ANDERSON GREENWOOD 9300H LOW PRESSURE PILOT OPERATED RELIEF VALVE

Reduce valve size and cost with the highest capacity available for liquefied gas carriers; an evolution of more than 50 years' experience in marine applications from both the Anderson Greenwood (AGCO) and Luceat brands

FEATURES

- Highest flow available on the market enables the use of smaller valves for the same required capacity.
- Simple self-guiding seat design allows for repeatable seat tightness.
- Main diaphragm protected from flow impact during discharge.
- Robust and low profile design for violent motion at sea.
- Separate nozzle ring set high in valve body, protected from condensates and particulates. Approval from marine process classification societies.
- Approval from prominent classification societies.
- Marine industry accessories and options such as auxiliary setters and field test connections available.
- Backed by engineering expertise in the development of custom solutions.
- Based on the robust design of the field-tested 9300 Series.

GENERAL APPLICATION

The 9300H is a pilot operated relief valve designed to provide reliable pressure and/or vacuum protection for marine liquefied gas carriers.

TECHNICAL DATA

Body material:	CF8M stainless steel
Sizes:	2" x 3" to 12" x 16" (DN 50 x 80 to 300 x 400)
Temperature range:	-320° to 200°F (-196° to 93°C)
Pressure range:	4 in. w.c. to 10 psig (10 mbar to 685 mbarg)
Vacuum range:	2.5 in. w.c. to 5 psig (7.5 mbarg to 340 mbarg)

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MARINE INDUSTRY SPECIFIC REQUIREMENTS/ADVANTAGES

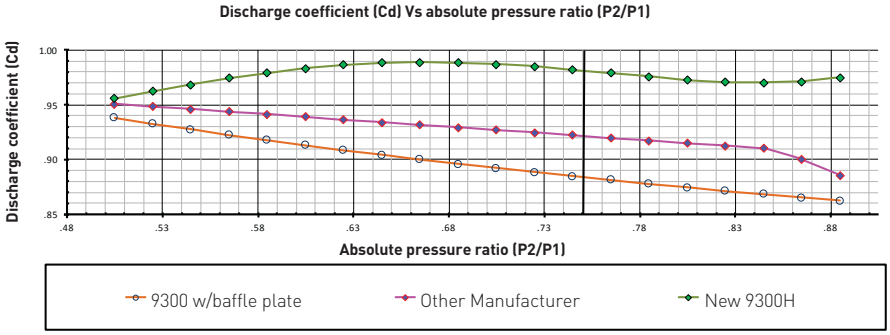
Marine industry specific requirements:

The 9300H has been designed specifically to meet the technical requirements of marine-based applications.

- Certified by prominent classification societies including, Lloyd's Register (LRS), American Bureau of Shipping (ABS), Bureau Veritas (BV) and DNV GL.
- Service support around the world, including commissioning at start up and service expertise over valve life cycle.
- Engineering support during front-end of design process, with drawings and technical information available for consultation.
- Pilot valve mounted directly to main valve cap means low clearances and low center of gravity, ensuring exceptional, repeatable performance at sea.
- Marine pilot valve accessories including auxiliary setters, field test connections, and remote valve monitoring is readily available.
- Backed by over 50 years of experience in the marine industry.

Advantages

- Unparalleled capacity allows the specification of smaller and fewer valves for a given application reducing installation costs. Allows the specification of smaller valves for the same capacity, providing highest value and minimizing other installation costs such as inlet piping size (up to 80% more than previous generations).
- Valve diaphragm is protected when the valve is open eliminating the need for a costly diaphragm sheild, reducing condensate formation and simplifying valve maintenance.
- Separate nozzle ring allows bubble tight seat tightness even in rough condition with significant valve body piping stresses
- Valve seat is positioned high in the body protecting the soft goods from condensate, debris and freezing.
- Valve disc integrated into the diaphragm, ensuring proper alignment over the valve's life cycle.
- GORETEX insert utilized in seat design to provide additional cushion, providing the tightest seal possible for long term usage.
- Diaphragms tested beyond 100,000 cycles, ensuring reliable performance over time.



In subsonic flow applications the difference between the inlet pressure and the outlet pressure is extremely important when calculating flow. In many valve designs, inefficiencies in the flow path can reduce the flow coefficient as the pressure ratio increases. The 9300H is designed to maintain an industry leading flow coefficient throughout a relief event over the valve's entire pressure range.

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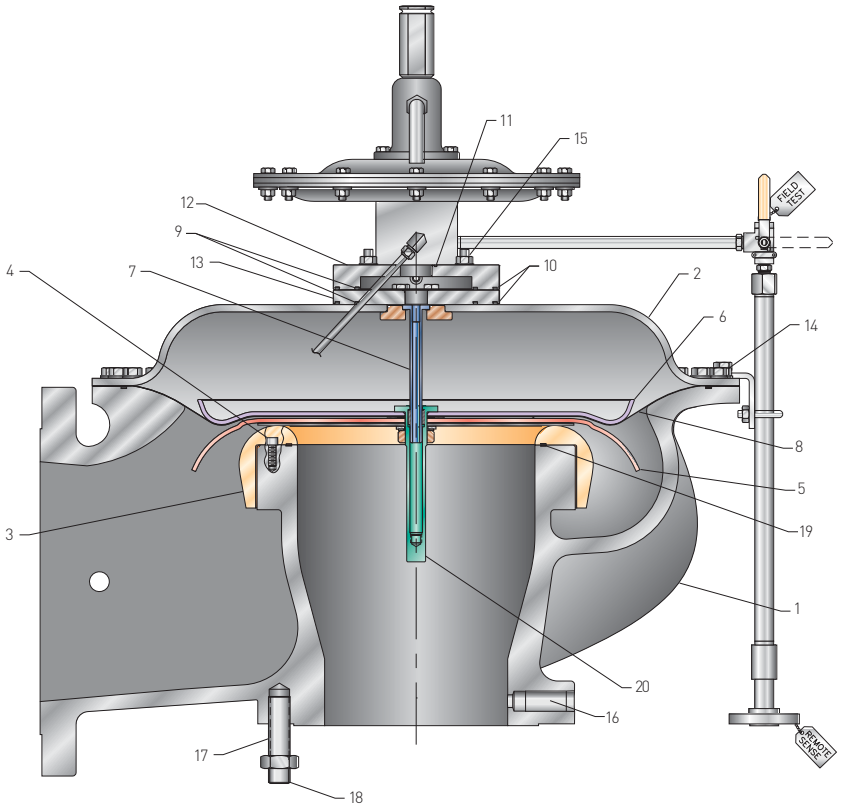
MATERIAL SPECIFICATION - MAIN VALVE



MATERIAL SPECIFICATION - MAIN VALVE

Item	Description	Material
1	Body	SST SA 351-CF8M
2	Cap	SST A240 316/316L
3	Nozzle ring	SST SA 351-CF8M
4	Screw - socket head cap	SST SA193-B8M
5	Plate seat	SST A240 316/316L
6	Plate blousing	SST A240 316/316L
7	Rod-guide	SST A479-316/316L, SST 17-4PH
8	Diaphragm	PFA
9	O-ring	PFA
10	O-ring	Nitrile
11	O-ring	PFA
12	Pilot upper mounting plate[1]	SST A479-316L
13	Pilot lower mounting plate	SST A479-316L
14	Bolt - hex cap	SST SA193-B8M
15	Washer - lock	SST 316
16	Plug - pipe	SST
17	Stud	SST SA193-B8M
18	Nut - hex	SST SA194-8M
19	Nozzle seal	PTFE
20	Guide Collar	SST A479-316L

NOTE

1. Assembled with pilot valve.

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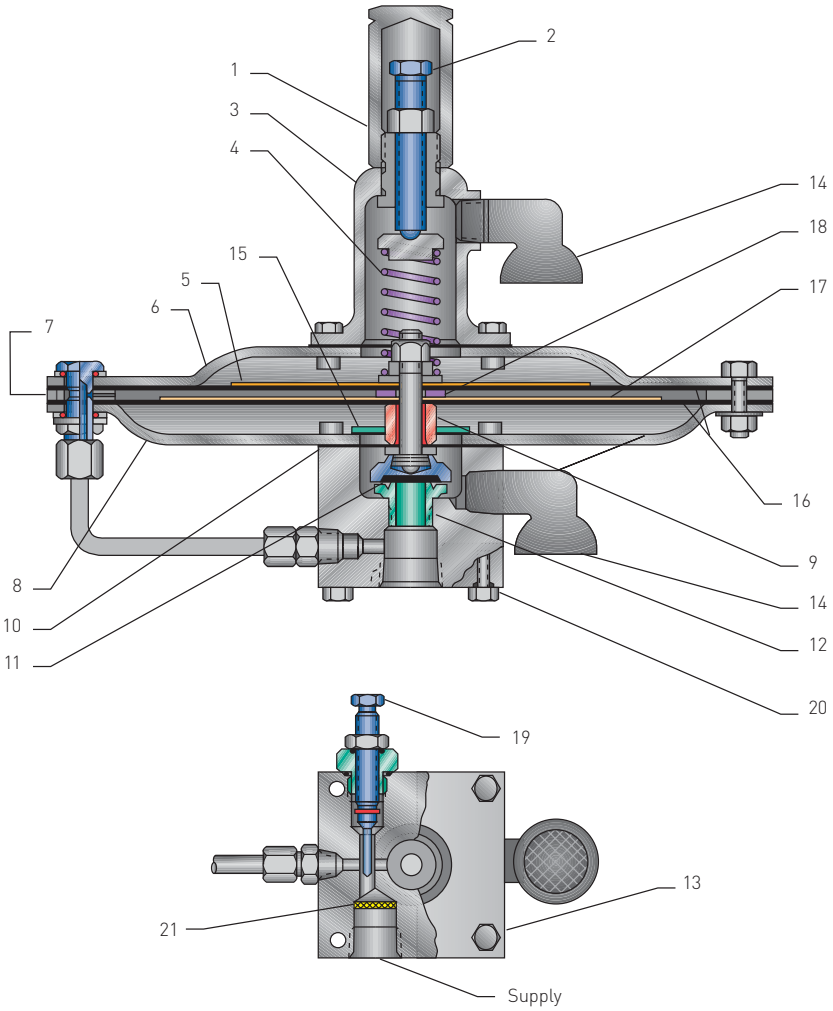
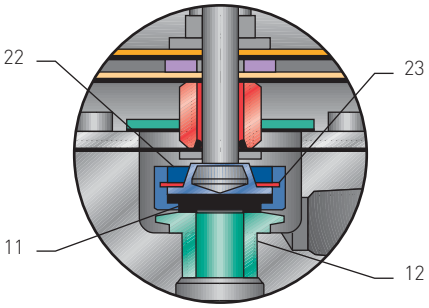
MATERIAL SPECIFICATION - PILOT VALVE



VIEW A-A



MATERIAL SPECIFICATION - PILOT VALVE

Item	Description	Material
1	Cap	SST 316
2	Pressure adjustment bolt	SST 17-4/ SS 316
3	Bonnet	SST A351-CF8M
4	Spring	SST
5	Sense plate	SST 302/304/316
6	Upper case	SST 316
7	Spacer ring	SST 316
8	Lower case	SST 316
9	Boost spacer	SST 316
10	Spindle diaphragm	PTFE
11	Seat	PTFE
12	Nozzle	SST A351-CF8M
13	Body	SST 316/316L
14	Vent	SST 316
15	Check plate	SST 304/316
16	Diaphragms	PTFE
17	Boost plate	SST 302/304/316
18	Sense spacer	SST 316
19	Needle	SST 316
20	Body bolt seal	PTFE
21	Filter screen	SST 316
22	Seat retainer	SST 304/316
23	Retainer ring	SST PH15-7M0
24	Nuts/bolts/tubing	SST 18-8/316

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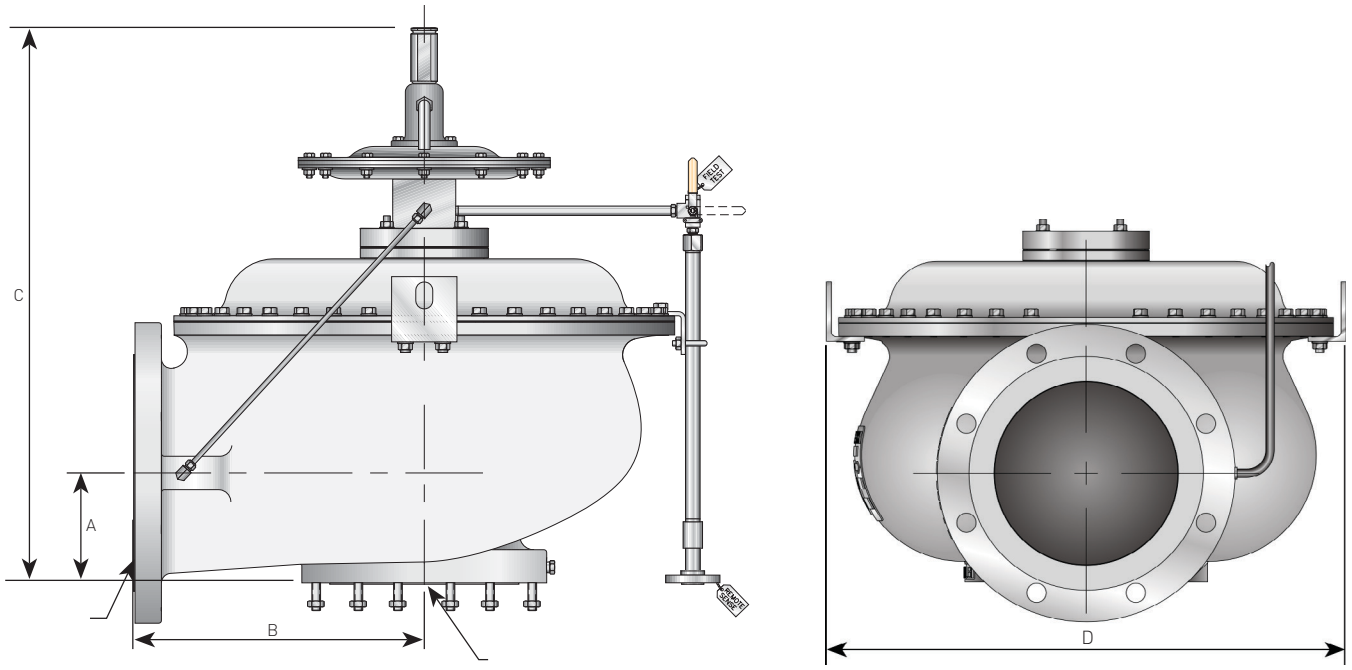
DIMENSIONS AND WEIGHTS



DIMENSIONS AND WEIGHTS

	Dimensions, in (mm)				
Valve size, in (DN)	**'A'**	**'B'**	**'C'**	**'D'**	**Weight, lbs (kg)**
2 x 3 (50 x 80)	2.8 (67)	6.0 (152)	19.5 (496)	9.7 (246)	91 (40)
3 x 4 (80 x 100)	3.5 (89)	8.4 (213)	21.6 (549)	14.4 (367)	131 (57)
4 x 6 (100 x 150)	4.5 (114)	10.8 (273)	23.8 (603)	19.9 (505)	202 (88)
6 x 6 (150 x 150)	5.0 (127)	13.6 (344)	28.2 (716)	25.0 (635)	390 (170)
6 x 8 (150 x 200)	5.0 (127)	13.1 (332)	27.4 (697)	25.0 (635)	406 (177)
8 x 10 (200 x 250)	6.8 (171)	17.3 (438)	32.4 (822)	33.0 (838)	745 (324)
10 x 12 (250 x 300)	7.3 (185)	20.0 (508)	36.3 (921)	39.9 (1013)	1138 (495)
12 x 16 (300 x 400)	9.3 (235)	24.1 (611)	41.0 (1042)	45.0 (1142)	1905 (829)

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PRESSURE/VACUUM SETTINGS AND SIZING

PRESSURE/VACUUM SETTINGS

	Vacuum settings (piloted)				Vacuum setting (weight loaded)		Pressure settings (piloted)			
	LP internals		HP internals		LP internals	HP internals	LP internals		HP internals	
Size, in	Min set (wc)	Max set (psig)	Min set (wc)	Max set (psig)	Full lift (wc)	Full lift (wc)	Min set (wc)	Max set (psig)	Min set (wc)	Max set (psig)
2" x 3"	-	-	9.0	5.0	-	9.0	-	-	12.0	10.0
3" x 4"	4.0	5.0	6.0	5.0	4.0	6.0	4.0	10.0	5.0	10.0
4" x 6"	4.0	5.0	6.0	5.0	4.0	6.0	4.0	10.0	10.0	10.0
6" x 6"	4.0	5.0	10.0	5.0	4.0	10.0	4.0	10.0	12.0	10.0
6" x 8"	4.0	5.0	10.0	5.0	4.0	10.0	4.0	10.0	12.0	10.0
8" x 10"	4.0	5.0	11.0	5.0	4.0	12.0	4.0	10.0	12.0	10.0
10" x 12"	4.0	5.0	12.0	5.0	4.0	12.0	4.0	10.0	12.0	10.0
12" x 16"	4.0	5.0	10.0	5.0	4.0	10.0	4.0	10.0	16.0	10.0

PRESSURE/VACUUM SETTINGS

	Vacuum settings (piloted) (mbarg)				Vacuum settings (weight loaded) (mbarg)		Pressure settings (piloted) (mbarg)			
	LP internals		HP internals		LP internals	HP internals	LP internals		HP internals	
Size, in	Min set	Max set	Min set	Max set	Full lift	Full lift	Min set	Max set	Min set	Max set
2" x 3"	-	-	22	345	-	22	-	-	30	690
3" x 4"	10	345	15	345	10	15	10	690	12	690
4" x 6"	10	345	15	345	10	15	10	690	25	690
6" x 6"	10	345	25	345	10	25	10	690	30	690
6" x 8"	10	345	25	345	10	25	10	690	30	690
8" x 10"	10	345	27	345	10	30	10	690	30	690
10" x 12"	10	345	30	345	10	30	10	690	30	690
12" x 16"	10	345	25	345	10	25	10	690	40	690

SIZING

COEFFICIENTS OF DISCHARGE

Connection size, in (DN)	K_d Equation (where x equals P2/P1)	P2/P1 application interval	Min K_d	Max K_d
2 x 3 (50 x 80)	$K_d = -1.24x^4 + 2.79x^3 - 2.19x^2 + 0.85x + 0.78$	.498<P2/P1<.989	0.93	0.99
3 x 4 (80 x 100)	$K_d = 7.32x^4 - 23.82x^3 + 27.98x^2 - 13.96x + 3.47$	.498<P2/P1<.975	0.96	1.00
4 x 6 (100 x 150)	$K_d = -4.66x^4 + 5.80x^3 + 2.28x^2 - 4.55x + 2.20$	.498<P2/P1<.995	0.93	1.00
6 x 6 (150 x 150)	$K_d = 11.45x^4 - 35.76x^3 + 40.794x^2 - 20.06x + 4.36$	.498<P2/P1<.995	0.77	0.80
6 x 8 (150 x 200)	$K_d = 9.18x^4 - 31.24x^3 + 38.06x^2 - 19.48x + 4.51$	.498<P2/P1<.995	0.95	1.00
8 x 10 (200 x 250)	$K_d = 22.65x^4 - 69.98x^3 + 79.12x^2 - 38.53x + 7.76$	.498<P2/P1<.995	0.94	1.00
10 x 12 (250 x 300)	$K_d = -23.59x^4 + 78.26x^3 - 96.55x^2 + 52.41x - 9.61$	.595<P2/P1<.995	0.92	0.94
12 x 16 (300 x 400)	$K_d = 15.36x^4 - 45.21x^3 + 48.46x^2 - 22.28x + 4.65$	.460<P2/P1<.995	0.94	0.99

Where x equals the absolute pressure ratio of P2/P1

P2 = absolute pressure at valve outlet

P1 = absolute pressure at valve inlet

ORIFICE AREA

Size, in (DN)	in^2	cm^2
2 x 3 (50 x 80)	3.65	23.6
3 x 4 (80 x 100)	8.35	53.9
4 x 6 (100 x 150)	14.25	92.0
6 x 6 (150 x 150)	31.74	204.8
6 x 8 (150 x 200)	31.74	204.8
8 x 10 (200 x 250)	54.48	351.5
10 x 12 (250 x 300)	85.28	550.2
12 x 16 (300 x 400)	120.57	777.9

The 9300H flow K_d equations were derived from testing performed at the National Board certified Emerson flow test lab in El Campo, Texas and witnessed by several leading marine classification societies. K_d curves were derived from testing performed on each different size valve.

ACCESSORIES

Auxiliary setters
Auxiliary setters allow the primary pilot to be set easily to a second or third set pressure where it is desirable to have different set pressures when under different jurisdictions or when a ship is in port.

Backflow preventer
The backflow preventer prevents a pilot operated pressure relief valve from reverse flow when sufficient vacuum is present at the inlet flange. The backflow preventer also prevents reverse flow when the pressure at the outlet flange (superimposed back pressure) is greater than the current system pressure.

Differential pressure switch
A differential pressure switch acts as a lift indicator for pilot operated valves that are applied at low pressures. Indicates to the user when the valve has lifted.

Field test connection
All 9300H Marine valves come equipped with a connection that allows the user to test the pilot valve functionality while the valve is in line.

Pilot valve discharge to main valve outlet
Minimizes excess emissions by routing the pilot valve discharge to the valve's outlet to be recovered downstream.

SERVICE

In addition to the supply of Emerson's industry-leading valves, our services include the repair of valves installed on liquefied gas carriers around the world. This is provided by Emerson Service, a global network of service centers. We understand that project needs may differ depending on the type of end-user, shipbuilder and location. Accordingly, we offer a wide variety of options to take advantage of Emerson Service.

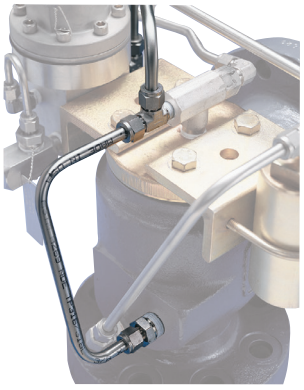
These include:
- Attendance of vessels in dry dock for maintenance and repair.
- Commissioning of installation.
- Provision of spare valves as well as technicians for overhauls.
- Extensive database management of spare valves and parts.
- Engineering expertise with a wealth of experience in marine applications.
- Soft good kits available.

AUXILIARY SETTERS

BACKFLOW PREVENTER

FIELD TEST CONNECTION

PILOT EXHAUST TUBED TO MAIN VALVE OUTLET (PEMVO)



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SELECTION

SELECTION GUIDE

Example:	93	9	0	H	P	02	R	S	TT	L	R	M	-
Series													
93 9300H Series low pressure pilot													
Pressure pilot													
9 90 Series pilot													
Vacuum pilot													
0 None													
Capacity													
H High flow capacity design													
Configuration													
P Pressure only													
C Combination pressure/vacuum													
Size													
02 2" x 3"													
03 3" x 4"													
04 4" x 6"													
66 6" x 6"													
06 6" x 8"													
08 8" x 10"													
10 10" x 12"													
12 12" x 16"													
Flange face													
R Raised face													
Body material													
S Stainless steel													
Pilot internals													
TT PTFE diaphragms and seals													
Internals setting													
L Low pressure stainless													
H High pressure stainless													
Pressure sensing													
R Remote													
H Remote ½" 150#													
W Remote 1" 150#													
N Internal													
Pilot exhaust													
M Exhaust to main valve outlet													

Accessories (optional)

A1 FTC: 3 way ball valve with lock
A2 FTC: 3 way ball valve
A3 FTC: hand valve and check valve
B Manual blowdown
D Auxiliary filter
E Remote blowdown
G Back flow preventer
H1 1 x auxiliary setting
H2 2 x auxiliary settings
I DP switch- remote lift indicator