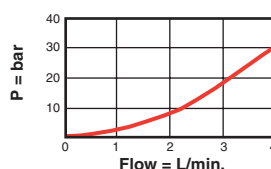


Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
1 L/min.	DBAP-PCN	T - 9A	27,7	22,2	42,1	35 - 40

Performance Curves

DBAP

Pressure Differential vs. Flow



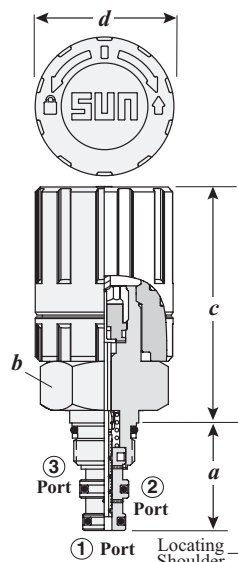
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- The minimum pilot pressure required to operate the valve is determined by the following formula: pilot pressure = 6 bar + pressure at port 1 divided by 100. This results in a pilot pressure range of 1,4 to 5 bar.
- All ports will accept 350 bar with the exception of the pilot port which accepts 35 bar maximum.

OPTION ORDERING INFORMATION

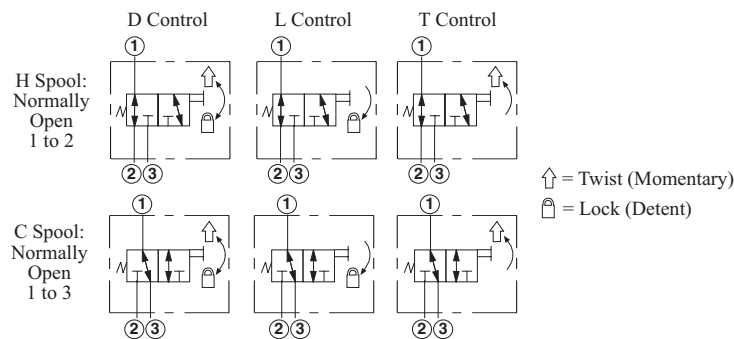
DBAP - ***			
Nominal Capacity	Pilot Control Port	Spool Configuration	Seal Material
A 1 L/min.	E External SAE-4 Port	H Normally Open Port 1 to 2, 1 to 3 Closed	N Buna-N
	F External 1/8 NPTF Port	C Normally Open Port 1 to 3, 1 to 2 Closed	V Viton
	P External 1/8 BSPP Port		

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3-WAY, 2-POSITION, MANUALLY OPERATED, DIRECTIONAL SPOOL VALVE, PILOT CAPACITY



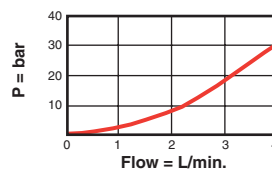
Performance Curves



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
1 L/min.	DBAM - LCN	T - 9A	27,4	22,2	61,0	35,6	35 - 40

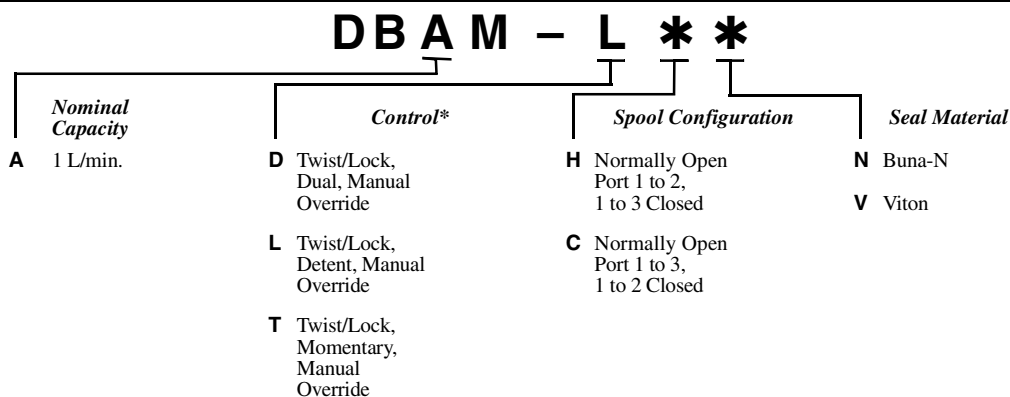
DBAM

Pressure Differential vs. Flow



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,6 cc/min. at 350 bar.
- This valve is designed for intermittent use such as a manual override. The manual control assembly has a mechanical life expectancy of about 10,000 cycles.
- The dual-operation control option D allows the operator to either shift the valve momentarily by twisting the knob clockwise or shift it into a mechanically detented position by twisting counter-clockwise.
- The detent/lock control option L allows the operator to shift the valve into a mechanically detented position by twisting the knob counter-clockwise. This detented position will be maintained until the operator twists the knob clockwise and allows the valve to return to its normal position.
- The momentary/twist control option T allows the operator to momentarily shift the valve by twisting the knob clockwise and releasing. Once released, the valve returns to its normal position.

OPTION ORDERING INFORMATION

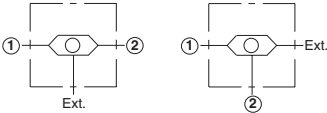
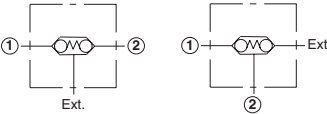
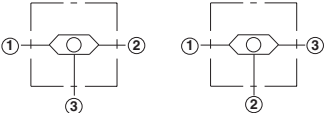
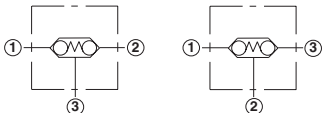
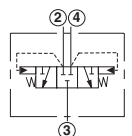
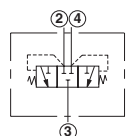
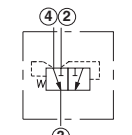


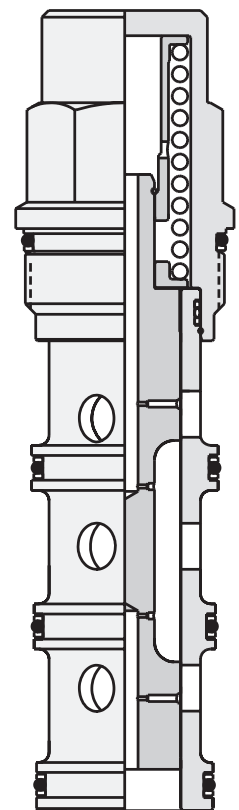
* See page 178 for information on Control Options

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

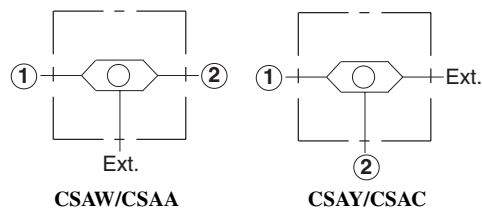
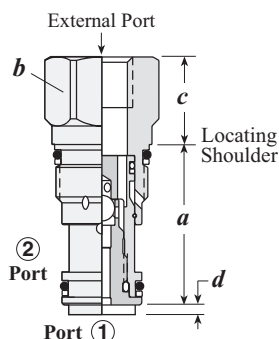
NOTES

Shuttle Valves

Cartridge Type	Page
	156
	157
	158
	159
	160
	161
	162



SINGLE BALL SHUTTLE, SIGNAL EXTERNAL OR SIGNAL AT PORT 2



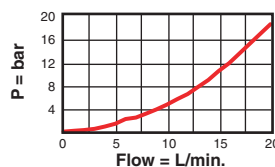
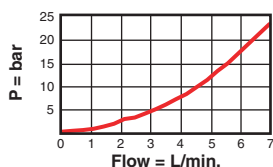
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
5 L/min.	CSAW – BXN	T - 162A	31,0	19,1	20,8	1,2	35 - 40
5 L/min.	CSAY – BXN	T - 162A	31,0	19,1	20,8	1,2	35 - 40
10 L/min.	CSAA – BXN	T - 13A	35,1	22,2	19,1	—	45 - 50
10 L/min.	CSAC – BXN	T - 13A	35,1	22,2	19,1	—	45 - 50

Performance Curves

CSAW/CSAY

CSAA/CSAC

Typical Pressure Drop



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Shuttle cartridges feature hardened steel balls and seats for excellent wear characteristics and contamination tolerance.
- The single ball allows for the decay of the pressure signal when both load ports drop to a lower pressure.

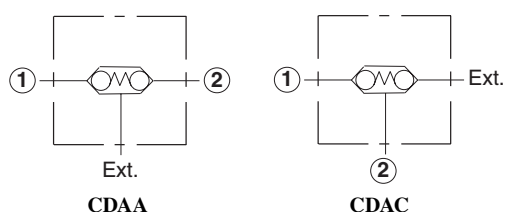
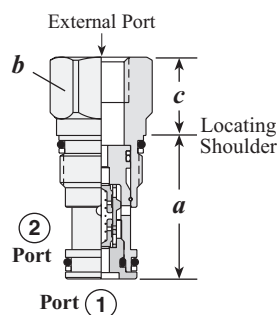
OPTION ORDERING INFORMATION

CS A * - * X *			
Nominal Capacity and Version	Control	Adjustment Range	Seal Material
W 5 L/min. Signal at External Port	B External 1/4 BSPP Port	X Not Adjustable	N Buna-N
Y 5 L/min. Signal at Port 2	E External SAE-4 Port		V Viton
A 10 L/min. Signal at External Port			
C 10 L/min. Signal at Port 2			

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

BACK-TO-BACK CHECK/SHUTTLE, SIGNAL EXTERNAL OR SIGNAL AT PORT 2

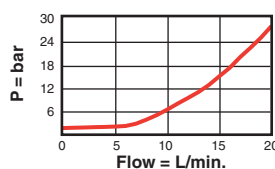


Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
10 L/min.	CDAA – BBN	T - 13A	35,1	22,2	19,1	45 - 50
10 L/min.	CDAC – BBN	T - 13A	35,1	22,2	19,1	45 - 50

Performance Curves

CDAA/CDAC

Typical Pressure Drop



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Back-to-back check cartridges feature hardened, spherically lapped, guided poppets and a lightly stressed helical spring that result in excellent wear characteristics and extremely low leakage rates.
- The back-to-back checks do not provide a means of lowering a signal. They will trap a high signal if the load pressures drop to a lower pressure. Some means of bleeding off the signal should be provided.

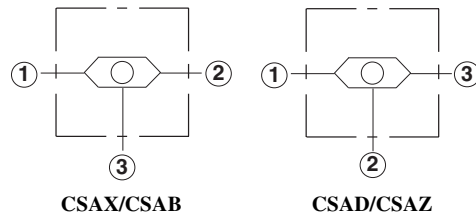
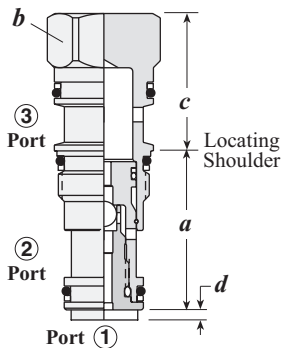
OPTION ORDERING INFORMATION

CD A * - * B *			
Nominal Capacity and Version	Control	Cracking Pressure	Seal Material
A 10 L/min. Signal External	B External 1/4 BSPP Port	B 1 bar	N Buna-N
C 10 L/min. Signal at Port 2	E External SAE-4 Port		V Viton

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

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SINGLE BALL SHUTTLE VALVE WITH SIGNAL AT PORT 3 OR PORT 2



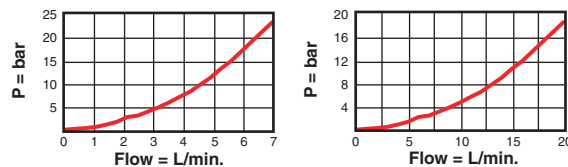
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (Nm)
			a	b	c	d	
5 L/min.	CSAX – XXN	T - 163A	31,0	19,1	31,8	1,2	35 - 40
5 L/min.	CSAZ – XXN	T - 163A	31,0	19,1	31,8	1,2	35 - 40
10 L/min.	CSAB – XXN	T - 11A	35,1	22,2	30,2	—	45 - 50
10 L/min.	CSAD – XXN	T - 11A	35,1	22,2	30,2	—	45 - 50

Performance Curves

CSAX/CSAZ

CSAB/CSAD

Typical Pressure Drop



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Shuttle cartridges feature hardened steel balls and seats for excellent wear characteristics and contamination tolerance.
- The single ball allows for the decay of the pressure signal when both load ports drop to a lower pressure.

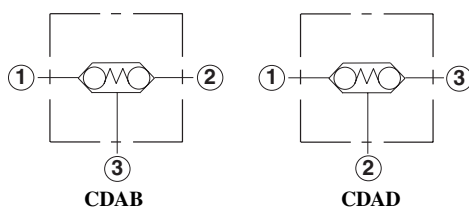
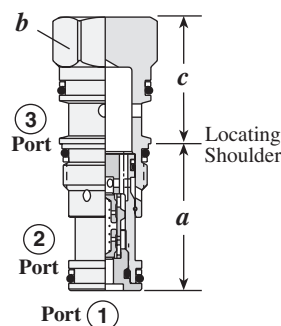
OPTION ORDERING INFORMATION

CS A * – X X *			
Nominal Capacity and Version	Control	Adjustment Range	Seal Material
X 5 L/min. Signal at Port 3	X Not Adjustable	X Not Adjustable	N Buna-N
Z 5 L/min. Signal at Port 2	A Auxiliary External SAE-4 Port		V Viton
B 10 L/min. Signal at Port 3	B Auxiliary External 1/4 BSPP Port		
D 10 L/min. Signal at Port 2	E External SAE-4 Port, Port 3 Blocked		

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BACK-TO-BACK CHECK/SHUTTLE, SIGNAL AT PORT 2 OR PORT 3

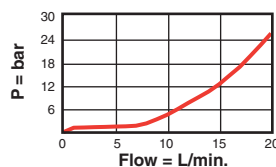


Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
10 L/min.	CDAB – XBN	T - 11A	35,1	22,2	30,2	45 - 50
10 L/min.	CDAD – XBN	T - 11A	35,1	22,2	30,2	45 - 50

Performance Curves

CDAB/CDAD

Typical Pressure Drop



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Back-to-back check cartridges feature hardened, spherically lapped, guided poppets and a lightly stressed helical spring that result in excellent wear characteristics and extremely low leakage rates.
- The back-to-back checks do not provide a means of lowering a signal. They will trap a high signal if the load pressures drop to a lower pressure. Some means of bleeding off the signal should be provided.

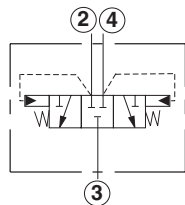
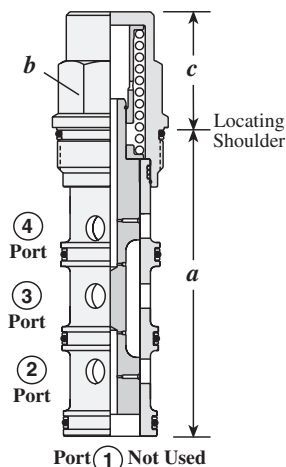
OPTION ORDERING INFORMATION

CD A * - X B *			
Nominal Capacity and Version	Control	Cracking Pressure	Seal Material
B 10 L/min. Signal at Port 3	X Not Adjustable	B 1 bar	N Buna-N
D 10 L/min. Signal at Port 2	CDAB only: A Auxiliary External SAE-4 Port B Auxiliary External 1/4 BSPP Port E External SAE-4 Port, Port 3 Blocked		V Viton

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LOW SIDE, 3-POSITION, HOT OIL SHUTTLE



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	DSCH – XHN	T - 31A	84,8	22,2	30,0	45 - 50
80 L/min.	DSEH – XHN	T - 32A	92,2	28,6	34,0	60 - 70
160 L/min.	DSGH – XHN	T - 33A	114,4	31,8	42,0	200 - 215
320 L/min.	DSIH – XHN	T - 34A	139,7	41,3	51,0	465 - 500

Performance Curves

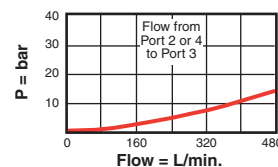
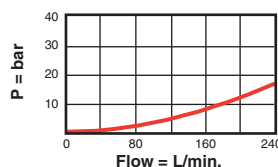
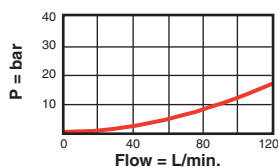
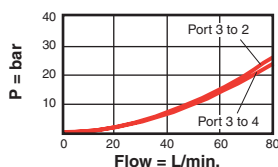
DSCH

DSEH

DSGH

DSIH

Performance Details with Valve Shifted



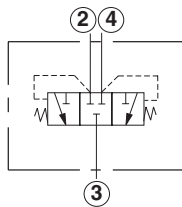
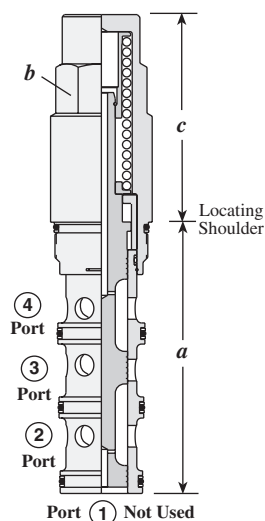
- Maximum operating pressure = 350 bar.
- Pilot flow = DSCH, DSEH: 0,38 L/min., DSGH, DSIH: 0,75 L/min.
- The spool incorporates a hydraulic stop that eliminates mechanical impact and therefore the potential for internal damage.
- The hydraulic stop results in a small pilot flow from the high side work port (port 2 or 4) to the common port (port 3).
- A unique feature due to the hydraulic stop is that the hot oil relief setting can be confirmed with the transmission in neutral.
- Although this valve goes into a 4 port cavity, the nose (port 1) is not used.
- Low shift values can potentially result in charge pump pressure alone inadvertently shifting the valve. Use care when selecting shift pressure.

OPTION ORDERING INFORMATION

DS * H – X * *			
Nominal Capacity	Control	Shifting Pressure	Seal Material
C 40 L/min.	X Not Adjustable	G 10 bar	N Buna-N
E 80 L/min.		H 14 bar	V Viton
G 160 L/min.		E 5 bar	
I 320 L/min.		DSEH, DSGH only:	
		D 3,5 bar	

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HIGH SIDE, 3-POSITION, SHUTTLE



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DSCS - XCN	T - 31A	84,8	22,2	36,5	45 - 50
120 L/min.	DSES - XCN	T - 32A	92,2	28,6	41,4	60 - 70
240 L/min.	DSGS - XCN	T - 33A	114,3	31,8	72,0	200 - 215
480 L/min.	DSIS - XCN	T - 34A	139,7	41,3	107,0	465 - 500

Performance Curves

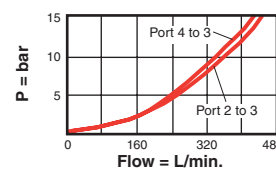
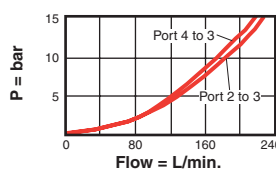
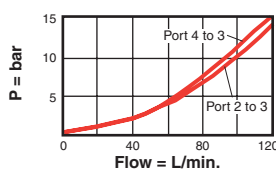
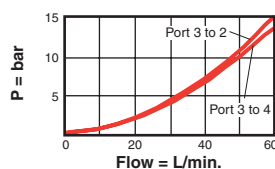
DSCS

DSES

DSGS

DSIS

Pressure Differential vs. Flow



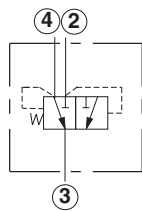
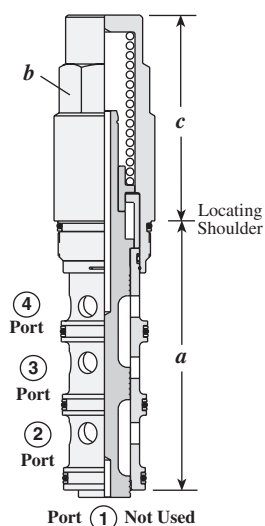
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = DSCS: 30 cc/min. at 70 bar, DSES: 50 cc/min. at 70 bar, DSGS: 65 cc/min. at 70 bar, DSIS: 80 cc/min. at 70 bar.
- Pilot flow = DSCS, DSES: 0,38 L/min., DSGS, DSIS: 0,75 L/min.
- This valve provides overrunning load control in regeneration applications where the load tends to extend the cylinder. Because there is spool leakage, it does not prevent drift.
- Hardened spool/sleeve construction provides excellent wear characteristics and minimizes cross leakage.
- Although this valve goes into a 4 port cavity, the nose (port 1) is not used.

OPTION ORDERING INFORMATION

DS * S - X * *			
Nominal Capacity	Control	Shifting Pressure	Seal Material
C 60 L/min.	X Not Adjustable	C 2 bar	N Buna-N
E 120 L/min.		E 5 bar	V Viton
G 240 L/min.		F 7 bar	
I 480 L/min.		G 10,5 bar	

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SPRING OFFSET, 2-POSITION, HIGH SIDE SHUTTLE



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
60 L/min.	DSCO – XCN	T - 31A	84,8	22,2	36,5	45 - 50
120 L/min.	DSEO – XCN	T - 32A	92,2	28,6	41,4	60 - 70
240 L/min.	DSGO – XCN	T - 33A	114,3	31,8	72,0	200 - 215
480 L/min.	DSIO – XCN	T - 34A	139,7	41,3	107,0	465 - 500

Performance Curves

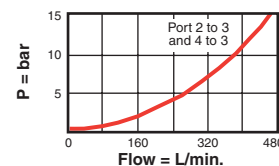
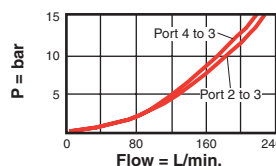
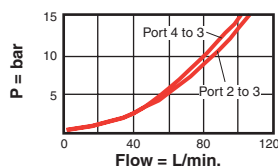
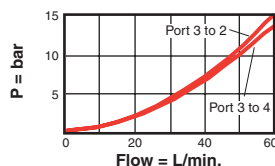
DSCO

DSEO

DSGO

DSIO

Pressure Differential vs. Flow



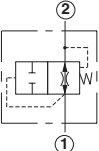
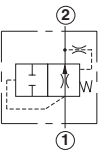
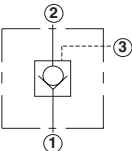
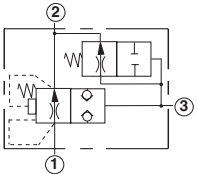
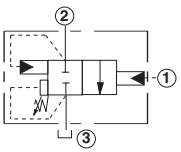
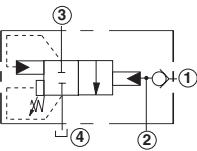
- Maximum operating pressure = 350 bar.
- Although this valve goes into a 4 port cavity, the nose (port 1) is not used.

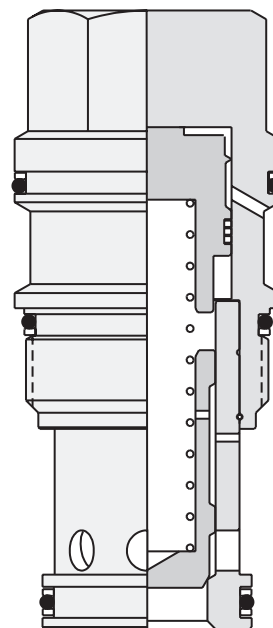
OPTION ORDERING INFORMATION

DS * O – X * *			
Nominal Capacity	Control	Minimum Control Pressure	Seal Material
C 60 L/min.	X Not Adjustable	C 2 bar	N Buna-N
E 120 L/min.		E 5 bar	V Viton
G 240 L/min.			
I 480 L/min.			

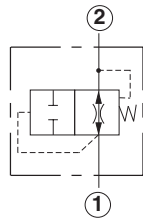
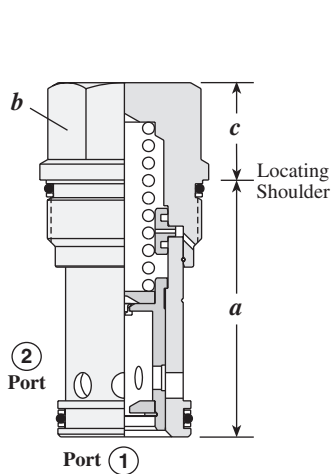
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Circuit Savers

Cartridge Type	Page
	164
	165
	166
	167
	168
	169



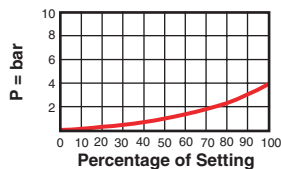
FIXED ORIFICE, FLOW FUSE



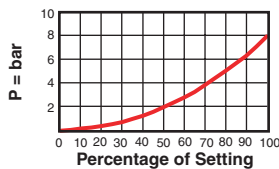
Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
23 L/min.	FQCA – XAN	T - 13A	35,1	22,2	19,1	45 - 50
60 L/min.	FQEA – XAN	T - 5A	41,1	28,6	17,5	60 - 70
95 L/min.	FQGA – XAN	T - 16A	62,0	31,8	24,6	200 - 215
200 L/min.	FQIA – XAN	T - 18A	79,5	41,3	30,2	465 - 500

Performance Curves

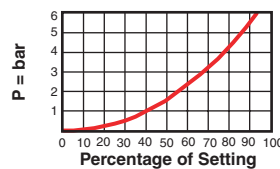
FQCA



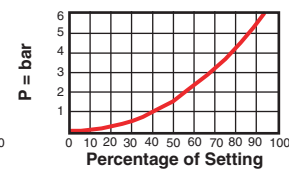
FQEA



FQGA



FQIA



Typical Pressure Drop

- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = FQCA: 30 cc/min. at 70 bar, FQEA: 50 cc/min. at 70 bar, FQGA: 65 cc/min. at 70 bar, FQIA: 80 cc/min. at 70 bar.
- Valve closes when flow from port 1 to port 2 exceeds the setting of the valve. Valve resets when pressures at port 1 and port 2 are equal.
- Flow setting should be at least 25% above maximum normal system flow.
- Customer must specify a flow rating. Factory set flow ratings are within +/- 10% of the requested flow ratings.

OPTION ORDERING INFORMATION

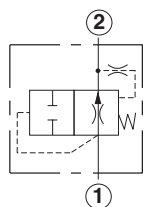
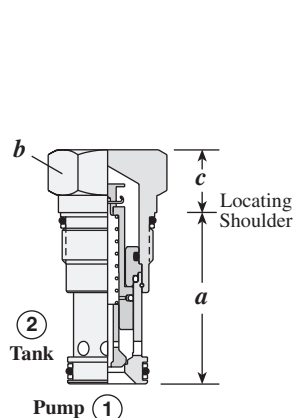
F Q * A – X A *			
Nominal Capacity	Control	Setting Range	Seal Material
C 23 L/min.	X Not Adjustable	A* Replaceable Orifice FQCA: 2 - 23 L/min. FQEA: 4 - 60 L/min. FQGA: 4 - 95 L/min. FQIA: 4 - 200 L/min.	N Buna-N
E 60 L/min.		B* Permanent Orifice FQCA: 2 - 23 L/min. FQEA: 4 - 60 L/min. FQGA: 4 - 95 L/min. FQIA: 4 - 200 L/min.	V Viton
G 95 L/min.			
I 200 L/min.			

* Special setting is required.
Specify at time of order.

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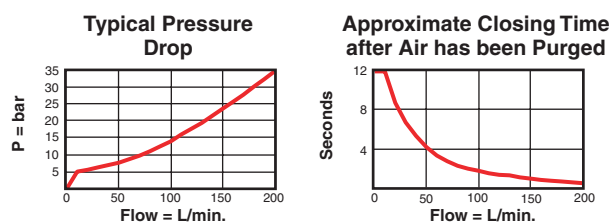
AIR BLEED AND START-UP



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
15 - 200 L/min.	NQEB - XAN	T - 3A	47,8	28,6	17,5	60 - 70

Performance Curves

NQEB



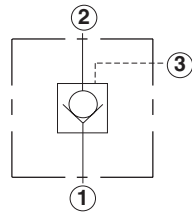
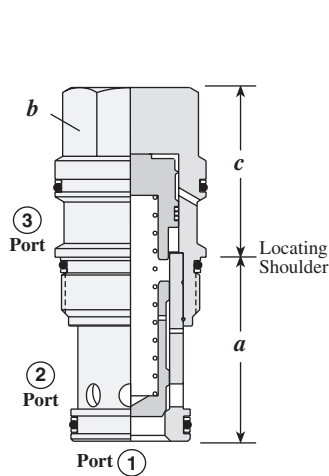
- Maximum operating pressure = 350 bar.
- Air-bleed and start-up valves require a minimum of 15 L/min. flow rate and 5,5 bar system pressure.
- The valve will re-open when system pressure falls below 1,7 bar.
- After air has been purged, closing times vary from approximately 12 seconds at 15 L/min. to 0.5 seconds at 200 L/min.

OPTION ORDERING INFORMATION

NQEB - XA*			
Nominal Capacity	Control	Adjustment Range	Seal Material
E 15-200 L/min.	X Not Adjustable	A Not Adjustable	N Buna-N
			V Viton

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CHECK, PILOT-TO-CLOSE, 1.8:1 PILOT RATIO



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	COBA – XCN	T - 163A	31,0	19,1	31,0	35 - 40
80 L/min.	CODA – XCN	T - 11A	35,1	22,2	30,2	45 - 50
160 L/min.	COFA – XCN	T - 2A	35,1	28,6	35,1	60 - 70
320 L/min.	COHA – XCN	T - 17A	46,0	31,8	46,0	200 - 245
640 L/min.	COJA – XCN	T - 19A	63,5	41,3	58,7	465 - 500

Performance Curves

COBA

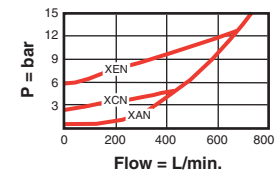
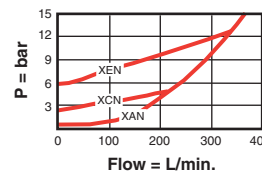
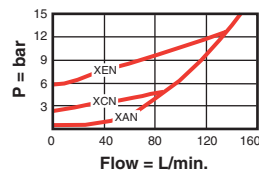
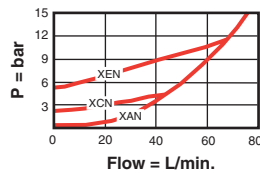
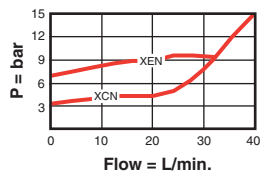
CODA

COFA

COHA

COJA

Typical Pressure Drop



- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,07 cc/min.
- Nominal Pilot Ratio = 1.8:1. This means that a pressure of 70 bar at the pilot port will close a valve against a pressure of 125 bar at port 1. Any decay or loss of pilot pressure could allow the valve to open, even if it is a momentary decay or loss.
- Reverse flow through the valve from port 2 to port 1 is not possible under any condition.
- Pressure at the port 2 area directly opposes pilot pressure.
- With equal pressures at all ports the valve is closed.

OPTION ORDERING INFORMATION

CO * A - X * *

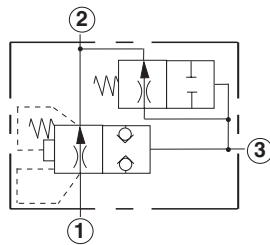
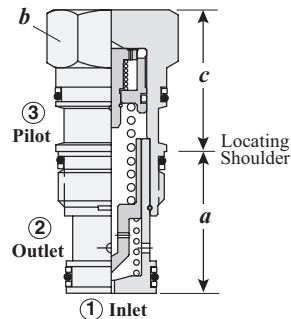
Nominal Capacity	Control*	Cracking Pressure	Seal Material
B 40 L/min.	X Standard Pilot	A*0,3 bar	N Buna-N
D 80 L/min.	* See page 178 for information on Control Options	B*1,0 bar	V Viton
F 160 L/min.		C 2,0 bar	
H 320 L/min.		D 3,5 bar	
J 640 L/min.		E 5,0 bar	
		F 7,0 bar	

* COBA is not available in A and B Cracking Pressures.

Consult the Sun website for our most recent and complete information on the full Corrosion Resistant line of products.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

CHECK, PILOT-TO-CLOSE, 120:1 PILOT RATIO

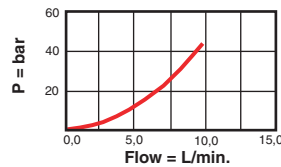


Orifice Diameter	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
1,27 mm	COFO - XDN	T - 2A	35,1	28,6	35,1	60 - 70

Performance Curves

COFO

Pressure Differential vs. Flow



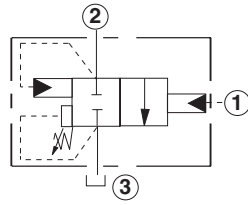
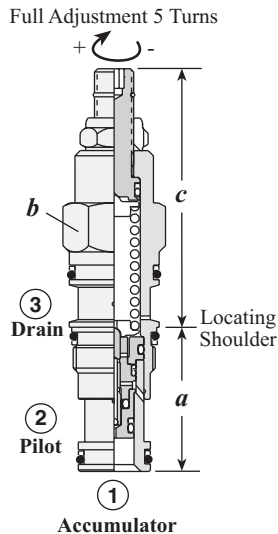
- Maximum operating pressure = 350 bar.
- Maximum valve leakage at 24 cSt = 0,3 cc/min.
- Pilot ratio = 120:1.
- Features hardened steel seats for excellent wear characteristics and contamination tolerance.
- The valve is a poppet design that results in very low leakage of stored fluid from the accumulator.
- When pump pressure is below 20 bar there is a leak path from port 3 to tank (port 2).
- The discharge of the accumulator is across a 1,27 mm diameter orifice. The discharge time for large accumulators with low pre-charge pressures may be too long.

OPTION ORDERING INFORMATION

COFO - XDN			
Orifice Diameter	Control	Minimum Pilot Pressure	Seal Material
F 1,27 mm	X Standard Pilot	D 3,5 bar	N Buna-N
			V Viton

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ACCUMULATOR SENSE, PUMP UNLOAD, PILOT CAPACITY



Pilot Flow Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
0,75 L/min.	QPAA – LAN	T - 11A	35,0	22,2	63,5	67,8	69,3	45 - 50

- Maximum operating pressure = 350 bar.
- The pressure differential between unload and reset will be within +/- 1% of the stated ratio of the valve with up to an additional 1,7 bar due to dynamic seal friction.
- The accumulator sensing area is positively sealed.
- The spool design of this valve allows it to maintain a fixed differential ratio because the areas are created by diameters on the spool that will not wear or change with use.
- Minimum clearance between the spool and sleeve, and seal on the pilot piston diameter significantly reduce the potential for silting.
- When applying this cartridge, a separate drain line is required to prevent erratic operation caused by tank line pressure fluctuations.
- Careful consideration should be given when selecting an adjustment range. System pressure drops and flows tend to affect the operation of unloading valves. Low operating pressures combined with low differential pressures result in a very narrow band between unload and reset, requiring precise system design. High flow rates typically mean high pressure drops, which subtract from the differential with which the valve has to work.

OPTION ORDERING INFORMATION

Q P A * - * * *				
Pilot Flow Capacity	Version	Control**	Adjustment Range	Seal Material
A 0,75 L/min.	A 15% Nominal Differential	L Standard Screw Adjustment	A 70 - 210 bar Standard Set at 70 bar	N Buna-N
	B 20% Nominal Differential	C* Tamper Resistant Factory Set	B 35 - 105 bar Standard Set at 35 bar	V Viton
	C 30% Nominal Differential	K Handknob with Lock Knob	C 140 - 350 bar Standard Set at 140 bar	
	D 50% Nominal Differential	* <i>Special setting is required. Specify at time of order.</i>	D 18 - 55 bar Standard Set at 18 bar	

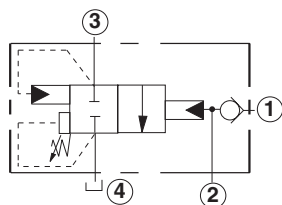
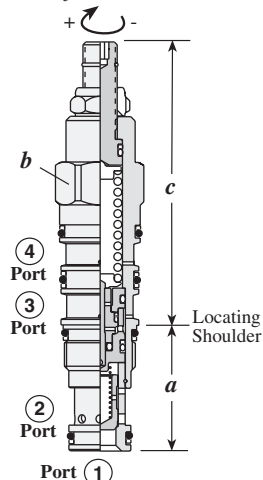
** See page 178 for information on Control Options

Customer specified special setting stamped on hex.

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ACCUMULATOR SENSE, PUMP UNLOAD WITH CHECK, PILOT CAPACITY

Full Adjustment 5 Turns



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
45 L/min.	QCDA – LAN	T - 21A	35,0	22,2	78,5	82,6	84,8	45 - 50
60 L/min.	QCDB – LAN	T - 21A	35,0	22,2	78,5	82,6	84,8	45 - 50
60 L/min.	QCDC – LAN	T - 21A	35,0	22,2	78,5	82,6	84,8	45 - 50
60 L/min.	QCDD – LAN	T - 21A	35,0	22,2	78,5	82,6	84,8	45 - 50

- Maximum operating pressure = 350 bar.
- Pilot flow capacity = 0,75 L/min.
- Pressure drop, port 1 to port 2 = 7 bar at 60 L/min.
- Free flow check cracking pressure = 0,3 bar.
- The pressure differential between unload and reset will be within +/- 1% of the stated ratio of the valve with up to an additional 1,7 bar due to dynamic seal friction.
- The accumulator sensing area is positively sealed.
- The spool design of this valve allows it to maintain a fixed differential ratio because the areas are created by diameters on the spool that will not wear or change with use.
- Minimum clearance between the spool and sleeve, and seal on the pilot piston diameter significantly reduce the potential for silting.
- When applying this cartridge, a separate drain line is required to prevent erratic operation caused by tank line pressure fluctuations.
- Careful consideration should be given when selecting an adjustment range. System pressure drops and flows tend to affect the operation of unloading valves. Low operating pressures combined with low differential pressures result in a very narrow band between unload and reset, requiring precise system design. High flow rates typically mean high pressure drops, which subtract from the differential with which the valve has to work.

OPTION ORDERING INFORMATION

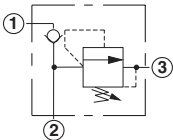
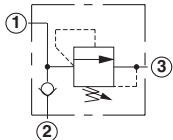
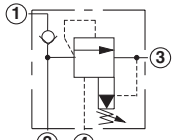
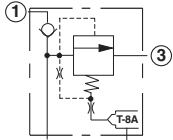
Q C D * – * * *						
Nominal Capacity		Version	Control**		Adjustment Range	Seal Material
DA	45 L/min.	A 15% Nominal Differential	L	Standard Screw Adjustment	A 70 - 210 bar Standard Set at 70 bar	N Buna-N
DB	60 L/min.	B 20% Nominal Differential	C*	Tamper Resistant Factory Set	B 35 - 105 bar Standard Set at 35 bar	V Viton
DC	60 L/min.	C 30% Nominal Differential	K	Handknob with Lock Knob	C 140 - 350 bar Standard Set at 140 bar	
DD	60 L/min.	D 50% Nominal Differential	* Special setting is required. Specify at time of order.		D 18 - 55 bar Standard Set at 18 bar	

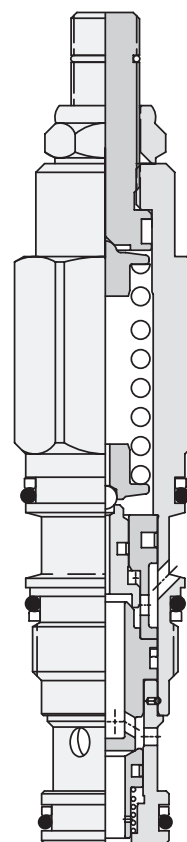
** See page 178 for information on Control Options

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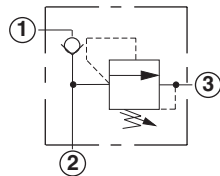
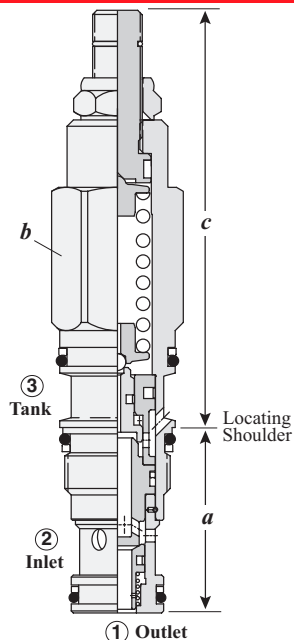
NOTES

Hybrid Relief Valves

	<i>Cartridge Type</i>	<i>Page</i>
	Direct Acting Relief, Before Check	172
	Direct Acting Relief, After Check	173
	Pilot Operated, Balanced Piston, Ventable, Relief, Before Check	174
	Pilot Operated, Balanced Piston, Ventable, Relief, Before Check, with Integral Pilot Control Cavity	175



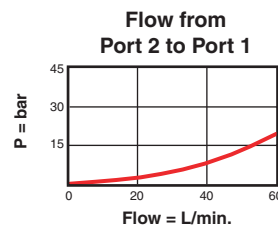
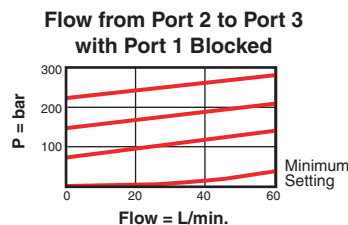
DIRECT ACTING RELIEF, BEFORE CHECK



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
40 L/min.	HRDA – LAN	T - 11A	35,0	22,2	78,5	82,6	84,8	45 - 50

Performance Curves

HRDA



- Maximum operating pressure = 350 bar.
- Maximum relief valve leakage at reseal = 0,3 cc/min.
- Maximum check valve leakage = less than 0,07 cc/min.
- Check cracking pressure = 1,7 bar.
- Typical response time = 10 ms.
- The seals on the adjust screw are exposed to system pressure which means this valve can only be adjusted when the pressure is removed. The setting procedure is: check the setting, remove the pressure, adjust the valve, check the new setting.
- Select a spring range where the desired relief setting is approximately mid-range between the minimum and maximum pressure to ensure maximum valve repeatability.
- One purpose of this dual function cartridge is to offer pump isolation and relief protection in single and/or multiple pump circuits.
- The direct acting relief exhibits rapid response characteristics that minimize pressure overshoot and also provides low reseal leakage (less than 0,3 cc/min. at 85% of cracking pressure).
- This valve deviates from Sun's normal flow path for relief valves. It is probably not useable in existing standard Sun relief manifolds.

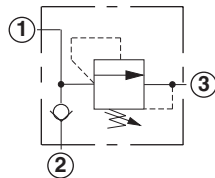
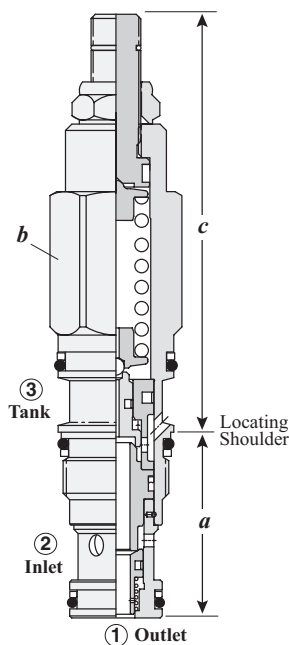
OPTION ORDERING INFORMATION

H R D A - * * *			
Nominal Capacity	Control	Adjustment Range	Seal Material
D 40 L/min.	L Standard Screw Adjustment	A 35 - 210 bar Standard Set at 70 bar	N Buna-N
	C* Tamper Resistant Factory Set	W 55 - 315 bar Standard Set at 70 bar	V Viton
	K Handknob with Lock Knob	D 14 - 50 bar Standard Set at 28 bar	

* Special setting is required.
Specify at time of order.

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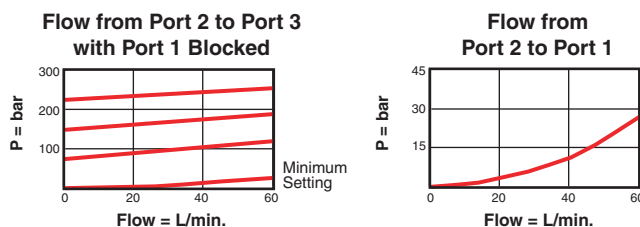
DIRECT ACTING RELIEF, AFTER CHECK



Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
40 L/min.	HRDB – LA*	T - 11A	35,0	22,2	78,5	82,6	84,8	45 - 50

Performance Curves

HRDB

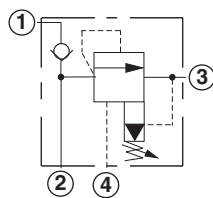
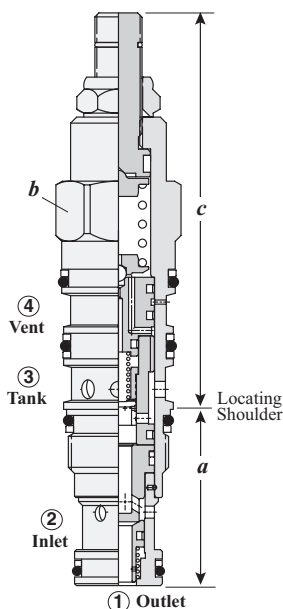


- Maximum operating pressure = 350 bar.
- Maximum relief valve leakage at reseal = 0,3 cc/min.
- Maximum check valve leakage = less than 0,07 cc/min.
- Check cracking pressure = 1,7 bar.
- Typical response time = 10 ms.
- This cartridge can be used to provide relief protection on the system side of the circuit.
- The seals on the adjust screw are exposed to system pressure which means this valve can only be adjusted when the pressure is removed. The setting procedure is: check the setting, remove the pressure, adjust the valve, check the new setting.
- Select a spring range where the desired relief setting is approximately mid-range between the minimum and maximum pressure to ensure maximum valve repeatability.
- The direct acting relief exhibits rapid response characteristics that minimize pressure overshoot and also provides low reseal leakage (less than 0,3 cc/min. at 85% of cracking pressure).
- This valve deviates from Sun's normal flow path for relief valves. It is probably not useable in existing standard Sun relief manifolds.

OPTION ORDERING INFORMATION

H R D B - L A *			
Nominal Capacity	Control	Adjustment Range	Seal Material
D 40 L/min.	L Standard Screw Adjustment	A 35 - 210 bar Standard Set at 70 bar	N Buna-N
	C* Tamper Resistant Factory Set	W 55 - 315 bar Standard Set at 70 bar	V Viton
	K Handknob with Lock Knob		
* Special setting is required. Specify at time of order.			

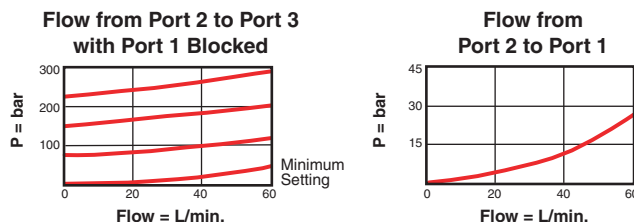
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Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions					Installation Torque (Nm)
			a	b	c			
					L	C	K	
40 L/min.	HVCA – LAN	T - 21A	35,0	22,2	78,5	82,6	84,8	45 - 50

Performance Curves

HVCA



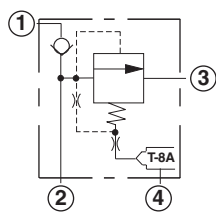
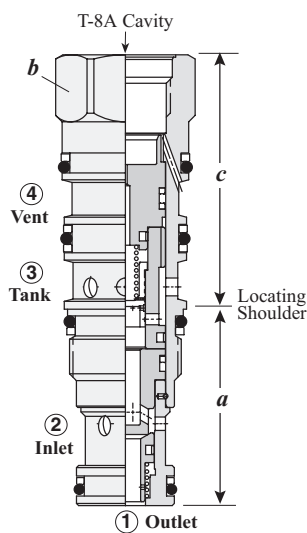
- Maximum operating pressure = 350 bar.
- Maximum relief valve leakage at reseal = 0,3 cc/min.
- Maximum check valve leakage = less than 0,07 cc/min.
- Check cracking pressure = 1,7 bar.
- Typical response time = 10 ms.
- Minimum setting is 5 bar for all spring ranges.
- Back pressure at port 3 (tank) is directly additive to the valve setting at a 1:1 ratio.
- A remote pilot relief on port 4 (vent) will control the valve below its setting.
- One purpose of this dual function cartridge is to offer pump isolation and relief protection in single and/or multiple pump circuits. Another purpose is to act as a main stage in an accumulator sense, pump unload circuit.
- This valve deviates from Sun's normal flow path for relief valves. It is probably not useable in existing standard Sun relief manifolds.

OPTION ORDERING INFORMATION

H V C A – L A N			
Nominal Capacity	Control	Adjustment Range	Seal Material
C 40 L/min.	L Standard Screw Adjustment	A 5 - 210 bar Standard Set at 70 bar	N Buna-N
	C* Tamper Resistant Factory Set	B 5 - 105 bar Standard Set at 70 bar	V Viton
	K Handknob with Lock Knob	D 5 - 55 bar Standard Set at 28 bar	
	<i>* Special setting is required. Specify at time of order.</i>	W 5 - 315 bar Standard Set at 70 bar	

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PILOT OPERATED, BALANCED PISTON, VENTABLE, RELIEF, BEFORE CHECK, WITH INTEGRAL PILOT CONTROL CAVITY

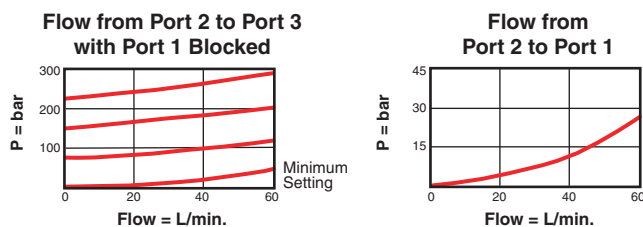


The -8 control option allows the pilot control valve to be incorporated directly into the end of the relief cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 141.

Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (Nm)
			a	b	c	
40 L/min.	HVCA - 8D*	T - 21A	35,0	22,2	45,2	45 - 50

Performance Curves

HVCA-8



- Maximum operating pressure = 350 bar.
- Maximum relief valve leakage at reseal = 0,3 cc/min.
- Maximum check valve leakage = less than 0,07 cc/min.
- Typical response time = 10 ms.
- Check cracking pressure = 1,7 bar.
- The main stage orifice is protected against contamination.
- One purpose of this dual function cartridge is to offer pump isolation and relief protection in single and/or multiple pump circuits. Another purpose is to act as a main stage in an accumulator sense, pump unload circuit.
- With the -8 control option, the main stage valve should first be installed to the correct torque value. The T-8A pilot control valve should then be installed into the main stage valve to its required torque value.
- This valve deviates from Sun's normal flow path for relief valves. It is probably not useable in existing standard Sun relief manifolds.

OPTION ORDERING INFORMATION

HVCA - 8 D *			
Nominal Capacity	Control	Adjustment Range	Seal Material
C 40 L/min.	8 with T-8A cavity in hex body for pilot operation. See pilot control section for alternate options.	D 5 bar	N Buna-N V Viton

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***New Models are continually added
to a Growing Product Line. . .***

CORROSION RESISTANT CARTRIDGE VALVES

**with ASTM S32101 Duplex Stainless Steel (EN 1.4162)
and ASTM grade 5 Titanium (Ti-6Al-4V) External Components**

- Heat treated Internal Components in Carbon and Alloy Steels.
- Tested under 1,000 hours of salt spray to ASTM B117-03.
- Superior Cavity Design and Unique Floating Style Screw-in Cartridge Construction.
- 350 bar / 5000 psi Working Pressure at All Ports.
- Standard Valve Performance.
- Recommended for Marine, Oil and Gas Industries, and for use in Aero-drives.

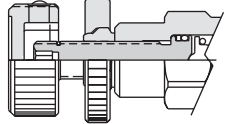
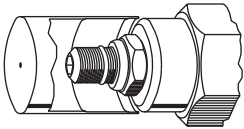
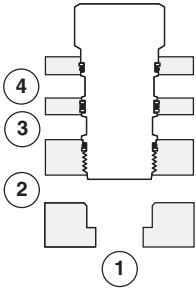
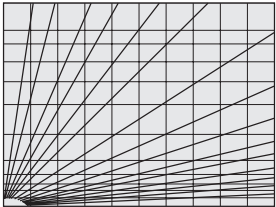


View our full range of Corrosion Resistant Cartridge Valves,
call your Sun Distributor or consult the Sun website:

www.sunhydraulics.com

Products: Cartridges: Corrosion Resistant: View All Corrosion Resistant Cartridges

General Information

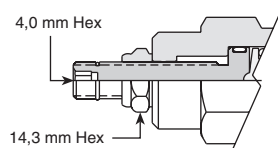
	<i>Page</i>	
Cartridge Control Options	178	
Cartridge Control Kits	179	
Cavity Plugs	183	
Coil Connector Options for Solenoid Cartridges	187	
Orifice Pressure Drop Data	192	

Cartridge Control Options

General Purpose Controls (for use in systems where adjustment may be changed after installation.)

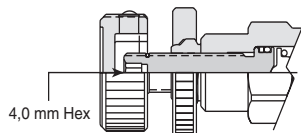
L Standard Screw Adjustment

O-ring seal on adjust screw. Adjust screw positively retained. Overset protection-pilot spring cannot go solid.



K Handknob with Lock Knob

Handknob and lock knob added to L control. Sun handknob kits for field conversion are available. (Except for counterbalance.)

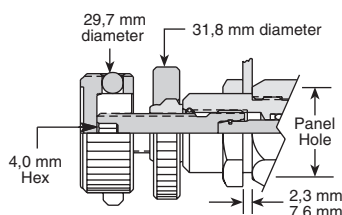


O Handknob with Panel Mount

Special threaded cartridge hex body with panel nut for mounting cartridge through access hole in control panel. Handknob and lock knob included.

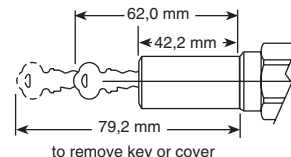
Panel Hole:

Series 1 cartridges 19,0 mm dia.
Series 2 cartridges 25,4 mm dia.
Panel nut hex size identical to cartridge hex size.



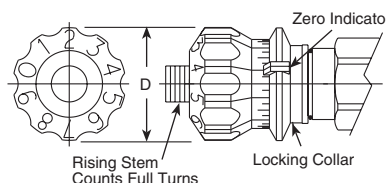
Key Lock Kit

Optional adjustment Key Lock Cover Kit for L controls allows adjustment to be locked with a key to prevent unauthorized changes in valve setting. Adjustment is easily accessible when lock assembly is removed. Requires replacement of standard locknut with special locknut which accepts lock assembly, and a new wire stop ring for overset protection. (Except for Series 0 and counterbalance.)



H Calibrated Handknob with Detent Lock

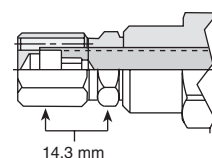
Fully calibrated handknob for flow control cartridges. 40 radial calibrations per turn. Moveable zero indicator. (Minor disassembly required.) Rising detented locking collar positively locks adjustment knob against vibration or accidental tampering. Any desired setting may be recorded and repeated. U.S. Patent #4,577,831.



Diameter Series	28,7 mm 1	35,1 mm 2	41,1 mm 3	41,1 mm 4
	NCCB	NCEB	NCFB	NGBB
	NCCC	NCEC	NCFB	NGBB
	NFCC	NFDC	NFEC	NFFC
	NFCD	NFDD	NFED	NFFD
	FDBA	FDCB	FDEA	FDFA

Maximum Setting Limiter

For limiting the maximum setting of cartridges with L adjust within their specified range (except Series 0 and counterbalance). These controls come in two varieties: basic Maximum Setting Limiter and Maximum Setting Limiter with Handknob. Once kit is installed, the setting of cartridges can be adjusted within their specified range not to exceed the new permanent maximum setting.

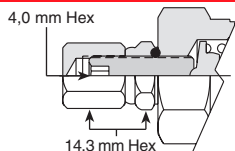


The maximum setting limiters can only be ordered as a kit at this time. Will be available as cartridge control options in future. **Contact your Sun Distributor when ordering as cartridge control option.**

Special Purpose Controls (for use in systems where adjustment is seldom changed after installation)

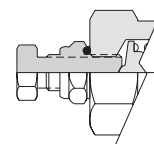
J Socket Head Set Screw with Cap

Stem seal - Seal under locknut. Adjustment screw not retained. No overset protection.



F Wrench Adjustment

Stem seal - Seal under locknut. Adjusting screw is not retained. Overset protection-pilot spring cannot go solid.



Counterbalance Cartridge Controls

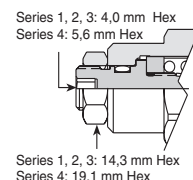
All Sun counterbalance cartridges are built with a leakproof adjustment - O-ring seals are on the adjusting screw-but are not designed for frequent adjustment in the field. Cartridges that are factory pre-set by Sun to a customer specified pressure setting are available and can be installed directly on a machine without the need for further adjustment.

C Tamper Resistant Factory Set

See "C" Control description above.

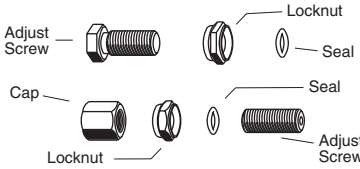
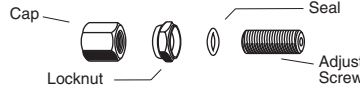
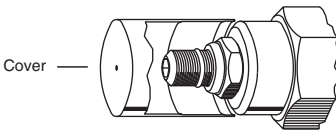
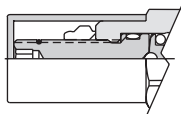
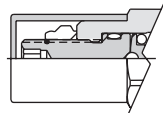
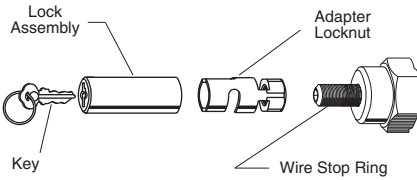
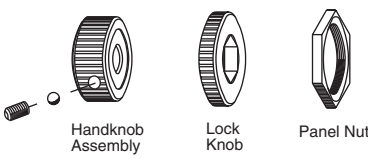
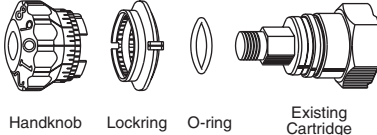
L Standard Leakproof Screw Adjustment

O-ring seal on adjust screw.



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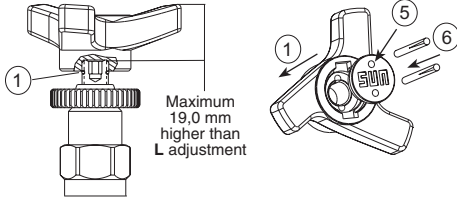
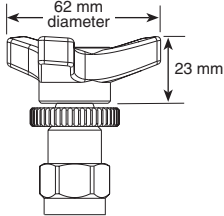
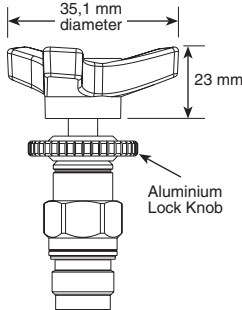
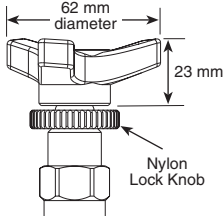
Cartridge Control Kits

Service Kit No. Description	Use specifically with Control/Cartridge	Description	Notes
Adjustment Screw Kit 991-006	All F controls (Zinc plated steel)		To assure a complete seal on the stem - release all pressure on the cartridge after setting. Then... tighten locknut (and cap, on J).
Adjustment Screw Kit 991-010	All J controls (Zinc plated steel)		
Tamper Resistant Cover (Zinc plated steel) 991-000 991-001 991-002 991-003 991-004 991-001-A00 991-002-A00 991-003-A00 991-004-A00	All Sun Models with L adjustment (Except Counterbalance, Series 1 and 2) Series 0 - 19,0 mm hex Series 2 - 28,6 mm hex Series 3 - 31,8 mm hex Series 4 - 41,0 mm hex Series 1 - 22,2 mm hex Series 2 - 28,6 mm hex (Stainless steel) Series 3 - 31,8 mm hex (Stainless steel) Series 4 - 41,0 mm hex (Stainless steel) Series 1 - 22,2 mm hex (Stainless steel)	 	1. Adjust valve to desired setting and tighten locknut. 2. Using an arbor press or a soft hammer, install cover until it seats on cartridge hex. 3. Cover is a press fit on cartridge shoulder.
991-032 991-033 991-032-A00 991-033-A00	For Series 1 and 2, Counterbalance Series 1 - 22,2 mm hex (Zinc plated steel) Series 2 - 28,6 mm hex (Zinc plated steel) Series 1 - 22,2 mm hex (Stainless steel) Series 2 - 28,6 mm hex (Stainless steel)		
Key Lock Kit 993-008	For all Sun cartridges with L adjustment (except Series 0 and counterbalance cartridges).		1. Remove original wire stop ring and locknut. 2. Thread on the adapter locknut and install new wire stop ring through slot provided. 3. Adjust valve to desired setting and tighten adapter locknut. 4. Slide lock assembly over adapter, lock and remove key.
K Handknob Kit (Plastic) 991-211 991-222 (Plastic)	Use this kit to adapt all L controls to K controls (except Series 0 and counterbalance cartridges). K control for Series 0		Only cartridges date stamped "41" or later and originally supplied with plastic knobs. Lock knob snaps onto locknut furnished on cartridge.
Panel Handknob Kit (Plastic) 991-215 Panel Handknob Kit (Plastic) 991-216	O controls All Series 1 cartridges 22,2 mm hex, M20 thread O controls All Series 2 cartridges 28,6 mm hex, 1"-14 thread		
H Calibrated Handknob Kit (Plastic) 991-219 991-220 991-221	H controls All series of flow controls FDCB, NCEB, NCEC, NFDC, NFDD only FDEA, FDFA, NCFB, NCFC, NCGB, NCGC, NFEC, NFED, NFFC, NFFD only FDDB, NCCB, NCCC, NFCC, NFCD only		Only for cartridges originally supplied with an H handknob. Valves can not be modified in the field. Note: The H control is Only available for the cartridges shown to the left.

Cartridge Control Kits continued on next page.

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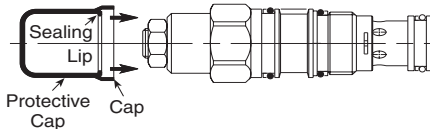
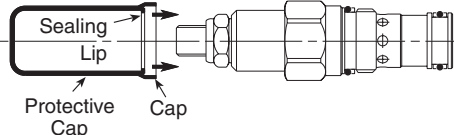
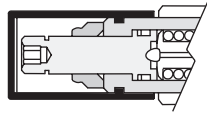
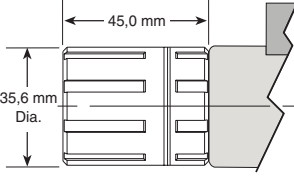
Cartridge Control Kits

Service Kit Number Description	Use specifically with Control/Cartridge	Description	Notes
Tri-grip Handknob Kit (Plastic) 991-034	For all Series 1, 2, 3, 4 valves with L or O adjustment except Series 0 and counterbalance cartridges.	Install while cartridge is screwed in cavity to prevent damage. 	1. Do not remove stop ring. 2. Install lock knob by snapping onto the locknut. 3. Install star knob until contact is made with the stop ring. (Caution: During installation on flow control valves that have no stop ring, make sure valve can be shut with hand knob installed.) 4. Insert pins in cover so that they project on backside. 5. Put cover on with inserted pins and drive pins in until flush with cover.
	The handknob can be used as a Maximum Setting Limiter.		When knob is used as a maximum Setting Limiter: 1. Set valve at desired maximum setting. 2. Tighten lock nut (12,5 Nm.). 3. Remove stop ring. 4. Install lock knob. 5. Install handknob until flush with the lock knob. 6. Insert pins in cover so that they project on backside. 7. Put cover on with inserted pins and drive pins in until flush with cover.
Tri-grip Handknob Kit with Optional Maximum Setting Limiter 35,1 diameter (Plastic with aluminium lock knob) 991-039	For all Series 1, 2, 3, 4 valves with L or O adjustment except Series 0 and counterbalance cartridges.		Follow installation instructions described above.
Tri-grip Handknob Kit (Plastic with stainless steel insert) 991-040	For use with corrosion resistant cartridge line.		1. Do not remove stop ring. 2. Install lock knob by snapping onto the locknut. 3. Install handknob until contact is made with the stop ring. (Caution: On flow control valves that have no stop ring, ensure that valve can be shut with handknob installed.) 4. Insert pins in holes in cover until they project through. 5. Install cover by driving the pins into the holes in the handknob until the pins are flush with the top of cover. 6. Follow instructions listed above to install Handknob when used as a Maximum Setting Limiter.

Cartridge Control Kits continued on next page.

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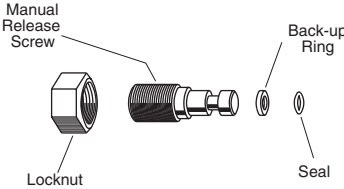
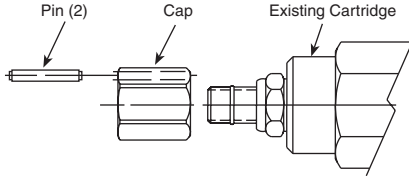
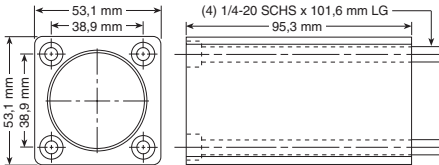
Cartridge Control Kits

Service Kit Number Description	Use specifically with Control/Cartridge	Description	Notes
Protective Cap (Series 1 Counterbalance) 991-026	For all Series 1 Counterbalance with L control. (Constructed of flexible polyethylene plastic).		Installation Instructions (with cartridge already installed in body/manifold): 1. Insure that screw adjustment mechanism (L control) is set to proper setting. 2. Press protective cap over end of cartridge assembly as shown in illustration at left. 3. Press firmly against end of protective cap until cap lip stretches over beginning of cartridge hex, expelling air within chamber. 4. To remove protective cap, gently pull away from cartridge hex until cap comes loose. 5. Replace protective cap with new one if any abrasions, nicks, or tears are evident along cap lip including interior edge and sealing lip.
Protective Cap (Series 1 cartridges) 991-027	For all Series 1 with L control. (Constructed of flexible polyethylene plastic).		Installation Instructions: 1. Adjust valve to desired setting and tighten locknut. 2. To install, press the cap onto the cartridge's hex body until a snapping sound is heard. Do not force the cap to bottom out against the top of the hex. A small gap should remain. Pull back on the cap to verify a successful installation. 3. This tamper resistant cap is designed to be non-removable. Once removed, it can not be re-assembled to the cartridge.
Tamper Resistant Cap (Series 1 cartridges) 991-035	For all Series 1 with L control. (Black Delrin injection molded cap).		
Typical Installation: 1. Ensure that O-ring is installed in seat located at the bottom of the assembly. 2. Remove existing coil nut assembled to end of solenoid tube and discard. 3. Thread twist/lock manual override assembly on to end of solenoid tube. Position coil connector to point in desired direction and hand-tighten manual override assembly until it bottoms out on solenoid coil and creates snug fit.			
T Twist and Lock Manual Override (momentary/twist operation) (Black plastic) 991-225	Only for use with DAAL, DAAM, DBAL, DBAM, DTDA, DMDA, DNDA, DLDA, DWDA, Sun Solenoid products.		Operating instructions for Momentary Manual Override Assembly 991-225 To manually actuate valve momentarily, hand turn Manual Override Assembly in clockwise direction until it reaches its internal stop. Hold in position to maintain actuated operation. Once released, valve will return to its normal (de-energized) position. <i>The top face of override assembly depicts an arrow pointing in a clockwise direction with smaller arrow pointing to return position indicating momentary operation.</i>
L Twist and Lock Manual Override (detent/lock operation) (Black plastic) 991-226	Only for use with DAAL, DAAM, DBAL, DBAM, DTDA, DMDA, DNDA, DLDA, DWDA, Sun Solenoid products.		Operating instructions for Locking Manual Override Assembly 991-226 To manually actuate valve and lock, hand turn Override Assembly in counter-clockwise direction until it reaches its internal detent and locks into place. <i>The top face of override assembly depicts an arrow pointing in a counter-clockwise direction towards a "lock" symbol indicating locking operation.</i>
D Twist Momentary/ Twist Lock Manual Override (momentary/twist operation) (Black plastic) 991-227	Only for use with DAAL, DAAM, DBAL, DBAM, DTDA, DMDA, DNDA, DLDA, DWDA, Sun Solenoid products.	 	Operating instructions for Dual (Momentary/Twist) Manual Override Assembly 991-227 To manually actuate valve momentarily, follow the instructions shown above for Momentary Operation. To manually actuate valve and lock, follow the instructions shown above for Locking Operation.

Cartridge Control Kits continued on next page.

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Cartridge Control Kits

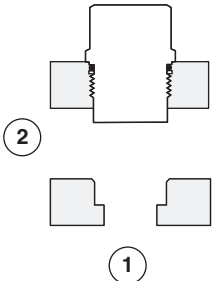
Service Kit Number Description	Use specifically with Control/Cartridge	Description
Adjustment Screw Kit 991-112-003 Viton 991-112-007 Buna-N	CKCA-L** CKCB-L** CKCC-L**	CKCD-L** CPCA-L**
Adjustment Screw Kit 991-212-003 Viton 991-212-007 Buna-N	CKEA-L** CKEB-L** CKEC-L**	CKED-L** CPEA-L**
		 Manual Release Screw Locknut Back-up Ring Seal Only cartridges date stamped “62” or earlier.
Maximum Setting Limiter (Zinc plated steel) 991-022	All models with an L adjustment control (Except Series 0 and counterbalance.) The maximum setting limiters can only be ordered as a kit at this time. Will be available as cartridge control options in the future with customer specified settings. Contact your Sun Distributor when ordering as cartridge control option.	 Pin (2) Cap Existing Cartridge Installation Instructions: Kit consists of 2 Driv-Lok pins (811-001-011), Hex Cap (375-020). To prevent any damage to nose end and/or any moving parts, only install this kit while cartridge is screwed into a cavity. 1. Set adjustment to desired level within recommended range of valve and tighten jam nut to 12Nm. 2. Remove maximum setting stop ring from the adjust screw. 3. Thread hex cap onto the adjust screw until it bottoms out against jam nut and tighten to 12 Nm. 4. Insert one of the Driv-Lok pins into the hex cap holes and tap into place using a hammer until flush. Repeat procedure with second Driv-Lok pin. 5. Install is now completed.
Lockwire Kit 991-012	All M , Q and R controls (except solenoid operated cartridges).	 Locking Wire Lead Seal
Position Switch Protective Cover (6061-T6 Aluminium) 991-043	LOHC-Z**	 Installation: Threaded holes will need to be machined in the manifold to install cover. Number of Holes: 4 Mounting Hole Thread: .250-20 UNC -2B Mounting Hole Depth: 13,5 mm

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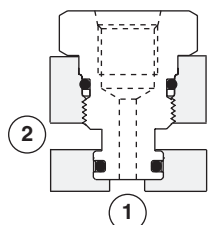
Cavity Plugs

It is sometimes desirable to remove a Sun cartridge valve and still maintain the integrity of the hydraulic system. This may be necessitated by the need to flush a system after repairs or a piping change, or to change an operating function in the circuit. For these requirements, Sun offers two styles of cavity plugs - all ports blocked and main ports open to flow.

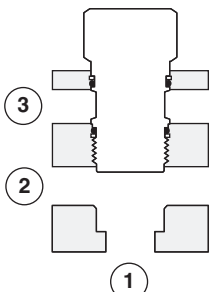
Plugs for Two Port Cavities

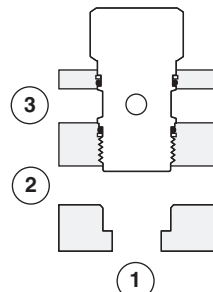
	All Ports Open		All Ports Blocked
	Series	Cavity	Cavity Plug Model Code*
	P	T-8A	XAOA-XX*
	0	T-162A	XZOA-XX* +XZOC-XX*
	1	T-10A T-13A	XFOA-XX*
	2	T-3A T-5A	XCOA-XX*
	3	T-16A	XIOA-XX*
	4	T-18A	XKOA-XX*
			XACA-XX*
			XZCA-XX* XZCC-XX*
			XFCA-XX* XGCA-XX*
			XCCA-XX* XDCA-XX*
			XICA-XX*
			XKCA-XX*

+ Flush Style Plug: Tighten via 5/16" Allen Wrench

	Port 1 Open to External SAE-4 Port, Port 2 Blocked		Port 2 Open to External SAE-4 Port, Port 1 Blocked
	Series	Cavity	Cavity Plug Model Code*
	P	T-8A	XACA-EX*
	0	T-162A	XZCA-EX*
	1	T-10A	XFCA-EX*
	1	T-13A	XGCA-EX*
			XACC-EX*

Plugs for Three Port Cavities

	Port 1 to 2 Open, Port 3 Blocked		All Ports Blocked
	Series	Cavity	Cavity Plug Model Code*
	P	T-9A	XAOB-XX*
	0	T-163A	XZOB-XX*
	1	T-11A	XEOA-XX*
	2	T-2A	XBOA-XX*
	3	T-17A	XHOA-XX*
	4	T-19A	XJOA-XX*
			XACB-XX*
			XZCB-XX*
			XECA-XX*
			XBCA-XX*
			XHCA-XX*
			XJCA-XX*

	All Ports Open		Port 1 Open to External SAE-4 Port, Ports 2 and 3 Blocked
	Series	Cavity	Cavity Plug Model Code*
	P	T-9A	
	0	T-162A	XZOD-XX*
	1	T-11A	XEOB-XX*
	2	T-2A	XBOB-XX*
	3	T-17A	XHOB-XX*
	4	T-19A	XJOB-XX*
			XACB-EX*

Cavity Plugs continued on next page.

*Insert in the seventh position model code digit N to order Buna-N seals or V to order Viton seals.

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Plugs for Three Port Cavities (*continued*)

		Ports 1 to 3 Open, Port 2 Blocked	Ports 2 to 3 Open, Port 1 Blocked
Series	Cavity	Cavity Plug Model Code*	Cavity Plug Model Code
P	T-9A	XAOC-XX*	
0	T-163A		XZAA-XX*
1	T-11A	XEBA-XX*	XEAA-XX*
2	T-2A	XBBA-XX*	XBAA-XX*
3	T-17A	XHBA-XX*	
4	T-19A	XJBA-XX*	

Plugs for Four Port Cavities (Internal Locating Shoulder)

		Ports 1 to 2 Open Ports 3 and 4 Blocked	All Ports Blocked
Series	Cavity	Cavity Plug Model Code*	Cavity Plug Model Code
1	T-21A	XMOA-XX*	XMCA-XX*
2	T-22A	XNOA-XX*	XNCA-XX*
3	T-23A	XPOA-XX*	XPCA-XX*
4	T-24A	XQOA-XX*	XQCA-XX*

		All Ports Open
Series	Cavity	Cavity Plug Model Code*
1	T-21A	XMOB-XX*

Plugs for Four Port Cavities (External Locating Shoulder)

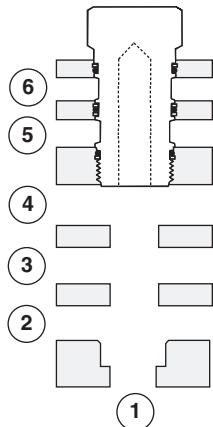
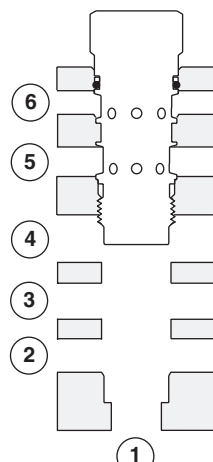
		All Ports Open	All Ports Blocked
Series	Cavity	Cavity Plug Model Code*	Cavity Plug Model Code*
1	T-31A	XFOA-XX*	XRCA-XX*
2	T-32A	XCOA-XX*	XSCA-XX*
3	T-33A	XIOA-XX*	XTCA-XX*
4	T-34A	XKOA-XX*	XVCA-XX*

Cavity Plugs continued on next page.

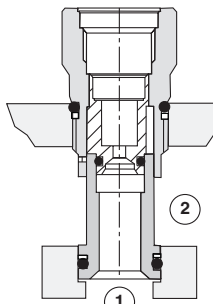
*Insert in the seventh position model code digit N to order Buna-N seals or V to order Viton seals.

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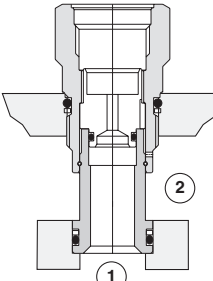
Plugs for Six Port Cavities

		Ports 1, 2, 3 and 4 Open Ports 5 and 6 Blocked		All Ports Blocked	
		Series	Cavity	Cavity Plug Model Code*	Cavity Plug Model Code*
		1	T-61A	XMOA-XX*	XRCC-XX*
		2	T-62A	XNOA-XX*	XSCC-XX*
		3	T-63A	XPOA-XX*	XTCC-XX*
		4	T-64A	XQOA-XX*	XVCC-XX*
		All Ports Open			
		Series	Cavity	Cavity Plug Model Code*	
		1	T-61A	XMOB-XX*	

Cavity Adaptor (Converts Sun T-10A Cavity to Sun T-8A Cavity)

		All Ports Open	
		Cavity	Cavity Plug Model Code*
		T-10A	XFAA-8X*
		T-10A	+XFAB-8X*
		+ with filter screen	

Cavity Adaptor (Converts Sun T-13A Cavity to Sun T-8A Cavity)

		All Ports Open	
		Cavity	Cavity Plug Model Code*
		T-13A	XGAA-8X*

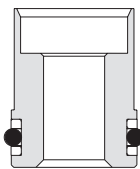
Cavity Plugs continued on next page.

*Insert in the seventh position model code digit N to order Buna-N seals or V to order Viton seals.

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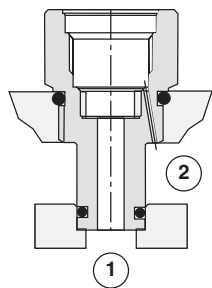
Cavity Plugs

Cavity Adaptor (Converts Sun T-162A Cavity to Sun T-8A Cavity)



All Ports Open	
Cavity	Cavity Plug Model Code*
T-162A	XZCA-8X*

Cavity Adaptor (Converts Waterman 12-2 Cavity to the Sun T-8A Cavity)



All Ports Open	
Cavity	Cavity Plug Model Code*
12-2	XAAA-8X*

For detailed and complete information on
Sun's full list of cavity plugs visit www.sunhydraulics.com.
Products: Accessories: Cavity Plugs

*Insert in the seventh position model code digit N to order Buna-N seals or V to order Viton seals.

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Sun Coil Options for Solenoids (Metal Housing, Round)

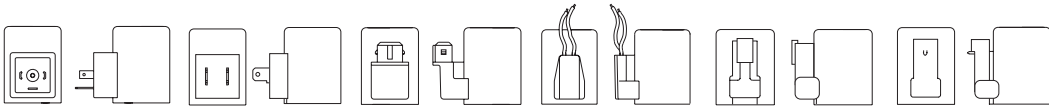
A wide variety of coil options are available for Sun's extensive line of solenoid operated cartridge valves. These metal housing, round coil options are listed in the table below.

Consult the Sun website to view detailed information on our coil options. Every solenoid operated cartridge product page has a Coil Technical Information link and shows a list of cartridge models that use the specific coil that you are viewing.

- Go to Products: Cartridges: Coils: View All Coils
- Or use the Coil Search. Go to Products: Cartridges: Coil Search or Products: Accessories: Coil Search.

19 MILLIMETER TUBED COILS FOR SOLENOID CARTRIDGE VALVES

Standard Coils: Metal Housing, Round

							
Voltage	Operating Voltage Range	ISO/DIN 43650 Form A Coil Part Number Only	SAE J858A Coil Part Number Only	AMP Junior Timer ¹ Coil Part Number Only	Twin Lead Coil Part Number Only	Metri-Pack 150-2M ² Coil Part Number Only	Deutsch DT04-2P ³ Coil Part Number Only
115 V AC 50/60 Hz	+/- 10% nominal	770-211	----	----	----	----	----
230 V AC 50/60 Hz	+/- 10% nominal	770-223	----	----	----	----	----
12 V DC	+/- 10% nominal	770-212	770-512	770-612	770-712	770-812	770-912
14 V DC	+/- 10% nominal	770-214	770-514	770-614	770-714	770-814	770-914
24 V DC	+/- 10% nominal	770-224	770-524	770-624	770-724	770-824	770-924
24 V AC	+/- 10% nominal	770-297	----	----	----	----	----
28 V DC	+/- 10% nominal	770-228	770-528	770-628	770-728	770-828	770-928
36 V DC	+/- 10% nominal	770-236	770-536	770-636	770-736	770-836	770-936
48 V DC	+/- 10% nominal	770-248	770-548	770-648	770-748	770-848	770-948
127 V DC	+/- 10% nominal	770-299	----	----	----	----	----
220 V DC	+/- 10% nominal	770-298	----	----	----	----	----

¹ AMP Junior Timer mating connections are a product of AMP/Tyco Electronics.

² Metri-Pack mating connections are a product of Delphi.

³ Deutsch mating connections are a product of the Deutsch Company.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Sun Coil Options with Embedded Electronic Proportional Amplifiers

A variety of coils are available for Sun's wide line of electro-proportional solenoid operated cartridge valves. These metal housing, round coil options are listed in the table below. Consult the Sun website for our full line of coil options. See page 190 for explanation of part numbering system.

19 MILLIMETER TUBED COILS FOR ELECTRO-PROPORTIONAL SOLENOID CARTRIDGE VALVES

Coils with Embedded Electronic Proportional Amplifiers: Deutsch DT04-6P

Coil Part Number Only	Analog Input Range	Output Current	Voltage		Card Function
790-4A12A	0-20 mA	1200 mA	12 V DC	Proportional Amplifier	includes Separate Command Common, +5V Reference, Enable Switch
790-4A12V	0-10 V	1200 mA	12 V DC	Proportional Amplifier	includes Separate Command Common, +5V Reference, Enable Switch
790-4E12V	-----	(6 sec) 2000 mA Maximum (holding) 1600 mA Maximum	12 V DC	Power Saver	-----
790-4F12V	9-28 V	1200 mA	12 V DC	Ramping Amplifier	
790-4A24A	0-20 mA	600 mA	24 V DC	Proportional Amplifier	includes Separate Command Common, +5V Reference, Enable Switch
790-4A24V	0-10 V	600 mA	24 V DC	Proportional Amplifier	includes Separate Command Common, +5V Reference, Enable Switch
790-4E24V	-----	(6 sec) 2000 mA Maximum (holding) 2000 mA Maximum	24 V DC	Power Saver	-----
790-4F24V	9-28 V	600 mA	24 V DC	Ramping Amplifier	-----

Coils with Embedded Electronic Proportional Amplifiers: ISO/DIN 43560, Form A

790-2B12A	0-20 mA	1200 mA	12 V DC	Proportional Amplifier	(B) Separate Command Common
790-2B12V	0-10 V	1200 mA	12 V DC	Proportional Amplifier	(B) Separate Command Common
790-2C12A	0-20 mA	1200 mA	12 V DC	Proportional Amplifier	(C) +5V Reference
790-2C12V	0-10 V	1200 mA	12 V DC	Proportional Amplifier	(C) +5V Reference
790-2D12A	0-20 mA	1200 mA	12 V DC	Proportional Amplifier	(D) Enable Switch
790-2D12V	0-10 V	1200 mA	12 V DC	Proportional Amplifier	(D) Enable Switch

Coils Table for ISO/DIN 43560, Form A, continued on next page.

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.



Sun Coil Options with Embedded Electronic Proportional Amplifiers

19 MILLIMETER TUBED COILS FOR ELECTRO-PROPORTIONAL SOLENOID CARTRIDGE VALVES

Coils with Embedded Electronic Proportional Amplifiers: ISO/DIN 43560, Form A

Coil Part Number Only	Analog Input Range	Output Current	Voltage	Card Function	
790-2E12V	-----	(6 sec) 2000 mA Maximum (holding) 1600 mA Maximum	12 V DC	Power Saver	-----
790-2F12V	9-28 V	1200 mA	12 V DC	Ramping Amplifier	-----
790-2B24A	0-20 mA	600 mA	24 V DC	Proportional Amplifier	(B) Separate Command Common
790-2B24V	0-10 V	600 mA	24 V DC	Proportional Amplifier	(B) Separate Command Common
790-2C24A	0-20 mA	600 mA	24 V DC	Proportional Amplifier	(C) +5V Reference
790-2C24V	0-10 V	600 mA	24 V DC	Proportional Amplifier	(C) +5V Reference
790-2D24A	0-20 mA	600 mA	24 V DC	Proportional Amplifier	(D) Enable Switch
790-2D24V	0-10 V	600 mA	24 V DC	Proportional Amplifier	(D) Enable Switch
790-4E24V	-----	(6 sec) 2000 mA Maximum (holding) 2000 mA Maximum	24 V DC	Power Saver	-----
790-4F24V	9-28 V	600 mA	24 V DC	Ramping Amplifier	-----

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Sun Weatherized Coils and Coil Kits

Sun weatherized coils and kits are designed for Sun's full flow solenoid operated and electro-proportional cartridge valves. They are protection against high-pressure wash-downs or marine environments for Sun's electrically-actuated cartridge valves.

These coil kits are only available with the Metri-Pack Series 150-2M connector with a choice of four voltages. Weatherized Coil Details:

- Available in four voltages: 12 V DC, 14 V DC, 24 V DC, and 28 V DC.
- Rated for the IP69K which is the Ingress Protection rating for high-pressure, high-temperature wash-down applications. The enclosures are not only dust tight, but must withstand high-pressure and steam cleaning. Additional information about IP ratings can be found on the Sun website.
- Includes a built-in TVS surge suppression diode.
- RoHS compliant.
- Passed a 1000 hour salt fog test, ensuring corrosion resistance for marine applications.

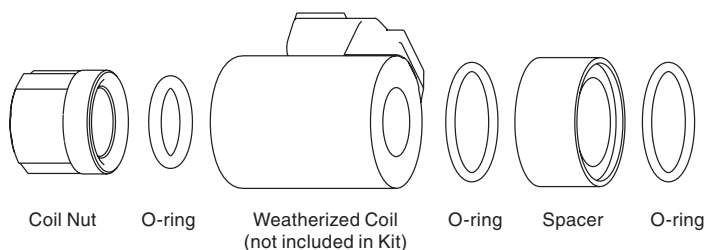
19 MILLIMETER TUBED (ROUND) COILS (Metri-Pack Series 150-2M Connector) FOR FULL FLOW SOLENOID AND ELECTRO-PROPORTIONAL CARTRIDGE VALVES

Voltage	Operating Voltage Range	Metri-Pack 150-2M Coil Part Number Only	Used for Cartridge Models
14 V DC	+/- 10% nominal	773-814	DAAL, DBAL, DLDA, DMDA, DNDA, DNDC, DTCA, DWDA
12 V DC	+/- 10% nominal	773-812	DAAL, DBAL, DLDA, DMDA, DNDA, DNDC, DTCA, DTDA, DWDA, FMDA, FMDB, PRDL, PRDM, PRDN, PRDP, RBAN
24 V DC	+/- 10% nominal	773-824	DAAL, DBAL, DLDA, DMDA, DNDA, DNDC, DTCA, DTDA, DWDA, FMDA, FMDB, PRDL, PRDM, PRDN, PRDP, RBAN, RBAP
28 V DC	+/- 10% nominal	773-828	DAAL, DBAL, DLDA, DMDA, DNDA, DNDC, DTCA

A weatherization kit is required in conjunction with a weatherized coil and a modified cavity (consult the Sun website to view cavity modification instructions for the use of each kit). The coil is not included in the kits and must be purchased separately. Weatherization kits are cartridge model code and cavity dependant. **These kits are intended for new installations only and are not suitable for retrofitting existing equipment or for standard Sun bodies.**

- Consult www.sunhydraulics.com for complete details on weatherized coils and weatherized coil kits. Go to Products: Cartridges: Coils: Weatherized Coils. View individual Weatherized Coil Seal Kit page for detailed installation instructions.

WEATHERIZED (ROUND) COIL KITS FOR METRI-PACK SERIES 150-2M CONNECTOR



Metri-Pack 150-2M Kit Number Only	Weatherized Kits for Specific Cavities	Used for Cartridge Models
991-055	T-11A Cavity	DMDA, DWDA, PRDL, PRDP, FMDA, FMDB
991-056	T-13A and T-31A Cavities	DLDA, DTCA, DTDA (T-13A), DNDA (T-31A)
991-057	T-31A Cavity (3-position, 4-way)	DNDC
991-058	T-8A and T-9A Cavities	RBAP, DAAL, DBAL
991-059	T-8A Cavity	RBAN
991-060	T-11A Cavity	PRDM, PRDN

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

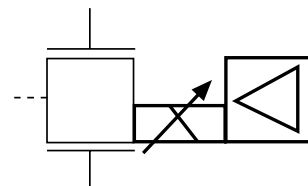


Sun Coil 790-***** Part Numbering System

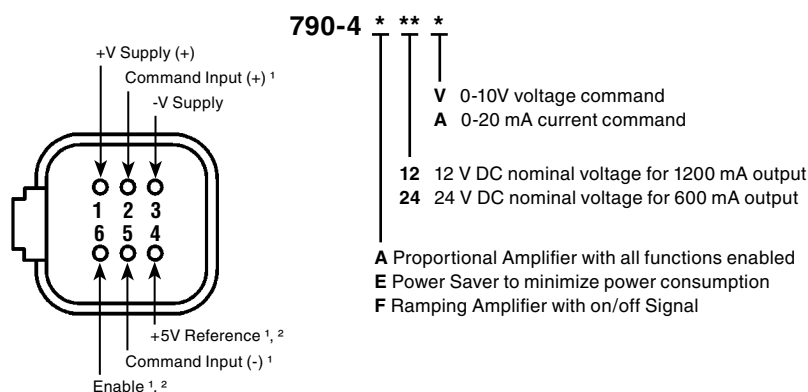
Sun coils (790-*****) have an embedded amplifier for proportional control. Different versions (see table on pages 188 and 189 of this catalogue) include maximum current of 625 mA or 1200 mA. The command Signal is a voltage (0-10 V) or a current (0-20 mA).

Proportional amplifiers:

- 790-4***** (for the Deutsch DT04-6P) use 6 pins and can be used for different wirings.
- 790-2***** (for ISO/DIN 4360, Form A) use 4 pins and is available in version B through F.
- See illustration below.
- 790-*E*** (Power Saver) works automatically when power is applied.
- 790-*F*** (Ramping Amplifier) can be controlled with on/off signals.

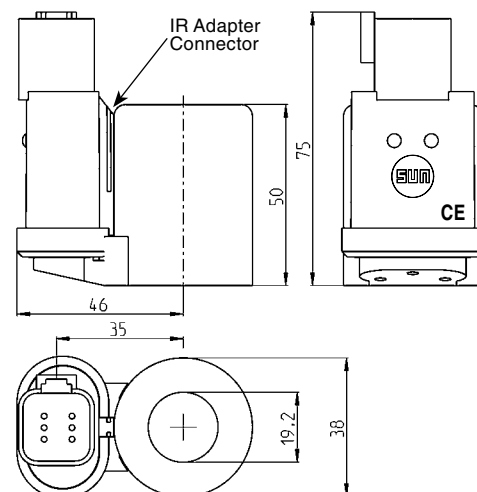


Deutsch DT04-6P Embedded Electronic Amplifier

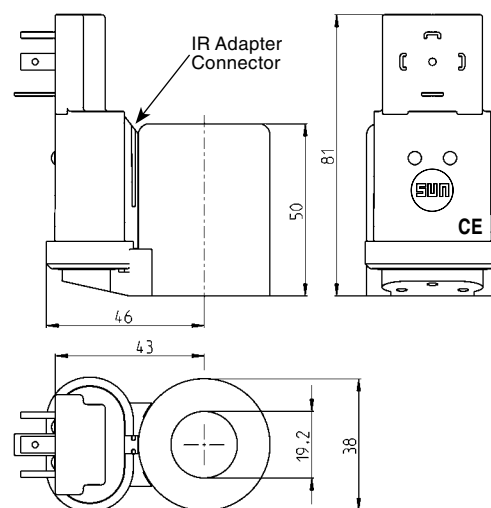
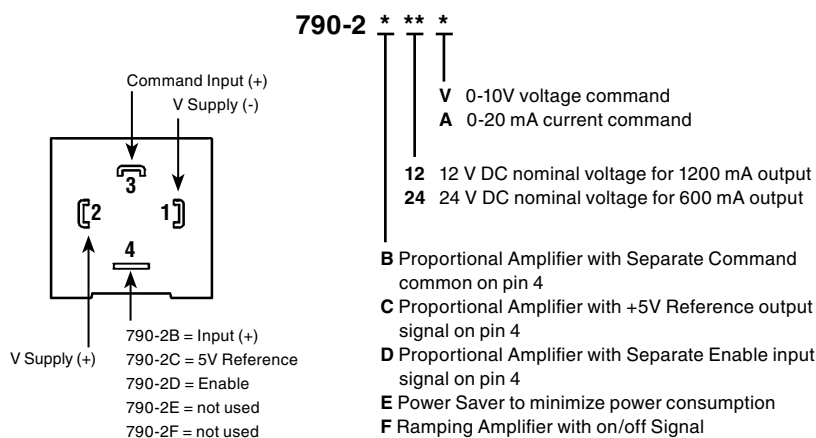


¹ Not used on Power Saver

² Not used on Ramping Amplifier



ISO/DIN 4360, Form A Embedded Electronic Amplifier



Additional Sun Tools for Embedded Electronics:

991-700	Hand Held Programmer (HHP): Access configuration setting in digital proportional valve amplifier, models C1V, C2A, and 790 series.
991-702	Infrared Cable Adapter: Provides Serial interface between 790 series embedded digital proportional amplifier and HHP
991-703	Infrared Cable Adapter: Provides Serial interface between C1V and C2A digital proportional amplifier and HHP
991-704	Infrared Cable Adapter: USB interface for 790-***** (includes Sun Amplifier Set-up Software on CD or download from website*)
991-705	Infrared Cable Adapter: USB interface for C1V***, C2A*** (includes Sun Amplifier Set-up Software on CD or download from website*)
991-706	Deutsch Cable Assembly: Use with 790 series embedded amplifier equipped with a Deutsch DT04-6P connector

* Go to www.sunhydraulics.com. Products: Amplifiers and Amplifier Accessories.

ORIFICE PRESSURE DROP DATA

No allowance has been made for viscosity effects, or regain of pressure downstream.

These charts are based on the formula:

$$Q = \alpha A \sqrt{\frac{2\Delta P}{\rho}}$$

Where:

Q = Flow m³/sec.

α = orifice coefficient

A = orifice dia. cm²

ΔP = pressure drop N/m²

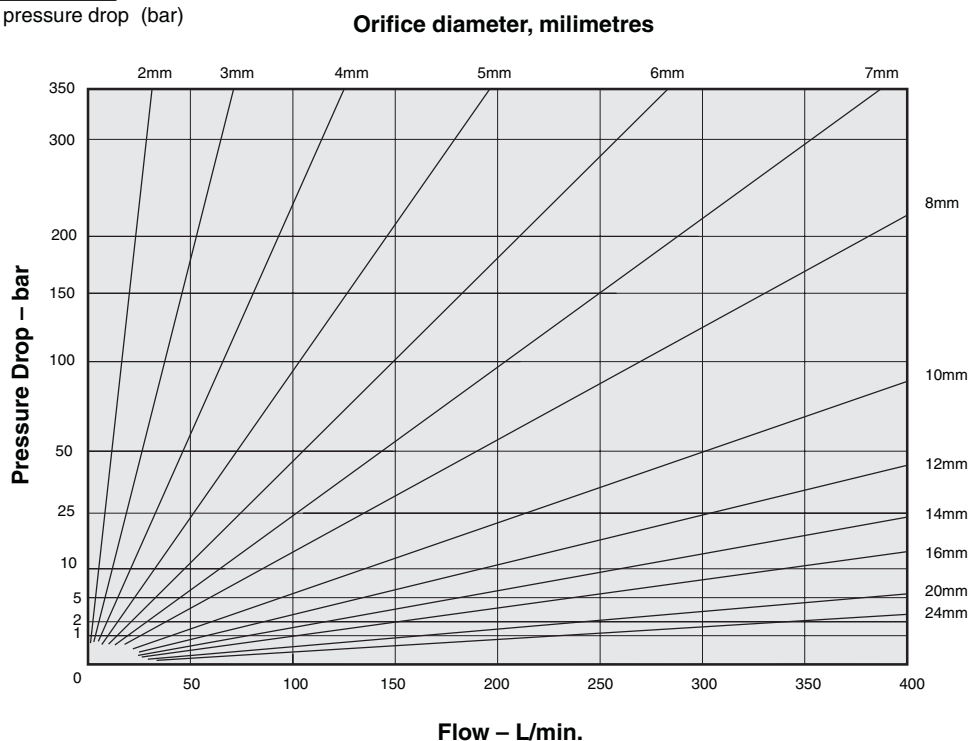
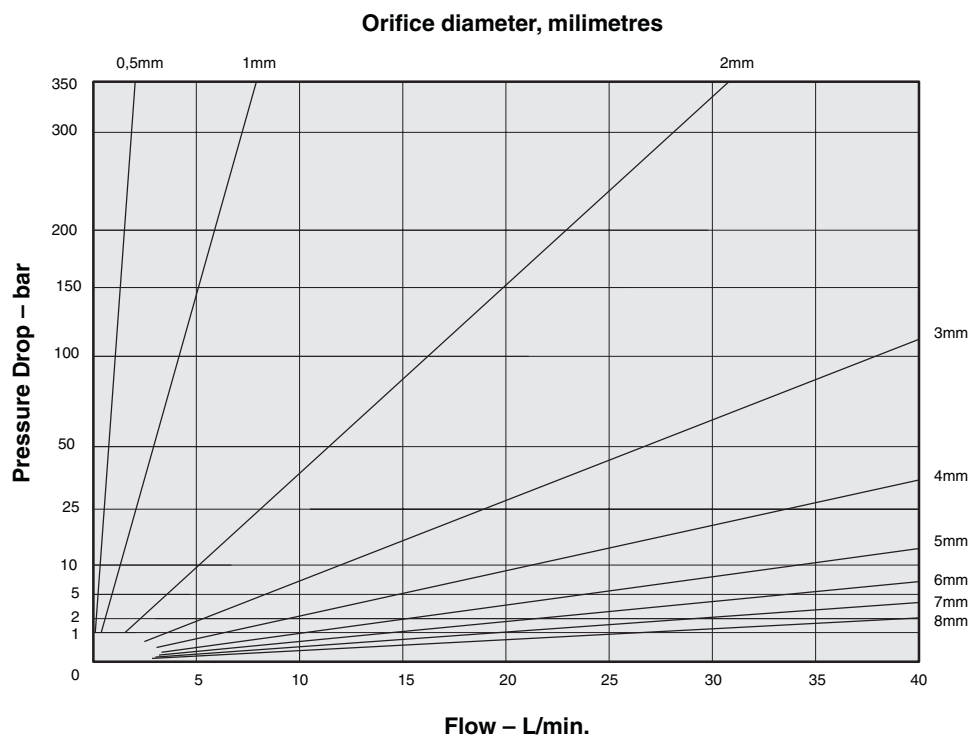
ρ = density Ns²/m⁴

This equation becomes:

$$Q \text{ (l/min)} = 0.4212 \times d^2 \text{ (mm)} \sqrt{\text{pressure drop (bar)}}$$

when $c = 0.6$

$$\rho = 0.9 \text{ g/cm}^3$$



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Sun Model Code System

Sun cartridges have a seven digit model code. Each of the digits in the seven digit sequence has a significance as shown in the typical model code.

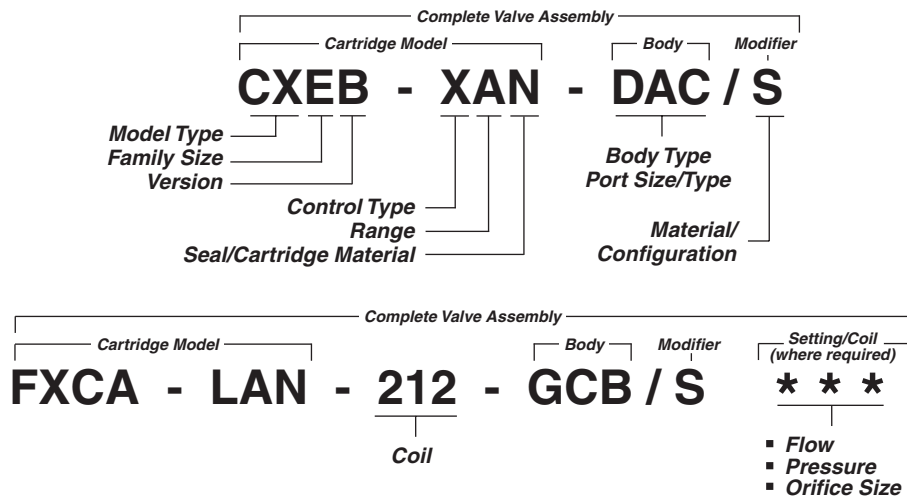
The three letter Body Model Code reference applies to most standard line mount bodies and sandwich bodies.

The first two digits of the Body Model Code indicate the body type and the third letter advises the main port size/type.

If the body is required in ductile iron, a slash and a fourth letter is added as shown in the top example. If other requirements are needed refer to the proper modifiers shown in the table.

MODIFIERS			
Body Configuration	Modifier	To Convert to Viton, Change Modifier to:	Examples
Aluminium	None	/V	ZMQ becomes ZMQ/V
Ductile Iron	/S	/Y	ZMQ/S becomes ZMQ/Y
Aluminium - metric	/M	/Z	ZMQ/M becomes ZMQ/Z
Ductile Iron - metric	/T	/W	ZMQ/T becomes ZMQ/W

EXAMPLES OF TYPICAL SUN MODEL CODE STRUCTURE:



EXAMPLES:

RPEC-LAN-FEV 105 bar

Pilot Operated Relief Valve, 95 L/min., Buna-N Seals, set at 105 bar;
Through Port, Aluminium, 0.50 BSPP Ports, 0.25 BSPP Gage Port.

DLDA-XCN-212-GAU/S

Solenoid Operated, 2-position, 2-way, Spool Valve, No Manual Override, Buna-N Seals;
90 Degree, Ductile Iron Body, 0.375 BSPP Ports, 12 V DC Coil, DIN 43650 Connector.

FXEA-LAN-ICX 60,0 L/min.

Fixed Orifice, Pressure Compensated Flow Control Valve, Tuning Adjustment, Buna-N Seals, set at 60,0 L/min.;
Inline Ports, Aluminium Body, 1.00 BSPP Ports.

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Model Code Index

<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>
CACA - ***	T-11A	60	CBGY - ***	T-17A	54	CSAX - ***	T-163A	158
CACG - ***	T-11A	60	CBHA - ***	T-19A	58	CSAY - ***	T-162A	156
CACK - ***	T-11A	60	CBHG - ***	T-19A	59	CSAZ - ***	T-163A	158
CACL - ***	T-11A	60	CBIA - ***	T-19A	54	CVCV - ***	T-21A	50
CAEA - ***	T-2A	60	CBIB - ***	T-19A	54	CVEV - ***	T-22A	50
CAEG - ***	T-2A	60	CBIG - ***	T-19A	55	CVGV - ***	T-23A	50
CAEK - ***	T-2A	60	CBIH - ***	T-19A	55	CVIV - ***	T-24A	50
CAEL - ***	T-2A	60	CBIL - ***	T-19A	55	CWCA - ***	T-21A	61
CAGA - ***	T-17A	60	CBIY - ***	T-19A	54	CWCG - ***	T-21A	62
CAGG - ***	T-17A	60	CDA - ***	T-13A	157	CWCK - ***	T-21A	61
CAGK - ***	T-17A	60	CDAB - ***	T-11A	159	CWCL - ***	T-21A	62
CAGL - ***	T-17A	60	CDAC - ***	T-13A	157	CWEA - ***	T-22A	61
CAIA - ***	T-19A	60	CDAD - ***	T-11A	159	CWEG - ***	T-22A	62
CAIG - ***	T-19A	60	CKBB - ***	T-163A	48	CWEK - ***	T-22A	61
CAIK - ***	T-19A	60	CKBD - ***	T-163A	48	CWEL - ***	T-22A	62
CAIL - ***	T-19A	60	CKCB - ***	T-11A	48	CWGA - ***	T-23A	61
CBBA - ***	T-11A	58	CKCD - ***	T-11A	48	CWGG - ***	T-23A	62
CBBB - ***	T-11A	56	CKCV - ***	T-11A	49	CWGK - ***	T-23A	61
CBBC - ***	T-11A	56	CKEB - ***	T-2A	48	CWGL - ***	T-23A	62
CBBD - ***	T-11A	57	CKED - ***	T-2A	48	CWIA - ***	T-24A	61
CBBG - ***	T-11A	59	CKEV - ***	T-2A	49	CWIG - ***	T-24A	62
CBBL - ***	T-11A	57	CKGB - ***	T-17A	48	CWIK - ***	T-24A	61
CBBY - ***	T-11A	58	CKGD - ***	T-17A	48	CWIL - ***	T-24A	62
CBCA - ***	T-11A	54	CKGV - ***	T-17A	49	CXAA - ***	T-8A	74
CBCB - ***	T-11A	54	CKIB - ***	T-19A	48	CXAD - ***	T-162A	75
CBCG - ***	T-11A	55	CKID - ***	T-19A	48	CXBA - ***	T-162A	74
CBCH - ***	T-11A	55	CKIV - ***	T-19A	49	CXCD - ***	T-13A	75
CBCL - ***	T-11A	55	CNAC - ***	T-162A	83	CXCE - ***	T-11A	77
CBCY - ***	T-11A	54	CNBC - ***	T-162A	76	CXDA - ***	T-13A	74
CBDA - ***	T-2A	58	CNCC - ***	T-13A	83	CXED - ***	T-5A	75
CBDB - ***	T-2A	56	CNCD - ***	T-11A	78	CXEE - ***	T-2A	77
CBDC - ***	T-2A	56	CNDC - ***	T-13A	76	CXFA - ***	T-5A	74
CBDD - ***	T-2A	57	CNEC - ***	T-5A	83	CXGD - ***	T-16A	75
CBDG - ***	T-2A	59	CNED - ***	T-2A	78	CXGE - ***	T-17A	77
CBDL - ***	T-2A	57	CNFC - ***	T-5A	76	CXHA - ***	T-16A	74
CBEA - ***	T-2A	54	CNGC - ***	T-16A	83	CXID - ***	T-18A	75
CBEB - ***	T-2A	54	CNGD - ***	T-17A	78	CXIE - ***	T-19A	77
CBEG - ***	T-2A	55	CNHC - ***	T-16A	76	CXJA - ***	T-18A	74
CBEH - ***	T-2A	55	CNIC - ***	T-18A	83	DAAH - ***	T-8A	147
CBEL - ***	T-2A	55	CNID - ***	T-19A	78	DAAL - ***	T-8A	133
CBEY - ***	T-2A	54	CNJC - ***	T-18A	76	DAAL - ***	T-8A	146
CBFA - ***	T-17A	58	COBA - ***	T-163A	166	DAAL - S**	T-8A	133
CBFB - ***	T-17A	56	CODA - ***	T-11A	166	DAAL - S**	T-8A	146
CBFC - ***	T-17A	56	COFA - ***	T-2A	166	DAAP - ***	T-8A	149
CBFD - ***	T-17A	57	COFO - ***	T-2A	167	DAAM - ***	T-8A	148
CBFG - ***	T-17A	59	COHA - ***	T-17A	166	DBAH - ***	T-9A	151
CBFL - ***	T-17A	57	COJA - ***	T-19A	166	DBAL - ***	T-9A	136
CBGA - ***	T-17A	54	CSAA - ***	T-13A	156	DBAL - ***	T-9A	150
CBGB - ***	T-17A	54	CSAB - ***	T-11A	158	DBAL - S**	T-9A	136
CBGG - ***	T-17A	55	CSAC - ***	T-13A	156	DBAL - S**	T-9A	150
CBGH - ***	T-17A	55	CSAD - ***	T-11A	158	DBAM - ***	T-9	153
CBGL - ***	T-17A	55	CSAW - ***	T-162A	156	DBAP - ***	T-9A	152

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Model Code Index

<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>
DCCC - ***	T-61A	129	DOJR - 8**	T-24A	106	DVBB - 8**	T-11A	123
DCCD - ***	T-61A	130	DOJS - ***	T-24A	104	DVBC - 8**	T-11A	123
DCDC - ***	T-62A	129	DPBA - ***	T-11A	118	DVBD - 8**	T-11A	123
DCDD - ***	T-62A	130	DPBB - ***	T-11A	118	DVBM - 8**	T-21A	124
DCEC - ***	T-63A	129	DPBC - ***	T-11A	118	DVBN - 8**	T-21A	124
DCED - ***	T-63A	130	DPBD - ***	T-11A	118	DVBO - 8**	T-21A	124
DCFC - ***	T-64A	129	DPBM - ***	T-21A	119	DVBP - 8**	T-21A	124
DCFD - ***	T-64A	130	DPBN - ***	T-21A	119	DVCA - 8**	T-2A	123
DFCA - 8**	T-13A	127	DPBO - ***	T-21A	119	DVCB - 8**	T-2A	123
DFCB - 8**	T-13A	128	DPBP - ***	T-21A	119	DVCC - 8**	T-2A	123
DFDA - 8**	T-5A	127	DPCA - ***	T-2A	118	DVCD - 8**	T-2A	123
DFDB - 8**	T-5A	128	DPCB - ***	T-2A	118	DVCM - 8**	T-22A	124
DFEA - 8**	T-16A	127	DPCC - ***	T-2A	118	DVCN - 8**	T-22A	124
DFEB - 8**	T-16A	128	DPCD - ***	T-2A	118	DVCO - 8**	T-22A	124
DFFA - 8**	T-18A	127	DPCM - ***	T-22A	119	DVCP - 8**	T-22A	124
DKDP - ***	T-21A	103	DPCN - ***	T-22A	119	DWDA - ***	T-11A	135
DKDR - ***	T-21A	101	DPCO - ***	T-22A	119	FCBB - ***	T-162A	85
DKDR - 8**	T-21A	102	DPCP - ***	T-22A	119	FCCB - ***	T-13A	85
DKDS - ***	T-21A	100	DRAX - ***	T-21A	122	FCDB - ***	T-5A	85
DKFP - ***	T-22A	103	DRAY - ***	T-21A	122	FCEB - ***	T-16A	85
DKFR - ***	T-22A	101	DRBA - ***	T-11A	120	FCFB - ***	T-18A	85
DKFR - 8**	T-22A	102	DRBB - ***	T-11A	120	FDBA - ***	T-13A	86
DKFS - ***	T-22A	100	DRBC - ***	T-11A	120	FDCB - ***	T-5A	86
DKHP - ***	T-23A	103	DRBD - ***	T-11A	120	FDEA - ***	T-16A	86
DKHR - ***	T-23A	101	DRBM - ***	T-21A	121	FDFA - ***	T-18A	86
DKHR - 8**	T-23A	102	DRBN - ***	T-21A	121	FPCC - ***	T-13A	90
DKHS - ***	T-23A	100	DRBO - ***	T-21A	121	FPCH - ***	T-13A	91
DKJP - ***	T-24A	103	DRBP - ***	T-21A	121	FQCA - ***	T-13A	164
DKJR - ***	T-24A	101	DRBR - ***	T-21A	121	FQEA - ***	T-5A	164
DKJR - 8**	T-24A	102	DSCH - ***	T-31A	160	FQGA - ***	T-16A	164
DKJS - ***	T-24A	100	DSCO - ***	T-31A	162	FQIA - ***	T-18A	164
DLDA - ***	T-13A	134	DSCS - ***	T-31A	161	FRBA - ***	T-163A	87
DLDA - S**	T-13A	134	DSCX - ***	T-31A	125	FRCA - ***	T-11A	87
DMDA - ***	T-11A	137	DSCY - ***	T-31A	126	FRDA - ***	T-2A	87
DMDA - S**	T-11A	137	DSEH - ***	T-32A	160	FREA - ***	T-17A	87
DNDA - ***	T-31A	138	DSEO - ***	T-32A	162	FRFA - ***	T-19A	87
DNDA - S**	T-31A	138	DSES - ***	T-32A	161	FSCA - ***	T-31A	95
DNDC - X**	T-31A	139	DSEX - ***	T-32A	125	FSCD - ***	T-31A	94
DODP - ***	T-21A	107	DSEY - ***	T-32A	126	FSCH - ***	T-31A	97
DODR - ***	T-21A	105	DSGH - ***	T-33A	160	FSCS - ***	T-31A	96
DODR - 8**	T-21A	106	DSGO - ***	T-33A	162	FSDA - ***	T-32A	95
DODS - ***	T-21A	104	DSGS - ***	T-33A	161	FSDD - ***	T-32A	94
DOFP - ***	T-22A	107	DSGX - ***	T-33A	125	FSDH - ***	T-32A	97
DOFR - ***	T-22A	105	DSGY - ***	T-33A	126	FSDS - ***	T-32A	96
DOFR - 8**	T-22A	106	DSIH - ***	T-34A	160	FSEA - ***	T-33A	95
DOFS - ***	T-22A	104	DSIO - ***	T-34A	162	FSED - ***	T-33A	94
DOHP - ***	T-23A	107	DSIS - ***	T-34A	161	FSEH - ***	T-33A	97
DOHR - ***	T-23A	105	DSIX - ***	T-34A	125	FSES - ***	T-33A	96
DOHR - 8**	T-23A	106	DSIY - ***	T-34A	126	FSFA - ***	T-34A	95
DOHS - ***	T-23A	104	DTDA - ***	T-13A	132	FSFD - ***	T-34A	94
DOJP - ***	T-24A	107	DTDA - S**	T-13A	132	FSFH - ***	T-34A	97
DOJR - ***	T-24A	105	DVBA - 8**	T-11A	123	FSFS - ***	T-34A	96

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.

Model Code Index

<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>
FVCA - ***	T-21A	88	LOHC - ***	T-17A	108	MBEM- X**	T-2A	70
FVCA - 8**	T-21A	89	LOHC - Z**	T-17A	110	MBGM- X**	T-17A	70
FVDA - ***	T-22A	88	LOHD - ***	T-17A	108	MBIM - X**	T-19A	70
FVDA - 8**	T-22A	89	LOHD - 8**	T-17A	109	MWEA- ***	T-22A	66
FVEA - ***	T-23A	88	LOHO - ***	T-17A	108	MWEA- X**	T-22A	67
FVEA - 8**	T-23A	89	LOHO - Z**	T-17A	111	MWGA- ***	T-23A	66
FVFA - ***	T-24A	88	LOJA - ***	T-19A	108	MWGA- X**	T-23A	67
FVFA - 8**	T-24A	89	LOJA - 8**	T-19A	109	MWIA - ***	T-24A	66
FXBA - ***	T-162A	84	LOJB - ***	T-19A	108	MWIA - X**	T-24A	67
FXCA - ***	T-13A	84	LOJB - 8**	T-19A	109	MWEB- ***	T-22A	66
FXDA - ***	T-5A	84	LOJC - ***	T-19A	108	MWEB- X**	T-22A	67
FXEA - ***	T-16A	84	LOJD - ***	T-19A	108	MWGB- ***	T-23A	66
FXFA - ***	T-18A	84	LOJD - 8**	T-19A	109	MWGB- X**	T-23A	67
HRDA - ***	T-11A	172	LOJO - ***	T-19A	108	MWIB - ***	T-24A	66
HRDB - ***	T-11A	173	LPBA - ***	T-163A	114	MWIB - X**	T-24A	67
HVCA - ***	T-21A	174	LPBC - ***	T-163A	114	MWEG- ***	T-22A	66
HVCA - 8**	T-21A	175	LPDA - ***	T-11A	114	MWEG- X**	T-22A	67
LHDA - ***	T-31A	116	LPDC - ***	T-11A	114	MWGG- ***	T-23A	66
LHDT - ***	T-31A	115	LPFA - ***	T-2A	114	MWGG- X**	T-23A	67
LHFA - ***	T-32A	116	LPFC - ***	T-2A	114	MWIG - ***	T-24A	66
LHFT - ***	T-32A	115	LPHA - ***	T-17A	114	MWIG - X**	T-24A	67
LHHA - ***	T-33A	116	LPHC - ***	T-17A	114	MWEM- X**	T-22A	71
LHHT - ***	T-33A	115	LPJA - ***	T-19A	114	MWGM- X**	T-23A	71
LHJA - ***	T-34A	116	LPJC - ***	T-19A	114	MWIM - X**	T-24A	70
LKDC - ***	T-11A	112	LRBA - ***	T-163A	113	NCBB - ***	T-162A	82
LKFC - ***	T-2A	112	LRBC - ***	T-163A	113	NCCC - ***	T-13A	82
LKHC - ***	T-17A	112	LRDA - ***	T-11A	113	NCCD - ***	T-13A	82
LKJC - ***	T-19A	112	LRDC - ***	T-11A	113	NCEB - ***	T-5A	82
LODA - ***	T-11A	108	LRFA - ***	T-2A	113	NCCB - ***	T-13A	82
LODA - 8**	T-11A	109	LRFC - ***	T-2A	113	NCEC - ***	T-5A	82
LODB - ***	T-11A	108	LRHA - ***	T-17A	113	NCFB - ***	T-16A	82
LODB - 8**	T-11A	109	LRHC - ***	T-17A	113	NCFC - ***	T-16A	82
LODC - 8**	T-11A	109	LRJA - ***	T-19A	113	NCGB - ***	T-18A	82
LODD - ***	T-11A	108	LRJC - ***	T-19A	113	NCGC - ***	T-18A	82
LODD - 8**	T-11A	109	MBEA - ***	T-2A	64	NFAB - ***	T-8A	145
LODO - ***	T-11A	108	MBEA - X**	T-2A	65	NFBC - ***	T-162A	80
LOEC - Z**	T-2A	110	MBGA - ***	T-17A	64	NFCC - ***	T-13A	80
LOFA - ***	T-2A	108	MBGA - X**	T-17A	65	NFCD - ***	T-13A	81
LOFA - 8**	T-2A	109	MBIA - ***	T-19A	64	NFDC - ***	T-5A	80
LOFB - ***	T-2A	108	MBIA - X**	T-19A	65	NFDD - ***	T-5A	81
LOFB - 8**	T-2A	109	MBEB - ***	T-2A	64	NFEC - ***	T-16A	80
LOFC - ***	T-2A	108	MBEB - X**	T-2A	65	NFED - ***	T-16A	81
LOFC - Z**	T-2A	110	MBGB - ***	T-17A	64	NFFC - ***	T-18A	80
LOFD - ***	T-2A	108	MBGB - X**	T-17A	65	NFFD - ***	T-18A	81
LOFD - 8**	T-2A	109	MBIB - ***	T-19A	64	NQEB - ***	T-3A	165
LOFO - ***	T-2A	108	MBIB - X**	T-19A	65	PBBB - ***	T-163A	34
LOFO - Z**	T-2A	111	MBEG - ***	T-2A	64	PBDB - ***	T-11A	34
LOGC - Z**	T-17A	110	MBEG - X**	T-2A	65	PBDB - 8**	T-11A	36
LOHA - ***	T-17A	108	MBGG - ***	T-2A	64	PBFB - ***	T-2A	34
LOHA - 8**	T-17A	109	MBGG - X**	T-17A	65	PBFB - 8**	T-2A	36
LOHB - ***	T-17A	108	MBIG - ***	T-19A	64	PBFC - ***	T-2A	35
LOHB - 8**	T-17A	109	MBIG - X**	T-19A	65	PBHB - ***	T-17A	34

Visit www.sunhydraulics.com for current list pricing and complete technical information on all Sun products.



Model Code Index

<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>	<i>Model Code</i>	<i>Cavity</i>	<i>Page</i>
PBHB - 8**	T-17A	36	RBAA - ***	T-3A	143	RSDC - 8**	T-11A	31
PBHC - ***	T-17A	35	RBAC - ***	T-10A	9	RSFC - ***	T-2A	26
PBJB - ***	T-19A	34	RBAC - ***	T-10A	143	RSFC - 8**	T-2A	31
PBJB - 8**	T-19A	36	RBAE - ***	T-8A	9	RSFE - ***	T-2A	29
PBJC - ***	T-19A	35	RBAE - ***	T-8A	143	RSHC - ***	T-17A	26
PPDB - ***	T-11A	37	RBAP - ***	T-8A	14	RSHC - 8**	T-17A	31
PPDB - 8**	T-11A	45	RBAP - ***	T-8A	142	RSHE - ***	T-17A	29
PPFB - ***	T-2A	37	RBAN - ***	T-8A	15	RSJC - ***	T-19A	31
PPFB - 8**	T-2A	45	RBAR - ***	T-8A	144	RSJC - 8**	T-19A	26
PPFC - ***	T-2A	38	RDBA - ***	T-162A	7	RSJE - ***	T-19A	29
PPHB - ***	T-17A	37	RDDA - ***	T-10A	7	RVBA - ***	T-163A	18
PPHB - 8**	T-17A	45	RDDT - ***	T-10A	8	RVBB - ***	T-163A	21
PPHC - ***	T-17A	38	RDFA - ***	T-3A	7	RVCA - ***	T-11A	18
PPJB - ***	T-19A	37	RDFT - ***	T-3A	8	RVCB - ***	T-11A	21
PPJB - 8**	T-19A	45	RDHA - ***	T-16A	7	RVCD - ***	T-21A	22
PPJC - ***	T-19A	38	RDJA - ***	T-18A	7	RVCD - 8**	T-21A	23
PRDB - ***	T-11A	37	RPCC - ***	T-162A	6	RVCS - ***	T-11A	19
PRDL - ***	T-11A	43	RPEC - ***	T-10A	6	RVEA - ***	T-2A	18
PRDP - ***	T-11A	44	RPEC - 8**	T-10A	16	RVEB - ***	T-2A	21
PRFB - ***	T-2A	39	RPES - ***	T-10A	10	RVED - ***	T-22A	22
PRHB - ***	T-17A	39	RPES - 8**	T-10A	17	RVED - 8**	T-22A	23
PRJB - ***	T-19A	39	RPET - ***	T-10A	11	RVES - ***	T-2A	19
PSDT - ***	T-21A	42	RPGC - ***	T-3A	6	RVET - ***	T-2A	20
PSFT - ***	T-22A	42	RPGC - 8**	T-3A	16	RVGS - ***	T-17A	19
PSHT - ***	T-23A	42	RPGD - ***	T-3A	13	RVGA - ***	T-17A	18
PSJT - ***	T-24A	42	RPGS - ***	T-3A	10	RVGB - ***	T-17A	21
PVDA - ***	T-21A	40	RPGS - 8**	T-3A	17	RVGD - ***	T-23A	22
PVDA - 8**	T-21A	46	RPGT - ***	T-3A	11	RVGD - 8**	T-23A	23
PVDB - ***	T-21A	41	RPIC - ***	T-16A	6	RVGT - ***	T-17A	20
PVFA - ***	T-22A	40	RPIC - 8**	T-16A	16	RVIA - ***	T-19A	18
PVFA - 8**	T-22A	46	RPID - ***	T-16A	13	RVIB - ***	T-19A	21
PVFB - ***	T-22A	41	RPIS - ***	T-16A	10	RVID - ***	T-24A	22
PVHA - ***	T-23A	40	RPIS - 8**	T-16A	17	RVID - 8**	T-24A	23
PVHA - 8**	T-23A	46	RPIT - ***	T-16A	11	RVIS - ***	T-19A	19
PVHB - ***	T-23A	41	RPKC - ***	T-18A	6	RVIT - ***	T-19A	20
PVJA - ***	T-24A	40	RPKC - 8**	T-18A	16	SCCA - ***	T-11A	27
PVJA - 8**	T-24A	46	RPKD - ***	T-18A	13	SCEA - ***	T-2A	27
PVJB - ***	T-24A	41	RPKS - ***	T-18A	10	SCGA - ***	T-17A	27
QCDA - ***	T-21A	169	RPKS - 8**	T-18A	17	SCIA - ***	T-19A	27
QCDB - ***	T-21A	169	RPKT - ***	T-18A	11	SQBB - ***	T-163A	28
QCDC - ***	T-21A	169	RQCB - ***	T-162A	12	SQDB - ***	T-11A	28
QCDD - ***	T-21A	169	RQEB - ***	T-10A	12	SQFB - ***	T-2A	28
QPAA - ***	T-11A	168	RQGB - ***	T-3A	12	SQHB - ***	T-17A	28
QPAB - ***	T-11A	168	RQIB - ***	T-16A	12	SQJB - ***	T-19A	28
QPAC - ***	T-11A	168	RQKB - ***	T-18A	12	SXCA - ***	T-11A	30
QPAD - ***	T-11A	168	RSBC - ***	T-163A	26	SXEA - ***	T-2A	30
RBAA - ***	T-3A	9	RSDC - ***	T-11A	26			

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NOTES

WARRANTY INFORMATION, PERFORMANCE ASSURANCE, AND APPLICATION LIMITATIONS

Caution

Sun Hydraulics Limited manufactures a variety of cartridge valves that will fit into the same Sun cavity. Each cartridge is marked with a seven-digit part identification code and a four-digit date code, stamped on the hex surfaces. Designers and users of Sun components are advised that **physical interchangeability of cartridges does not necessarily mean functional interchangeability.** When

replacing any Sun cartridges, users should first check with the manufacturer's service literature, their local Sun distributor, or the Sun factory before making any part substitutions.

NOTE: To avoid serious injury, the manufacturer's service literature must be consulted before working on any hydraulic system.

Limited Warranty

Sun Hydraulics Limited warrants its products free from defects in material, workmanship, and design for a period of three years after their installation, provided the installation date is less than one year after manufacture. **"O-rings" and seals are specifically exempted from this warranty.** In no instance is there any warranty of fitness for a particular use and Sun cannot and does not accept responsibility of any type for any of its products that have been subjected to improper installation, improper application, negligence, tampering, or abuse, or which have been repaired

or altered outside of the Sun Hydraulics factory. Sun Hydraulics Limited liability under this warranty shall extend only to repair or replacement, f.o.b. Sun's factory, of any defective part or product determined by inspection as not conforming to this warranty. Sun makes no other warranties, expressed or implied, and is not responsible for any consequential damages resulting from use by any buyer or user, Sun Hydraulics' liability being limited to the value of product sold or obligation to replace a defective part.

Performance Assurance

All Sun cartridges valves are individually tested at the factory and preset to specific pressure or flow settings where indicated in this catalogue. However, as the actual performance of buyers' equipment cannot be reproduced in Sun's testing laboratory, assurance of suitability of Sun products in the

buyer's application is the responsibility of the buyer. This is typically accomplished by the manufacture of a prototype followed by a test or qualification program on the part of the buyer.

Application Limitations

Sun product designs and manufacturing facilities have been specifically developed to provide products for commercial, industrial and mobile hydraulic applications and Sun products are only warranted for these types of uses. **Sun's distributors are not authorised to approve the use of Sun products in any of the following applications:**

- Any steering or braking systems for passenger-carrying vehicles or on-highway trucks.
- Aircraft or space vehicles.

- Ordnance equipment.
- Life support equipment.
- Any end product which is used in a nuclear power plant application.

Specific written approval for any application of Sun products in any of the above named applications should be obtained from Sun Hydraulics. Consultation with Sun distributors or factory engineers is advisable in any situations where applicability is questionable.

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International Distribution

Sun Hydraulics' authorized distributors are qualified to assist customers in the selection, application and purchase of our products. Distributors stock a wide range of product and provide many services, including but not limited to, system design and fabrication, technical service, repair, education and training. Sun believes that its distributors add value to the products it manufactures and through their work contribute to the efficiency, effectiveness and growth of the economy.

COUNTRY	DISTRIBUTOR	TELEPHONE (Dial Intl. Access Code before Country Code number listed below)			FACSIMILE (Dial Intl. Access Code before Country Code number listed below)			EMAIL ADDRESS	
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		Country Code	City Code	Local Number	Country Code	City Code	Local Number		
Argentina	Verion I.C.S.A.	54	11	4754-0044	54	11	4755-7167	vendas@verion.com.ar	
Australia	Custom Fluidpower	61	1300	781-178	61	7	3267-3777	enquiry@ custom. com.au	
Austria	Dorninger Hytronics GmbH	43	7236	20820-0	43	7236	20820-555	sales@hytronics.at	
Azerbaijan	Hydrolink Caspian Ltd.	994	12	497-4791	994	12	497-4628	baku@hydrolinkaz.com	
Bahrain	Hydrolink Bahrain W.L.L	937	17	467-553	937	17	467-554	info@hydrolinkbah.com	
Belgium	Doedijns Hydraulics B.V.	32	23	61-74-01	32	23	61-74-05	info@doedijns.com	
Bosnia	Kladivar Ziri	386	451	59-209	386	451	59-110	ales.bizjak@kladivar.com	
Brazil	Verion Oleohidraulica LTDA	55	11	6100-7400	55	11	6100-7409	vendas@verion.com.br	
Canada	Berendsen Fluid Power Ltd. -MB	1	204	786-7436	1	204	772-5082	winnipeg@bfpna.com	
	Indumo Inc. - PQ	1	514	331-5550	1	514	331-5209	apequette@indumo.com	
	Kinecor Inc. - AB	1	780	955-2155	1	780	955-2589	lamyotte@kincor.com	
	Lynch Fluid Controls, Inc. - ON	1	905	363-2400	1	905	363-1191	sales@lynch.ca	
	Peerless Eng. Sales, Ltd. - BC	1	604	659-4100	1	604	659-4121	info@peerlesse.com	
	TRC Hydraulics Inc. - NF	1	506	853-1986	1	506	859-6152	bruce.thompson@trc hydraulics.com	
Chile	Eximtec LTDA.	56	2	207-6590	56	2	207-6591	eximtec@eximtec.cl	
China	Sun Hydraulics Systems (Shanghai) Co., Ltd.	86	21	5778-0778	86	21	5778-0768	sunchina@online.sh.cn	
Croatia	Kladivar Ziri	386	451	59-209	386	451	59-110	ales.bizjak@kladivar.com	
Czech Republic	Sun Hydraulics GmbH	49	2431	8091-0	49	2431	8091-19	sales@sunhydraulik.de	
Denmark	PMC Hydropower A/S	45	751	44-444	45	751	44-545	info@pmchhydropower.dk	
Egypt	Delta Hydraulic Engineering Company	20	2	02-2296-0790	20	2	02-2297-4360	deltahydeng@yahoo.com	
Finland	PMC Polarteknik Oy Ab	358	20	770-9700	358	20	770-9701	info@pmcpolarteknik.com	
France	Sun Hydraulics SARL	33	557	291-529	33	557	291-857	info@sunfr.com	
Germany	Sun Hydraulik GmbH	49	2431	8091-0	49	2431	8091-19	sales@sunhydraulik.de	
Greece	Fluid Power Engineering Ltd.	30	210	558-0402	30	210	558-0403	info@fpe.gr	
Hong Kong	Sun Hydraulics Systems (Shanghai) Co., Ltd.	86	21	5778-0778	86	21	5778-0768	sunchina@online.sh.cn	
Hungary	Innotechnik Kft.	36	1	453-9050	36	1	453-9055	inno@innotechnik.hu	
Iceland	Landvelar EHF	354	---	580-5800	354	---	580-5801	landvelar@landvelar.is	
India	Sun Hydraulics (India	91	80	252-36325	91	80	252-31855	reddy@sunhydraulics.com	
Israel	Nahum Goldenberg NG, Ltd.	972	3	534-7976	972	3	534-3049	info@hydrocad.com	
Italy	Oleobi S.r.l.	39	051	606-5111	39	051	606-5190	info@oleobi.it	
Japan	Kawasaki Heavy Industries, Ltd.	81	78	991-1808	81	78	991-1809	webseiki@khi.co.jp	
Kazakhstan	Hydrolink Kazakhstan	7	727	334-0445	7	727	334-0446	alamty@hydrolinkkz.com	
Korea	Sun Hydraulics Korea Corporation	82	32	813-1350	82	32	813-1147	sales@sunhydraulics. co.kr	
Kosovo	Kladivar Ziri	386	451	59-209	386	451	59-110	ales.bizjak@kladivar.com	
Macedonia	Kladivar Ziri	386	451	59-209	386	451	59-110	ales.bizjak@kladivar.com	
Malaysia	Fluid Power (Pte.) Ltd.	65	6	254-7777	65	6	253-0319	enquiry@fluidpower.com. sg	

International Distribution continued on following page.





International Distribution

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		Country Code	City Code	Local Number	Country Code	City Code	Local Number	
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	Joymatic S.A. de C.V.	52	55	5396-0732	52	55	5341-2873	carolina@rahymex.com. mx
Montenegro	Kladivar Ziri	386	451	59-209	386	451	59-110	ales.bizjak@kladivar.com
Netherlands	Doedijns Hydraulics B.V.	31	182	30-28-88	31	182	30-27-77	info@doedijns.com
New Zealand	Hydraulic Cartridge Valves, Ltd.	64	9	573-1051	64	9	573-1052	hcv@hcv.co.nz
Norway	Hydranor A/S	47	48	06-56-56	47	32	86-56-55	hydranor@hydranor.no
	PMC Servi A/S	47	64	97-97-97	47	64	97-98-99	post@pmcservi.no
Peru	Powermatics S. A.	51	1	615-8800	51	1	348-4121	powermatic@powermatic. com.pe
Philippines	German Hydraulic & Plant Services, Inc.	63	2	813-5349	63	2	813-6158	sae_germ@german hydraulics.com.ph
Poland	Bibus Menos Sp. z.o.o.	48	58	660-9598	48	58	661-7132	ple@bibusmenos.pl
	Rockfin Sp. z.o.o.	48	58	684-9804	48	58	684-9807	poczta@rockfin.com.pl
Portugal	Hidromac LDA	351	1	299-437-140	351	1	229-437-149	info@hidromac.pt
Qatar	Hydrolink Qatar	974	4	620-483	974	4	620-484	pksharma@hydrolink group.com
Russia	AdamKo	7	812	313-2207	7	812	313-2207	konkinas@mail.ru
	Bibus Russia	7	812	251-62-71	7	812	251-90-14	info@bibus.ru
Romania	Bibus Eurofluid SRL	40	269	206-276	40	269	206-275	office@bibuseurofluid.ro
	SC ST Technik SRL	40	265	318-611	40	265	318-971	sttechnik@yahoo.com
Saudi Arabia	Hydrolink Company Limited	966	3	814-1313	966	3	814-0088	crajan@hydrolinkksa.com
Serbia	Kladivar Ziri	386	451	59-209	386	451	59-110	ales.bizjak@kladivar.com
Singapore	Fluid Power (Pte.) Ltd.	65	6	254-7777	65	6	253-0319	enquiry@fluidpower. com.sg
Slovenia	Kladivar Ziri	386	451	59-209	386	451	59-110	ales.bizjak@kladivar.com
Spain	Ingenieria y Distribucion de Equipaminentos Hidraulicos S.L.	34	94	369-6095	34	94	369-6507	info@ingenieria ydistribucion.com
South Africa	Axiom Hydraulics (Pty.) Ltd.	27	11	334-3068	27	11	334-4543	axiomjhb@mweb.co.za
Sweden	HYDNET ab	46	31	499-490	46	31	499-499	info@hydnet.se
	Specma JMS Systemhydraulik AB	46	31	727-6820	46	31	727-6837	sales.g@jms.nu
Switzerland	ATP Hydraulik AG	41	41	799-49-49	41	41	799-49-48	info@atphydraulik.ch
Taiwan	Taiphil Pioneer Corporation	886	22	505-6992	886	22	500-7051	tailinks@ms24.hinet.net
Thailand	Tavasin Limited Partnership	66	2	691-5900	66	2	691-5820	taec@thai-a.com.th
Turkey	NGR Hidrolik San. ve Tic Ltd. Sti	90	312	395-7032	90	312	395-7033	info@ngrhidrolik.com
Ukraine	Hydrotek Ukraine Ltd.	38	044	583-1456	38	044	583-1456	hydrocontrol@gmail.com
United Arab Emirates	Hydrolink FZE (Corporate Offices)	971	4	886-1414	971	4	886-1413	info@hydrolinkgroup.com
	Hydrolink Abu Dhabi	971	2	554-3720	971	2	554-3721	hydroauh@eim.ae
	Hydrolink Co. Ltd.	971	6	528-0801	971	6	528-0830	info@hydrolinkgroup.com
United Kingdom	Sun Hydraulics Limited	44	2476	217-400	44	2476	217-488	sales@sunuk.com
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