Safety Relief Valve Brochure

UTILITY SOLUTIONS GROUP

Introduction

Safety Relief Valve Purpose

Safe practice in the transmission, distribution, and utilization of gas requires a device to limit line pressure to a predetermined safe maximum. This prevents over-pressurizing the system. Mechanical failure, accidents, and foreign material in the lines may render other types of safeguards inoperative and cause a dangerous over-pressurization of the system.

Leaking bypass valves occasionally will permit pressure to build during off-peak hours. Pressure regulators with damaged valves or seats are not able to effectively shut off when required, thereby permitting a possibly dangerous over-pressurization condition.

The most effective safeguard is a device which opens as necessary and discharge to atmosphere enough of the excess to maintain safe pressures within the system.

The most positive and commonly used device is a mechanical relief valve, correctly installed at a safe dispersal point and set to discharge to atmosphere when line pressure exceeds a predetermined set-point. Relief valves are easily installed, economical, and provide a large relieving capacity. They automatically close when the pressure returns to normal. Often a small relief valve can be used advantageously alongside larger relief valves. The smaller relief valve can be set for a lower discharge pressure. This alleviates minor pressure fluctuations without venting a large amount of gas through the larger relief valve.

Operation

Operation of Utility Solutions Group Relief Valves are effective and simple. They are normally installed in a vertical line with the outlet connected to a rigid discharge stack, with a suitable protective cap. A soft-seated valve is exposed to line pressure and under normal conditions is held tightly closed by the force exerted by spring weight. When line pressures increase sufficiently to overcome the spring weight closing force, the relief valve opens to discharge gas. The relief valve automatically closes after pressure returns to normal.

Selection of Type

Relief pressure and capacity requirements will largely determine which relief valve type to use. Maximum pressures, relief ranges, capacities, ease of adjustment, tamper protection, and price may all dictate relief valve selection. For example, the 257S requires a pressure buildup to achieve maximum capacity. The 250 Relief Valves offer capacity and pressure buildups (as noted on Pages 9 through 12 of this bulletin) and interchangeability of parts between spring and dead-weight models.

These are some of the considerations when selecting the type of relief valve best suited for each application.

Selection of Size

Several factors must be considered in sizing a relief valve.

1. **Initial Relief Pressure**

   (Pc) when the valve first permits flow. To conserve gas, it should be higher than normal operating pressures. For distribution use, it is usually 12 to 16 ounces. At higher operating pressures, the gap between normal and initial relief pressure can be greater.

2. **Maximum Blowing Pressure**

   (Pm) the highest permissible pressure to which the line pressure may increase, which largely determines valve capacity. After initial opening, a further increase in pres- sure is required for full valve travel.

3. **Discharge Capacity of Relief Valve**

   At maximum blowing pressure See capacity tables, which give discharge in CFH of standard gas. When the allowable increase is a greater percentage than shown in the capacity table, use the flow capacity shown for the actual maximum blowing pressure.

4. **Relief Volume Required**

   Must be determined from system layout, inlet pressures, regulator capacities, minimum load and other operating conditions. A relief valve, operating at a low differential, obviously would be unable to discharge the total flow of an equal size regulator operating at a high differential, if the regulator failed wide open. In this connection it is important to analyze the operating characteristics of the regulator used.

   In some regulators, diaphragm failure will not result in wide open flow; nor can a valve drop wide open It is also very important that pressure regulators be correctly sized to suit load conditions. In this way, relief volume requirements can be greatly reduced.

   In some situations the safety valve may be required to relieve only the leakage through faulty regulator valves in the closed position or leaking bypass valves. In this instance the capacity of a safety valve of the same nominal pipe size as the outlet line would be adequate.

   Where full capacity relief is required, the capacity of the regulator must be determined using the maximum expected inlet pressure. That volume would be the required discharge capacity of the safety valve less any minimum load, assuming the regulator failed wide open.

How to Order

Specify

1. Model Number and Size
2. Connections
3. Initial Relief Pressure (Pc)
4. Maximum Blowing Pressure (Pm)
5. Discharge Capacity (SCFH)
6. Type of Gas (natural, propane, etc.)

Maximum Emergency Pressures

The maximum pressure the relief valve inlet may be subjected to under abnormal conditions without causing damage to the internal parts of the relief valve is set-point plus buildup (Maximum Blowing Pressure). Contact Utility Solutions Group for information on determining the maximum blowing pressure.

Set-point is defined as the relief pressure at which the relief valve is adjusted to open.

If the above pressure limit is exceeded, the relief valve must be taken out of service and inspected. Damaged or otherwise unsatisfactory parts must be repaired or replaced.

The maximum pressure that can be safely contained by the diaphragm case of all relief valves: – 175 psi. Safely contained means no leakage as well as no bursting.

CAUTION

Before using any of the above data, make sure this entire section is clearly understood.

The relief valve is very often the final protection for the downstream system and it is therefore very important that the worst failure condition be considered for proper sizing of the relief valve.

Capacities at Other Pressures

Capacity for pressure reductions not listed in the table can be calculated with the following formula:

$Q = K\sqrt{P_o(P_i - P_o)}$ ..... (for P_i/P_o less than 1.894)

$Q = \frac{K P_i}{2}$ ..... (for P_i/P_o less than 1.894)

Q = Maximum capacity of regulator, in SCFH of 0.6 specific gravity natural gas

K = the "K" factor, the regulator constant (see table below)

P_i = absolute inlet pressure (psi)

P_o = absolute outlet pressure (psi)

Periodic Inspection

Relief valves are pressure control devices with moving parts subject to wear that is dependent upon particular operating conditions. To assure continuous satisfactory operation, a periodic inspection schedule must be adhered to with the frequency of inspection determined by the severity of service and applicable laws and regulations.

Metrication

Use the following for metric conversions:

std. meters^3/hr. × 35.31 = std. ft.^{3}/hr. (SCFH) std. ft.^{3}/hr.(SCFH) × 0.0283 = std. meters^3/hr.
kilograms/centimeter^2 (kg/cm2) × 14.22 = psi psi × 0.0703 = kilograms/centimeter2 (kg/cm^2)
kilopascals (kPa) × 0.145 = psi psi × 6.90 = kilopascals (kPa)
bars × 14.50 = psi psi × .069 = bars
millimeters water (mm H_2O) × .0394 = in. w.c. in. w.c. × 25.4 = millimeters water (mm H_2O)
millimeters mercury (mm Hg) × 0.535 = in. w.c. in. w.c. × 1.868 = millimeters mercury (mm Hg)

Temperature Limits

Relief valves may be used for flowing gas temperatures from -20°F to 150°F.

Buried Service

Relief valves are not recommended for buried service.

Other Gas

Relief valves are mainly used on natural gas. However, they perform equally well on LP gas, nitrogen, dry CO^2, air and others.

Type of Gas	Correction Factor
Air (Specific Gravity 1.0)	0.77
Propane (Specific Gravity 1.53)	0.63
1350 BTU Propane-Air Mix (Specific Gravity 1.20)	0.71
Nitrogen (Specific Gravity 0.97)	0.79
Dry Carbon Dioxide (Specific Gravity 1.52)	0.63

For other non-corrosive gases, use the following formula:

$$\text{Correction factor} = \sqrt{\frac{0.60}{\text{Specific gravity of the gas}}}$$

Model 257S Safety Relief Valve

LARGE CAPACITY FOR

- Gas Distribution Systems
- Metering Sets
- Industrial Applications

HORIZONTAL OR VERTICAL PIPING

- Install as shown in horizontal pipe or sideways in vertical pipe.

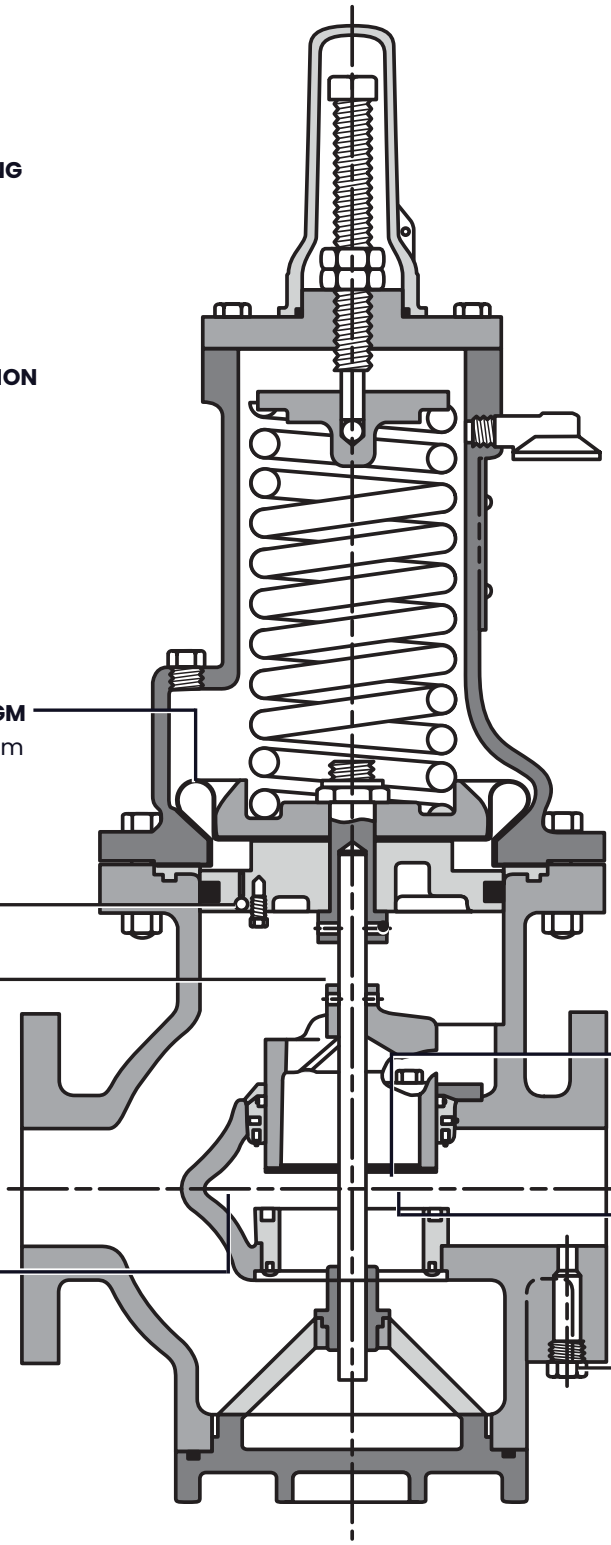
Note: Horizontal mounting is recommended.

HEAVY DUTY IRON CONSTRUCTION

- Weatherproof
- Watertight
- Indoor or Outdoor

MATERIALS OF CONSTRUCTION

Component	Material
Body	Cast Iron (ASTM A 126 Class B)
Diaphragm Case	Cast Iron (ASTM A 126 Class B)
Spring Housing	Cast Iron (ASTM A 126 Class B)
Housing Cover (Spring Cage Cap)	Steel
Upper Diaphragm Plate	Aluminum
Diaphragm	Buna-N with Dacron Reinforcement
O-Ring Piston	Cast Iron
Diaphragm Stud	Steel
Valve Stem	Stainless Steel
Stem Bushing	Stainless Steel
Valve	Steel
Valve Sleeve	Aluminum (Teflon Coated)
Valve Sleeve Guide	Steel with Low Friction Insert
Valve Soft Seat	Puly-U



PATENTED ROLL-OUT DIAPHRAGM

- Maximum relief with minimum pressure build up.
- Accurate repeatability

PATENTED BALL CHECK DIAPHRAGM SENTRY

TEST PLUG ON INLET

DRAIN PLUG ON OUTLET

- for vertical piping

POLY-U MOLDED SOFT SEAT

- Tight seat and re-seat

PATENTED DOUBLE-PORT SINGLE SEAT VALVE

- Large capacity

DRAIN PLUG ON OUTLET

- for horizontal piping

Pipe Sizes 2", 3", and 4"

Flanged ANSI 125 lb. FF (Flat Faced)
(Maximum working pressure 175 psi)

Pressure Relief Range

2 to 100 psi

Roll-Out Diaphragm

The Model 257S is a unique safety relief valve. It features the same Roll-Out Diaphragm principle that has achieved such remarkable success in the widely used 441-57S and 461-57S Regulators.

The Roll-Out Diaphragm is a combination of strength and flexibility in which diaphragm action is constantly matched with spring action. The result is a major advance in relief valve performance.

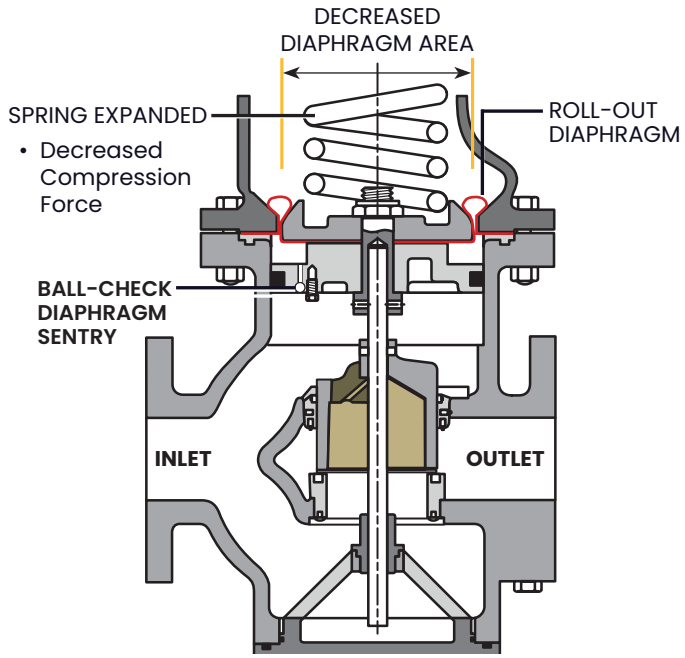
It takes a pressure buildup to open the 257S wide for maximum relief capacity. Conventional spring type relief valves require large increases in pressure to open wide – whereas the Roll-Out Diaphragm fully opens the 257S with only a small increase above the set-point.

In addition it closes with minimum "blow down" when pressure returns to normal. The 257S is versatile offers excellent repeatability – use it for any relief pressure between 2 and 100 psi.

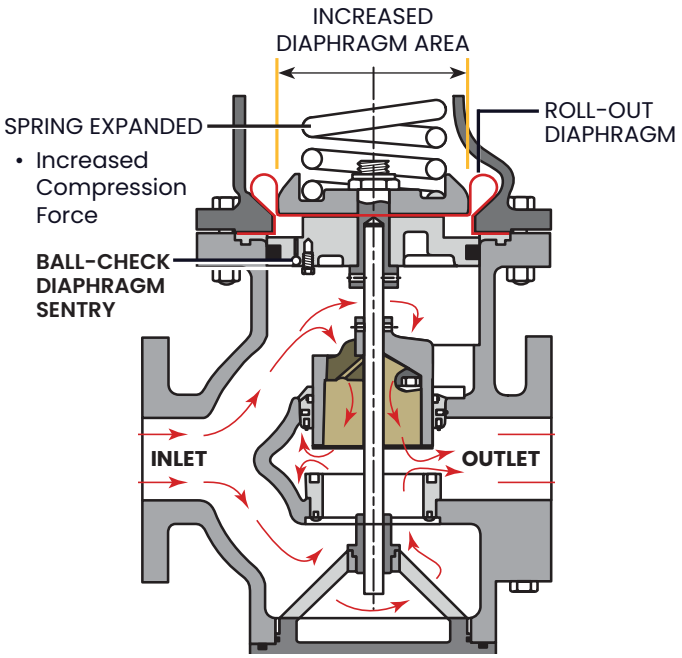
Double-Port Soft Seat is a unique design that offers:

- Large Capacity
- Tight Seat and Re-seat
- Easy Servicing
- Sturdy Construction
- No Adjustments

The drawings below show how this relief valve works.



VALVE CLOSED

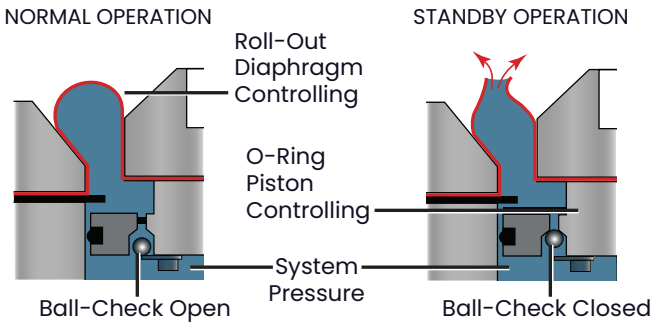


VALVE CLOSED

Ball-Check Diaphragm Sentry

This feature maintains relief protection if something should cause a failure in the diaphragm. Sentry operation is illustrated by the two small sketches. Normally, the ball is open for unobstructed passage of pressure to the Roll-Out Diaphragm. The O-Ring piston normally serves as a guide to maintain correct diaphragm alignment. In the event of diaphragm failure, the ball check is immediately closed by the escaping gas. This traps the gas beneath the piston which then becomes a substitute for the diaphragm to maintain operation.

The set-point (Pc) with the piston is approximately 70% normal. This has two advantages. In the average installation it causes the 257S to open partly and thereby give a warning. In addition, it makes the wide-open pressure (Pm) approximately the same for sentry as for normal operation so there is no sacrifice in protection.



Relief Pressure Adjustment Range

Relief Range	Color of Spring	Part Numbers
2 to 4 psi	Yellow	091-00-021-05
4 to 8 psi	Gray	91-00-021-04
8 to 12 psi	Blue	091-00-021-03
12 to 24 psi	Red	091-00-021-02
24 to 48 psi	Brown	091-00-021-01
48 to 65 psi	Black	091-00-021-00
65 to 100 psi	White spring is nested inside of black	091-00-021-00 091-00-021-08

Note: Do not exceed maximum pressure of each spring.

Discharge Capacity in 1000 SCFH of Natural Gas

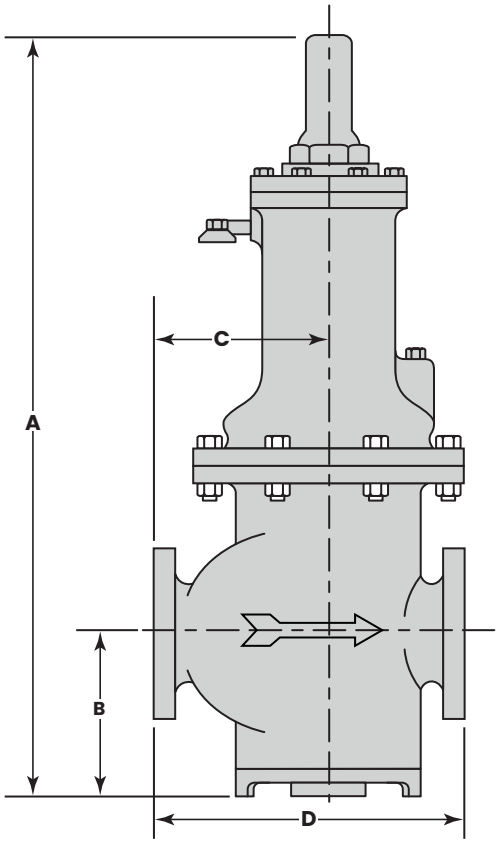
(0.6 Specific Gravity – 14.65 psi -60°F)

Relief Blowing Pressure PSI Pi	2" Pipe Size	3" Pipe Size	4" Pipe Size
2	30	54	92
3	37	66	112
4	43	77	130
5	48	86	145
10	67	121	205
15	82	148	251
20	96	174	294
25	110	199	337
30	124	224	380
40	152	275	465
50	180	325	551
60	208	376	636
70	236	426	772
80	264	477	807
90	292	527	893
100	320	578	978
K	5,600	10,100	17,100

For best results when utilizing stack piping, contact Utility Solutions Group for capacity and sizing. Sizing the relief valve closer than +/- 12% could cause the actual maximum relief valve blowing pressure to exceed the calculated maximum due to spring rate, K factors, and part tolerances.

Note: Capacities are based on relief valve blowing full open to atmosphere.

Dimensions



Size	A	B	C	D	Weight
2"	24 ¼"	5 ⅜"	5 ⅝"	10"	95 lbs.
3"	24 ¾"	5 ⅜"	6 ½"	11 ¾"	105 lbs.
4"	26 ½"	5 ⅞"	6 ¾"	12 ½"	125 lbs.

Model 250 Safety Relief Valves

LARGE CAPACITY
- Gas Distribution Systems
- Metering Sets
- Industrial Applications

HEAVY DUTY IRON CONSTRUCTION
- Weatherproof
- Water Tight
- Indoors or Outdoors

VERTICAL PIPING
- Install as shown in vertical line
- DO NOT mount the 250-DW or 250-S relief valve in a horizontal position

MATERIALS OF CONSTRUCTION

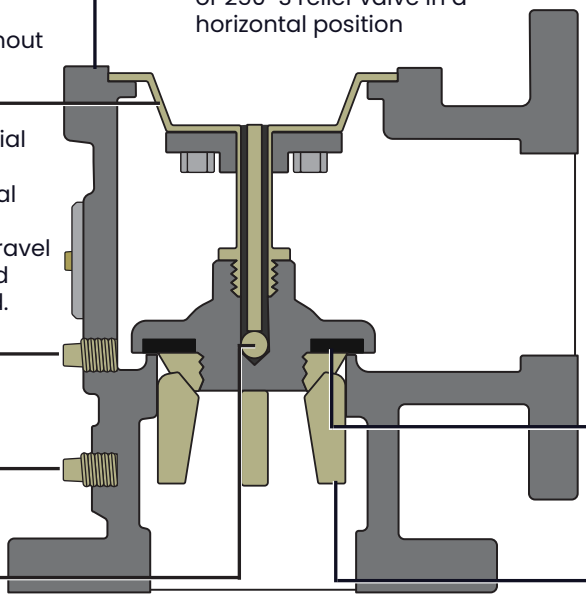
Component	Material
Body	**Cast Iron (ASTM A 126 Class B)**
Diaphragm Case	**Cast Iron (ASTM A 126 Class B)**
Spring Housing	**Cast Iron (ASTM A 126 Class B)**
Diaphragm Plate	Cast Iron
Diaphragm	Buna-N with Dacron Reinforcement
Valve Stem	Stainless Steel
Stem Bushing	Stainless Steel
Valve	Steel
Valve Disc	Buna-N
Valve Gland	Brass
Valve Wing	Brass

ANGLE TYPE BODY
- Large exit area for high flow rate
- Allows valve removal without disturbing piping

DEEP MOLDED DIAPHRAGM
- Provides maximum life after initial opening
- Diaphragm does not affect initial relief
- Without the diaphragm, value travel is 15% to 20% of its diameter and discharge capacity is restricted.

DRAIN PLUG
- For moisture which may enter through discharge stack

TEST PLUG ON INLET



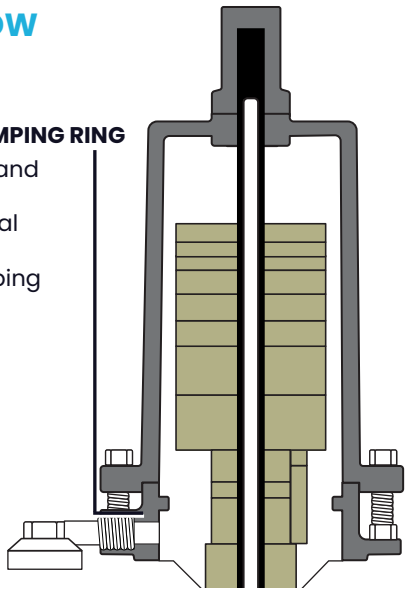
BUNA-N SOFT SEAT
- Provides tight seat and reseat
- Retained for ease of replacement

STAINLESS STEEL THRUST BEARING
- Transmits loading force to reduce friction

WING GUIDES
- Permits high valve lift and flow capacity

Model 250-DW

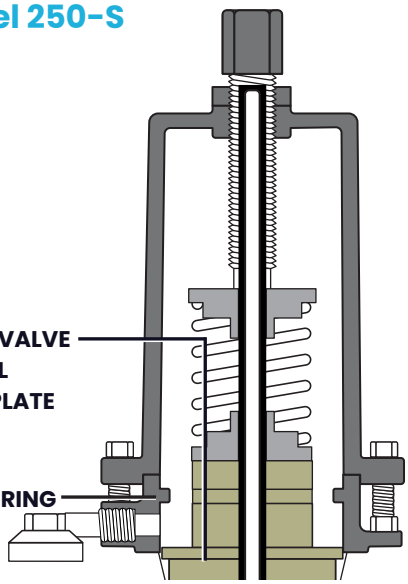
DIAPHRAGM CLAMPING RING
- Models 250-S and 250-DW
- Permits removal of top cover without disturbing diaphragm assembly



Model 250-S

RELIEF VALVE TRAVEL STOP PLATE

STOP RING



Pipe Sizes 2" – 3" – 4"

Flanged ANSI 125 lb. FF (Flat Faced)
2" Available with NPT Connections
(Maximum working pressure 175 psi)

Pressure Relief Range

8 oz to 70 psi

Model 250-DW Deadweight Loaded

Relief Pressure Adjustment Range

Size	Valve Diameter	Relief Pressure Adjustment Range	Minimum Relief Pressure Without Weights (oz)	Adjustment Weights		Maximum Number of Weights
				Size	Will Increase Relief Pressure (oz)	
2″	1 ¾″	8 oz to 6 psi	15 (8 oz special)	3" × 1" 3" × ½" 3" × ¼"	12 6 3	7 – 1"
3″	3″	8 oz to 36 oz	8	3" × 1" 3″ × ½″ 3″ × ¼″	4 2 1	7 – 1″
	2 ½″	11 oz to 50 oz	11	3″ × 1″ 3" × ½" 3" × ¼"	6 3 1.5	7 – 1″
4″	4″	8 oz to 32 oz	8	3" × ½" 3" × ¼"	1 0.5	Use these weights first, immediately above diaphragm
				3" × 1" 3" × ½" 3" × ¼"	4 2 1	6 – 1″ × 3 ¾″

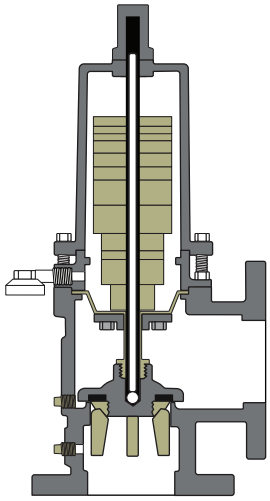
Discharge Capacity in SCFH of natural gas

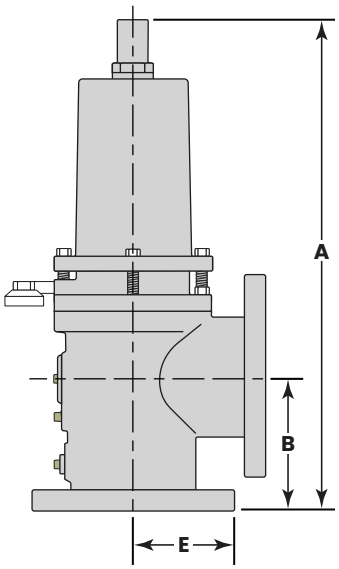
(0.6 Specific Gravity – 14.65 psi -60°F)

Allowing 25% Increase Above Initial Relief Pressure							
Pc Initial Relief Pressure		Pm Maximum Blowing Pressure Pm = 1.25 Pc		Discharge Capacity allowing pressure increase from Pc to Pm			
				2″	3″		4″
				1″ Valve Lift	1 ½″ Valve Lift		1 ¾" Valve Lift
psi	oz	psi	oz	1 ¾″ dia	3″ dia	2 ½″ dia	4″ dia
0.50	8.0	-	10	9,250	23,600	-	51,000
0.75	12.0	-	15	11,250	29,000	-	62,400
1.00	16.0	-	20	13,150	33,500	-	72,100
1.25	20.0	-	25	14,700	37,400	-	80,600
1.50	24.0	-	30	16,100	41,000	-	88,300
1.60	25.5	2	32	16,500	42,000	-	90,000
1.75	28.0	-	35	17,400	44,300	-	95,400
2.00	32.0	-	40	18,600	47,300	-	102,000
2.25	36.0	-	45	19,700	50,200	-	-
2.50	40.0	-	50	20,800	-	44,100	-
2.75	44.0	-	55	21,800	-	46,200	-
3.00	48.0	-	60	22,800	-	48,300	-
4.00	-	5.00	-	26,300	-	-	-
5.00	-	6.25	-	29,400	-	-	-
6.00	-	7.50	-	32,200	-	-	-

Discharge Capacity in SCFH of natural gas (continued)

(0.6 Specific Gravity – 14.65 psi -60°F)





Allowing 50% Increase Above Initial Relief Pressure							
Pc Initial Relief Pressure		Pm Maximum Blowing Pressure Pm = 1.5 Pc		Discharge Capacity allowing pressure increase from Pc to Pm			
				2″	3″		4″
				1″ Valve Lift	1 ½″ Valve Lift		1 ¾″ Valve Lift
psi	oz	psi	oz	1 ¾″ dia	3″ dia	2 ½″ dia	4″ dia
0.50	8.0	-	12	10,100	32,400	-	55,800
0.75	12.0	-	18	12,400	39,600	-	68,400
1.00	16.0	-	24	14,400	45,800	-	79,000
1.25	20.0	-	30	16,100	51,200	-	88,300
1.30	21.0	2.00	32	16,600	53,000	-	91,000
1.50	24.0	-	36	17,600	56,100	-	96,700
1.75	28.0	-	42	19,000	60,600	-	104,500
2.00	32.0	-	48	20,300	64,800	-	111,700
2.25	36.0	-	54	21,600	68,700	-	-
2.50	40.0	-	60	22,700	-	56,200	-
2.75	44.0	-	66	23,900	-	59,000	-
3.00	48.0	4.50	72	24,800	-	61,600	-
4.00	-	6.00	-	28,800	-	-	-
5.00	-	7.50	-	32,200	-	-	-
6.00	-	9.00	-	35,200	-	-	-

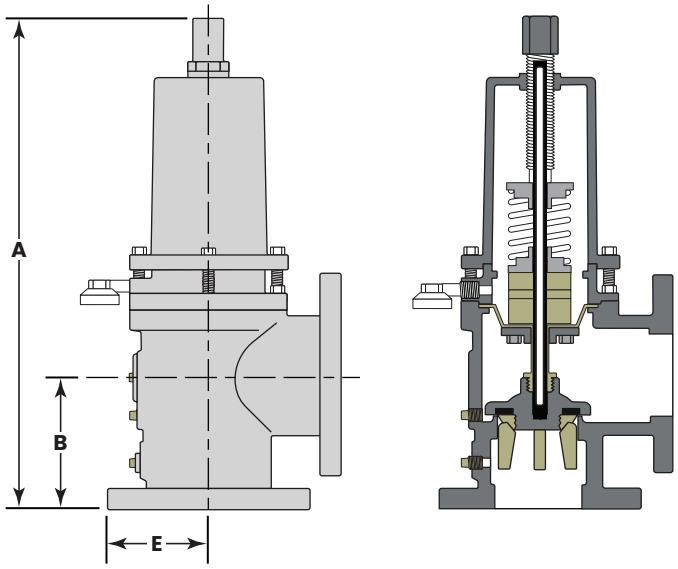
Dimensions

Size	A	B	E	Weight
2″ NPT	16 ¾″	3 ¼″	3 ¼″	30
2″ Flanged		4 ¼″	4 ¼″	40
3″	18 ¼″	5″	5″	65
4″	20″	6″	6″	110

Model 250-S Spring Loaded

Dimensions

Size	A	B	E	Weight
2" NPT	19 ½"	3 ¼"	3 ¼"	40
2" Flanged		4 ¼"	4 ¼"	40
3"	20 ¾"	5"	5"	65
4"	22 ¼"	6"	6"	65



Relief Pressure Adjustment Range

Color of Spring	Relief Pressure Adjustment Range, psi			
	2"	3"	4"	
	1 ¾" dia.	3" dia.	4" dia.	3" dia.
Aluminum	2 - 10	1 - 4	1.00 - 2.25	-
Green	10 - 16	4 - 6	2.25 - 3.50	-
Yellow	16 - 26	6 - 10	3.50 - 5.50	-
Gray	26 - 40	10 - 15	5.50 - 7.50	-
Blue	30 - 70	15 - 30	7.50 - 16.00	15 – 30

Discharge Capacity in SCFH of natural gas

(0.6 Specific Gravity – 14.65 psi -60°F)

Allowing 50% Increase Above Initial Relief Pressure				
Pc Initial Relief Pressure	Pm Maximum Blowing Pressure Pm = 1.5 Pc	Discharge Capacity allowing pressure increase from Pc to Pm		
		2"	3"	4"
		1" Valve Lift	1" Valve Lift	1 ⅛" Valve Lift
psi	psi	1 ¾" dia.	3" dia	4" dia
3	4.5	18,700	49,500	68,400
4	6.0	21,600	57,200	79,000
5	7.5	24,100	64,000	88,300
6	9.0	26,400	70,100	96,700
7	10.5	28,500	75,700	104,500
8	12.0	30,500	81,000	111,700
9	13.5	32,400	85,900	118,500
10	15.0	34,100	90,500	124,900
12	18.0	37,600	99,700	137,700
15	22.5	42,800	113,600	156,800
20	30.0	51,500	136,700	-
25	37.5	60,300	159,800	-
30	45.0	69,000	182,900	-
40	60.0	86,400	-	-

Discharge Capacity in SCFH of natural gas (continued)

(0.6 Specific Gravity – 14.65 psi -60°F)

Allowing 100% Increase Above Initial Relief Pressure				
Pc Initial Relief Pressure	Pm Maximum Blowing Pressure Pm = 2 Pc	Discharge Capacity allowing pressure increase from Pc to Pm		
		2″	3″	4″
		1″ Valve Lift	1″ Valve Lift	1 ⅛″ Valve Lift
psi	psi	1 ¾″ dia.	3″ dia	4″ dia
3	6	28,800	73,300	101,400
4	8	33,200	84,600	117,100
5	10	37,100	94,600	130,900
6	12	40,700	103,600	143,400
7	14	44,000	112,000	155,000
8	16	47,000	119,900	165,900
9	18	50,200	128,800	176,900
10	20	53,300	135,700	187,800
12	24	59,500	151,400	209,600
15	30	68,800	175,100	242,400
20	40	84,300	216,600	-
25	50	99,300	254,000	-
30	60	115,300	293,500	-
40	80	146,200	-	-

UTILITY SOLUTIONS GROUP

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