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 to prevent over pressuring the system. Mechanical failure, accidents or foreign matter in the lines may render other types of safeguards inoperative and cause a dangerous over pressuring 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 shutoff when required, thereby permitting a possibly dangerous overpressure condition.

The surest safeguard is a device which will open as necessary and discharge to atmosphere enough of the excess to maintain a safe pressure in 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. Easy to install, the relief valve offers an economical installation with large relieving capacity. It automatically closes when the pressure returns to normal. Many times a small relief valve can be used advantageously with a larger relief valve. The smaller relief valve can be set for a lower discharge pressure to take care of minor pressure fluctuations without the necessity of venting a large amount of gas to atmosphere through the larger relief valve.

Operation

The operation of Sensus Relief Valves is positive and simple. They are normally installed in a vertical line with the outlet usually 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 weights of a spring. When line pressure increases sufficiently to overcome the closing force, the relief valve opens to discharge gas. The relief valve automatically closes after pressure returns to normal.

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Selection of Type

The relief pressure and capacity requirements will largely dictate the relief valve type to use. Where relief ranges and capacities may overlap, the maximum blowing pressure, ease of adjustment, protection against tampering, and price may dictate the selection. For example, the 257S requires a pressure buildup to achieve maximum capacity (as noted in the Relief Valve Set-Point Section of Sensus Bulletin RDS-1452). The 250 Relief Valves offer capacity and pressure buildups (as noted on pages 9 and 10 of this bulletin) and interchangeability of parts between spring and deadweight models.

These are some of the considerations you should make when selecting the type of relief valve best suited for your 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 pressure 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) found at the Relief Valve Set-Point Section of Sensus Metering Systems Bulletin RDS-1452.

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 formulae:

- 1. $Q = K \sqrt{P_0(P_1 P_0)}$
- **2.** $Q = \frac{KP_1}{2}$
 - Q = maximum capacity of the regulator (in SCFH of 0.6 specific gravity natural gas)
 - K = the "K" factor, the regulator constant (from bottom of table on Page 7)
 - P₁ = **absolute** inlet pressure (psia)

P₂ = **absolute** outlet pressure (psia)

Use formula 1 when $\frac{P_1}{P_0}$ is less than 1.894

Use formula 2 when $\frac{P_1}{P}$ is greater than 1.894

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.

Temperature Limits

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

Metrication

Use the following for metric conversions:

std. meters³/hr. x 35.31 = std. ft.³/hr. (SCFH) std. ft.³/hr.(SCFH) x 0.0283 = std. meters³/hr.

kilograms/centimeter² (kg/cm²) x 14.22 = psig psig x 0.0703 = kilograms/centimeter² (kg/cm²)

kilopascals (kPa) x 0.145 = psig psig x 6.90 = kilopascals (kPa)

bars x 14.50 = psig

psig x .069 = bars

millimeters water (mm H_2O) x .0394 = in. w.c. in. w.c. x 25.4 = millimeters water (mm H_2O)

millimeters mercury (mm Hg) x 0.535 = in. w.c. in. w.c. x 1.868 = millimeters mercury (mm Hg)

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 CO₂, air and others.

Other Gases	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: Correction Factor =	$\sqrt{\frac{0.6}{\text{Specific Gavity}}}$ of the Gas



100

Materials of Construction

- Body, Diaphragm Case 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 Sleeve
 Aluminum
 (Teflon Coated)
- Valve Sleeve Guide Steel with Low Friction Insert
- Valve Steel
- Valve Soft Seat
 Poly-U

Poly-U Molded Soft Seat

Tight seat and reseat

Patented Double-Port Single Seat Valve

Large capacity

Drain Plug on Outlet

for horizontal piping

Metering Sets

Large Capacity for

Industrial Applications

Gas Distribution Systems

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
- Indoors or Outdoors

Patented Roll-Out Diaphragm

 Maximum relief with minumum pressure build up.

Inlet

Accurate repeatability

Patented Ball-Check

Diaphragm Sentry

Test Plug on Inlet

Drain Plug on Outlet

for vertical piping

Pipe Sizes 2" - 3" - 4"

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

Pressure Relief Range

Outlet

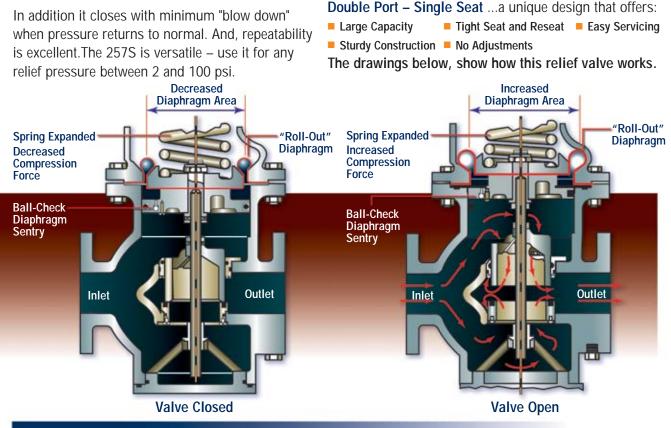


"Roll-Out" Diaphragm

The 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, as shown in the Relief Valve Set-Point Section of Sensus Metering Systems Bulletin RDS-1452.

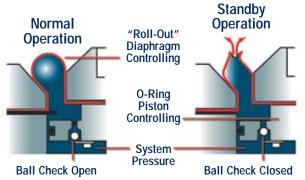


Ball-Check Diaphragm Sentry

This feature maintains relief protection if something should cause a failure in the diaphragm.

Sentry operation is illustrated by the two small sketches above. 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. Standby

The set point (Pc) with the piston is approximately 70% of 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 Rang	je
Relief Range	Color of Spring	Part Numbers
2 to 4 psi	Yellow	091-00-021-05
4 to 8 psi	Gray	091-00-021-04
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	Black with a White inner spring	091-00-021-00 091-00-021-08

Note: Do not exceed maximum pressure of each spring.

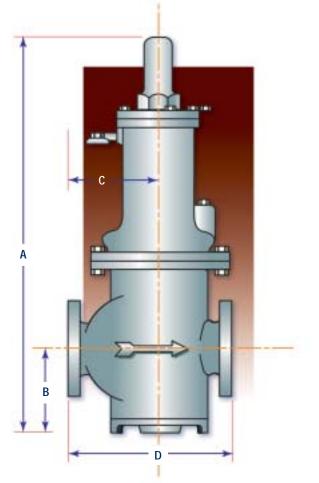
Discharge Capacity in 1000 SCFH of Natural Gas (0.6 Specific Gavity – 14.65 psia -60°F)

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
К	5600	10100	17100

For best results the capacity and sizing with stack piping should be calculated based upon the nomagrams in Sensus Meter Systems Bulletin RDS-1452. 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.

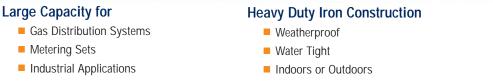




Di	mensior	IS		
Size	А	В	С	D
2"	24-1/4"	5-3/8"	5-5/8"	10"
3"	24-3/4	5-3/8"	6-1/2"	11-3/4"
4"	26-1/2"	5-7/8"	6-3/4"	12-1/2"

Weight (Ibs.)					
2"	3"	4"			
95	105	125			

Model 250 Safety Relief Valves



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

- Body, Diaphragm Clamping Spring Housing Weight Cover
 Cast Iron
 (ASTM A 12) (Class D)
 - (ASTM A 126 Class B)
- Diaphragm Plate Cast Iron
- Diaphragm
 Buna-N with Nylon
 Reinforcement
- Valve Stem Stainless Steel
- Stem Bushing Stainless Steel
- Valve Steel
- Valve Disc Buna-N
- Valve Gland Brass
- Valve Wing Brass

Buna-N Soft Seat

- Provides tight seat and reseat
- Retained for ease of replacement

Wing Guides

Permits high valve lift and flow capacity

 Transmits loading force to reduce friction

Test Plug on Inlet

Stainless Steel

Angle Type Body -

disturbing piping

initial opening

Drain Plug

Deep Molded Diaphragm

Large exit area for high flow rate

Allows valve removal without

Provides maximum life after

Diaphragm does not affect initial relief

Without the diaphragm, value travel is 15% to 20% of its diameter and

discharge capacity is restricted.

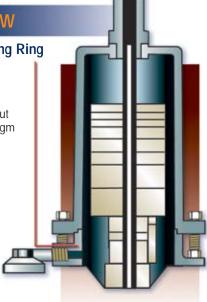
For moisture which may enter

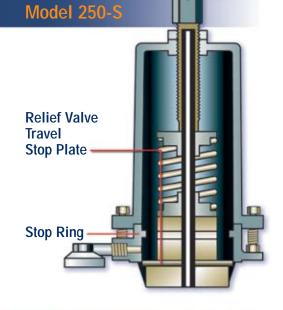
through discharge stack

Model 250-DW

Diaphragm Clamping Ring

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





Pipe Sizes 2" - 3" - 4"

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

8 oz to 70 psi

Pressure Relief Range

Model 250-DW Deadweight Loaded



Safety Relief Valves

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

Allowing 25% Increase Above Initial Relief Pressure **Discharge** Discharge Capacity allowing pressure increase from Pc to Pm Рс Pm Capacity Initial Maximum Blowing 2" 4" in SCFH of 3" **Relief Pressure** Pressure Pm = 1.25 Pc 1" valve lift 1-1/2" valve lift 1-3/4" valve lift natural gas psi 0Z psi ΟZ 1-3/4" dia 3" dia 2-1/2" dia 4" dia 3" dia (0.6 Specific Gravity 0.50 8.0 10 9,250 23,600 51,000 14.65 psia – 60°F) 0.75 12.0 11,250 62,400 15 29,000 1.00 16.0 20 13,150 33,500 72,100 20.0 25 14,700 37,400 80,600 1.25 1.50 24.0 30 16,100 41,000 88,300 90,000 25.5 2.00 1.60 32 16,500 42,000 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 75,300 40.0 50 79,300 2.50 20,800 44,100 2.75 44.0 55 21,800 46,200 83,200 3.00 48.0 60 22,800 48,300 86,900 4.00 5.00 26,300 5.00 6.25 29,400 7.50 32,200 6.00 Allowing 50% Increase Above Initial Relief Pressure Discharge Capacity allowing pressure increase from Pc to Pm Рс Pm Initial Maximum Blowing 2" 3" 4" **Relief Pressure** Pressure Pm = 1.5 Pc 1" valve lift 1-1/2" valve lift 1-3/4" valve lift 3" dia psi 07 psi oz 1-3/4" dia 2-1/2" dia 4" dia 3" dia 10,100 55,800 0.50 8.0 12 32,400 0.75 12.0 18 12,400 39,600 68,400 14,400 45,800 79,000 1.00 16.0 24 1.25 20.0 30 16,100 51,200 88,300 21.0 2.00 91,000 1.30 32 16,600 53,000 1.50 24.0 17,600 56,100 96,700 36 1.75 28.0 42 19,000 60,600 104,500 2.00 111,700 32.0 48 20,300 64,800 82,500 2.25 36.0 54 21,600 68,700 2.50 40.0 60 22,700 56,200 86,900 2.75 44.0 23,900 59,000 91,200 66 3.00 48.0 4.50 72 24,800 61,600 95,200 А 4.00 6.00 28,800 5.00 7.50 32,200 6.00 9.00 35,200

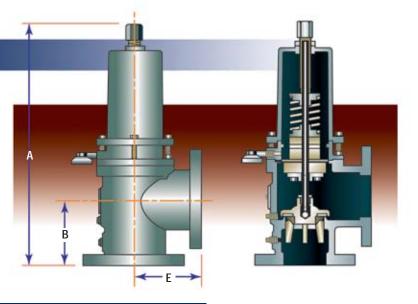
	Dimensions					
Size	А	В	E	Weight Lbs.		
2" NPT	16-3/4	3-1/4"	3-1/4"	30		
2" Flgd.		4-1/4"	4-1/4""	40		
3"	18-1/4	5"	5"	65		
4"	20"	6"	6"	110		

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Model 250-S Spring Loaded

	Dimensions				
Size	А	В	E	Weight Lbs.	
2" NPT	19-1/2"	3-1/4"	3-1/4"	40	
2" Flgd.	19-1/2	4-1/4"	4-1/4""	40	
3"	20-3/4"	5"	5"	65	
4"	22-1/4"	6"	6"	00	



Relief Pressur	e Adjustment	Range	
		Relief Pressure A	djustment Range, psi
	೧ "	2"	/ "

	2"	<u>ა</u> კ.	4	
Color of Spring	1-3/4" dia.	3" dia.	4" dia.	3" dia.
Aluminum Green Yellow Gray Blue	2 - 10 10 - 16 16 - 26 26 - 40 30 - 70	1 - 4 4 - 6 6 - 10 10 - 15 15 - 30	1.00 - 2.25 2.25 - 3.50 3.50 - 5.50 5.50 - 7.50 7.50 - 16.00	15 – 30

Discharge Capacity in SCFH of natural gas (0.6 Specific Gravity 14.65 psia – 60°F)

	Allowing 50% Increase Above Initial Relief Pressure						
Рс	Pm	Discharge Capa	city allowing pres	sure increase fro	om Pc to Pm		
Initial	Maximum Blowing	2"	3"		" 		
Relief Pressure	Pressure Pm = 1.5 Pc	1" valve lift	1" valve lift	1-1/8" v	alve lift		
psi	psi	1-3/4" dia	3" dia	4" dia	3" 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		141,500		
25	37.5	60,300	159,800		165,400		
30	45.0	69,000	182,900		189,300		
40	60.0	86,400					

Allowing 100% Increase Above Initial Relief Pressure

	- J				
Рс	Pm	Discharge Capa	city allowing press	sure increase fro	om Pc to Pm
Initial	Maximum Blowing	2"	3"	4	
Relief Pressure	Pressure Pm = 2 Pc	1" valve lift	1" valve lift	1-1/8" v	alve lift
psi	psi	1-3/4" dia	3" dia	4" dia	3" 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		222,900
25	50	99,300	254,000		263,900
30	60	115,300	293,500		304,800
40	80	146,200			

Other Sensus Metering Systems Gas Pressure Regulators



Sensus Metering Systems produces a broad product line of Gas Pressure Regulators which are widely used throughout the natural gas industry. These regulators are also suitable for non-corrosive industrial gas applications such as propane, butane, air, nitrogen, dry CO₂, etc. For additional detailed information on a particular model, please request the indicated bulletin from the local Sensus sales office.

Multi-Purpose Service Regulators

Model 043-B

Bulletin: R-1307 3/8", 1/2", 3/4", 1" pipe size Inlet pressures to 125 psi Outlet pressures 3-1/2" w.c. to 2 psi Capacity to 2,200 CFH Available with 90° angle or straight-through body Internal relief valve standard

Model 143-B

Bulletin: R-1308 3/4", 1" and 1-1/4" pipe size Inlet Pressures to 125 psi Outlet pressures 3-1/2" w.c. to 2 psi Capacity to 2,700 CFH Available with 90 angle or straight-through body Internal relief valve standard

Model 143-80

Bulletin: R-1301 3/4", 1", 1-1/4" pipe size Inlet pressures to 125 psi Outlet pressures 3-1/2" w.c. to 6 psi Capacity to 2,400 CFH Available with or without internal relief valve

Industrial Service Regulators

Models 243-8, 243-12, 243-8HP

Bulletin: R-1306 1-1/4", 1-1/2" and 2" pipe size Inlet pressures to 125 psi Outlet Pressures 3-1/2" w.c. to 10 psi Capacity to 25,000 CFH Also available: internal relief valve, low pressure cut-off external control line, back pressure regulator, relief valve, vacuum regulator and vacuum breaker.

Sensus Metering systems also produces Industrial and Combustion Regulators, High Pressure and High Capacity Regulators. Detailed information available on request.

Industrial Field Regulators

For intermediate to high pressure applications. Ideal on pipeline taps servicing plants and buildings. Appropriate for double stage reduction ahead of service regulators, and for high pressure burners and compressed air systems.

Model 046

Bulletin: R-1312 3/4", 1" and 1-1/4" pipe size Inlet pressures to 1000 psi Outlet pressures 3 to 200 psi Capacity to 40,000 SCFH Internal relief valve also available

Model 141A

Bulletin: R-1311 2" pipe size Inlet Pressures to 1500 psi Outlet Pressures 5 to 400 psi Capacity to 55,000 SCFH

Pilot Loaded Regulators

For intermediate and high pressure applications requiring precise pressure reduction with minimal droop. Ideal for standard and high capacity flows on burners, driers, dehydrators and compressor lines. Appropriate for fixed factor billing.

Model 243-RPC

Bulletin: R-1343 1-1/4", 1-1/2" and 2" pipe size Inlet pressures to 150 psi Outlet pressures 3-1/2" w.c. to 35 psi Capacity to 76,000 SCFH

Model 1200

Bulletin: R-1342 Pipe Size: 2" (flanged) Inlet pressures to 1200 psi Outlet pressures 20 to 600 psi Capacity to 789,000 SCFH

Model 121-RPC

Bulletin: RDS-1328 Pipe size: 1-1/2", 2" and 2-1/2" Inlet pressures to 60 psi Outlet pressures to 3-1/2" w.c. to 35 psi Capacity to 186,000 SCFH

Model 1100

Bulletin: R-1341 Pipe size: 2" (screwed or flanged) Inlet pressures to 400 psi Outlet pressures 3" w.c. to 100 psi Capacity to 414,000 SCFH



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