KOGAS R&D DIVISION

CR-CAT-2015 / No. 1-3

Cryogenic Control Valves
Cryogenic Safety Relief Valves

Mt.H CONTROL VALVES CO., LTD.

Dear and Valuable Customers!

Mt.H has abundant experience and various achievements of safety relief valves and control valves for protection and safety in industrial plant projects and marine service and Mt.H also has consulted, provided, produced and supplied these valves to our customers with frontier spirit and business philosophy since 1978.
Therefore, we believe that these our efforts have contributed modern industry development and safety of each field including environment for human prosperity. Presently, We have faced with the various demand of industry, plants, environmental conservation, marine services, offshore gas facility, refining, natural gas, Petroleum Drilling and other chemical plants.
Mt.H has foreseen this situation and then set our policy to satisfy the needs of our customers. Mt.H has been developing Its technology in cryogenic safety and control valves field.
Mt.H`s cryogenic pilot operated safety valve has been nominated as New Excellent Product for LNG/LPG service by KOREA Government on May 2011.
We believe our cryogenic valves offer sufficient satisfaction to our customers and all needed places with our policy.

- The best technique, product and service provided to customers.
- Offer the most reasonable price.
- Construct faith and cooperation between Mt.H and customers.
- Strong after sales service supports customers.

We can offer you with our best efforts.
Thank You.

E.S.Kang / Chairman Y.C. Kim / President

Contens





A Company History

APR. 1978	The company was established under the nameof Halla Automatic Valves.
May. 1985	Concluded the license agreement with AKOGmbH in Germany.
OCT. 1988	First shipment of the valves for marine to Japan.
FEB. 1992	Awarded the prize for developing by Hyundai Heavy Industries Co., Ltd.
MAR. 1996	Awarded "A-Mark" for Quality Control Prize by Hyundai Heavy Industries Co., Ltd.
JAN. 1997	Type approved by the KR, ABS for the fabrication of valves. - Main Starting Valves - Crank Case Relief Valves
OCT. 1997	Awarded the medal for developing by Prime Minister. - Crank Case Relief Valve Trap
APR. 1998	Awarded the medal for small and medium business company's day by President.
AUG. 1999	Achieved ISO-9001 certificate.
NOV. 2001	Appointed as the small and medium enterprise of the innovated technology by the Small and Medium Business Administration.
APR. 2002	Moved factory from Sinpyong to Nok-San National Industrial Complex. and company name is changed from "Halla Automatic Valves Co., Ltd." to "Mt.H Control Valves Co., Ltd."
SEP. 2002	Achieved advanced ISO-9001/2000 certificate by Korea Accreditation Board
DEC. 2005	Established R&D center NO. 20052975
DEC. 2007	Achieved GTT Approval certificate (FRU/N 07-1167)
DEC. 2006	Registered Venture Company NO. 20060100999
NOV. 2010	Achieved Excellent Invention Certificate for Korea Invention Promotion Association
APR. 2011	Achieved New Excellent Product Certificate for Korea Agency for Technology and Standards Ministry of Knowledge Economy (Republic of Korea)
DEC. 2011	Registered in KOGAS as a major supplier for equipment(cryogenic pilot operated safety valves)
NOR. 2012	Export cryogenic pilot operated safety valves to the Middle East
MAR. 2013	Supply cryogenic pilot operated safety valves with vacuum breakers to samcheok LNG terminal.
FEB. 2014	Supply cryogenic pilot operated safety valves with vacuum breakers to samcheok LNG terminal.
JUL. 2014	Extension of NEP Cert. for cryogenic pilot operated safety valves(Ministry of Knowledge economy)
SEP. 2015	In Progressing of ASME 'UV' Certificate for Safety Relief Valve(Scheduled Oct. 2015)

CRYOGENIC PILOT OPERATED SAFETY RELIEF VALVES

HSP-OVT SERIES

1. General

Mt.H Pilot operated safety relief valves have been designed and manufactured in accordance with the ISO 9001 quality system and international standard and code. Pilot operated safety relief valves have been tested and examined, using sophisticated measuring instruments and facilities under the low temperature circumstance. In particular, Pilot operated safety valves are fully verified and evidenced through international evaluation bodies.
Pilot operated safety relief valves can be used widely two ultimate conditions, very low temperature and/or very low pressure service, having cryogenic materials which have durable characteristic. Specially, These valves are designed for use with tanks of ultra low temperature liquefied gases such as LNG/LPG (Land and Ocean cargo tank and insulation space).

2. Features and Advantage

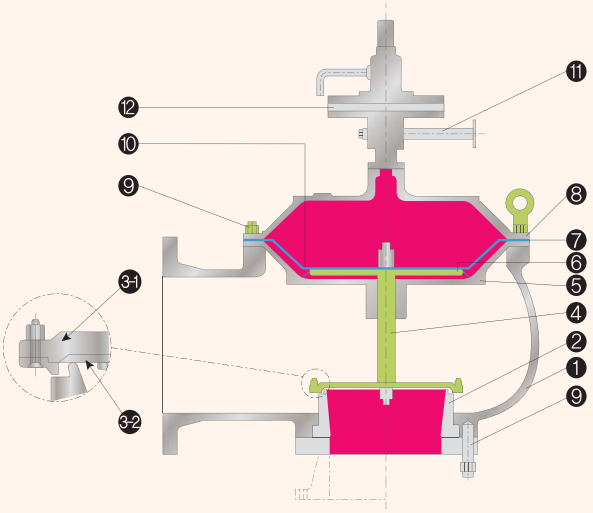
- Compact and simple design for small installation space
- Smart concept and idea
- Remote sensing for pilot valve for easy maintenance, adjustment, and operation
- On Board Calibration (No Remove)
- Full lift of disc for large discharge capacity
- No leakage and small blow-down for min. loss of medium
- Discharge coefficient(K_d) certified by national measurement Testing Lab.
- TYPE APPROVAL obtained by classification society

CERTIFICATE

3. Application International Standard Code / Certificate

- Classification of society
- IGC code / IMO
- ANSI rule for fitting, valve-flanged
- API rule for seat tightness of pressure relief valves
- ASME rule for insulation and operation
- MSS rule (Manufactures Standardization Society of the valve and fitting Industry)
- NEP (New Excellent Product)
- Excellent Invention

Construction

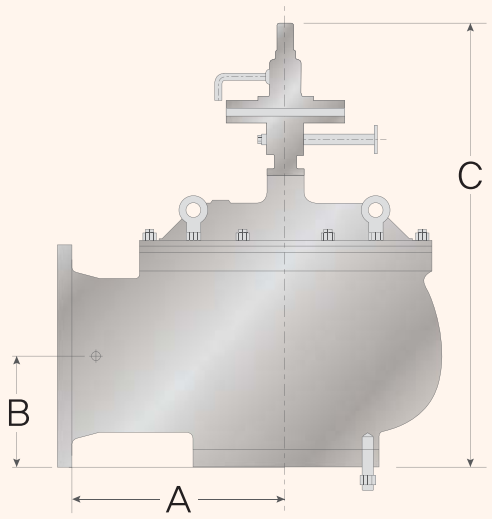


Standard Material

NO	Item	Material
1	Main Body	ASTM A351 CF8M / ASTM B26 356-T6
2	Nozzle	Stainless Steel(A351 CF8M)
3-1	Disc	Stainless Steel
3-2	Disc	Teflon
4	Spindle	Stainless Steel
5	Retainer	ASTM A351 CF8M / ASTM B26 356-T6
6	Plate	Stainless Steel
7	Gasket	Teflon
8	Cover	ASTM A351 CF8M / ASTM B26 356-T6
9	Stud Bolts/Nuts	Stainless Steel
10	Diaphragm	Teflon
11	Pilot Pipe	Stainless Steel
12	Pilot Valve	Stainless Steel

Note

- Other material (SCS, SC, FCD and etc) shall be supplied depend on fluid, Temp. and service conditions.



Standard Dimension and Weight

Size (inch)	ANSI Flange Rating (LBS)		Dimensions (mm)			Weight (kg)
INLETxOUTLET	INLET	OUTLET	A	B	C	
2x3	150	150	150	105	580	60
3x4	150	150	180	115	620	75
4x6	150	150	200	140	700	125
6x6	150	150	315	140	750	165
6x8	150	150	315	175	820	170
8x10	150	150	400	200	910	270
10x12	150	150	500	230	980	380
12x16	150	150	560	280	1090	650
14x18	150	150	630	300	1170	950

Specifications

Description	Technical Specification
Pressure Range, kPa (kgf/㎠)	1 to 250 (0.01 to 2.5)
Temp. Range (℃)	-196 to +80
Service	• Natural gas & Petroleum Drilling • Air Separation Plant • Low Pressure Storage • Receiving Terminals (LNG) • Liquefied Gas Storage • LNG/LPG Carrier • LEG Storage • Petroleum Refining Plants and Other Chemical Plants
Applied Gas	LNG(CH_4) / LPG / LEG(CH_2) / O_2 / N_2 / CO_2 / Etc.

HSP-OVT SERIES

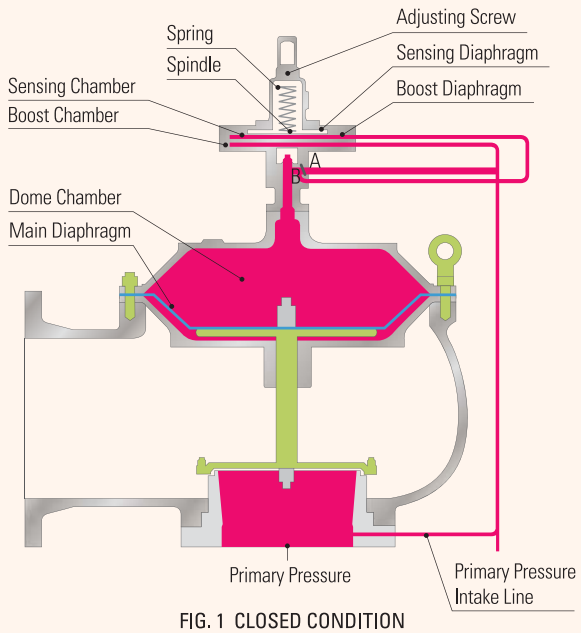


FIG. 1 CLOSED CONDITION

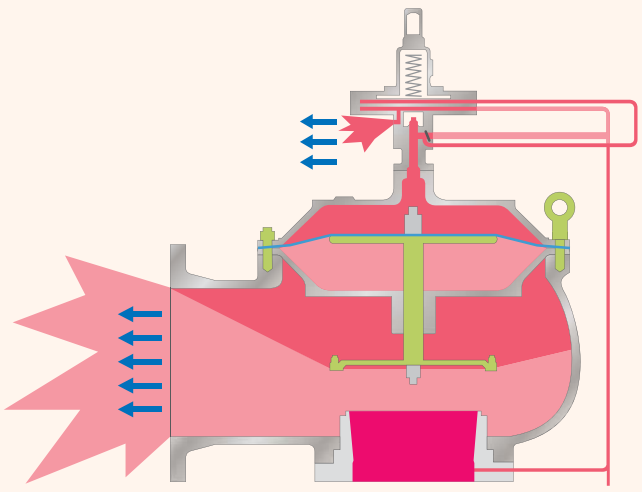


FIG. 2 OPERATION OF MAIN VALVE

1. CLOSED CONDITION (FIG. 1)

Pressure is supplied to the dome chamber of the main valve from the pressure intake line of the primary side through the adjusting needle (A) and the fixed needle (B), and then to the sensing chamber from downstream of the adjusting needle (A). Furthermore, pressure is also directly introduced to the boost chamber from the pressure intake line in order to always equalize it with the system pressure. In this condition, the system pressure (PO), the dome pressure (PD), the sensing pressure (PS) and the boost pressure (PB) are all the same, as expressed in the following formula.

$$PO=PD=PS=PB$$

Since the main valve is so designed that the pressure receiving area of the piston (AD) is larger than that of the disc (AO), the disc of the main valve is firmly pressed against the nozzle seat by the load obtained by (AD-AO) x PO. In the pilot valve, the sensing chamber and the boost chamber are balanced in pressure and the force which acts to open the pilot valve is the one obtained by multiplying the pressure receiving area of the sensing diaphragm (AS) with PS. The following relation is maintained for the pilot valve.

$$\text{Spring Load } F > AS \times PS$$

adjusting needle (A) and the fixed needle (B) due to the full lift of the pilot valve, the dome chamber pressure drops. Owing to this pressure drop of the dome chamber, the disc of the main valve is lifted by the system pressure, attaining a full lift at the specified pressure.

2. OPERATION OF MAIN VALVE (FIG. 2)

Since the flow rate of fluid discharged from the pilot valve is larger than that of fluid flowing into the dome chamber through the adjusting needle (A) and the fixed needle (B) due to the full lift of the pilot valve, the dome chamber pressure drops. Owing to this pressure drop of the dome chamber, the disc of the main valve is lifted by the system pressure, attaining a full lift at the specified pressure.

PD : Main valve dome pressure
PS : Pilot sensing pressure
PB : Pilot boost pressure

AO : Pressure receiving area of main valve disc
AD : Pressure receiving area of main valve dome
AS : Pressure receiving area of sensing diaphragm
AB : Pressure receiving area of boost diaphragm

Sizing for Subcritical Flow

1. Formula

<API RP 520>

Fluid	SI Units	US Customary Units
Gas or Vapor	$A = \frac{17.9 \times W}{F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1-P_2)}}$	$A = \frac{W}{735 \times F_2 K_d K_c} \sqrt{\frac{ZT}{MP_1(P_1-P_2)}}$
	$A = \frac{47.95 \times V}{F_2 K_d K_c} \sqrt{\frac{ZTM}{P_1(P_1-P_2)}}$	$A = \frac{V}{4645 \times F_2 K_d K_c} \sqrt{\frac{ZTM}{P_1(P_1-P_2)}}$
	$A = \frac{258 \times V}{F_2 K_d K_c} \sqrt{\frac{ZTG}{P_1(P_1-P_2)}}$	$A = \frac{V}{864 \times F_2 K_d K_c} \sqrt{\frac{ZTG}{P_1(P_1-P_2)}}$

2. Nomenclature

A = Required orifice area, mm^2[in^2]

W = Relieving capacity, kg/hr[lb/hr]

F_2 = Coefficient of subcritical flow

$$= \sqrt{\left(\frac{k}{k-1}\right)(r)^{2/k}\left[\frac{1-r^{(k-1)/k}}{1-r}\right]}$$

k = Ratio of the specific heats.

r = Ratio of back pressure to upstream relieving pressure, P_2/P_1

K_d = Coefficient of discharge by actual test, experimentally

P_1 = Upstream relieving pressure, kPaa[psia]

P_2 = Back pressure, KPaa[psia]

K_c = Combination correction factor for installation

T = Relieving temperature of the inlet gas or vapor, K(℃+273) [R(°F+460)]

Z = Compressibility factor

M = Molecular weight of the gas or vapor, kg/k_{mole} (lb_m/lb_{mole})

V = Relieving capacity, Nm^3/min at 0℃ and 101.3kPaa [SCFM at 14.7psia and 60°F]

G = Specific gravity of gas(air=1.0) [at 0℃ and 101.3kPaa]

Capacity Table

Air Flow Capacity, set pressure + 10% overpressure[Nm^3/hr]

SIZE(inch)	2x3	3x4	4x6	6x6	6x8	8x10	10x12	12x16	14x18
ORIFICE AREA(cm^2)	21.6	47.7	82.1	186.2		334.5	479.1	759.6	1017.8
SET PRESS.(barg)									
0.01	-	-	-	2,130	-	-	-	-	-
0.04	563	1,242	2,136	4,255	4,841	8,697	12,455	19,745	20,233
0.06	689	1,520	2,615	5,208	5,925	10,643	15,242	24,164	30,873
0.08	794	1,754	3,017	6,009	6,836	12,280	17,586	27,880	38,661
0.10	888	1,959	3,370	6,713	7,637	13,719	19,647	31,147	45,099
0.20	1,250	2,760	4,748	-	10,759	19,326	27,677	43,878	68,534
0.25	1,398	3,080	5,298	-	12,006	21,566	30,884	48,963	77,514
0.29	1,500	3,312	5,697	-	12,911	23,192	33,213	52,654	83,954
0.40	1,755	3,874	6,663	-	15,100	27,124	38,844	61,582	99,332
0.60	2,134	4,709	8,101	-	18,358	32,977	47,226	74,870	121,853
0.80	2,446	5,400	9,288	-	21,049	37,810	54,148	85,844	140,220
1.00	2,717	5,996	10,315	-	23,375	41,988	60,131	95,330	155,966
1.20	2,957	6,526	11,226	-	25,441	45,699	65,445	103,754	169,866
1.40	3,174	7,006	12,501	-	27,309	49,055	70,251	111,373	182,378
1.60	3,373	7,445	12,806	-	29,021	52,130	74,656	118,356	193,800
1.80	3,557	7,851	13,506	-	30,606	54,977	78,733	124,819	204,337
2.00	3,729	8,231	14,158	-	32,084	57,633	82,536	130,849	214,138
2.20	3,890	8,587	14,771	-	33,472	60,126	86,107	136,510	223,317
2.40	4,042	8,923	15,349	-	34,782	62,480	89,477	141,853	231,961

CRYOGENIC CONVENTIONAL SAFETY RELIEF VALVES

HSF-FCA SERIES

1. General

Mt.H Spring loaded safety relief valves have been designed and manufactured in accordance with the ISO 9001 quality system and international standard and code. Spring loaded safety relief valves have been tested and examined, using sophisticated measuring instruments and facilities under the low temperature circumstance. In particular, Spring loaded safety relief valves are fully verified and evidenced through international evaluation bodies. Spring loaded safety relief valves can be used widely from ambient temperature to very low temperature(cryogenic) pressure service, having cryogenic materials which have durable characteristic. Specially, These valves are designed for use with pipe line of ultra low temperature liquefied gas such as LNG/LPG.

2. Features and Advantage

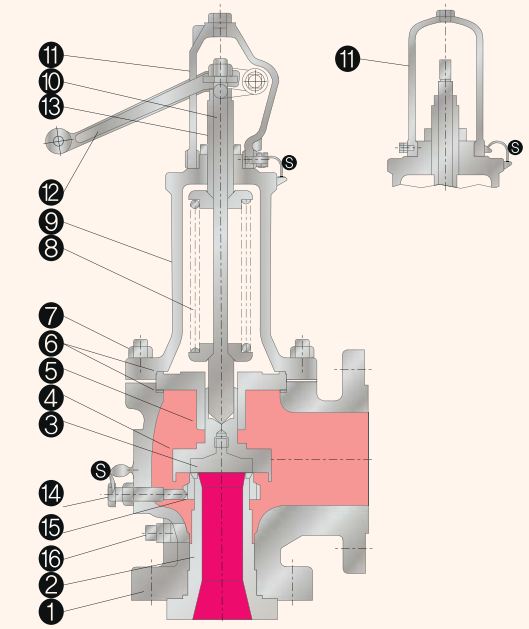
- Compact and simple design for small installation area
- Smart concept and idea for easy maintenance, adjustment, and operation
- Full lift of disc for large discharge capacity
- No leakage and small blow-down for min. loss of medium
- Discharge coefficient(K_d) certified by national measurement Testing Lab.
- TYPE APPROVAL obtained by classification society

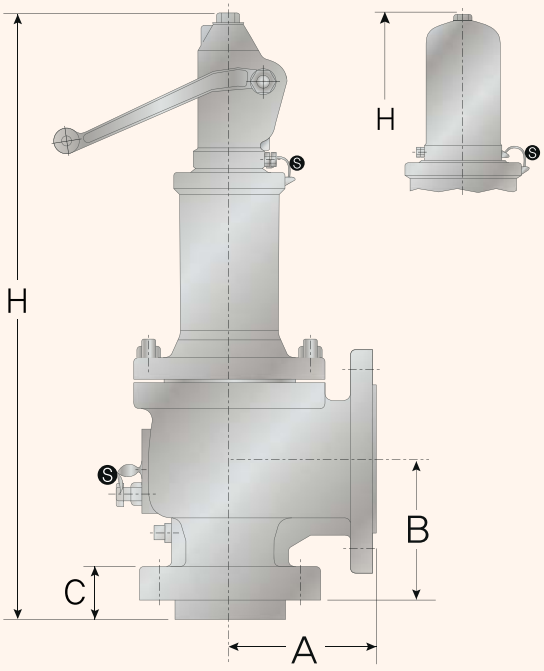
3. Application International Standard and Code

- Classification of society
- IGC code / IMO
- ANSI rule for fitting, valve-flanged
- API rule for seat tightness of pressure relief valves
- ASME rule for insulation and operation
- MSS rule (Manufactures Standardization Society of the valve and fitting Industry)

CERTIFICATE

Construction





Standard Material

NO	Item	Material
1	Body	ASTM A351 CF8M
2	Nozzle	Stainless Steel(A351 CF8M)
3	Disc	Stainless Steel
4	Holder	Stainless Steel
5	Guide	Stainless Steel
6	Gasket	Teflon
7	Stud Bolts/Nuts	Stainless Steel
8	Spring	Stainless Steel
9	Spring Case	ASTM A351 CF8M
10	Stem	Stainless Steel
11	Cap	ASTM A351 CF8M
12	Handle	Stainless Steel(A351 CF8M)
13	Adjusting Screw	Stainless Steel
14	Set Bolt/Nut	Stainless Steel
15	Control Ring	Stainless Steel(A351 CF8M)
16	Drain Plug	Stainless Steel

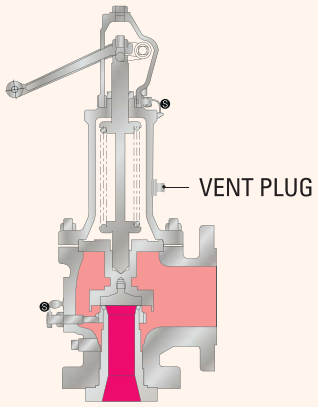
Other material can be supplied.

Standard Dimension and Weight

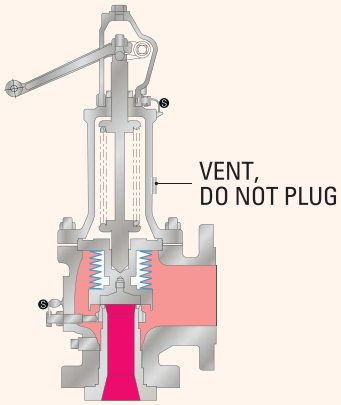
Size (inch)	ANSI Flange Rating (LBS)		Dimensions (mm)				Weight (kg)
INLETxOUTLET	INLET	OUTLET	A	B	C	H	
3/4x1	150	150	96	96	25	370	13.2
1x2	150	150	114	98	30	370	15.5
1x2	150	150	121	124	30	485	20.5
1x2	150	150	121	124	30	485	23.0
1x3	150	150	124	130	34	515	26.5
2x3	150	150	124	137	45	520	34.0
3x4	150	150	165	169	39	710	57.0
4x6	150	150	229	181	50	865	68.0
3/4x1	300	150	96	96	25	370	14.0
1x2	300	150	114	98	30	370	16.0
1x2	300	150	121	124	30	485	21.0
1x2	300	150	121	124	30	485	24.0
1x3	300	150	124	130	34	515	27.5
2x3	300	150	124	137	45	520	34.5
3x4	300	150	165	169	39	710	57.5
4x6	300	150	229	181	50	865	69.0

Specifications

Description	Technical Specification
Pressure Range, MPa(kgf/㎠)	0.1 to 1.0 (1.0 to 10) / Max. 350bar(option)
Temp. Range (℃)	-196 to +125
Service	• Natural gas & Petroleum Drilling • High Pressure Gas Supply Line • Receiving Terminals • LNG/LPG Carrier • Petroleum Refining Plants and Other Chemical Plants



Conventional



Balanced Bellows

Conventional Safety Relief Valve

This standard rugged configuration is equipped with corrosion resistant trim and a stainless steel body, bonnet and cap. The components are top guided, providing for free and repeatable action. The flat disc seat provides for easy maintenance and remachining. The exclusive "Eductor Tube" minimizes bonnet cavity pressure so that product performance is predictable. The nozzle is bottom inserted and rigidly held in position, providing a corrosion resistant path of flow to the valve and corrosion resistant seating surfaces.

Bellows Construction

This valve is the same as the conventional design except that a bellows has been added. When the bellows is installed, the eductor tube is removed. A bellows is added to the conventional valve to deal with any of several situations:

(1) Back pressure entering the valve through the valve outlet is excessive or variable. If back pressure fluctuates with ±10% of a nominal value, a bellows is required. If a built up back pressure exceeds 10% of the set pressure or cold differential set pressure, a bellows must be used.

(2) If the entering fluid is a slurry, highly viscous, or of a nature that it can enter the critical clearances between the guides/ disc holder, protect that area with a bellows.

(3) If the fluid being handled is corrosive to the upper works of the valve, isolate the bonnet chanber through use of a bellows

Sizing

1. Formula for Critical Flow

<API RP 520>

Fluid	SI Units	US Customary Units
Gas or Vapor	$A = \frac{13.16 \times W}{CK_dP_1K_bK_c}\sqrt{\frac{TZ}{M}}$	$A = \frac{W}{CK_dP_1K_bK_c}\sqrt{\frac{TZ}{M}}$
	$A = \frac{35.25 \times V\sqrt{TZM}}{CK_dP_1K_bK_c}$	$A = \frac{V\sqrt{TZM}}{6.32 \times CK_dP_1K_bK_c}$
	$A = \frac{189.75 \times V\sqrt{TZG}}{CK_dP_1K_bK_c}$	$A = \frac{V\sqrt{TZG}}{1.175 \times CK_dP_1K_bK_c}$

2. Nomenclature

A = Required orifice area, mm^2[in^2]
W = Relieving capacity, kg/hr[lb/hr]
C = Coefficient determined from an expression of the ratio of the specific heats of the gas or vapor

$$C = 520\sqrt{k\left(\frac{2}{k+1}\right)^{\left(\frac{k+1}{k-1}\right)}}$$

k = Ratio of the Specific heats (Cp/Cv)
K_d = Coefficient of discharge by actual test, experimentally
P_1 = Upstream relieving pressure, kPaa[psia]
K_b = Capacity correction factor due to back pressure
K_c = Combination correction factor for installation
T = Relieving temperature of the inlet gas or vapor, 273℃ [460°F]
Z = Compressibility factor
M = Molecular weight of the gas or vapor, kg/k_{mole} (lb_m/lb_{mole})
V = Relieving capacity, Nm^3/min at 0℃ and 101.3kPaa [SCFM at 14.7psia and 60°F]
G = Specific gravity of gas(air=1.0) [at 0c and 101.3kPaa]

CRYOGENIC CONVENTIONAL SAFETY RELIEF VALVES

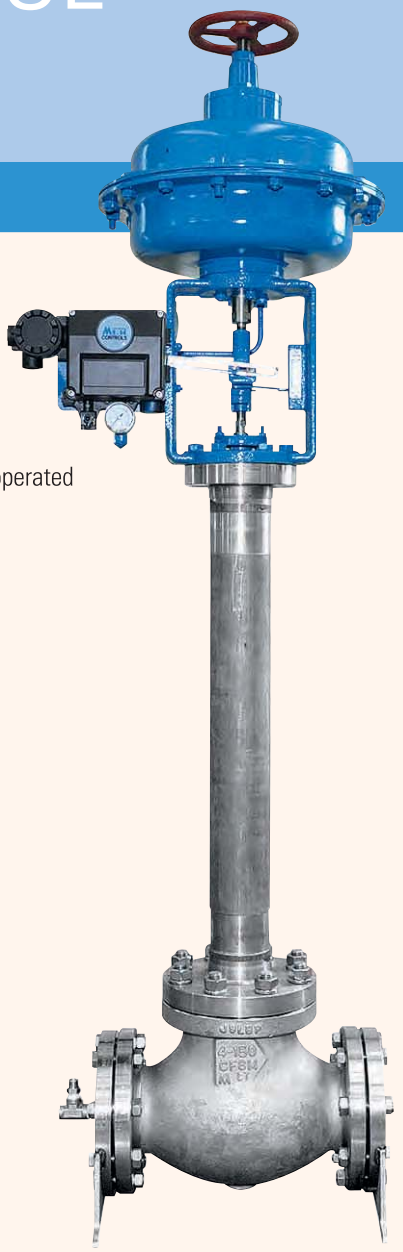
Capacity Table

Air Flow Capacity, set pressure + 10% overpressure[Nm^3/hr]

SIZE(inch) / SET PRESSURE.(barg)	3/4 x 1	1 x 2	1.5 x 2	1.5 x 2.5	1.5 x 3	2 x 3	3 x 4	4 x 6
1	113	226	500	500	750	1,207	2,660	3,351
2	171	344	760	760	1,140	1,835	4,045	5,095
3	230	462	1,018	1,018	1,530	2,465	5,430	6,840
4	289	579	1,278	1,278	1,920	3,092	6,815	8,584
5	348	697	1,538	1,538	2,310	3,721	8,199	10,329
6	406	815	1,797	1,797	2,700	4,350	9,584	12,073
7	465	932	2,057	2,057	3,090	4,978	10,968	13,818
8	524	1,050	2,317	2,317	3,480	5,606	12,353	15,562
9	582	1,168	2,577	2,577	3870	6,234	13,738	17,307
10	641	1,286	2,836	2,836	4,260	6,860	15,122	19,051
11	700	1,403	3,096	3,096	4,650	7,490	16,508	20,796
12	758	1,521	3,356	3,356	5,041	8,120	17,891	22,540
13	817	1,639	3,615	3,615	5,431	8,748	19,278	24,284
14	876	1,756	3,875	3,875	5,821	9,377	20,653	26,029
15	935	1,874	4,135	4,135	6,211	10,005	22,045	27,773
16	993	1,992	4,395	4,395	6,600	10,633	23,430	29,518
17	1,052	2,110	4,654	4,654	6,990	11,262	24,814	31,262
18	1,111	2,227	4,914	4,914	7,381	11,890	26,201	33,007
19	1,169	2,345	5,174	5,174	7,770	12,520	27,587	34,750
20	1,228	2,463	5,434	5,434	8,161	13,147	28,971	36,496
21	1,287	2,580	5,693	5,693	8,552	13,775	30,356	38,240
22	1,345	2,698	5,953	5,953	8,942	14,404	31,741	39,985
23	1,404	2,816	6,213	6,213	9,332	15,032	33,125	41,720
24	1,463	2,933	6,472	6,472	9,722	15,661	34,510	43,474
25	1,522	3,051	6,732	6,732	10,112	16,289	35,890	45,218
26	1,580	3,169	6,992	6,992	10,502	16,918	37,280	46,962
27	1,639	3,287	7,252	7,252	10,892	17,546	38,665	48,707
28	1,698	3,404	7,511	7,511	11,282	18,174	40,050	50,450
29	1,756	3,522	7,771	7,771	11,672	18,803	41,434	52,196
30	1,815	3,640	8,031	8,031	12,060	19,430	41,819	53,940

CRYOGENIC CONTROL VALVES

HND-FGC SERIES



1. General

The trim parts is devided into two of the top guided single seat type or cage balanced single seat type. The extension bonnet allows for use of cryogenic service up to -196℃. The actuators are designed compactly as multi-spring diaphragm operated type, and permit high thrust.

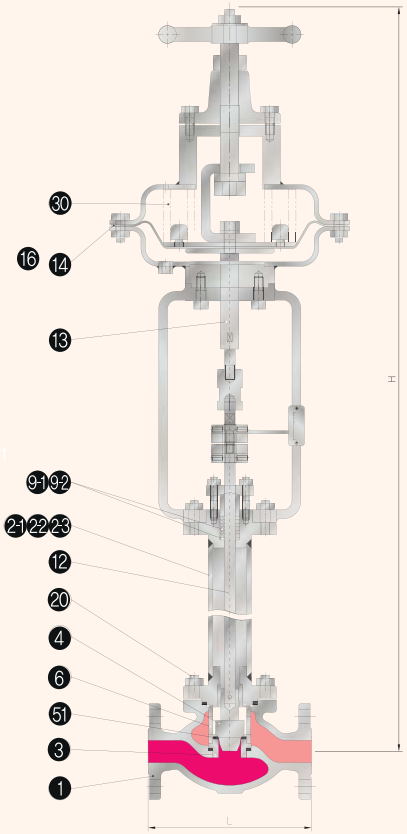
2. Features and Advantage

- Compact and simple
- Smart concept
- Inherent Flow Characteristics
  - Equal percentage
  - Parabolic
  - Modified parabolic
  - Linear
  - Quick opening
- Fluid
  - N_2Gas, CH_4Gas, Glycol Water, Fresh Water, Steam
- Temperature
  - Cryogenic~Ambient Temp. [-196~125℃/-321~260℉]
- Service
  - Storage Tanks or Cryogenic Storage Tanks
  - LNG Carrier Vessel, Liquefied Gas Storage Tank
  - LPG Carrier Vessel, LEG Storage Tank Refinery Plant
- Used Material
  - Stainless steel or equivalent for steel components
  - Teflon for gasket
- Accessory : P/P, E/P positioner
  P/P, E/P controller

3. Application International Standard and Code

- ANSI rule for fitting, valve-flanged
- API rule for Seat Tightness of pressure relief valves
- ASME rule for installation and operation
- BS6364 Valves for Cryogenic Service

Construction



Standard Material

NO	Item	Material
01	BODY	ASTM A315 CF8M
02-1	BONNET LOWER	SUS 316L
02-2	BONNET UPPER	SUS 316L
02-3	PIPE	SUS 316L
03	SOFT SEAT	SUS 316L
04	PLUG	SUS 316L
06	SOFT CASE	SUS 316L
09-1	V-PACKING	PTFE
09-2	V-PACKING	PTFE
12	STEM LOWER	SUS 316L
13	STEMM UPPER	SUS 304
14	DIAPHRAGM	BUNA. A / POLYESTER
20	SUTD BOLT	SUS 304
30	SPRING	SWOSC-V
51	SOFT SEAL	PTFE

Standard Material

- Actuator part
  Material : Carbon Steel (Normal temp.)
  SUS316L (Extremely low temp.)
  Actuator input signal Pr. : 0.2~1.0 Bar
  Actuator input signal Pr. : 0.4~2.0 Bar
- Yoke Part
  Material : FCD450 (Normal temp.)
  SUS316L (Extremely low temp.)

Standard Dimension and Weight

(Unit : mm)

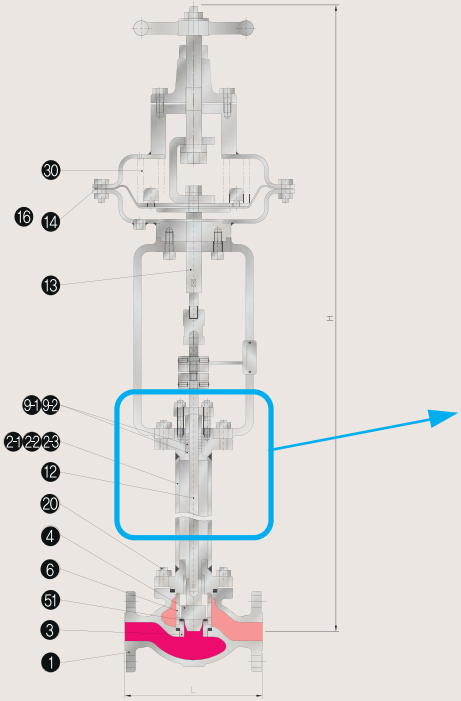
SIZE	Flange Rating (LBS)	L	H	LIFT
15A	ANSI 150	162	1163	15
20A	ANSI 150	184	1163	15
25A	ANSI 150	184	116	15
32A	ANSI 150	223	1244	20
40A	ANSI 150	223	1249	20
50A	ANSI 150	254	1310	25
65A	ANSI 150	276	1443	30
80A	ANSI 150	298	1500	30
100A	ANSI 150	352	1570	40
150A	ANSI 150	451	1790	50
200A	ANSI 150	568	1820	65
250A	ANSI 150	708	1920	75
300A	ANSI 150	775	1920	110
350A	ANSI 150	927	1920	110

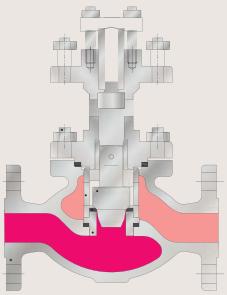
- Extension bonnet (Use for extremely low temperature line)
  Material : SUS316L
- Body(trim) part
  Material : SC480/SUS304 (Normal temp.)
  SCS16 or SCS16A/S316L (Extremely low temp.)

Specifications

Description	Technical Specification
Pressure Range, MPa(kgf/㎠)	0.1 to 1.0 (1.0 to 10)
Temp. Range (℃)	-196 to +70 ℃
Service	• Nature Gas & Petroleum Drilling • Air Separation Plant • Receiving Terminals • Liquefied Gas Storage • LNG/LPG Carrier • Petroleum Refining Plants and Other Chemical Plants

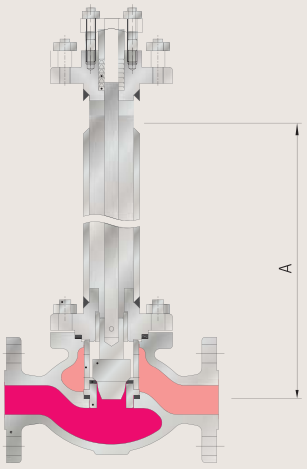
HND-FGC SERIES





Short Stem

HND-FGC



Extended Stem

HND-FCG-LT

NANE	STANDARD MATERIAL	LENGTH OF EXTENSION A(MM)		APPLICATION
SHORT STEM	CAST IRON CAST STEEL	-		-50℃~and over less than +80℃
EXTENDED STEM	STAINLESS STEEL (SUS PIPE)	SIZE	mm	-196℃ and over and less than +80℃
		15A~25A	500	
		38A~50A	600	
		80A~150A	700	
		200A	750	
		250A~300A	850	
		350A~500A	-	

CRYOGENIC CONTROL VALVES

Sizing

1. Compressible Fluid

1.1 Formula

$$Cv = \frac{Q}{417 \times P_1 \times Y} \sqrt{\frac{G_g \times T_1}{X}} \quad \text{(ISA 75. 01. 01)}$$

1.2 Nomenclature

Q = Volumetric Flow rate (m^3 / h)
P_1 = Inlet absolute static pressure (bar)
Y = Expansion factor
G_g = Gas Specific gravity
T_1 = Temperature (K)
X = Ratio of pressure differential to inlet absolute pressure ($\triangle P/P_1$)
P = differential pressure, P_1-P_2 (bar)

Expansion factor Y is defined by

$$Y = 1 - \frac{X}{3F_\gamma X_T}$$

F_r = Specific heat ratio factor
X_T = Pressure differential ratio factor

where $F_\gamma = \frac{\gamma}{1.4}$

X_T is given as 0.72 for typical glove valves.

2. Incompressible Fluid

2. 1 Formula

$$Cv = \frac{Q}{0.865} \sqrt{\frac{p_1/p_o}{\triangle P}} \quad \text{(ISA 75. 01. 01)}$$

2. 2 Nomenclature

Q = Volumetric Flow rate (m^3 / h)
$\triangle P$ = Differential Pressure (bar)
p_1/p_o = Relative density

VACUUM BREAKER

HVB-DW SERIES

1. General

Mt.H Weight loaded vacuum breakers have been designed and manufactured in accordance with the ISO 9001 quality system and international standard and code. Weight loaded vacuum breakers have been tested and examined, using sophisticated measuring instruments and facilities. Weight loaded vacuum breakers have been designed on storage tank damages and other process vessels or system to prevent structural damage due to excess internal vacuum. Specially, Weight loaded vacuum breakers can be used widely from negative pressure to positive pressure depend on storage tanks conditions to vacuum relief.

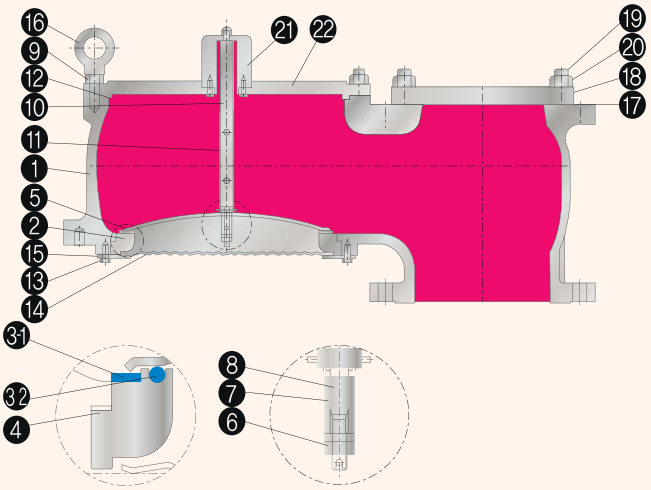
2. Features and Advantage

- Compact and simple design for small installation area
- Smart concept and construction for easy maintenance and operation
- Full lift of disc for large discharge capacity
- No leakage for min. loss of medium
- Easy vacuum set adjustments

3. Application International Standard and Code

- API rule for venting device
- ANSI rule for fitting, valve-flanged

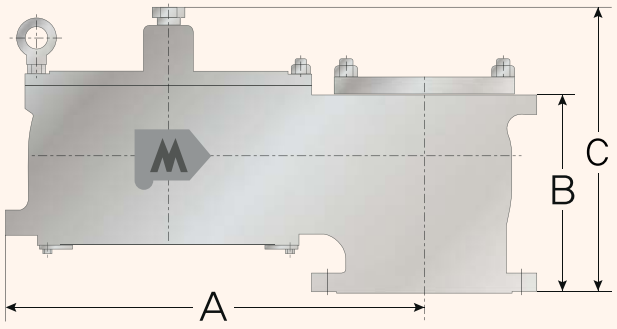
Construction



Standard Material

NO	Item	Material
1	Body	Aluminium
2	Nozzle	Aluminium
3-1	Main Seat	Teflon or EPDM
3-2	Sub Seat	NBR or VITON
4	Gasket	Teflon
5	Disc	Stainless Steel
6	Lock Nut	Stainless Steel
7	Spacer	Aluminium
8	Gasket	Teflon
9	Hex. Nut	Stainless Steel
10	Rod	Aluminium
11	Guide	Aluminium
12	Gasket	Teflon
13	Hex. Bolt	Stainless Steel
14	Screen	Stainless Steel
15	Retainer Plate	Stainless Steel
16	Eye Nut	Stainless Steel
17	Gasket	Teflon
18	Cap Outlet	Aluminium
19	Stud Bolt	Stainless Steel
20	Hex Nut	Stainless Steel
21	Plug	Stainless Steel
22	Cover	Aluminium

The material (SCS, CF8M, SC, FCD and etc) shall be supplied depend on fluid, Temp. and service conditions.



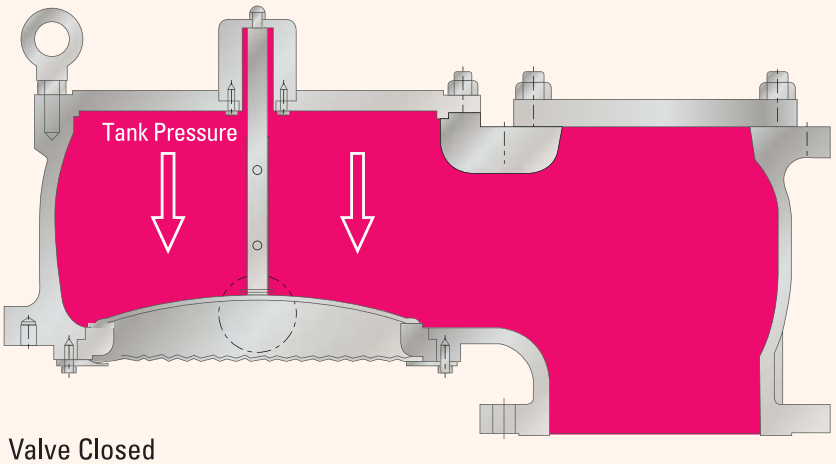
Standard Dimension and Weight

Size (inch)	ANSI Flange Rating (LBS)	Dimensions (mm)			Weight (kg)
INLETxOUTLET	INLET	A	B	C	
4(100)	150	419	217	297	22
6(150)	150	526	283	363	30
8(200)	150	640	305	444	55
12(300)	150	889	415	533	115

Specifications

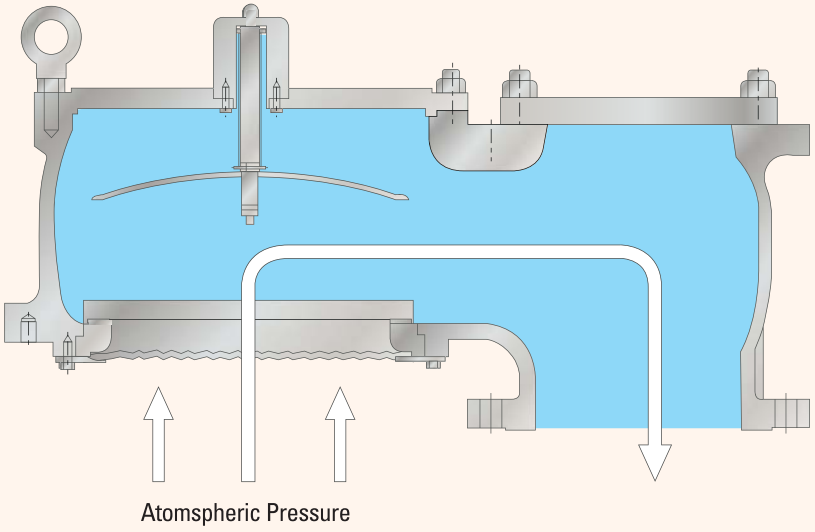
Description	Technical Specification			
Standard Vacuum Setting	[-2.2 mbarg] $\{\frac{1}{2}$ oz / in$^2\}$			
Vacuum Set Pressure Range	-2.2 to -6.6 mbarg $\{\frac{1}{2}$ oz/in^2 or $1\frac{1}{2}$ oz/in^2 Vacuum$\}$			
Maximum Positive Pressure	4 inch	6 inch	8 inch	12 inch
	5.86barg [85psig]	2.55barg [37psig]	4.48barg [65psig]	3.03barg [44psig]
Temp. Range	Ambient to 300°F [Ambient to 149°C]			
Service	Air (Vapor), Gas			

HVB-DW SERIES



Valve Closed

The valve is closed when internal tank pressure is positive conditions.

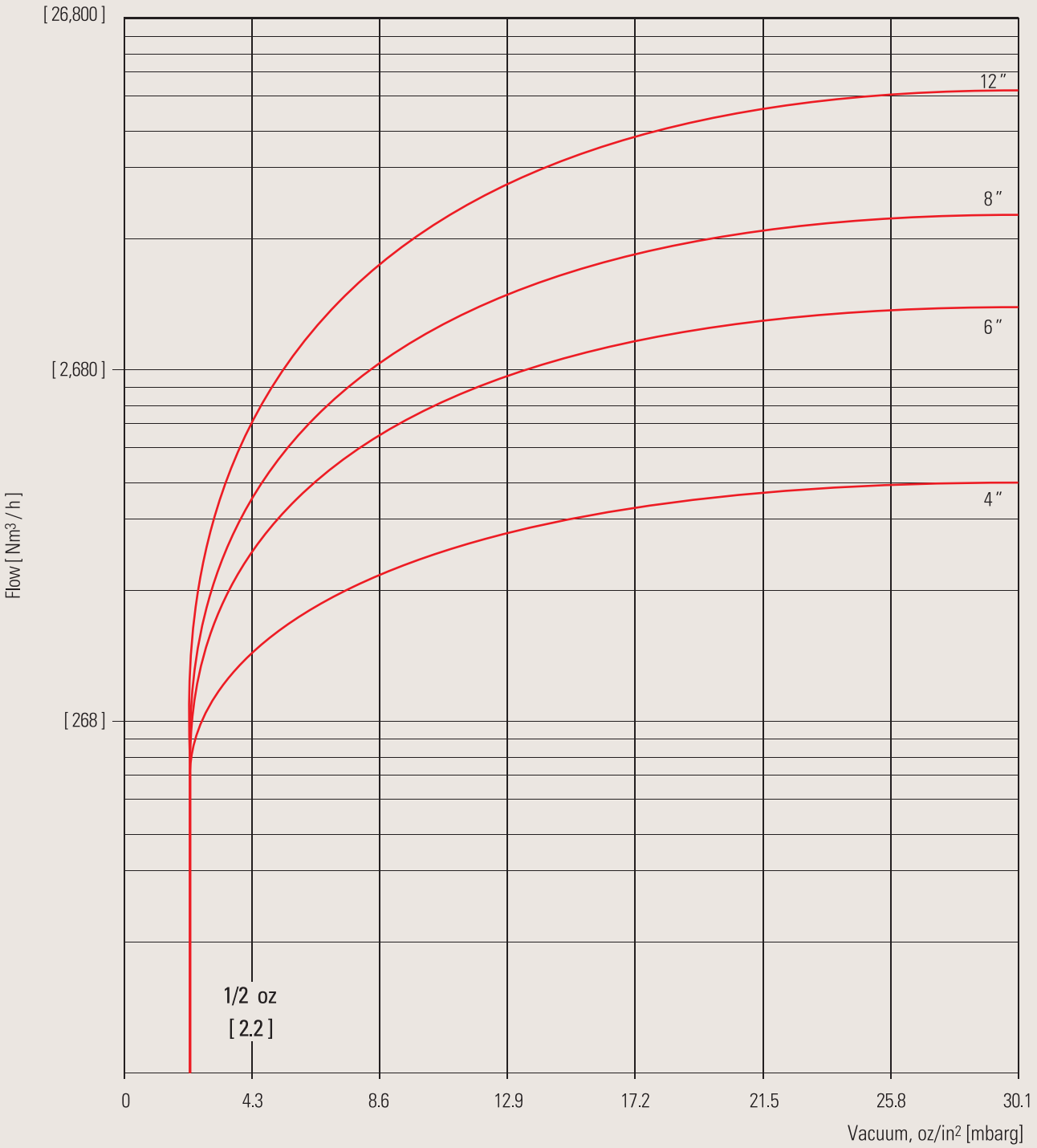


Valve Open

The valve is opening when internal tank pressure is vacuum set and negative conditions.

VACUUM BREAKER

Capacity Curve



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