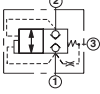
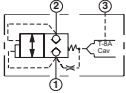
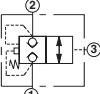


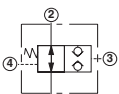
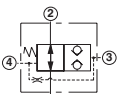
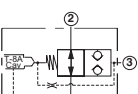
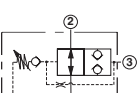
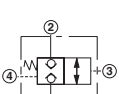
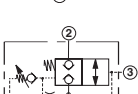
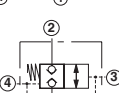
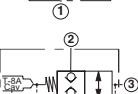
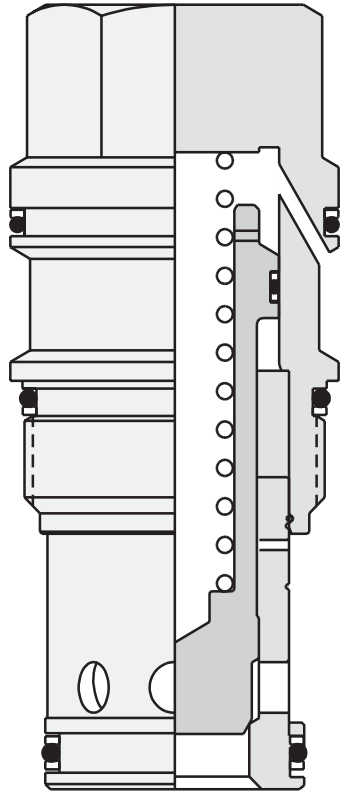
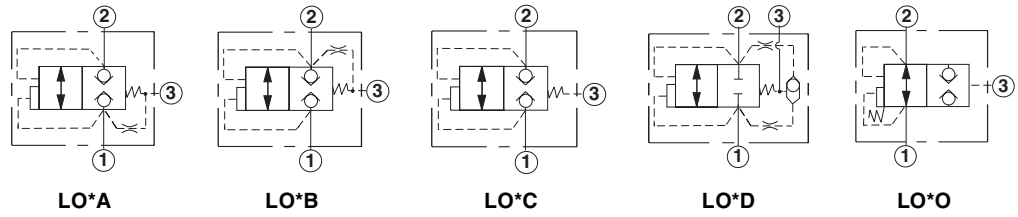
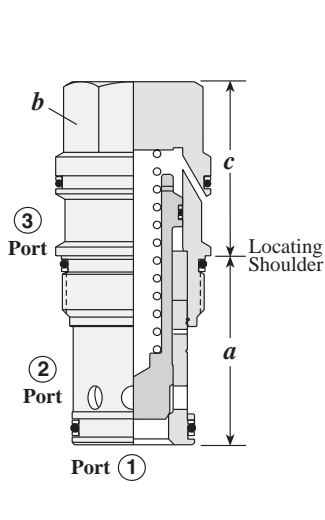


Logic Elements

	<i>Cartridge Type</i>	<i>Page</i>
	Unbalanced Poppet, Pilot-to-Close Switching Element	88
	Unbalanced Poppet, Pilot-to-Close Switching Element with Integral Pilot Control Cavity	89
	Unbalanced Poppet, Pilot-to-Open Switching Element	90
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	Normally Closed, Pressure Adjustable	98
	Normally Closed, Vent-to-Operate	99
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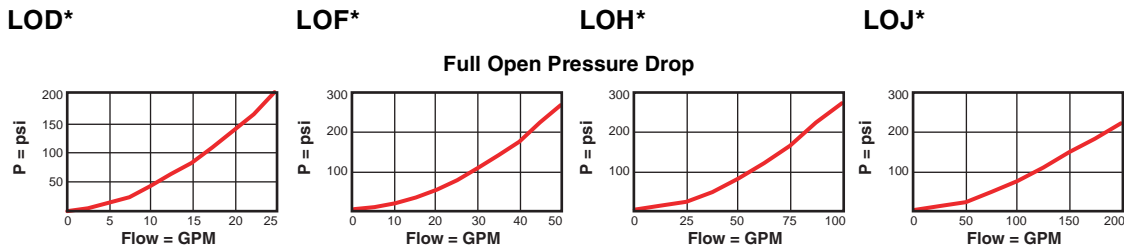


UNBALANCED POPPET, PILOT-TO-CLOSE SWITCHING ELEMENT



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (lb. ft.)
			a	b	c		
					X	E	
25 GPM	LODC – XDN	T - 11A	1.38	7/8"	1.19	1.19	30/35
50 GPM	LOFC – XDN	T - 2A	1.38	1 1/8"	1.38	1.38	45/50
100 GPM	LOHC – XDN	T - 17A	1.81	1 1/4"	1.81	1.81	150/160
200 GPM	LOJC – XDN	T - 19A	2.50	1 5/8"	2.31	2.31	350/375

Performance Curves



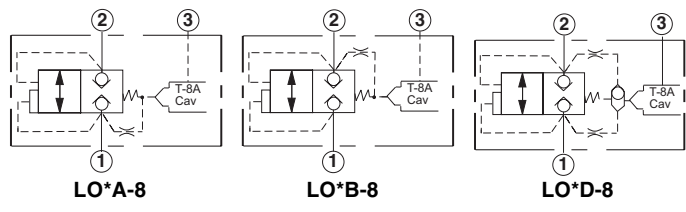
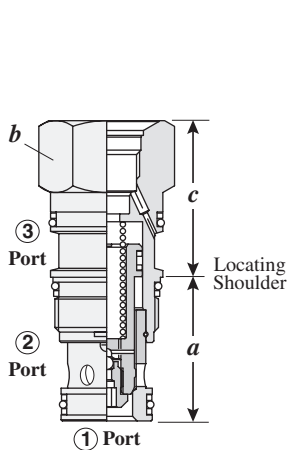
- Maximum operating pressure = 5000 psi
- Area ratio: A3 to A1 = 1.8:1
- Area ratio: A3 to A2 = 2.25:1
- Control orifice diameter = LODA, LODB, LODD, LOFA, LOFB, LOFD: .021 in., LOHA, LOHB, LOHD: .031 in., LOJA, LOJB, LOJD: .035 in.
- Pilot volume for complete shift = LOD*: .04 in³/min., LOF*: .07 in³/min., LOH*: .25 in³/min., LOJ*: .42 in³/min.
- 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.

Nominal Capacity	Version	Control**	Cracking Pressure A, B, C, D Versions	Seal
D 25 GPM	A Spring biased closed Port 1 pilot source	X Non-adjustable	D 50 psi at Port 1 (30 psi to close at Port 3 for O Version)	N Buna-N
F 50 GPM	B Spring biased closed Port 2 pilot source	Available in B and C Versions Only		V Viton
H 100 GPM	C Spring biased closed Port 3 pilot source	E SAE-4 Port in Hex Body, Port 3 blocked	Available in D and F Capacities Only	
J 200 GPM	D Spring biased closed higher of Ports 1 or 2 pilot source	L Stroke Adjustment		
	O Spring biased open Port 3 pilot source			

** See page 162 for information on Control Options

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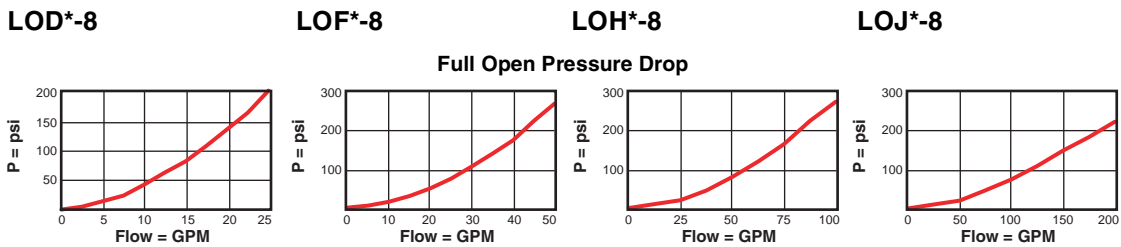
UNBALANCED POPPET, PILOT-TO-CLOSE SWITCHING ELEMENT WITH INTEGRAL PILOT CONTROL CAVITY



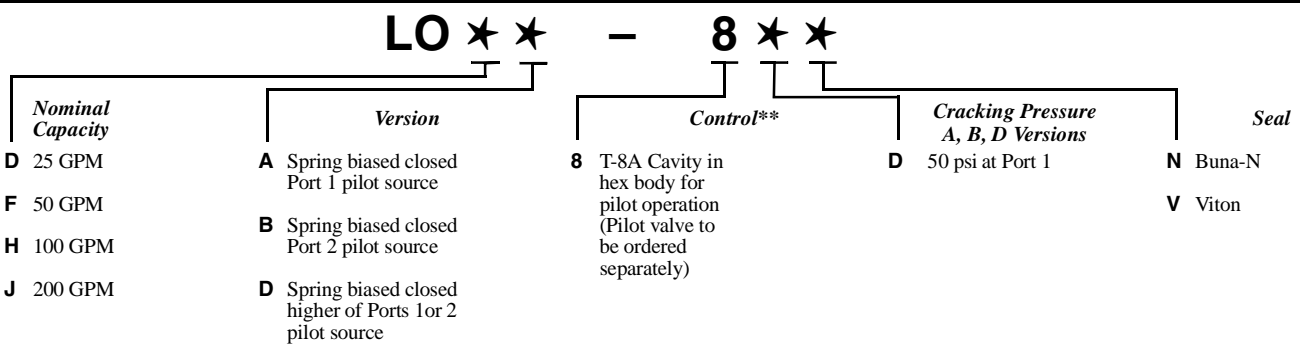
The -8 control option allows a pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include solenoid and air pilot operation. See Pilot Control Cartridges on page 121.

Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
25 GPM	LODA - 8DN	T - 11A	1.38	7/8"	1.19	30/35
50 GPM	LOFA - 8DN	T - 2A	1.38	1 1/8"	1.38	45/50
100 GPM	LOHA - 8DN	T - 17A	1.81	1 1/4"	1.81	150/160
200 GPM	LOJA - 8DN	T - 19A	2.50	1 5/8"	2.31	350/375

Performance Curves



- Maximum operating pressure = 5000 psi
- Area ratio: A3 to A1 = 1.8:1
- Area ratio: A3 to A2 = 2.25:1
- Control orifice diameter = LOD*-8, LOF*-8, LOF*-8: .021 in., LOH*, LOH*-8: .031 in., LOJ*, LOJ*-8: .035 in.
- 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.

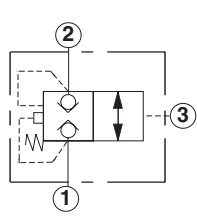
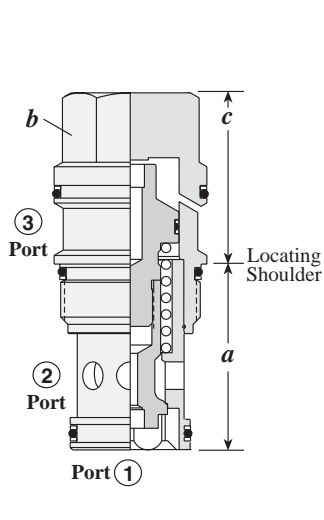


** See page 162 for information on Control Options

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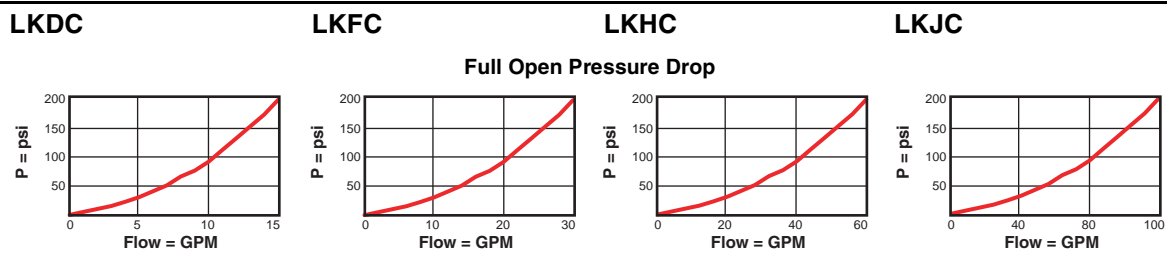


UNBALANCED POPPET, PILOT-TO-OPEN SWITCHING ELEMENT

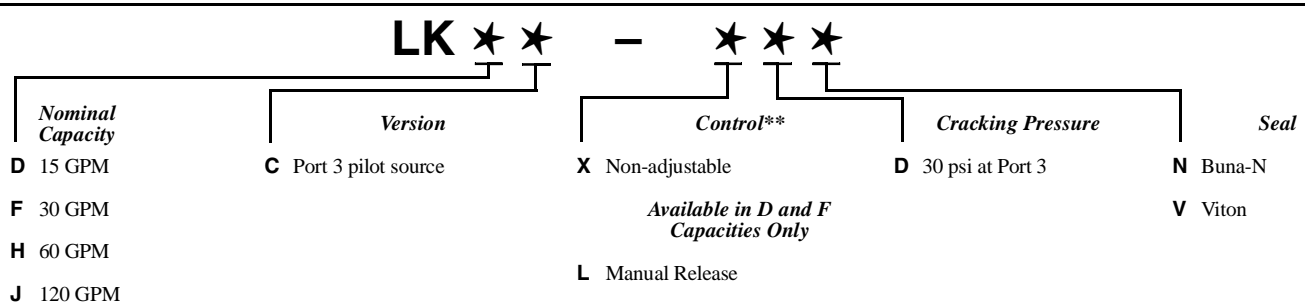


Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
15 GPM	LKDC – XDN	T - 11A	1.38	7/8"	1.19	30/35
30 GPM	LKFC – XDN	T - 2A	1.38	1 1/8"	1.38	45/50
60 GPM	LKHC – XDN	T - 17A	1.81	1 1/4"	1.81	150/160
120 GPM	LKJC – XDN	T - 19A	2.50	1 5/8"	2.31	350/375

Performance Curves



- Maximum operating pressure = 5000 psi
- Area ratio: A3 to A1 = 1.8:1
- Area ratio: A3 to A2 = 2.25:1
- Control orifice diameter = LKDC: .031 in., LKFC: .035 in., LKHC: .062 in., LKJC: .094 in.
- Pilot volume for complete shift = LKDC: .02 in³/min., LKFC: .06 in³/min., LKHC: .15 in³/min., LKJC: .30 in³/min.
- 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.

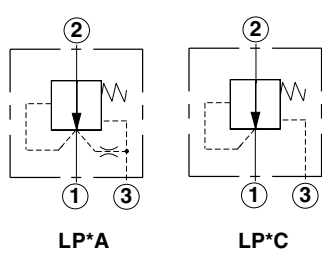
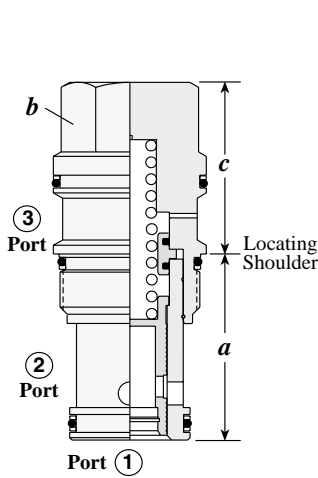


** See page 162 for information on Control Options

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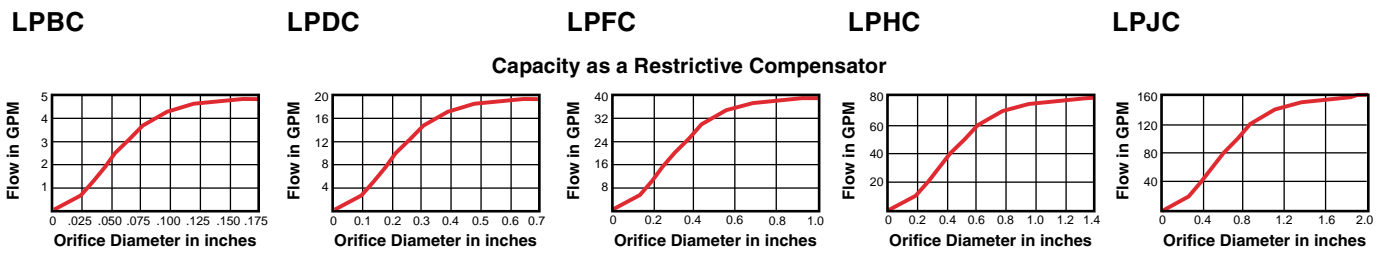


NORMALLY OPEN MODULATING ELEMENT

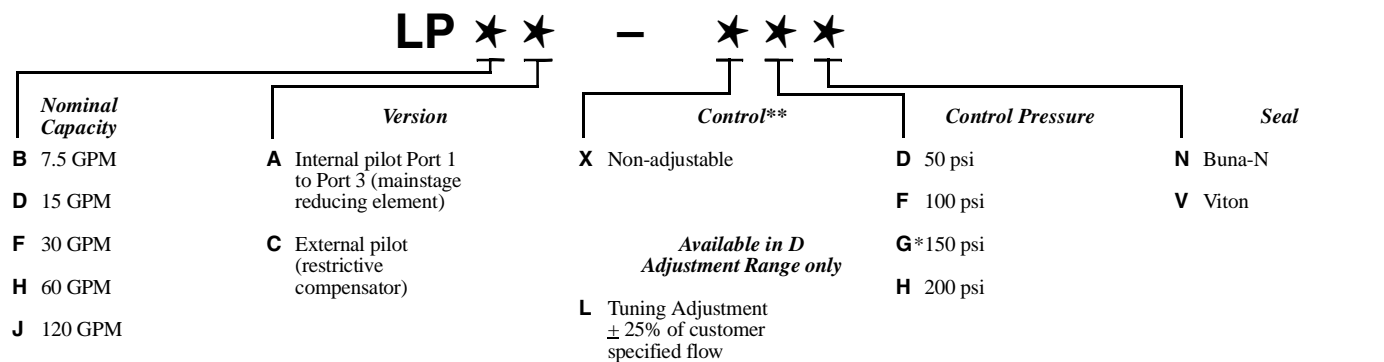


Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (lb. ft.)
			a	b	X	L	
7.5 GPM	LPBC – XHN	T - 163A	1.22	3/4"	1.25	2.55	25/30
15 GPM	LPDC – XHN	T - 11A	1.38	7/8"	1.19	2.50	30/35
30 GPM	LPFC – XHN	T - 2A	1.38	1 1/8"	1.38	2.82	45/50
60 GPM	LPHC – XHN	T - 17A	1.81	1 1/4"	1.81	3.27	150/160
120 GPM	LPJC – XHN	T - 19A	2.50	1 5/8"	2.31	3.94	350/375

Performance Curves



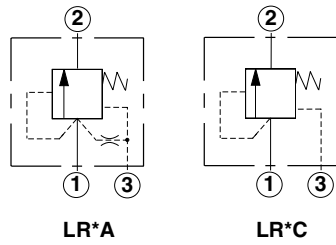
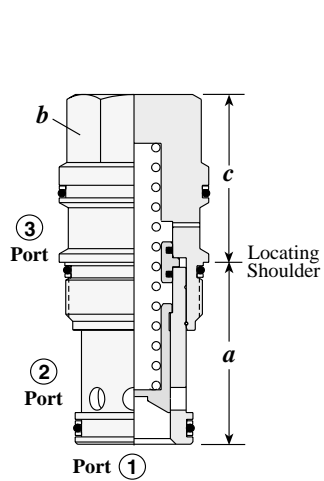
- Maximum operating pressure = 5000 psi
- Maximum leakage at 150 SUS, port 3 = 1 in³/min.
- Control orifice diameter = LPB*, LPD*, LPF*: .016 in., LPH*, LPJ*: .021 in.



** See page 162 for information on Control Options

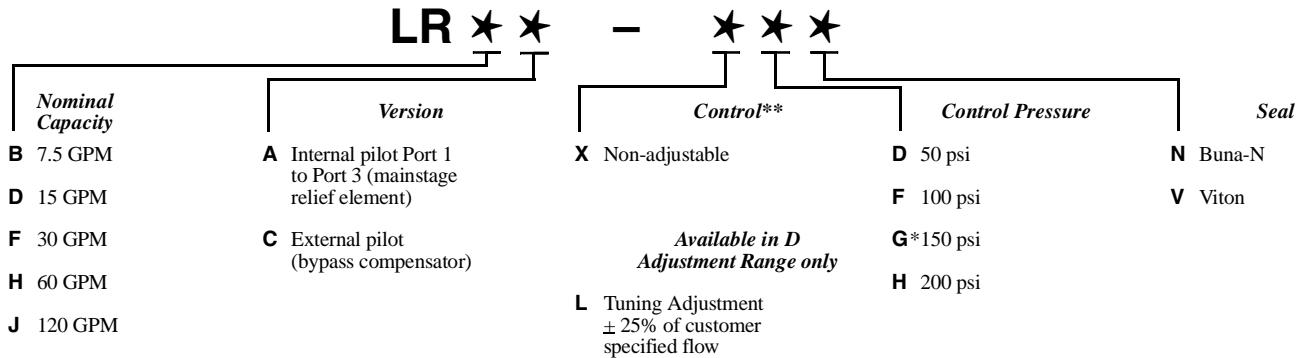
* G Adjustment Range not available in LPBA, LPBC.

NORMALLY CLOSED MODULATING ELEMENT



Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions				Installation Torque (lb. ft.)
			a	b	X	L	
7.5 GPM	LRBC – XHN	T - 163A	1.22	3/4"	1.25	2.55	25/30
15 GPM	LRDC – XHN	T - 11A	1.38	7/8"	1.19	2.50	30/35
30 GPM	LRFC – XHN	T - 2A	1.38	1 1/8"	1.38	2.82	45/50
60 GPM	LRHC – XHN	T - 17A	1.81	1 1/4"	1.81	3.27	150/160
120 GPM	LRJC – XHN	T - 19A	2.50	1 5/8"	2.31	3.94	350/375

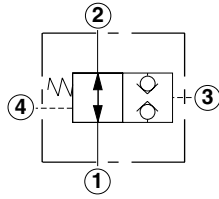
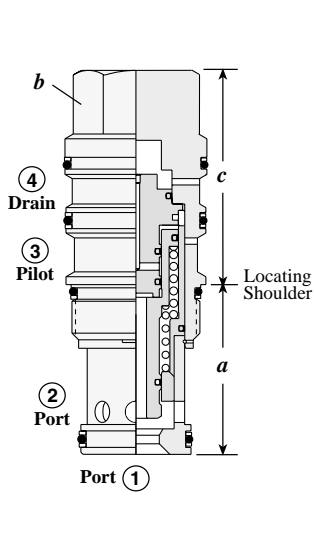
- Maximum operating pressure = 5000 psi
- Control orifice diameter = LRB*, LRD*, LRF*: .016 in., LRH*, LRJ*: .021 in.



** See page 162 for information on Control Options

* G Adjustment Range not available in LRBA, LRBC.

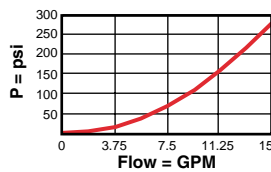
NORMALLY OPEN, DIRECT OPERATED



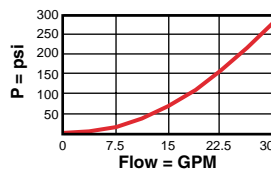
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
15 GPM	DODS – XHN	T - 21A	1.38	7/8"	1.78	30/35
30 GPM	DOFS – XHN	T - 22A	1.38	1 1/8"	2.00	45/50
60 GPM	DOHS – XHN	T - 23A	1.81	1 1/4"	2.47	150/160
120 GPM	DOJS – XHN	T - 24A	2.50	1 5/8"	3.16	350/375

Performance Curves

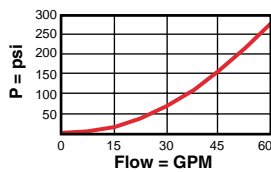
DODS



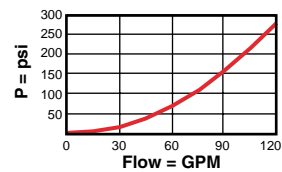
DOFS



DOHS



DOJS



Fully Open Pressure Differential vs. Flow

- Maximum operating pressure = 5000 psi (Port 1 and Port 2)
- Minimum pilot pressure to shift valve = DODS: 400 psi, DOFS, DOHS, DOJS: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Pilot volume for complete shift = DODS: .01 in³/min., DOFS: .02 in³/min., DOHS: .05 in³/min., DOJS: .17 in³/min.
- Valve will open when the pilot pressure falls below 145 psi.
- Any back pressure at the drain port is directly additive to the required pilot pressure for reliable operation.

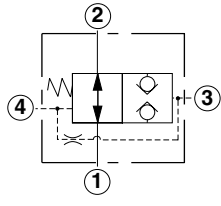
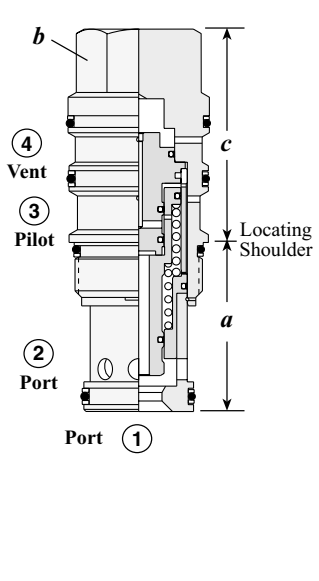
DO * S - * H *

Nominal Capacity	Control**	Control Pressure	Seal
D 15 GPM	X Non-adjustable	H 200 psi	N Buna-N
F 30 GPM			V Viton
H 60 GPM			
J 120 GPM			

** See page 162 for information on Control Options

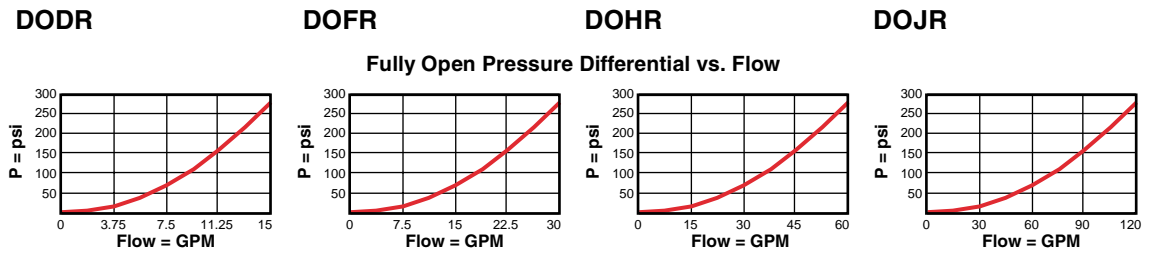
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NORMALLY OPEN, VENT-TO-OPERATE

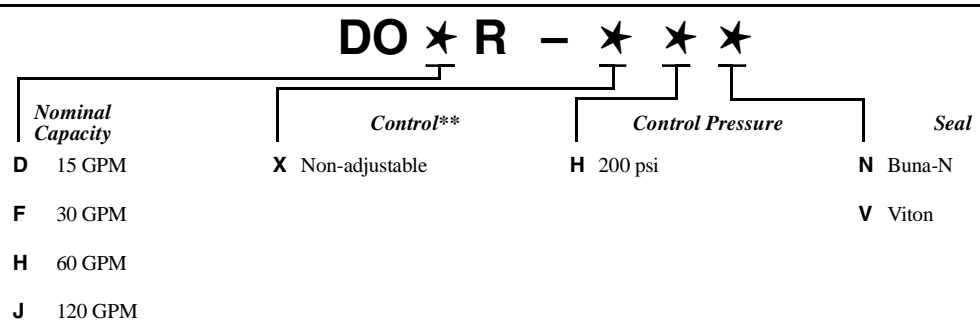


Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
15 GPM	DODR – XHN	T - 21A	1.38	7/8"	1.78	30/35
30 GPM	DOFR – XHN	T - 22A	1.38	1 1/8"	2.00	45/50
60 GPM	DOHR – XHN	T - 23A	1.81	1 1/4"	2.47	150/160
120 GPM	DOJR – XHN	T - 24A	2.50	1 5/8"	3.16	350/375

Performance Curves



- Maximum operating pressure = 5000 psi
- Minimum pilot pressure to shift valve with Port 4 vented to tank = DODR: 400 psi, DOFR, DOHR, DOJR: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Control pilot flow = DODR: 25 in³/min., DOFR: 22 in³/min., DOHR, DOJR: 35 in³/min.
- Valve will open when the pilot pressure falls below 145 psi or with Port 4 blocked.
- 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 DAAA-*** solenoid pilot valve is ideal for this application.

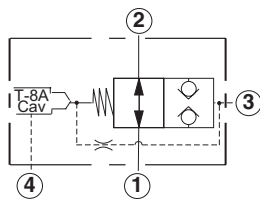
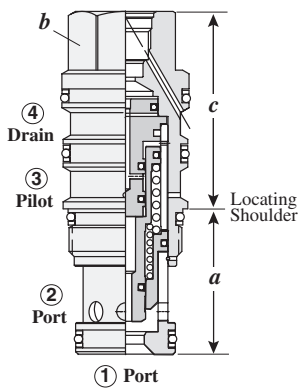


** See page 162 for information on Control Options

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NORMALLY OPEN, VENT-TO-OPERATE WITH INTEGRAL PILOT CONTROL CAVITY

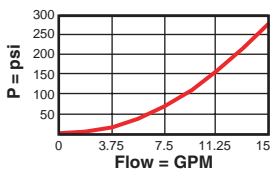


The -8 control option allows a pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 121.

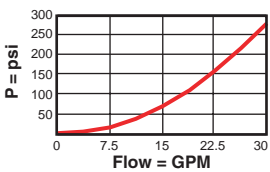
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
15 GPM	DODR - 8HN	T - 21A	1.38	7/8"	1.78	30/35
30 GPM	DOFR - 8HN	T - 22A	1.38	1 1/8"	2.00	45/50
60 GPM	DOHR - 8HN	T - 23A	1.81	1 1/4"	2.47	150/160
120 GPM	DOJR - 8HN	T - 24A	2.50	1 5/8"	3.16	350/375

Performance Curves

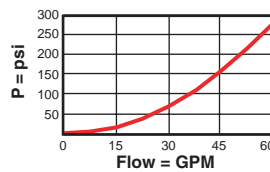
DODR-8



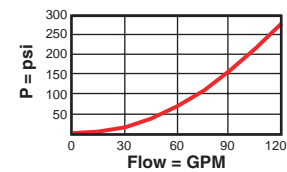
DOFR-8



DOHR-8



DOJR-8



Fully Open Pressure Differential vs. Flow

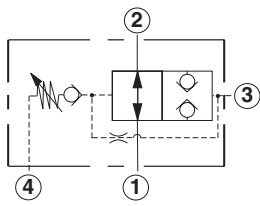
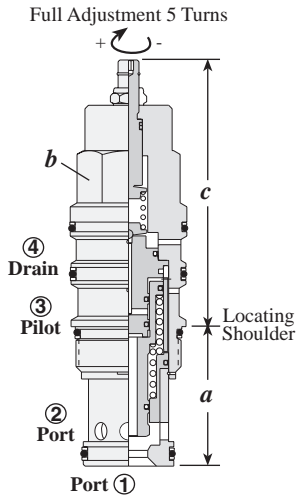
- Maximum operating pressure = 5000 psi
- Minimum pilot pressure to shift valve = DODR: 400 psi, DOFR, DOHR, DOJR: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Control pilot flow = DODR: 25 in³/min., DOFR: 22 in³/min., DOHR, DOJR: 35 in³/min.
- Valve will open when the pilot pressure falls below 145 psi.
- 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.

DO ★ R - 8 ★ ★

Nominal Capacity	Control**	Control Pressure	Seal
D 15 GPM	8 with T-8A cavity in hex body for pilot operation (see pilot control section for alternate options)	H 200 psi	N Buna-N
F 30 GPM			V Viton
H 60 GPM			
J 120 GPM			

** See page 162 for information on Control Options

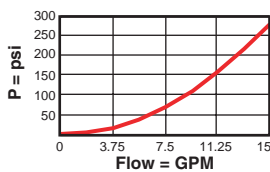
NORMALLY OPEN, PRESSURE ADJUSTABLE



Nominal Capacity	Typical Cartridge Model Code	Cavity	a	b	Cartridge Dimensions			Installation Torque (lb. ft.)
					L	C	K	
15 GPM	DODP – LAN	T - 21A	1.38	7/8"	3.11	3.15	3.35	30/35
30 GPM	DOFP – LAN	T - 22A	1.38	1 1/8"	3.43	3.50	3.70	45/50
60 GPM	DOHP – LAN	T - 23A	1.81	1 1/4"	3.94	3.98	4.17	150/160
120 GPM	DOJP – LAN	T - 24A	2.50	1 5/8"	4.76	4.92	5.04	350/375

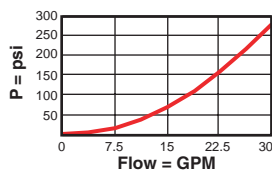
Performance Curves

DODP

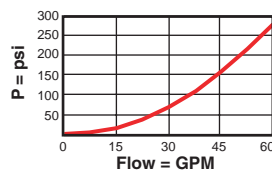


DOFP

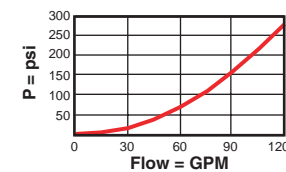
Fully Open Pressure Differential vs. Flow



DOHP



DOJP



- Maximum operating pressure = 5000 psi
- Minimum pilot pressure to shift valve = DODP: 400 psi, DOFP, DOH, DOJP: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Control pilot flow at shift = DODP, DOFP: 24 in³/min., DOHP, DOJP: 36 in³/min.
- Valve will open when the pilot pressure drops 85% below setting.
- Any back pressure at the drain port is directly additive to the required pilot pressure.

DO ★ P – ★ ★ ★

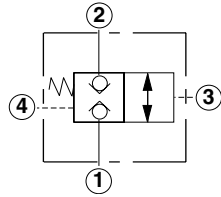
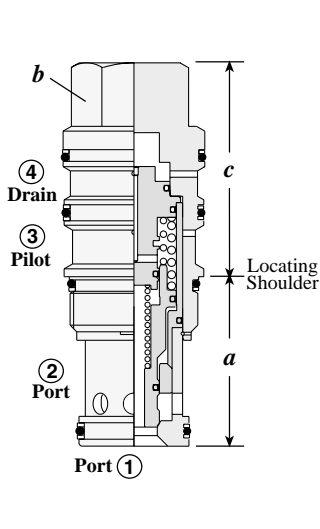
Nominal Capacity	Control**	Nominal Adjustable Shift Pressure Range	Seal
D 15 GPM	L Standard Screw	A 300 - 3000 psi	N Buna-N
F 30 GPM	C Tamper Resistant	B 300 - 1500 psi	V Viton
H 60 GPM	K Handknob	W 300 - 4500 psi	
J 120 GPM			

** See page 162 for information on Control Options

Customer may specify pressure setting.

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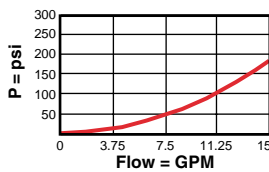
NORMALLY CLOSED, DIRECT OPERATED



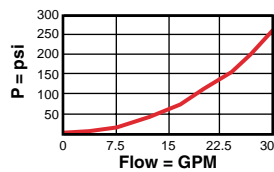
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
15 GPM	DKDS – XHN	T - 21A	1.38	7/8"	1.78	30/35
30 GPM	DKFS – XHN	T - 22A	1.38	1 1/8"	2.00	45/50
60 GPM	DKHS – XHN	T - 23A	1.81	1 1/4"	2.47	150/160
120 GPM	DKJS – XHN	T - 24A	2.50	1 5/8"	3.16	350/375

Performance Curves

DKDS

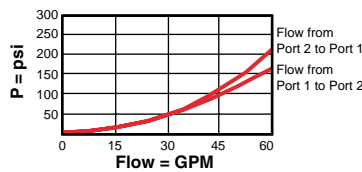


DKFS

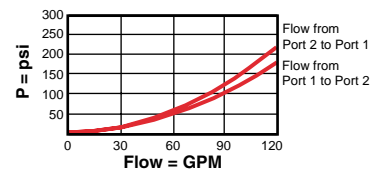


DKHS

Pilot Open Pressure Drop



DKJS



- Maximum operating pressure = 5000 psi
- Minimum pilot pressure to shift valve = DKDS: 400 psi, DKFS, DKHS, DKJS: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Pilot volume for complete shift = DKDS: .01 in³/min., DKFS: .02 in³/min., DKHS: .05 in³/min., DKJS: .17 in³/min.
- Valve will reseal when the pilot pressure drops 85% below setting.
- Any back pressure at the drain port is directly additive to the required pilot pressure.

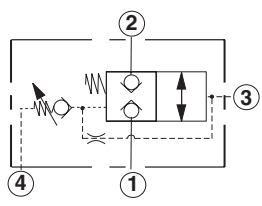
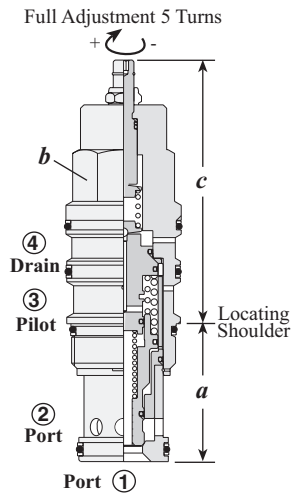
DK ★ S – ★ ★ ★

Nominal Capacity	Control**	Adjustment Range	Seal
D 15 GPM	X Non-adjustable	H 200 psi	N Buna-N
F 30 GPM			V Viton
H 60 GPM			
J 120 GPM			

** See page 162 for information on Control Options

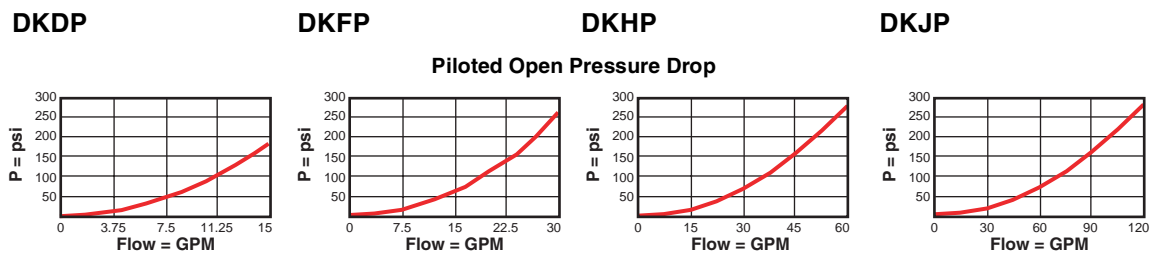


NORMALLY CLOSED, PRESSURE ADJUSTABLE



Nominal Capacity	Typical Cartridge Model Code	Cavity	a	b	Cartridge Dimensions			Installation Torque (lb. ft.)
					L	C	K	
15 GPM	DKDP – LAN	T - 21A	1.38	7/8"	3.11	3.16	3.34	30/35
30 GPM	DKFP – LAN	T - 22A	1.38	1 1/8"	3.44	3.50	3.70	45/50
60 GPM	DKHP – LAN	T - 23A	1.81	1 1/4"	3.94	3.98	4.17	150/160
120 GPM	DKJP – LAN	T - 24A	2.50	1 5/8"	4.78	4.92	5.04	350/375

Performance Curves



- Maximum operating pressure = 5000 psi
- Minimum pilot pressure to shift valve = DKDP: 400 psi, DKFP, DKHP, DKJP: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Control pilot flow at shift = DKDP, DKFP: 24 in³/min., DKHP, DKJP: 36 in³/min.
- Any back pressure at the drain port is directly additive to the required pilot pressure.
- Valve will reset when the pilot pressure falls to 85% of the cracking value.

DK ★ P – ★ ★ ★

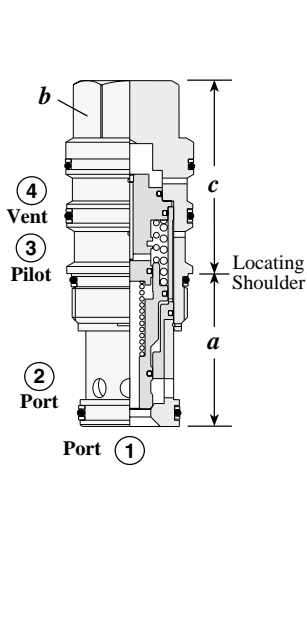
Nominal Capacity	Control**	Nominal Adjustable Shift Pressure Range	Seal
D 15 GPM	L Standard Screw	A 300 - 3000 psi	N Buna-N
F 30 GPM	C Tamper Resistant	B 300 - 1500 psi	V Viton
H 60 GPM	K Handknob	W 300 - 4500 psi	
J 120 GPM			

** See page 162 for information on Control Options
 Adjustment Range Options:
 A, B, and W are standard set at 1000 psi.
 Customer may specify pressure setting.

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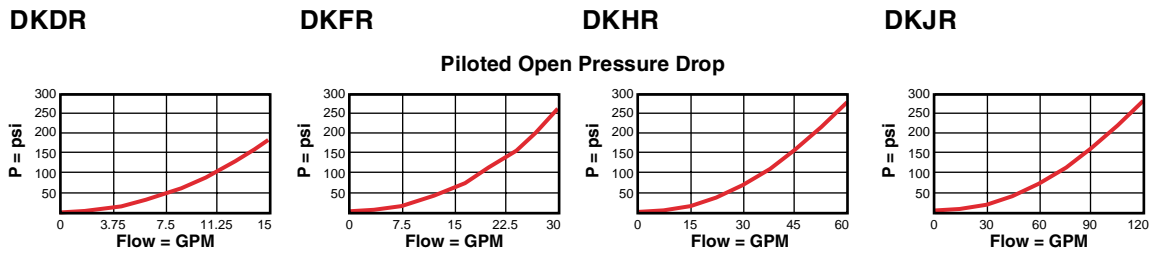


NORMALLY CLOSED, VENT-TO-OPERATE

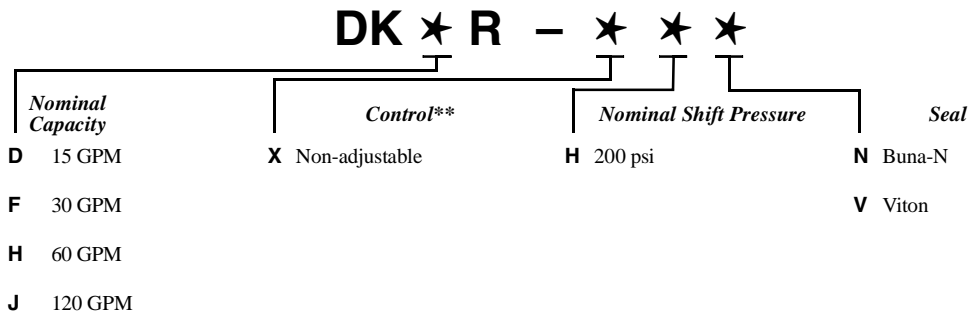


Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
15 GPM	DKDR - XHN	T - 21A	1.38	7/8"	1.78	30/35
30 GPM	DKFR - XHN	T - 22A	1.38	1 1/8"	2.00	45/50
60 GPM	DKHR - XHN	T - 23A	1.81	1 1/4"	2.47	150/160
120 GPM	DKJR - XHN	T - 24A	2.50	1 5/8"	3.16	350/375

Performance Curves



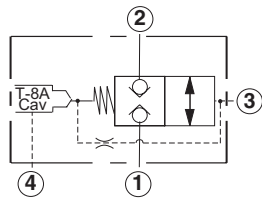
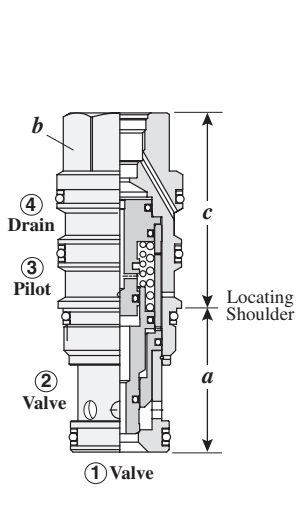
- Maximum operating pressure = 5000 psi
- Minimum pilot pressure to shift valve with Port 4 vented to tank = DKDR: 400 psi, DKFR, DKHR, DKJR: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Control pilot flow = DKDR: 25 in³/min., DKFR: 22 in³/min., DKHR, DKJR: 35 in³/min.
- Valve will reseat when the pilot pressure falls below 145 psi.
- 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 DAAA-*** solenoid pilot valve is ideal for this application.



** See page 162 for information on Control Options

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NORMALLY CLOSED, VENT-TO-OPERATE WITH INTEGRAL PILOT CONTROL CAVITY

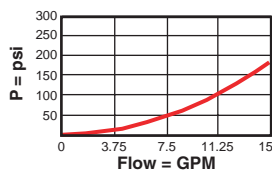


The -8 control option allows a pilot control valve to be incorporated directly into the end of the cartridge via the T-8A cavity. These pilot control cartridges are sold separately and include electro-proportional, solenoid, air pilot, and hydraulic pilot operation. See Pilot Control Cartridges on page 121.

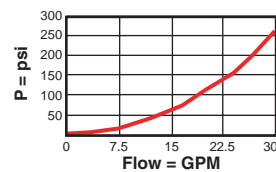
Nominal Capacity	Typical Cartridge Model Code	Cavity	Cartridge Dimensions			Installation Torque (lb. ft.)
			a	b	c	
15 GPM	DKDR – 8H*	T - 21A	1.38	7/8"	1.78	30/35
30 GPM	DKFR – 8H*	T - 22A	1.38	1 1/8"	2.00	45/50
60 GPM	DKHR – 8H*	T - 23A	1.81	1 1/4"	2.47	150/160
120 GPM	DKJR – 8H*	T - 24A	2.50	1 5/8"	3.16	350/375

Performance Curves

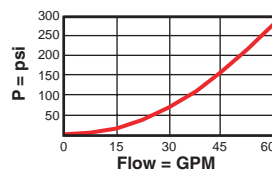
DKDR-8



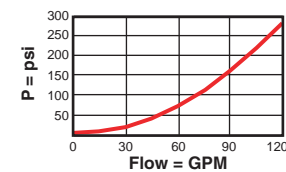
DKFR-8



DKHR-8



DKJR-8



Piloted Open Pressure Drop

- Maximum operating pressure = 5000 psi
- Minimum pilot pressure to shift valve with Port 4 vented to tank = DKDR: 400 psi, DKFR, DKHR, DKJR: 300 psi
- Maximum valve leakage, Port 1 to Port 2 or Port 2 to Port 1 = 5 drops/min.
- Control pilot flow = DKDR: 25 in³/min., DKFR: 22 in³/min., DKHR, DKJR: 35 in³/min.
- Valve will open when the pilot pressure falls below 145 psi.
- 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.

DK ★ R - 8 ★ ★

Nominal Capacity	Control**	Nominal Shift Pressure	Seal
D 15 GPM	8 with T-8A cavity in hex body for pilot operation (see pilot control section for alternate options)	H 200 psi	N Buna-N
F 30 GPM			V Viton
H 60 GPM			
J 120 GPM			

** See page 162 for information on Control Options