MODEL 1000HP-5 and MODEL 1000HP-36

CRYOGENIC PRESSURE REDUCING REGULATORS

Model 1000HP-5

Model 1000HP-5 and 1000HP-36 are cryogenic reducing regulators used primarily in handling liquified industrial gases. The Opt-5 construction is essentially of bronze and brass materials; Opt-36 is of austenitic stainless steel materials.

The design takes advantage of all the features of the basic 1000HP reducing regulator; see Technical Bulletin 1000HP-BASIC-TB. The availability of optional construction and body and trim materials is limited to those indicated herein.

The straight-thru flow path inherent in the 1000HP design allows for higher capacity. The streamlined path also reduces wear and maintenance for the flashing or cavitating conditions frequently associated with cryogenic service.

APPLICATIONS

Widely applied in pressure building service for remote liquid storage tanks for industrial gases (see Figure 1). Also used in distribution piping systems where there is the possibility of exposure to temperatures below -20°F (-29°C), and where higher flow capacity is required.

PRINCIPLES OF OPERATION

Reference Technical Bulletin 1000HP-BASIC-TB for the explanation of the design principles of the basic valve. Advantages due to all those principles indicated also apply to a 1000HP-CRYO regulator. The major difference between the 1000HP-BASIC and 1000HP-CRYO is the different materials required for the cryogenic temperature range of -325 to +100°F (-198 to +38°C).

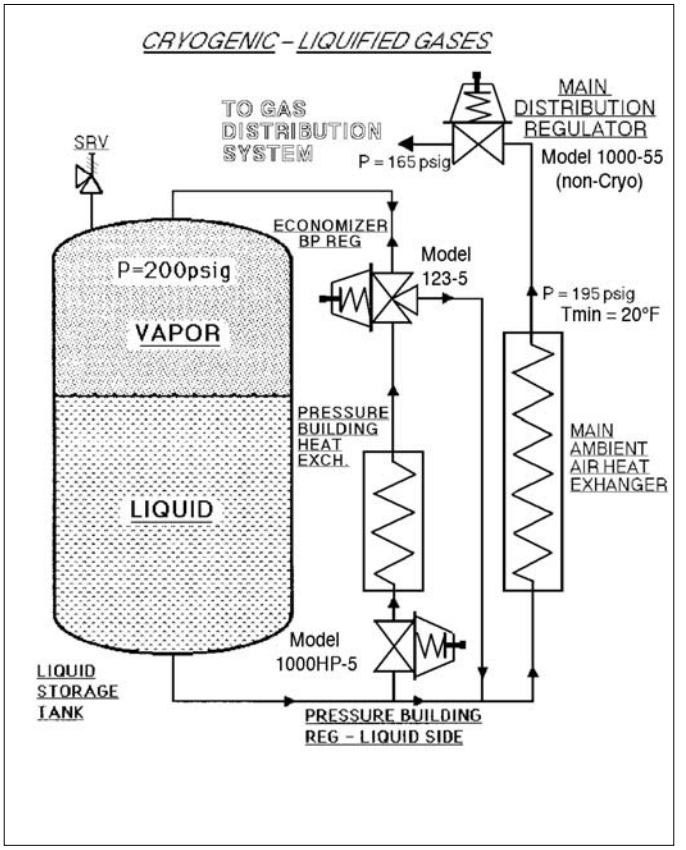


Figure 1: Cryogenic Storage Tank

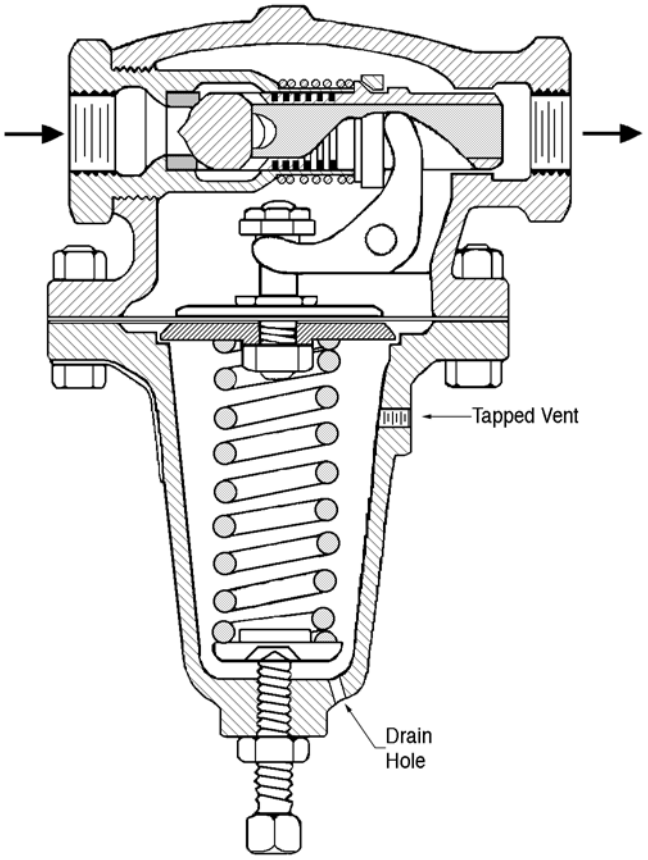


Figure 2: Model 1000HP-5 or -36, Metal Seated

STANDARD/GENERAL SPECIFICATIONS

Body Sizes: 1/2", 3/4", 1", 1-1/2" and 2"; (DN15, 20, 25, 40 and 50).

End Connections: Standard – NPT female.

Body/Spring Chamber/ Cylinder Material Combinations: Uniform – BRZ/BRZ/BRZ and SST/SST/SST.

BRZ = Cast bronze
SST - Cast stainless steel

See Table 4 for material specifications.

Trim Designs: Metal seated (see Figure 2) or composition seat (see Figure 3). Metal diaphragms ONLY.

Available in three trim material combinations only. See Table 5 for materials.

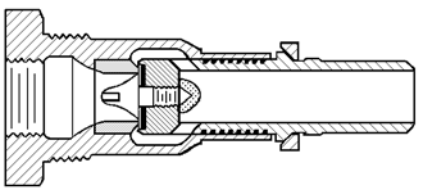


Figure 3: Composition Seat

Maximum Inlet Pressure: Dependent only on cylinder material. (See Table 3):

BRZ – 400 psig (27.6 Barg);
SST – 740 psig (51.0 Barg).

NOTE: 1000HP is a flow-to-open (FTO) design; this places an upper limitation on inlet pressure for a given outlet pressure setting.

Temperature Range: -325° to +100°F (-198° to +38°C). Consult factory for lower temperatures.

Outlet Pressure Range: See Table 1 for individual range spring span.

Body Size		Full Range		Number of Range Springs
In	(mm)	psig	(Barg)	
1/2"	(DN15)	10–300	(.69–20.7)	5
3/4"	(DN20)			6
1"	(DN25)	10–250	(.69–17.2)	6
1-1/2"	(DN40)	10–150	(.69–10.3)	3
2"	(DN50)	10–90	(.69–6.2)	3

Maximum Pressure Drop: **NOTE:** 1000HP is a flow-to-open (FTO) design; this places a lower limitation on outlet pressure setting for some inlet pressure levels.

Metal Seated Design:
"S1" trim designation – up to 650 psid (44.8 Bard).
Composition Seat Designs:
"B5" trim designation – up to 390 psid (26.9 Bard).
"S36" trim designation – up to 650 psid (44.8 Bard).

Minimum Pressure Drop: Opt-5: 1 psid (0.07 Bard).
Opt-36: 5 psid (0.34 Bard).
Opt-17+36: 1 psid (.07 Bard).

Seat Leakage: Meets ANSI/FCI 70-2.
Metal Seated – Class IV.
Composition Seat – Class VI.

See Tables 6 and 7 for flow capacity expressed in Cvs for full port and 1-step reduced port (Opt-12).

See Table 2 for "Wide Open Cv"; use for sizing of safety relief device.

Range Springs: Standard: SST.

Diaphragm Flange Bolting: Standard: SST.

Spring Chamber Internals: SST or BRZ/BR materials.

Gaskets: Standard: TFE/Silicate.

NOTE: Above gasket material is suitable for oxygen service.

Special Cleaning: All units are cleaned per Cashco Spec. #S-1134. Acceptable cleaning level for oxygen gas service.

Painting: None.

NOTE: Refer to OPTION SPECIFICATIONS for alternate/extra design options, and to TECHNICAL SPECIFICATIONS for a more complete description of the above specifications.

OPTION SPECIFICATIONS

Option -5: BRASS/BRONZE CRYOGENIC CONSTRUCTION. BRZ/BRZ/BR body/spring chamber/cylinder materials. Only B5 trim designation number available. Includes Opt-14 integral seat ring, Opt-17 piston spring, Opt-25 tapped spring chamber vent, 1/8" (DN6) drain hole, and Opt-55, cleaning for oxygen service.

Option -12: REDUCED PORT ORIFICE. Use when high inlet pressure negates use of the standard full port orifice. Also used when oversized body is desired to accommodate piping size. Available in metal seat or composition seat materials, in all trim designations, and in all body sizes. See Table 7 for flow capacity in Cvs.

Option -14: INTEGRAL SEAT. Standard for B5 trim designation no., full or Opt-12 reduced port; optional for S1 or S36 trim designation numbers. Pressed-in seat ring-to-cylinder joint is sealed as a path of leakage by brazing or welding. The procedure also serves as a permanent joint for flow conditions where service conditions are "severe", subject to vibration, or thermal cycling.

Seat ring is silver brazed to cylinder for "B5" series trim designation, and to

Opt.-14 Cont. 1/2" (DN15) body size cylinders with "S_" series trim designations. For all other body sizes with "S_" series designations the seat ring is welded to the cylinder.
Recommended for all hydrogen or helium applications. Recommended when pressure drop exceeds 300 psid (20.7 Bard). Required when pressure drop exceeds 450 psid (31.0 Bard).

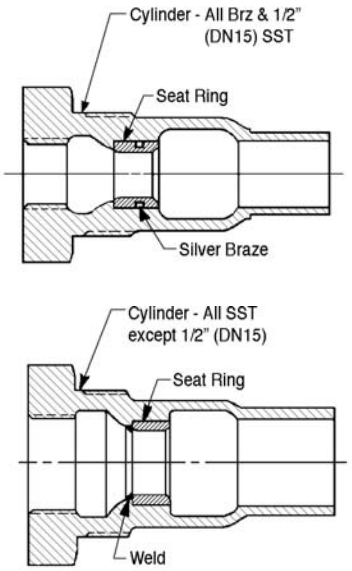


Figure 4: Opt-14 Integral Seat

Option -17: PISTON SPRING. Standard for B5 trim designation; optional for S1 or S36 trim designations. Required for applications where pressure drop is less than 5 psid (.34 Bard). Minimizes plug/cylinder frictional effects. 302 SST material only.

Option -25 (Std): TAPPED VENT. Primary use as location to inject purge gas to prevent ice buildup within spring chamber. 1/4" (DN8) NPT.

Option -26: PRESSURE TAP. 1/4" (DN8) NPT drain tap with plug in body top side registering outlet - P_2 - pressure. Recommended for downstream piping pressure sensing. Plug material similar to body material. Recommended for flashing or cavitating liquids.

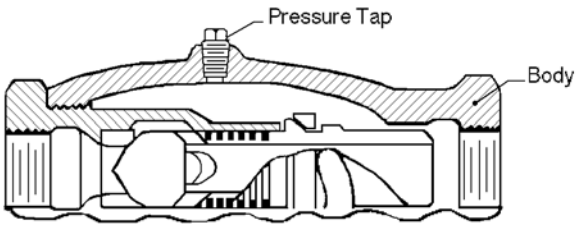


Figure 5: Opt-26 Pressure Tap

Option -36: SSTCRYOGENICCONSTRUCTION. SST/SST/SST body/spring chamber/cylinder materials. Only S1 or S36 trim designation numbers. Includes Opt-25 tapped spring chamber vent, 1/8" (DN6) drain hole, and Opt-55 cleaning for oxygen service.

Option -55 (Std.): SPECIAL CLEANING. Cleaning per Cashco Spec #S-1134. Acceptable cleaning level for oxygen gas service. **NOTE:** Design Pressure Rating shall not exceed 290 psig (20.0 Barg) when body/topworks are constructed of SST and cleaned with Option-55 for Oxygen service.

APPLICATION AND SELECTION

The following procedure will help determine a suitable selection for an application.

STEP 1. FIVE KNOWNS. The following minimal parameter / information must be available before a selection procedure can begin:

a. Service Fluid – What is it? Liquid or gas? Specific gravity (std. cond.)?
b. Inlet Pressure – P1 (upstream pressure).
c. Outlet Pressure – P2 (downstream pressure). How much can P2 vary as flow varies?
d. Desired Capacity – Cv, GPM, SCFH; minimum and maximum.
e. Fluid Temperature – T1, Specific gravity (actual).

STEP 2. INLET PRESSURE AND TEMPERATURE: Ensure that the actual design inlet pressure and temperature limits do not exceed the limits established in Table 3. Both body and spring chamber must comply.

STEP 3. SEAT DESIGN. Because the 1000HP is an FTO design, the seat design – metal or composition/soft – and materials must be selected before checking for pressure/pressure drop limitations.

CAUTION: Do not apply a metal seated 1000HP-5 or -36 in deadend service.

A composition seat will initially provide tight shutoff in clean fluid service, and will minimize downstream over-pressurization. Because TFE is not elastic, repeatable tight shutoff is frequently compromised. Minute leakage should be expected with a metal seated design.

A downstream safety relief valve is recommended. If inlet pressure P1 is greater than the outlet pressure rating, a downstream safety relief valve is required.

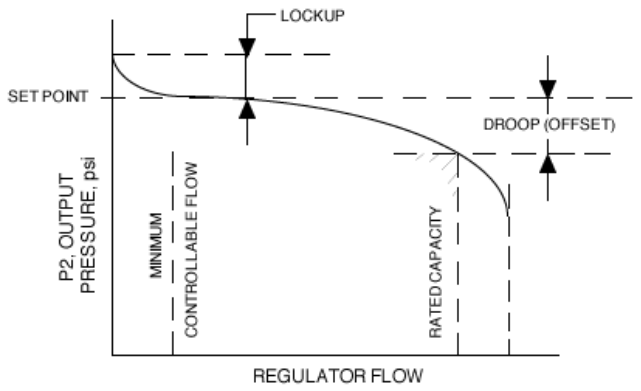
STEP 4. TRIM MATERIALS. Refer to Table 5 for the materials of each wetted part; consider material's suitability for corrosion.

STEP 5. INLET PRESSURE. Check Tables 6 and 7 for the maximum inlet pressure as a function of the outlet (setpoint) pressure – P2. If the actual inlet pressure – P1, is greater than the maximum allowable inlet pressure from Table 6, go to a 1-Step reduced port, Opt-12, maximum allowable inlet pressure from Table 7 (dependent on seat design).

STEP 6. OUTLET PRESSURE. All self-contained pressure reducing regulators "droop" or "fall-off" from a setpoint pressure level at a given flow as the flow rate increases.

This deviation in setpoint is described as "% droop". Droop is expressed on increasing flow, starting from a minimum flow level.

The "% droop" must be known to enter the capacity tables. The acceptable level of setpoint deviation should be known for the min-to-max flow variation.



A regulator may have a setpoint up to 10% below the lower stated range spring level. (Tags will show the standard ranges.) A setpoint above the higher range spring level is not recommended. Setpoint at the upper limit of a range spring is acceptable. If final setpoint is questionable and expected near the upper limit, the next higher range spring should be utilized. Best performance will be obtained when the lowest range spring is utilized.

STEP 7. FLUID JET. Depending on the fluid passing through the body, select a liquid or gas jet for proper aspiration effect.

STEP 8. CAPACITY. Flow capacities expressed as "Cv vs. Droop" are located in:

Table 6: Full Port & Metal Diaphragm.
Table 7: Reduced Port & Metal Diaphragm.

Using above "Cv vs. Droop" Capacity Tables 6 and 7, find the smallest body size to pass the calculated required Cv for the acceptable level of droop, the proper diaphragm classification, and the setpoint pressure – P2.

Consult factory for "EXCESSIVE PARTIAL CAVITATION" or "FULL CAVITATION" flow realm applications.

TECHNICAL SPECIFICATIONS

TABLE 1
RANGE SPRINGS – SST

Body Size		Standard – SST	
In.	**(mm)**	**psig**	**(Barg)**
1/2"	(DN15)	10–50	(.69–3.4)
		40–80	(2.7–5.5)
		65–100	(4.5–6.9)
		80–150	(5.5–10.3)
		120–300	(8.3–20.7)
3/4"	(DN20)	10–40	(.69–2.7)
		30–60	(2.1–4.1)
		50–70	(3.4–4.8)
		55–110	(3.8–7.6)
		90–150	(6.2–10.3)
		120–300	(8.3–20.7)
1"	(DN25)	10–30	(.69–2.1)
		25–45	(1.7–3.1)
		35–50	(2.4–3.4)
		40–80	(2.7–5.5)
		65–150	(4.5–10.3)
		120–250	(8.3–17.2)
1-1/2"	(DN40)	10–50	(.69–3.4)
		40–75	(2.7–5.2)
		60–150	(4.1–10.3)
2"	(DN50)	10–30	(.69–2.1)
		25–45	(1.7–3.1)
		35–90	(2.4–6.2)

TABLE 2
MAXIMUM CAPACITY – Cv
FOR SIZING SAFETY RELIEF DEVICE - (WITH PLUG WIDE OPEN)

Body Size		Orifice Size	
Inch	**(mm)**	**Standard (Full)**	**Opt-12 (Reduced Port)**
1/2"	(DN15)	5	3
3/4"	(DN20)	9	7
1"	(DN25)	9	8
1-1/2"	(DN40)	17	13
2"	(DN50)	22	20

NOTE: See Table 3. Indicated outlet pressure limits are those to contain overpressure conditions; such overpressure may cause internals damage. It is recommended that pressure safety devices – safety relief valve or rupture disc – have their setpoint relief pressures at 110% of the UVRS (UVRS = “Upper Value of Range Spring”). Example: For a 90–150 psig (6.2–10.3 Barg) range spring, the safety devices should be set to relieve at 110% x 150 psig = 165 psig (11.4 Barg).

TABLE 3
MAXIMUM ALLOWABLE PRESSURE vs. TEMPERATURE;
FOR PRESSURE CONTAINMENT OF
BODY, SPRING CHAMBER AND CYLINDER
(See Table 4 for Material Specifications)

Materials of Construction [1]	Inlet – Cylinder				Outlet – Body & Spring Chamber			
Description - Abbreviation Body/Spring Chamber/Cylinder	Pressure		Temperature		Pressure		Temperature	
	psig	(Barg)	°F	(°C)	psig	(Barg)	°F	(°C)
BRZ / BRZ / BR	400	(27.6)	-325 to +100	(-198 to +38)	400	(27.6)	-325 to +100	(-198 to +38)
SST / SST / SST	740	(51.0)	-325 to +100	(-198 to +38)	400	(27.6)	-325 to +100	(-198 to +38)

[1] For constructions containing following materials as the body, spring chamber, or cylinder, the pressure vs. temperature limits are based upon lower temperature limits as allowed by ANSI B31.3.

TABLE 4
MATERIAL SPECIFICATIONS OF
BODY, SPRING CHAMBER AND CYLINDER

Material	ASTM Specifications
BRZ – cast bronze	B62, Alloy 83600; 85% Cu, 5% Sn, 5% Pb, 5% Zn
SST – cast stainless steel	A351, Gr. CF8M (cast 316 SST)

TABLE 5
TRIM MATERIAL COMBINATIONS

Part	Trim Designation Nos.		
	Brass Trim #	SST Trim #	
	B5	S1	S36
Diaphragm	Phos. Bronze	302 SST	302 SST
Cylinder	Brass	CF8M	CF8M
Valve Seat	Brass	316 SST	316 SST
Plug	Brass	316 SST	316 SST
Seat Disc	TFE	None (Metal)	TFE
Seat Disc Screw	Brass	None	316 SST
Plug Collar	Brass	316 SST	316 SST
Rocker Arm Shaft	Brass	316 SST	316 SST
Rocker Arm	Bronze	CF8M	CF8M
Pusher Plate Stud	Brass	CF8M	CF8M
Pusher Plate	Bronze	CF8M	CF8M
Stud Collar	Brass	316 SST	316 SST
Cotter Pin	Brass	316 SST	316 SST
Nut	Brass	316 SST	316 SST

NOTE: Cashco does not recommend metal seated trim on any service flow that will dead end down stream of the pressure reducing regulator.

TABLE 6
Cv – FLOW CAPACITY

FULL PORT – METAL DIAPHRAGM

Based on 400 psid (27.6 Bard) max pressure drop limit for composition seat, and on 650 psid (44.8 Bard) for metal seat.

(F_L = 0.93)

METAL DIAPHRAGM – SIZE – 1/2" (DN15) – FULL PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	215	(14.8)	215	(14.8)	0.42	0.81	1.18	10–50	(.69–3.4)
15	(1.0)	335	(23.1)	335	(23.1)	0.47	0.89	1.27	10–50	(.69–3.4)
20	(1.4)	450	(31.0)	420	(29.0)	0.53	0.98	1.37	10–50	(.69–3.4)
25	(1.7)	570	(39.3)	425	(29.3)	0.58	1.04	1.45	10–50	(.69–3.4)
35	(2.4)	685	(47.2)	435	(30.0)	0.67	1.18	1.62	10–50	(.69–3.4)
50	(3.4)	740	(51.0)	450	(31.0)	0.88	1.52	2.01	40–80	(2.8–5.5)
75	(5.2)	740	(51.0)	475	(32.8)	1.03	1.78	2.34	65–100	(4.5–6.9)
100	(6.9)	740	(51.0)	500	(34.5)	1.59	2.58	3.50	80–150	(5.5–10.3)
125	(8.6)	740	(51.0)	525	(36.2)	1.72	2.69	3.50	80–150	(5.5–10.3)
150	(10.3)	740	(51.0)	550	(37.9)	1.40	2.48	3.40	120–300	(8.3–20.7)
175	(12.1)	740	(51.0)	575	(39.7)	1.49	2.56	3.50	120–300	(8.3–20.7)
200	(13.8)	740	(51.0)	600	(41.4)	1.58	2.64	3.50	120–300	(8.3–20.7)
250	(17.2)	740	(51.0)	650	(44.8)	1.67	2.72	3.50	120–300	(8.3–20.7)
300	(20.7)	740	(51.0)	700	(48.3)	1.77	2.88	3.50	120–300	(8.3–20.7)

METAL DIAPHRAGM – SIZE – 3/4" (DN20) – FULL PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	160	(11.0)	160	(11.0)	0.70	1.36	2.07	10–40	(.69–2.8)
15	(1.0)	250	(17.2)	250	(17.2)	0.76	1.50	2.20	10–40	(.69–2.8)
20	(1.4)	340	(23.4)	340	(23.4)	0.82	1.65	2.34	10–40	(.69–2.8)
25	(1.7)	425	(29.3)	425	(29.3)	0.88	1.77	2.44	10–40	(.69–2.8)
35	(2.4)	580	(40.0)	435	(30.0)	1.00	2.01	2.65	30–60	(2.1–4.1)
50	(3.4)	700	(48.3)	450	(31.0)	1.33	2.66	3.47	30–60	(2.1–4.1)
75	(5.2)	740	(51.0)	475	(32.8)	1.93	3.32	4.43	55–110	(3.8–7.6)
100	(6.9)	740	(51.0)	500	(34.5)	2.56	4.18	5.00	55–110	(3.8–7.6)
125	(8.6)	740	(51.0)	525	(36.2)	2.43	4.00	5.00	90–150	(6.2–10.3)
150	(10.3)	740	(51.0)	550	(37.9)	1.66	3.03	4.08	120–300	(8.3–20.7)
175	(12.1)	740	(51.0)	575	(39.7)	1.72	3.07	4.14	120–300	(8.3–20.7)
200	(13.8)	740	(51.0)	600	(41.4)	1.80	3.13	4.20	120–300	(8.3–20.7)
250	(17.2)	740	(51.0)	650	(44.8)	2.00	3.38	4.67	120–300	(8.3–20.7)
300	(20.7)	740	(51.0)	700	(48.3)	2.18	3.63	5.00	120–300	(8.3–20.7)

METRIC CONVERSION FACTOR: Cv ÷ 1.16 = kv

TABLE 6
Cv – FLOW CAPACITY

FULL PORT – METAL DIAPHRAGM

Based on 400 psid (27.6 Bard) max pressure drop limit for composition seat, and on 650 psid (44.8 Bard) for metal seat.

(F_L = 0.93)

METAL DIAPHRAGM – SIZE – 1" (DN25) – FULL PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	160	(10.0)	145	(10.0)	**0.78**	**1.55**	**2.42**	10–30	(.69–2.1)
15	(1.0)	220	(15.2)	220	(15.2)	**0.87**	**2.10**	**2.67**	10–30	(.69–2.1)
20	(1.4)	300	(20.7)	300	(20.7)	**0.96**	**1.92**	**2.93**	10–30	(.69–2.1)
25	(1.7)	375	(25.9)	375	(25.9)	**1.04**	**2.13**	**3.13**	10–30	(.69–2.1)
35	(2.4)	515	(35.5)	435	(30.0)	**1.21**	**2.54**	**3.53**	25–45	(1.7–3.1)
50	(3.4)	700	(48.3)	450	(31.0)	**1.67**	**3.47**	**4.62**	40–80	(2.8–5.5)
75	(5.2)	740	(51.0)	475	(32.8)	**2.25**	**4.79**	**6.00**	40–80	(2.8–5.5)
100	(6.9)	740	(51.0)	500	(34.5)	**3.03**	**5.20**	**6.00**	65–150	(4.5–10.3)
125	(8.6)	740	(51.0)	525	(36.2)	**3.10**	**5.30**	**6.00**	65–150	(4.5–10.3)
150	(10.3)	740	(51.0)	550	(37.9)	**2.88**	**5.02**	**6.00**	120–250	(8.3–17.2)
175	(12.1)	740	(51.0)	575	(39.7)	**2.95**	**5.11**	**6.00**	120–250	(8.3–17.2)
200	(13.8)	740	(51.0)	600	(41.4)	**3.03**	**5.20**	**6.00**	120–250	(8.3–17.2)
250	(17.2)	740	(51.0)	650	(44.8)	**3.18**	**5.32**	**6.00**	120–250	(8.3–17.2)

METAL DIAPHRAGM – SIZE – 1-1/2" (DN40) – FULL PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	115	(7.9)	115	(7.90)	**1.75**	**3.27**	**4.82**	10–50	(.69–3.4)
15	(1.0)	190	(13.1)	190	(13.1)	**2.04**	**3.79**	**5.42**	10–50	(.69–3.4)
20	(1.4)	260	(17.9)	260	(17.9)	**2.33**	**4.30**	**6.01**	10–50	(.69–3.4)
25	(1.7)	330	(22.8)	330	(22.8)	**2.62**	**4.82**	**6.61**	10–50	(.69–3.4)
35	(2.4)	435	(30.0)	435	(30.0)	**3.75**	**6.53**	**8.70**	10–50	(.69–3.4)
50	(3.4)	635	(43.8)	450	(31.0)	**4.15**	**7.15**	**9.10**	40–75	(2.8–5.2)
75	(5.2)	740	(51.0)	475	(32.8)	**5.97**	**9.32**	**10.70**	60–150	(4.1–10.3)
100	(6.9)	740	(51.0)	500	(34.5)	**6.10**	**9.40**	**10.75**	60–150	(4.1–10.3)
125	(8.6)	740	(51.0)	525	(36.2)	**6.23**	**9.49**	**10.78**	60–150	(4.1–10.3)
150	(10.3)	740	(51.0)	550	(37.9)	**6.37**	**9.58**	**10.80**	60–150	(4.1–10.3)

METRIC CONVERSION FACTOR: Cv ÷ 1.16 = kv

TABLE 6
Cv – FLOW CAPACITY

FULL PORT – METAL DIAPHRAGM

Based on 400 psid (27.6 Bard) max pressure drop limit for composition seat, and on 650 psid (44.8 Bard) for metal seat.

(F_L = 0.93)

METAL DIAPHRAGM – SIZE – 2" (DN50) – FULL PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	165	(11.4)	165	(11.4)	**2.10**	**4.27**	**6.55**	10–30	(.69–2.1)
15	(1.0)	270	(18.6)	270	(18.6)	**2.26**	**4.58**	**6.90**	10–30	(.69–2.1)
20	(1.4)	370	(25.5)	370	(25.5)	**2.42**	**4.90**	**7.25**	10–30	(.69–2.1)
25	(1.7)	470	(32.4)	425	(29.3)	**2.59**	**5.21**	**7.60**	10–30	(.69–2.1)
35	(2.4)	500	(34.5)	435	(30.0)	**5.55**	**9.60**	**11.30**	25–45	(1.7–3.1)
50	(3.4)	700	(48.3)	450	(31.0)	**6.85**	**10.35**	**12.00**	35–90	(2.4–6.2)
75	(5.2)	740	(51.0)	475	(32.8)	**5.87**	**9.70**	**11.40**	35–90	(2.4–6.2)
100	(6.9)	740	(51.0)	500	(34.5)	**6.48**	**10.03**	**11.73**	35–90	(2.4–6.2)

TABLE 7
Cv – FLOW CAPACITY

OPT -12, 1-STEP REDUCED PORT – METAL DIAPHRAGM

Based on 400 psid (27.6 Bard) max pressure drop limit for composition seat, and on 650 psid (44.8 Bard) for metal seat.

(F_L = 0.93)

METAL DIAPHRAGM – SIZE – 1/2" (DN15) – 1-STEP REDUCED PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	270	(18.6)	300	(20.7)	**0.23**	**0.57**	**0.87**	10–50	(.69–3.4)
15	(1.0)	405	(27.9)	415	(28.6)	**0.27**	**0.59**	**0.95**	10–50	(.69–3.4)
20	(1.4)	540	(37.2)	420	(29.0)	**0.31**	**0.61**	**1.03**	10–50	(.69–3.4)
25	(1.7)	670	(46.2)	425	(29.3)	**0.36**	**0.63**	**1.12**	10–50	(.69–3.4)
35	(2.4)	685	(47.2)	435	(30.0)	**0.44**	**0.66**	**1.28**	10–50	(.69–3.4)
50	(3.4)	740	(51.0)	450	(31.0)	**0.63**	**1.21**	**1.67**	40-80	(2.8–5.5)
75	(5.2)	740	(51.0)	475	(32.8)	**0.83**	**1.52**	**2.03**	65-100	(4.5–6.9)
100	(6.9)	740	(51.0)	500	(34.5)	**1.24**	**2.10**	**2.45**	80-150	(5.5–10.3)
125	(8.6)	740	(51.0)	525	(36.2)	**1.32**	**2.18**	**2.52**	80-150	(5.5–10.3)
150	(10.3)	740	(51.0)	550	(37.9)	**1.12**	**1.99**	**2.52**	120-300	(8.3-20.7)
175	(12.1)	740	(51.0)	575	(39.7)	**1.20**	**2.06**	**2.52**	120-300	(8.3-20.7)
200	(13.8)	740	(51.0)	600	(41.4)	**1.28**	**2.13**	**2.52**	120-300	(8.3-20.7)
250	(17.2)	740	(51.0)	650	(44.8)	**1.37**	**2.21**	**2.52**	120-300	(8.3-20.7)
300	(20.7)	740	(51.0)	700	(48.3)	**1.45**	**2.29**	**2.52**	120-300	(8.3-20.7)

METRIC CONVERSION FACTOR: Cv ÷ 1.16 = kv

TABLE 7
Cv – FLOW CAPACITY

OPT -12, 1-STEP REDUCED PORT – METAL DIAPHRAGM

Based on 400 psid (27.6 Bard) max pressure drop limit for composition seat, and on 650 psid (44.8 Bard) for metal seat.

(F_L = 0.93)

METAL DIAPHRAGM – SIZE – 3/4" (DN20) – 1-STEP REDUCED PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	190	(13.1)	325	(22.4)	0.42	0.81	1.18	10–40	(.69–2.8)
15	(1.0)	295	(20.3)	415	(28.6)	0.47	0.89	1.27	10–40	(.69–2.8)
20	(1.4)	395	(27.2)	420	(29.0)	0.53	0.98	1.37	10–40	(.69–2.8)
25	(1.7)	500	(34.5)	425	(29.3)	0.58	1.04	1.45	10–40	(.69–2.8)
35	(2.4)	685	(47.2)	435	(30.0)	0.67	1.18	1.62	30-60	(2.1–4.1)
50	(3.4)	740	(51.0)	450	(31.0)	0.88	1.52	2.01	30-60	(2.1–4.1)
75	(5.2)	740	(51.0)	475	(32.8)	1.03	1.78	2.34	55-110	(3.8–7.6)
100	(6.9)	740	(51.0)	500	(34.5)	1.59	2.58	3.50	55-110	(3.8–7.6)
125	(8.6)	740	(51.0)	525	(36.2)	1.72	2.69	3.50	90-150	(6.2–10.3)
150	(10.3)	740	(51.0)	550	(37.9)	1.40	2.48	3.45	120-300	(8.3-20.7)
175	(12.1)	740	(51.0)	575	(39.7)	1.49	2.56	3.50	120-300	(8.3-20.7)
200	(13.8)	740	(51.0)	600	(41.4)	1.58	2.64	3.50	120-300	(8.3-20.7)
250	(17.2)	740	(51.0)	650	(44.8)	1.67	2.72	3.50	120-300	(8.3-20.7)
300	(20.7)	740	(51.0)	700	(48.3)	1.77	2.88	3.50	120-300	(8.3-20.7)

METAL DIAPHRAGM – SIZE – 1" (DN25) – 1-STEP REDUCED PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	190	(13.1)	280	(19.3)	0.51	1.05	1.55	10–30	(.69–2.1)
15	(1.0)	290	(20.0)	430	(29.7)	0.57	1.17	1.74	10–30	(.69–2.1)
20	(1.4)	395	(27.2)	580	(40.1)	0.63	1.29	1.93	10–30	(.69–2.1)
25	(1.7)	495	(34.1)	675	(46.6)	0.68	1.29	1.93	10–30	(.69–2.1)
35	(2.4)	675	(46.6)	685	(47.2)	0.68	1.40	2.13	25-45	(1.7–3.1)
50	(3.4)	740	(51.0)	700	(48.3)	0.92	1.90	3.10	40-80	(2.8–5.5)
75	(5.2)	740	(51.0)	725	(50.0)	1.13	2..41	4.02	40-80	(2.8–5.5)
100	(6.9)	740	(51.0)	750	(51.7)	1.75	4.08	5.46	65-150	(4.5–10.3)
125	(8.6)	740	(51.0)	775	(53.4)	1.80	4.15	5.46	65-150	(4.5–10.3)
150	(10.3)	740	(51.0)	800	(55.2)	1.88	4.28	5.46	120-250	(8.3-17.2)
175	(12.1)	740	(51.0)	825	(56.9)	1.94	4.39	5.46	120-250	(8.3-17.2))
200	(13.8)	740	(51.0)	850	(58.6)	1.99	4.50	5.46	120-250	(8.3-17.2)
250	(17.2)	740	(51.0)	900	(62.1)	2.04	4.60	5.46	120-250	(8.3-17.2)
300	(20.7)	740	(51.0)	950	(65.5)	2.15	4.82	5.46	120-250	(8.3-17.2)

METRIC CONVERSION FACTOR: Cv ÷ 1.16 = kv

TABLE 7
Cv – FLOW CAPACITY

OPT -12, 1-STEP REDUCED PORT – METAL DIAPHRAGM

Based on 400 psid (27.6 Bard) max pressure drop limit for composition seat, and on 650 psid (44.8 Bard) for metal seat.

(F_L = 0.93)

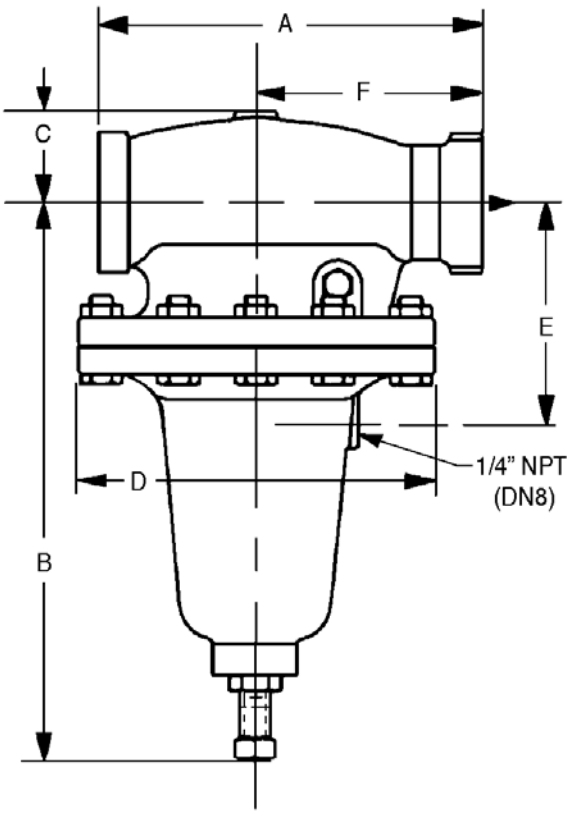
METAL DIAPHRAGM – SIZE – 1-1/2" (DN40) – 1-STEP REDUCED PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	185	(12.8)	255	(17.6)	**0.78**	**1.55**	**2.42**	10–50	(.69–3.4)
15	(1.0)	285	(19.7)	395	(27.2)	**0.87**	**2.10**	**2.67**	10–50	(.69–3.4)
20	(1.4)	385	(26.6)	420	(29.0)	**0.96**	**1.92**	**2.93**	10–50	(.69–3.4)
25	(1.7)	385	(26.6)	425	(29.3)	**1.04**	**2.13**	**3.13**	10–50	(.69–3.4)
35	(2.4)	660	(45.5)	435	(30.0)	**1.21**	**2.54**	**3.53**	10–50	(.69–3.4)
50	(3.4)	740	(51.0)	450	(31.0)	**1.67**	**3.47**	**4.62**	40-75	(4.1–5.2)
75	(5.2)	740	(51.0)	475	(32.8)	**2.64**	**4.75**	**6.00**	60-150	(4.1-10.3)
100	(6.9)	740	(51.0)	500	(34.5)	**2.72**	**4.84**	**6.00**	60-150	(4.1-10.3)
125	(8.6)	740	(51.0)	525	(36.2)	**2.80**	**4.93**	**6.00**	60-150	(4.1-10.3)
150	(10.3)	740	(51.0)	550	(37.9)	**2.88**	**5.02**	**6.00**	60-150	(4.1-10.3)

METAL DIAPHRAGM – SIZE – 2" (DN25) – 1-STEP REDUCED PORT										
Outlet Pressure		Max Inlet Pressure				Cv @ % DROOP			Range Spring	
		Metal Seated		Composition Seated						
psig	(Barg)	psig	(Barg)	psig	(Barg)	10%	20%	30%	psig	(Barg)
10	(.69)	165	(11.4)	165	(11.4)	**1.75**	**3.27**	**4.82**	10–30	(.69–2.1)
15	(1.0)	265	(18.3)	265	(18.3)	**2.04**	**3.79**	**5.42**	10–30	(.69–2.1)
20	(1.4)	365	(25.2)	365	(25.2)	**2.33**	**4.30**	**6.01**	10–30	(.69–2.1)
25	(1.7)	460	(31.7)	425	(29.3)	**2.62**	**4.82**	**6.61**	10–30	(.69–2.1)
35	(2.4)	530	(36.6)	435	(30.0)	**3.75**	**6.53**	**8.70**	25-45	(1.7–3.1)
50	(3.4)	700	(48.3)	450	(31.0)	**4.15**	**7.15**	**9.10**	35-90	(2.4–6.2)
75	(5.2)	740	(51.0)	475	(32.8)	**5.30**	**8.75**	**10.30**	35-90	(2.4–6.2)
90	(6.2)	740	(51.0)	500	(34.5)	**5.99**	**8.40**	**10.57**	35-90	(2.4–6.2)

METRIC CONVERSION FACTOR: Cv ÷ 1.16 = kv

DIMENSIONS AND WEIGHTS

Valve Size (Inches)	DIMENSIONS - ENGLISH (Inches)						Approx. Weight Lbs.
	A	B	C	D	E	F	
1/2"	5.94	10.00	1.62	5.62	3.75	3.94	8
3/4"	7.12	11.25	1.75	6.56	3.81	4.00	28
1"	7.94	11.75	2.12	7.38	4.38	4.6/9	37
1-1/2"	9.75	15.75	2.50	9.12	6.19	5.75	77
2"	11.25	16.00	2.88	11.25	7.06	6.62	109
Valve Size (mm)	DIMENSIONS - METRIC (mm)						Approx. Weight Kg.
	A	B	C	D	E	F	
DN15	151	254	41	143	95	100	4
DN20	181	286	44	167	97	102	13
DN25	202	298	54	187	111	119	17
DN40	248	400	64	232	157	146	35
DN50	286	406	73	286	179	168	49



NOTES

NOTES

PRODUCT CODE

06/03/04

TABLE 2 - SIZE & SERVICE		
Size	Service	
In (mm)	**Gaseous**	**Liquid**
1/2" (DN15)	**4**	**J**
3/4" (DN20)	**5**	**K**
1" (DN25)	**6**	**L**
1-1/2" (DN40)	**8**	**N**
2" (DN50)	**9**	**P**

TABLE 3 - BODY / SP. CHMBR. MATERIAL	
Body/Sp.Ch.	**CODE**
BRZ/BRZ	**3**
SST/SST	**A**
All Cleaned per Spec #S-1134 (Opt. -55)	

TABLE 4 - TRIM DESIGNATION NO.				
Brass Trim Option -5		Stainless Steel Trim Option -36		
Desig.	**CODE**	Desig.	Size	**CODE**
B5*	**B5**	S1	ALL	**S1**
		S36	ALL	**36**

TABLE 5 - RANGE SPRINGS					
SIZE	PSIG (BARG)	**CODE**	SIZE	PSIG (BARG)	**CODE**
1/2"	10-50 (.69-3.4)	**3**	1-1/2"	10-50 (.69-2.1)	**3**
	40-80 (2.8-5.5)	**B**		40-75 (2.8-5.2)	**A**
	65-100 (4.5-6.9)	**G**		60-150 (4.1-10.3)	**F**
	80-150 (5.5-10.3)	**J**	2"	10-40 (.69-2.1)	**1**
	120-300 (8.3-20.7)	**N**		30-60 (1.7-3.1)	**5**
3/4"	10-40 (.69-2.8)	**2**		50-150 (2.4-6.2)	**9**
	30-60 (2.1-4.1)	**6**			
	50-70 (3.4-4.8)	**C**			
	55-110 (3.8-7.6)	**E**			
	90-150 (6.2-10.3)	**K**			
	120-300 (8.3-20.7)	**N**			
1"	10-30 (.69-2.1)	**1**			
	25-45 (1.7-3.1)	**5**			
	35-50 (2.4-3.4)	**8**			
	40-80 (2.8-5.5)	**B**			
	65-150 4.5-10.3)	**H**			
	120-250 (8.3-17.2)	**M**			

BC □ – □ □□ **7** – **1** □ □ □□□□□□ **A**

Model 1000HP Pressure Reducing Regulator, Cryogenic Service

When ordering a valve per one of Cashco's special drawings, the code "X" and the 5-digit number following overrides all other options. Otherwise, proceed with the following.

ASSIGNMENT OF "OPTION" CODES

1. NUMERIC digits assigned first in "ascending" order.
2. ALPHA designations are assigned second (excluding the "X") in "alphabetical" order.
3. Left justify.
4. Add "0" to all unused squares.
5. If insufficient quantity of squares, consult factory for proper code.

TABLE 6 - TRIM VARIATIONS						
Description	Opt-5 BRZ/BRZ/BRZ		Opt -36 SST/SST/SST			
			Option	**CODE**	W/ -17 Opt.	
	Option	**CODE**			Option	**CODE**
Special Construction	---	**X**	--	**X**	--	**--**
No Special Trim Variation	--	**0**	--	**0**	--	**--**
Reduced Orifice (One-Step)	--	**--**	-12	**A**	-12+17	**1**
Integral Seat Surface	Std	**0**	-14	**C**	-14+17	**3**
Reduced Orifice & Integral Seat	-12*	**E**	-12+14	**E**	-12+14+17	**5**
Piston Spring Not Available	Std	**0**	-17	**H**	-17	**H**
* Integral Seat Standard						

TABLE 7 - OPTIONS		
Description	Option	**CODE**
1/4" (DN8) NPT Pressure Tap	-26	**F**

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