Type 299 Pressure Reducing Regulators

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D102308X012

Type 299 Pressure Reducing Regulator Features

D **Wide Variety of Applications—** Natural gas distribution systems, gas supply to industrial boilers, furnaces, ovens, mixers, plant air service.

D **Not an adaptation of existing regulators—** New design of intergrated cases and internal registration ports.

D **Accuracy—** Keeps constant inlet pressures to downstream equipment by accurately controlling distribution system pressures at widely varying flow rates and supply pressures for maximum efficiency and best operation, or by eliminating the need for pressure-compensating meters by holding a steady pressure to the meter inlet.

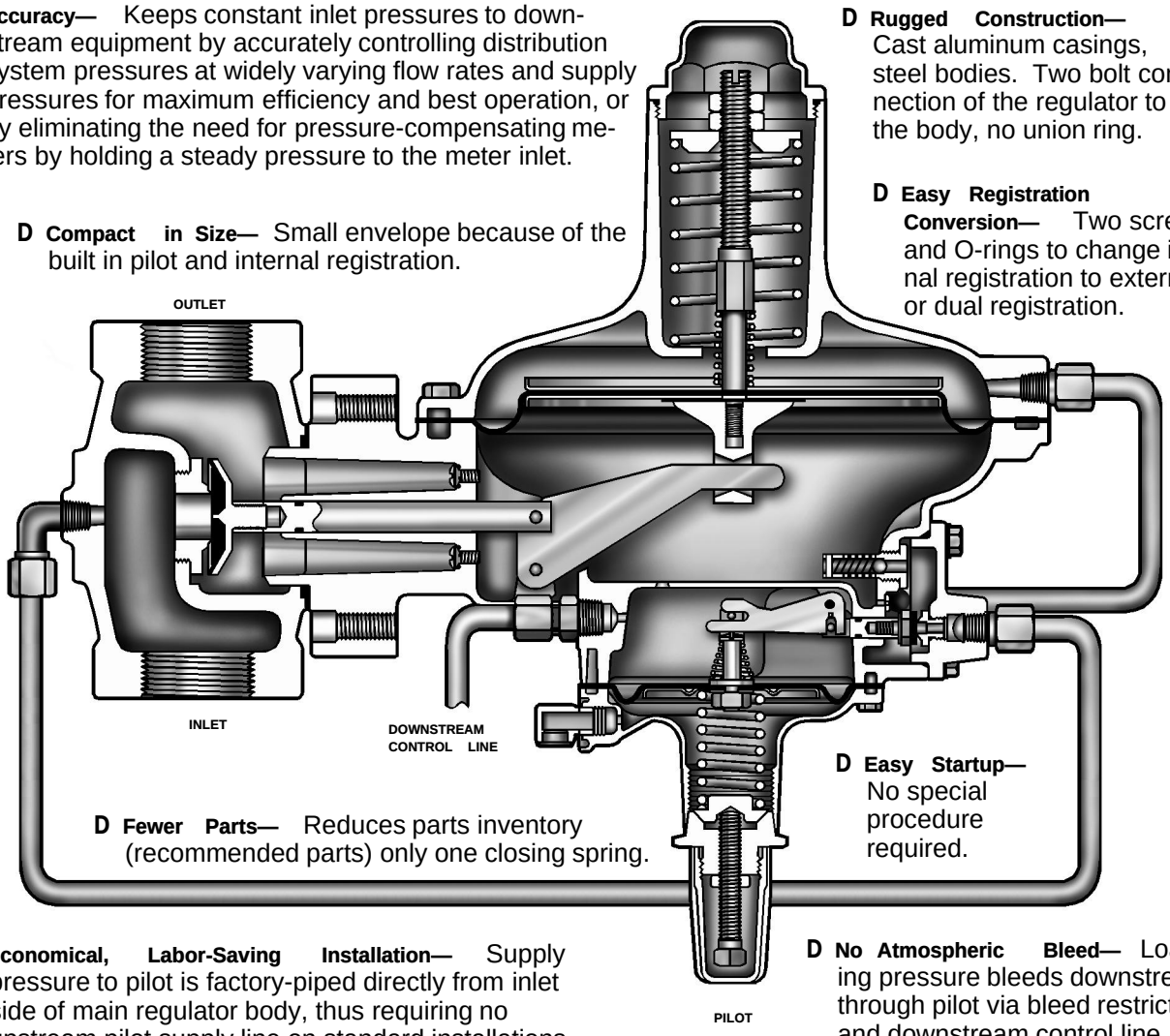
D **Compact in Size—** Small envelope because of the built in pilot and internal registration.

D **High-Capacity Pressure Control—** Actuator diaphragm responds quickly to downstream pressure change, causing immediate correction in main valve position. Pilot responds simultaneously and controls final positioning of main valve. This action permits full main valve travel, resulting in higher capacity than could be obtained without a pilot.

D **Reusable O-rings At All Servicable Joints—** No gaskets.

D **Rugged Construction—** Cast aluminum casings, steel bodies. Two bolt connection of the regulator to the body, no union ring.

D **Easy Registration Conversion—** Two screws and O-rings to change internal registration to external or dual registration.



D **Fewer Parts—** Reduces parts inventory (recommended parts) only one closing spring.

D **Easy Startup—** No special procedure required.

D **Economical, Labor-Saving Installation—** Supply pressure to pilot is factory-piped directly from inlet side of main regulator body, thus requiring no upstream pilot supply line on standard installations.

D **Easy to Maintain—** Main valve disk and orifice can be inspected without removing body from pipeline. Easy access two bolt flange permits quick removal of actuator and pilot from body.

D **No Atmospheric Bleed—** Loading pressure bleeds downstream through pilot via bleed restriction and downstream control line. No bleed occurs when regulator is shut off.

D **Highest Quality—** Designed and manufactured to ISO 9001 standards

Specifications

Body Size And End Connection Styles

■ 1-1/2-inch, 2-inch NPT screwed or,
■ 2-inch ANSI Class 125 and 250 flanged

Orifice Sizes and Maximum Allowable Inlet Pressure(1)

1/4 x 3/8-inch . . . . . 150 psig (10.3 bar)
3/8-inch . . . . . 150 psig (10.3 bar)
1/2-inch . . . . . 150 psig (10.3 bar)
3/4-inch . . . . . 125 psig (8.6 bar)
1-inch . . . . . 60 psig (4.1 bar)
1-3/16-inch . . . . . 40 psig (2.8 bar)

Outlet (Control) Pressure Ranges(1, 2)

See Table 1

Pressure Control Accuracy

+/– 1% of absolute control pressure

Minimum Differential Pressure For Full Stroke

1.5 psi (0.10 bar)

Maximum Emergency Outlet Pressure(1)

45 psig (3.1 bar)

Flow Coefficients

See Table 2

Typical Regulating Capacities

See Tables 3 to 5

Construction Materials

Actuator Upper Casing: Aluminum (A03800)
Actuator Lower Casing: Aluminum (A03800)
Pilot Spring Case: Aluminum (A03800)
Actuator Diaphragm: Nitrile
Pilot Diaphragm: Nitrile
Pilot Inlet Screen: 18–8 stainless steel
Valve Body: ■ Cast iron, or ■ steel
Orifice and Valve Stem: Aluminum (A92017)
Disk Holder: Aluminum (A92017)/nitrile
Main Disk Construction: Nitrile
Metal Trim Parts For Pilot: ■ Steel, ■ stainless steel, or ■ aluminum
Pilot Disk Construction: Nitrile
O-Rings: Nitrile
Fittings And Tubing: ■ Steel/stainless steel (std), ■ brass/copper, or ■ stainless steel

Approximate Weight

21 lbs (9.5 kg)

Temperature Capabilities(1)

–20° to 150°F (–29° to 65.5°C)

Control Line And Pilot Connections:

See Figure 5

Additional Options:

Three fixed restriction sizes to choose from:
.044-inch (1.12 mm) red (std. gain)
.071-inch (1.80 mm) green (low gain)
.082-inch (2.08 mm) blue (lower gain)
Pressure loading regulator(3): A Type 67AF with an internal 40 microns filter
Filter(3): A P590 Series filter installed in the pilot supply tubing between main body and pilot

1. The pressure/temperature limits in this bulletin and any applicable standard or code limitation should not be exceeded.
2. For optinum preformance, a pilot supply regulator may be installed in the pilot supply tubing between the main valve and pilot.
3. Only one (a pressure loading regulator or a P590 Series filter) may be ordered with the Type 299, but not both.

Table 1. *Outlet Pressure Ranges*

MAXIMUM RECOMMENDED PILOT SUPPLY PRESSURE	OUTLET (CONTROL) PRESSURE RANGE	PILOT CONTROL SPRING			
		Part Number	Color Code	Free Length Inches (mm)	Wire Diameter Inches (mm)
40 psi(1) (2.8 bar)	3.5 to 6 inches w.c. (9 to 15 mbar)	T13707T0012	Black	1.86 (47.2)	0.055 (1.4)
	6 to 9 inches w.c. (15 to 22 mbar)	T13589T0012	Yellow	2.05 (52.0)	0.051 (1.3)
	9 to 20 inches w.c. (22 to 49 mbar)	1N3112X0012	Silver	2.18 (55.4)	0.075 (1.9)
	16 to 40 inches w.c. (40 to 99 mbar)	1B413727222	Purple	2.12 (53.8)	0.092 (2.3)
150 psi (10.3 bar)	1 to 3.25 psig (0.07 to 0.14 bar)	T13593T0012	Lt. Blue	2.12 (53.8)	0.105 (2.7)
	3.25 to 6 psig (0.14 to 0.41 bar)	T13671T0012	Orange	2.40 (61.1)	0.120 (3.0)
	6 to 16 psig (0.41 to 1.10 bar)	T13600T0012	Red	2.10 (53.3)	0.142 (3.6)
	16 to 35 psig (1.10 to 2.4 bar)	T13771T0012	Zinc	2.15 (54.6)	0.207 (5.3)

1. Use a pilot supply regulator if actual inlet pressure exceeds 40 psi (2.8 bar).

Table 2. *Flow Coefficients and Orifice Diameters*

ORIFICE DIAMETER INCH (mm)	FOR RELIEF SIZING WIDE OPEN C_g	REGULATING C_g	C1 $\Delta P < 10$ psi	C1 $\Delta P \geq 10$ psi
1/4 x 3/8 (6.4 x 9.5)	53	50	26	26
3/8 (9.5)	117	115	30	28
1/2 (12.7)	203	200	30	28
3/4 (19.1)	437	430	32	30
1 (25.4)	725	710	36	34
1-3/16 (30.2)	910	885	37	35

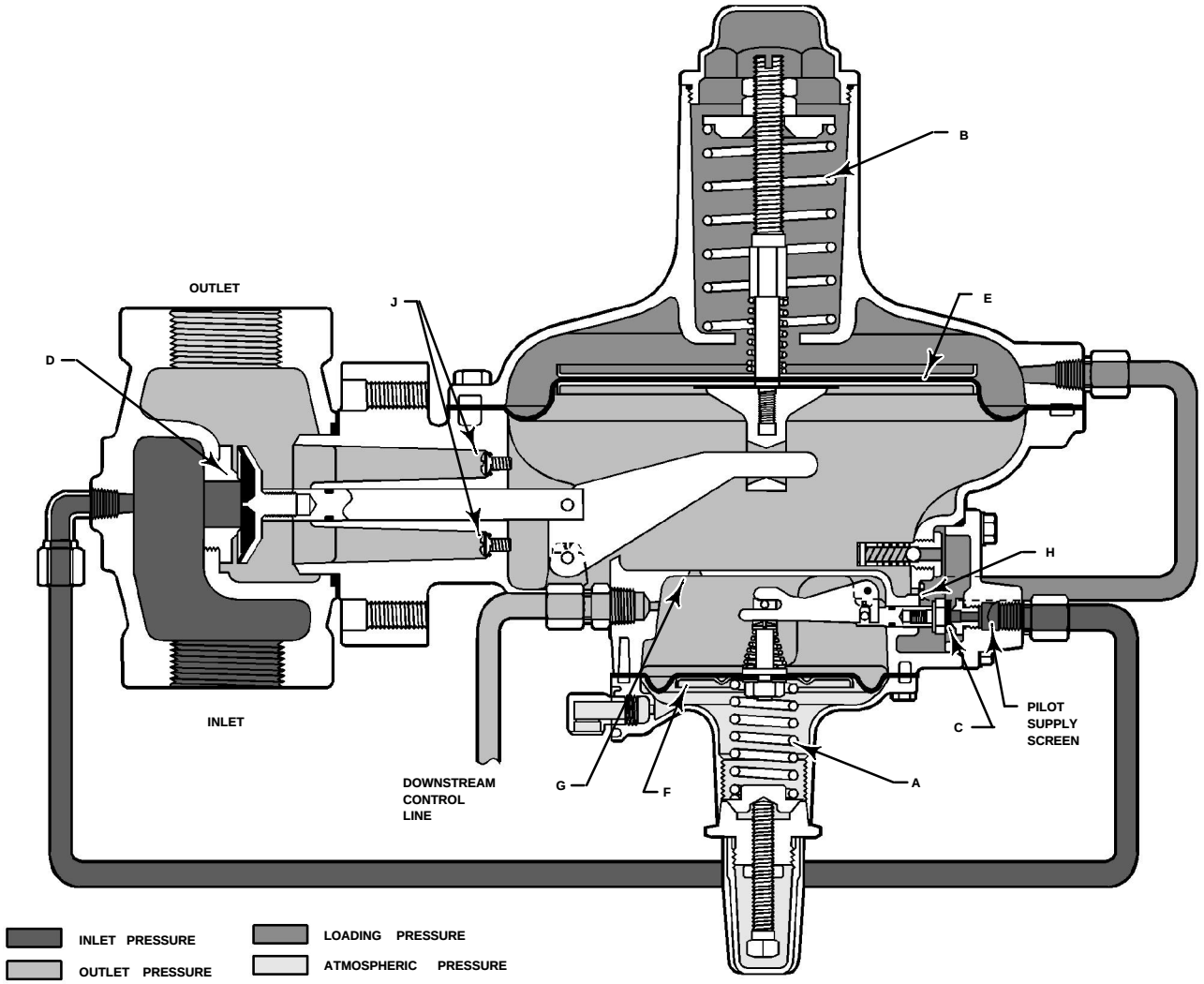


Figure 3. *Operational Schematic of Type 299 Regulator (External Registration)*

Principle of Operation

Letter keys in this section refers to figure 3 unless otherwise noted. Fast response and accuracy are made possible by the amplifying effect of the pilot and by the two-path control system. The function of the pilot is to sense change in the controlled pressure and amplify it into a larger change in the loading pressure. Any changes in outlet pressure act quickly on both the actuator diaphragm and the loading pilot, thus providing the precise pressure control that is characteristic of a two-path system.

A typical pilot has an approximate gain of 50, which means the outlet pressure needs to droop only 1/50 as much as a self-operated regulator in order to obtain the same pressure differences across the main diaphragm. Advantages of a pilot operated regulator are high accuracy and high capacity.

Upstream or inlet pressure is utilized as the operating medium, which is reduced through pilot operation to load the main diaphragm chamber. Tubing connects the inlet pressure to the pilot. Downstream or outlet pressure registers underneath main diaphragm (E) and on top of pilot diaphragm (F). There are three different versions of registration for the Type 299.

a. **Internal registration (screws (J) removed)—** Outlet pressure is registered through the throat to the main diaphragm chamber and then through a small port (G) to the top of the pilot diaphragm.

b. **External registration—** The throat is blocked by screws (J) and a downstream control line is connected to the pilot diaphragm chamber which is connected to the lower main diaphragm chamber by a small port (G).

c. **Dual registration (screws (J) removed)—**The lower main diaphragm chamber registers outlet pressure through the throat and pilot diaphragm chamber registers downstream pressure by use of a downstream control line. The port (G) between the chambers is blocked by inserting a screw (J).

In operation, assume the outlet pressure is less than the setting of pilot control spring (A). The top side of pilot diaphragm assembly (F) will have a lower pressure than the setting of spring (A). Spring (A) forces the diaphragm assembly upward, opening the pilot orifice (C). Additional loading pressure is supplied to the top side of main diaphragm (E).

This creates a higher pressure on the top side of main diaphragm (E) than on the bottom side, forcing the diaphragm downward. This motion is transmitted through a lever, which pulls the valve disk open, allowing more gas to flow through the valve.

When the gas demand in the downstream system has been satisfied, the outlet pressure increases. The increased pressure is transmitted through the downstream control line and acts on top of the pilot diaphragm (F). This pressure exceeds the pilot spring setting and forces the diaphragm down, closing orifice (C). The loading pressure acting on main diaphragm (E) bleeds to the downstream system through a bleed restriction (H).

With a decrease in loading pressure on top of main diaphragm (E), main spring (B) exerts an upward force on the diaphragm post connected to main diaphragm (E), pulling it upward. This moves the main valve toward its seat, decreasing flow to the downstream system.

Overpressure Protection

Like most regulators, the Type 299 has outlet pressure ratings lower than the inlet pressure ratings. Complete downstream overpressure protection is needed if the actual inlet pressure exceeds the outlet pressure rating.

Overpressure protection for internal parts is built into the main and pilot diaphragms by means of a small spring on each post. The springs will allow the diaphragms to move farther on the posts avoiding damage to or bending of the valve trim.

Overpressuring any portion of a regulator or associated equipment may cause leakage, part damage, or personal injury due to bursting of pressure-containing parts or explosion of accumulated gas. Regulator operation within ratings does not preclude the possibility of damage from external sources or from debris in the pipeline. A regulator should be inspected for damage periodically and after any overpressure condition.

The pilot is provided with a 1/4-inch NPT tapped connection in the spring case.

Monitoring Systems for Safety

Monitoring regulators serve as overpressure protection devices to limit system pressure in the event of open failure of a working regulator feeding the system. A method of using Type 299 regulators in monitoring systems are as follows:

- **Wide Open Monitor—** The control line of the upstream regulator is connected downstream of the second regulator (figure 4), so that during normal operation the monitoring regulator is standing wide open with the reduction to distribution pressure being taken across the working regulator. Only in case of open failure of the working regulator does the wide-open monitoring regulator take control at its slightly higher setting.

The upstream regulator can easily be field converted or ordered with screws and O-rings in the throat (figure 3). This seals off the path that otherwise would let line pressure ahead of the working regulator inlet try to close the wide-open monitoring regulator.

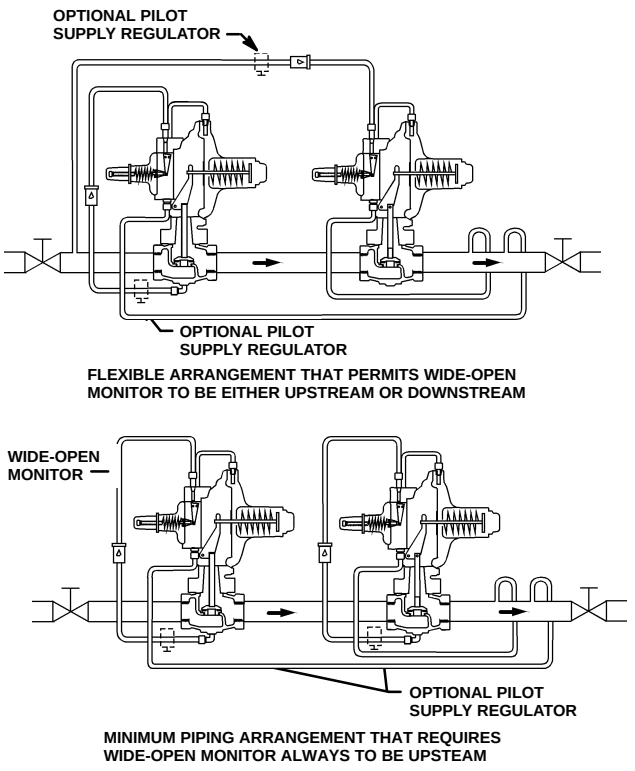


Figure 4. *Typical Wide-Open Monitor Installations*

Capacity Information

Tables 3 to 5 gives Type 299 natural gas regulating capacities at selected inlet pressures and outlet pressure settings. Flows are in scfh (60°F and 14.7 psia) of 0.6 specific gravity gas at 60°F. To determine equivalent capacities for air, propane, butane, or nitrogen, multiply the table 6 capacity by the following appropriate conversion factor: 0.775 for air, 0.628 for propane, 0.548 for butane, or 0.789 for nitrogen. For gases of other specific gravities, multiply the given capacity by 0.775 and divide by the square root of the appropriate specific gravity. Then, if capacity is desired in normal cubic meters per hour (m^3/hr) at 0°C and 1.01325 bar, multiply scfh by 0.0268.

To determine regulating capacities for pressures or constructions not given in tables 3 to 5, or to determine wide-open capacities for relief sizing at any inlet pressure, use the following formula and convert according to the factors in the preceding paragraph if necessary:

$$Q = \sqrt{\frac{520}{GT}}\ C_g\ P_1\ SIN\ \left(\frac{3417}{C_1}\sqrt{\frac{\Delta P}{P_1}}\right) DEG$$

where:

C_1 = C_g/C_v (See table 2)
C_g = Gas sizing coefficient (see table 2)
G = Gas specific gravity (air =1.0)
P_1 = Regulator inlet pressure, psia
ΔP = Pressure drop across regulator, psi
Q = Gas flow rate, scfh
T = Absolute temperature of gas at inlet, degree Rankine

Note

Due to boost, the above formula can not be used to obtain correct regulating capacities for regulators with internal registration.

The published capacities were obtained using inlet and outlet piping the same size as the regulator body size.

Pressure Registration Methods

Internal — use for easiest installation. Capacity is somewhat limited because of droop and /or boost associated with sensing pressure within the body.

External — use for higher capacity and /or upstream regulator in a monitor set. Capacity is increased because of better registration of pipeline pressure when a control line is used. The alternate 1/2-inch NPT control line connection can be used for piping convenience.

Dual (internal plus external) — use to improve performance over internal pressure registration when there is a low flow rate and high pressure drop and a large orifice (control line must be piped to the primary 1/4-inch NPT connection on the the pilot).

Installation

Although the actuator and pilot can be mounted in 90° increments relative to the body, the normal installation is with the body in a horizontal run of pipe and the pilot hanging vertically from the bottom of the actuator.

Control and vent lines necessary for installation are not supplied with a Type 299 regulator. Control and vent connection locations are shown in figure 5. In many instances good piping practice will require that outlet piping be swaged up above the body size to prevent excessive pressure drop along the outlet line. The piping should be expanded as close to the regulator outlet as possible.

Dimensional information also is given in figure 5.

Ordering Information

To order a particular construction specify the items listed below. In addition, any optional constructions must be specified.

Application

1. Composition and specific gravity of gas (including chemical analysis if possible).
2. Range of temperatures, flowing inlet pressures (maximum, minimum, nominal), and pressure drops.
3. Desired outlet pressure setting.
4. Range of flow rates (minimum controlled, maximum, normal).
5. Piping size(s).
6. Tubing fitting material.
7. Pilot supply regulator or a P590 series filter option.
8. Internal or External registration.
9. Body material.
10. Body end connection.

Construction

Refer to the Specifications on page 3. Carefully review each specification and/or referenced tables, specify the desired selection whenever there is a choice to be made.

Table 3. *Regulating Capacities For 1-1/2-inch and 2-inch External/Dual Registration in SCFH (60° F and 14.7 psia) of 0.6 Specific Gravity Natural Gas.*

OUTLET PRESSURE RANGE AND SETTING, CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
3.5 to 6 inches w.c. (8.8 to 15 mbar) 3-1/2-inch w.c. (8.8 mbar) T13707T0012 Black	2	0.14	760	1560	2700	5490	8170	9940
	5	0.34	1160	2460	4270	8790	13310	16250
	10	0.69	1590	3580	6230	13060	20300	24900
	15	1.0	1920	4410	7670	16480	27210	33910
	20	1.4	2240	5150	8960	19250	31790	39620
	25	1.7	2570	5890	10250	22030	36370	45330
	30	2.1	2890	6640	11540	24800	40950	51040
	40	2.8	3530	8120	14120	30350	50100	62450
	50	3.4	4180	9600	16700	35890	59260	
	60	4.1	4820	11090	19280	41440	68420	
	80	5.5	6110	14050	24440	52540		
	100	6.9	7400	17020	29600	63630		
	125	8.6	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
6 to 9 inches w.c. (15 to 22 mbar) 7-inch w.c. (17.5 mbar) T13589T0012 Yellow	2	0.14	750	1520	2650	5380	8000	9730
	5	0.34	1160	2440	4240	8730	13220	16130
	10	0.69	1590	3580	6220	13040	20250	24830
	15	1.0	1920	4410	7670	16480	27210	33910
	20	1.4	2240	5150	8960	19250	31790	39620
	25	1.7	2570	5890	10250	22030	36370	45330
	30	2.1	2890	6640	11540	24800	40950	51040
	40	2.8	3530	8120	14120	30350	50100	62450
	50	3.4	4180	9600	16700	35890	59260	
	60	4.1	4820	11090	19280	41440	68420	
	80	5.5	6110	14050	24440	52540		
	100	6.9	7400	17020	29600	63630		
	125	8.6	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
9 to 20 inches w.c. (22 to 49 mbar) 14-inch w.c. (35 mbar) 1N3112X0012 Silver	2	0.14	700	1430	2480	5040	7480	9090
	5	0.34	1140	2400	4170	8570	12950	15800
	10	0.69	1580	3560	6190	12970	20110	24640
	15	1.0	1920	4410	7670	16480	27210	33910
	20	1.4	2240	5150	8960	19250	31790	39620
	25	1.7	2570	5890	10250	22030	36370	45330
	30	2.1	2890	6640	11540	24800	40950	51040
	40	2.8	3530	8120	14120	30350	50100	62450
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	125	8.6	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
16 to 40 inches w.c. (40 to 99 mbar) 28-inch w.c. (70 mbar) 1B413727222 Purple	5	0.34	1110	2320	4020	8250	12430	15150
	10	0.69	1570	3530	6140	12830	19830	24290
	15	1.0	1920	4410	7670	16480	27210	33910
	20	1.4	2240	5150	8960	19250	31790	39620
	25	1.7	2570	5890	10250	22030	36370	45330
	30	2.1	2890	6640	11540	24800	40950	51040
	40	2.8	3530	8120	14120	30350	50100	62450
	50	3.4	4180	9600	16700	35890	59260	
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Table 3. *Regulating Capacities For 1-1/2-inch and 2-inch External/Dual Registration in SCFH (60° F and 14.7 psia) of 0.6 Specific Gravity Natural Gas. (continued)*

OUTLET PRESSURE RANGE AND SETTING , CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
1.0 to 3.25 psig (0.07 to 0.14 bar) 2 psig (0.13 bar) T13593T0012 Light Blue	5	0.34	1020	2100	3640	7440	11140	13560
	10	0.69	1550	3340	5810	12040	18460	22570
	15	1.0	1920	4360	7580	15990	25050	30760
	20	1.4	2240	5150	8960	19250	31790	39620
	25	1.7	2670	5890	10250	22030	36370	45330
	30	2.1	2890	6640	11540	24800	40950	51040
	40	2.8	3530	8120	14120	30350	50100	62450
	50	3.4	4180	9600	16700	35890	59260	
	60	4.1	4820	11090	19280	41440	68420	
	80	5.5	6110	14050	24440	52540		
	100	6.9	7400	17020	29600	63630		
	125	8.6	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
3.25 to 6 psig (0.14 to 0.41 bar) 5 psig (0.3 bar) T13671T0012 Orange	10	0.69	1390	2910	5050	10350	15600	19030
	15	1.0	1870	4190	7280	15150	23310	28530
	20	1.4	2240	5090	9850	18640	29180	35820
	25	1.7	2570	5890	10250	22030	36370	45330
	30	2.1	2890	6640	11540	24800	40950	51040
	40	2.8	3530	8120	14120	30350	50100	62450
	50	3.4	4180	9600	16700	35890	59260	
	60	4.1	4820	11090	19280	41440	68420	
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	100	6.9	7400	17020	29600	63630		
	125	8.6	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
6 to 16 psig (0.41 to 1.10 bar) 10 psig (0.7 bar) T13600T0012 Red	15	1.0	1580	3280	5690	11640	17470	21280
	20	1.4	2130	4720	8210	17000	25940	31690
	25	1.7	2540	5710	9940	20790	32220	39490
	30	2.1	2890	6580	11440	24150	37900	46560
	40	2.8	3530	8120	14120	30350	50100	62450
	50	3.4	4180	9600	16700	35890	59260	
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	80	5.5	6110	14050	24440	52540		
	100	6.9	7400	17020	29600	63630		
	125	8.6	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
6 to 16 psig (0.41 to 1.10 bar) 15 psig (1.0 bar) T13600T0012 Red	20	1.4	1750	3620	6290	12830	19190	23360
	25	1.7	2360	5220	9070	18700	28360	34610
	30	2.1	2820	6290	10940	22790	35050	42890
	40	2.8	3540	8070	14020	29650	46610	57270
	50	3.4	4180	9600	16700	35890	59260	
	60	4.1	4820	11090	19280	41440	68420	
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	100	6.9	7400	17020	29600	63630		
	125	8.6	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
16 to 35 psig (1.10 to 2.4 bar) 20 psig (1.4 bar) T13771T0012 Zinc	25	1.7	1920	3930	6840	13930	20800	23510
	30	2.1	2580	5690	9870	20280	30630	37340
	40	2.8	3480	7830	13610	28440	43980	53880
	50	3.4	4180	9550	16610	35140	55310	
	60	4.1	4820	11090	19280	41440	68420	
	80	5.5	6110	14050	24440	52540		
	100	6.9	7400	17020	29600	63630		
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16 to 35 psig (1.10 to 2.4 bar) 25 psig (1.7 bar) T13771T0012 Zinc	30	2.1	2070	4230	7360	14980	22310	27140
	40	2.8	3320	7350	12780	23420	40220	49120
	50	3.4	4140	9340	16250	34040	52830	
	60	4.1	4830	11030	19190	40630	64010	
	80	5.5	6110	14050	24440	52540		
	100	6.9	7400	17020	29600	63630		
	125	8.8	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
16 to 35 psig (1.10 to 2.4 bar) 30 psig (2.1 bar) T13771T0012 Zinc	40	2.8	2980	6520	11330	23190	34790	42370
	50	3.4	4020	8950	15560	32300	49460	
	60	4.1	4800	10850	18870	39600	61630	
	80	5.5	6110	14050	24440	52540		
	100	6.9	7400	17020	29600	63630		
	125	8.8	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			
16 to 35 psig (1.10 to 2.4 bar) 35 psig (2.4 bar) T13771T0012 Zinc	40	2.8	2350	4790	8330	16920	25150	30680
	50	3.4	3770	8300	14430	29690	44890	
	60	4.1	4700	10510	18270	38050	58520	
	80	5.5	6120	14000	24350	51600		
	100	6.9	7400	17020	29600	63630		
	125	8.8	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			

Table 4. *Regulating Capacities For 1–1/2-inch Internal Registration in SCFH (60° F and 14.7 psia) of 0.6 Specific Gravity Natural Gas.*

OUTLET PRESSURE RANGE AND SETTING, CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
3.5 to 6 inches w.c. (8.8 to 15 mbar) 3-1/2-inch w.c. (8.8 mbar) T13707T0012 Black	2	0.14	760	1560	2700	4050	4310	4540
	5	0.34	1160	2460	4270	7370	6420	6840
	10	0.69	1590	3580	6230	8440	8580	9260
	15	1.0	1920	4410	7670	9540	10300	10020
	20	1.4	2240	5150	8960	10650	10410	10790
	25	1.7	2570	5890	9770	10640	10520	10740
	30	2.1	2890	6640	10360	10640	10620	10690
	40	2.8	3530	8120	12170	10630	10500	10590
	50	3.4	4180	9600	11440	10610	11050	
	60	4.1	4820	11090	10700	10600	11610	
	80	5.5	6110	8760	8640	4500		
	100	6.9	5640	4500	4500	4500		
	125	8.6	5640	4500	4500	4500		
	150	10.3	5620	4500	4500			
6 to 9 inches w.c. (15 to 22 mbar) 7-inch w.c. (17.5 mbar) T13589T0012 Yellow	2	0.14	750	1520	2650	5380	5610	5790
	5	0.34	1160	2440	4240	7300	7290	7630
	10	0.69	1590	3580	6220	8500	8980	9470
	15	1.0	1920	4410	7670	9700	10670	10240
	20	1.4	2240	5150	8960	10900	10770	11010
	25	1.7	2570	5890	9930	10910	10870	11030
	30	2.1	2890	6640	10750	10920	10970	11060
	40	2.8	3530	8120	12390	10940	10870	11110
	50	3.4	4180	9600	11840	10970	11380	
	60	4.1	4820	11090	11280	10990	11580	
	80	5.5	6110	8980	9020	4500		
	100	6.9	5640	4500	4500	4500		
	125	8.6	5640	4500	4500	4500		
	150	10.3	5640	4500	4500			
9 to 20 inches w.c. (22 to 49 mbar) 14-inch w.c. (35 mbar) 1N3112X0012 Silver	2	0.14	700	1430	2480	5040	6900	7050
	5	0.34	1140	2400	4170	7230	8170	8430
	10	0.69	1580	3560	6190	8620	9780	9900
	15	1.0	1920	4410	7670	10020	11390	10670
	20	1.4	2240	5150	8960	11410	11480	11440
	25	1.7	2570	5890	10250	11460	11570	11620
	30	2.1	2890	6640	11540	11500	11660	11790
	40	2.8	3530	8120	12820	11580	11620	12140
	50	3.4	4180	9600	12630	11670	12030	
	60	4.1	4820	10890	12400	11750	12200	
	80	5.5	6110	8920	9920	4970		
	100	6.9	5640	4960	4970	4970		
	125	8.6	5640	4960	4970	4970		
	150	10.3	5640	4960	4970			
16 to 40 inches w.c. (40 to 99 mbar) 28-inch w.c. (70 mbar) 1B413727222 Purple	5	0.34	1110	2320	4020	6610	9500	9560
	10	0.69	1570	3530	6140	8870	11380	10750
	15	1.0	1920	4410	7670	10650	12850	11530
	20	1.4	2240	5150	8960	12440	12920	12310
	25	1.7	2570	5890	10250	12550	12980	12790
	30	2.1	2890	6640	11540	12650	13050	13260
	40	2.8	3530	8120	13690	12860	13110	14220
	50	3.4	4180	9600	14220	13070	13320	
	60	4.1	4820	10890	14630	13290	13450	
	80	5.5	6110	9070	11560	10670		
	100	6.9	7270	5420	5430	5430		
	125	8.6	6670	5420	5430	5430		
	150	10.3	6830	5420	5630			

Table 4. *Regulating Capacities For 1–1/2-inch Internal Registration in SCFH (60° F and 14.7 psia) of 0.6 Specific Gravity Natural Gas. (continued)*

OUTLET PRESSURE RANGE AND SETTING, CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
1.0 to 3.25 psig (0.07 to 0.14 bar) 2 psig (0.13 bar) T13593T0012 Light Blue	5	0.34	1020	2100	3640	7020	10790	10820
	10	.069	1550	3340	5810	8990	12180	11180
	15	1.0	1920	4360	7580	10970	13580	11960
	20	1.4	2240	5150	8960	12950	13630	12750
	25	1.7	2570	5890	10250	13090	13890	13370
	30	2.1	2890	6640	11540	13230	13740	14000
	40	2.8	3530	8120	14120	13500	13850	15250
	50	3.4	4180	9600	15010	13780	13970	
	60	4.1	4820	10890	15740	14050	14080	
	80	5.5	6110	9000	12230	11100		
	100	6.9	7400	5200	5200	5200		
	125	8.6	8170	5040	5200	5200		
	150	10.3	8450	5870	5900			
3.25 to 6 psig (0.14 to 0.41 bar) 5 psig (0.3 bar) T13671T0012 Orange	10	0.69	1390	2910	5050	8470	12010	12190
	15	1.0	1870	4190	7280	11290	14300	12400
	20	1.4	2240	5090	8850	12590	13820	13260
	25	1.7	2570	5890	10250	13210	14550	14310
	30	2.1	2890	6640	11540	13820	15290	15370
	40	2.8	3530	8120	14120	15060	15650	16630
	50	3.4	4180	9600	16700	15400	16010	
	60	4.1	4820	11090	16290	15750	16370	
	80	5.5	6110	14050	14000	13620		
	100	6.9	7400	17020	9020	9220		
	125	8.6	9020	7690	7690	7890		
	150	10.3	10630	6330	6360			
6 to 16 psig (0.41 to 1.10 bar) 10 psig (0.7 bar) T13600T0012 Red	15	1.0	1580	3280	5690	9930	13230	13570
	20	1.4	2130	4720	8210	11990	14130	14100
	25	1.7	2540	5710	9940	13400	15990	15870
	30	2.1	2890	6580	11440	14810	17850	17640
	40	2.8	3530	8120	14120	17640	18630	18920
	50	3.4	4180	9600	16700	18110	19400	
	60	4.1	4820	11090	17200	18580	20170	
	80	5.5	6110	14050	16950	17810		
	100	6.9	7400	17020	15350	15900		
	125	8.6	9020	20730	16740	16270		
	150	10.3	6790	6790	6830			
6 to 16 psig (0.41 to 1.10 bar) 15 psig (1.0 bar) T13771T0012 Zinc	20	1.4	1750	3620	6290	11380	14450	14950
	25	1.7	2360	5220	9070	13590	17440	17430
	30	2.1	2820	6290	10940	15810	20430	19910
	40	2.8	3540	8070	14020	20230	21610	21220
	50	3.4	4180	9600	16700	20820	22800	
	60	4.1	4820	11090	18110	21410	23890	
	80	5.5	6110	14050	19910	22000		
	100	6.9	7400	17020	21710	22600		
	125	8.6	9020	20730	23960	23190		
	150	10.3	10630	24440	26210			
16 to 35 psig (1.10 to 2.4 bar) 20 psig (1.4 bar) T13771T0012 Zinc	25	1.7	1920	3930	6840	12840	15670	16320
	30	2.1	2580	5690	9870	15200	20740	20760
	40	2.8	3480	7830	13610	22820	24600	23510
	50	3.4	4180	9550	16610	20950	23620	
	60	4.1	4820	11090	18080	23330	26120	
	80	5.5	6110	14050	20980	25120		
	100	6.9	7400	17020	23680	26930		
	125	8.6	9020	20730	26980	28020		
	150	10.3	10630	24440	30280			

Table 4. *Regulating Capacities For 1 1/2-inch Internal Registration in SCFH (60 _F and 14.7 psia) of 0.6 Specific Gravity Natural Gas. (continued)*

OUTLET PRESSURE RANGE AND SETTING, CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
16 to 35 psig (1.10 to 2.4 bar) 25 psig (1.7 bar) T13771T0012 Zinc	30	2.1	2070	4230	7360	14300	16880	17700
	40	2.8	3320	7350	12780	16810	24040	24090
	50	3.4	4140	9340	16250	21090	24430	
	60	4.1	4830	11030	18050	25240	28260	
	80	5.5	6110	14050	22050	28250		
	100	6.9	7400	17020	25650	31260		
	125	8.6	9020	20730	30000	32840		
	150	10.3	10630	24440	34360			
16 to 35 psig (1.10 to 2.4 bar) 30 psig (2.1 bar) T13771T0012 Zinc	40	2.8	2980	6520	11330	15750	18100	19080
	50	3.4	4020	8950	15560	21220	25240	
	60	4.1	4800	10850	18020	27150	30390	
	80	5.5	6110	14050	23130	31370		
	100	6.9	7400	17020	27630	35690		
	125	8.6	9020	20730	33030	37670		
	150	10.3	10630	24440	38430			
16 to 35 psig (1.10 to 2.4 bar) 35 psig (2.4 bar) T13771T0012 Zinc	40	2.8	2350	4790	8330	13640	19570	20850
	50	3.4	3770	8300	14430	21350	26060	
	60	4.1	4700	10510	18270	29060	32530	
	80	5.5	6120	14000	24350	34490		
	100	6.9	7400	17020	29600	39920		
	125	8.6	9020	20730	36050	42500		
	150	10.3	10630	24440	42500			

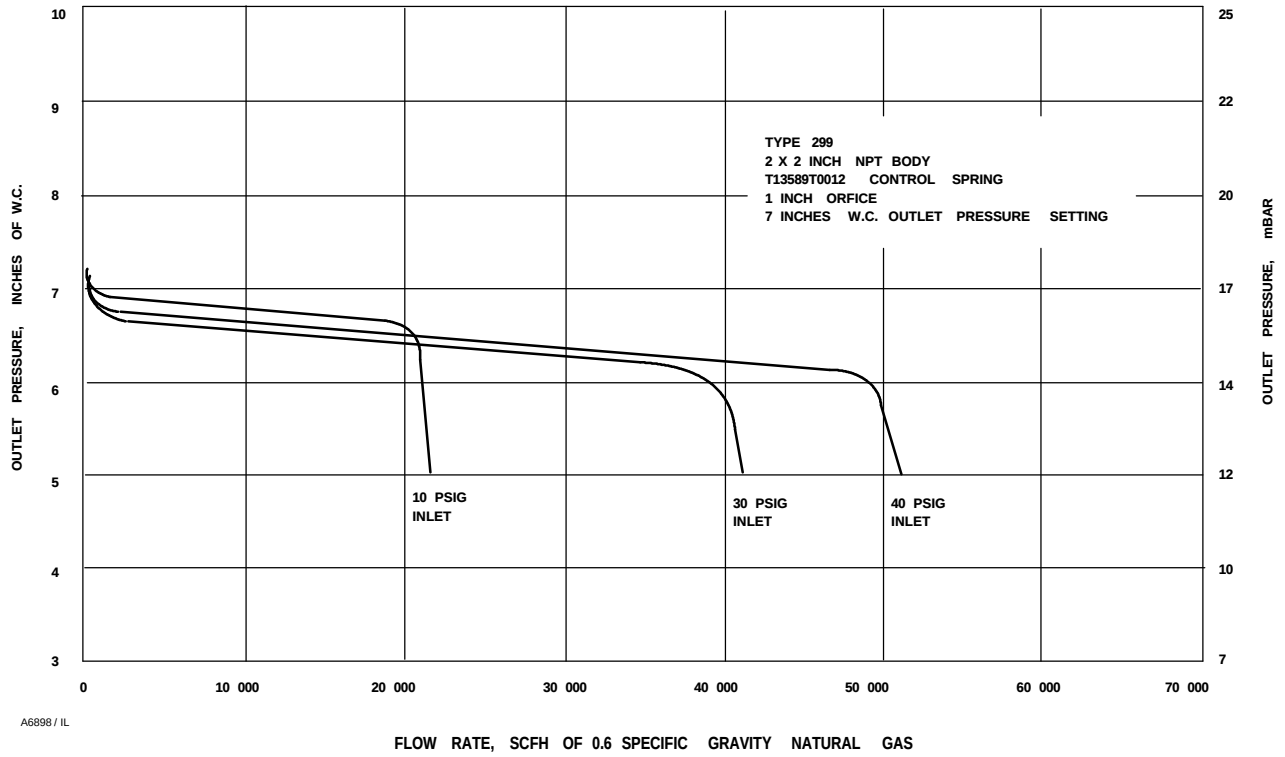


Figure 5. *Typical 7 Inches (17 mbar) Water Column Performance Curves*

Table 5. *Regulating Capacities For 2-inch Internal Registration in SCFH (60° F and 14.7 psia) of 0.6 Specific Gravity Natural Gas.*

OUTLET PRESSURE RANGE AND SETTING, CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
3.5 to 6 inches w.c. (8.8 to 15 mbar) 3-1/2-inch w.c. (8.8 mbar) T13707T0012 Black	2	0.14	760	1560	2700	4050	5710	6350
	5	0.34	1160	2460	4270	7470	6910	11260
	10	0.69	1590	3580	6230	11230	14780	14900
	15	1.0	1920	4410	7670	14210	17080	17230
	20	1.4	2240	5150	8960	17200	18230	17610
	25	1.7	2570	5890	10250	18290	19220	19040
	30	2.1	2890	6640	11540	19390	19220	20500
	40	2.8	3530	8120	14120	21580	19860	20720
	50	3.4	4180	9600	16700	20170	23010	
	60	4.1	4820	11090	19280	18760	19120	
	80	5.5	6110	14050	24440	5800		
	100	6.9	5640	5640	5640	5800		
	125	8.8	5640	5640	5640	5810		
	150	10.3	5620	5620	5620			
6 to 9 inches w.c. (15 to 22 mbar) 7-inch w.c. (17.5 mbar) T13589T0012 Yellow	2	0.14	750	1520	2650	5380	6260	6680
	5	0.34	1160	2440	4240	8730	10080	11530
	10	0.69	1590	3580	6220	13040	15700	15600
	15	1.0	1920	4410	7670	16480	18040	18140
	20	1.4	2240	5150	8960	19250	19290	18540
	25	1.7	2570	5890	10250	22030	20420	19880
	30	2.1	2890	6640	11540	24800	20630	21410
	40	2.8	3530	8120	14120	23200	21300	22080
	50	3.4	4180	9600	16700	20310	21830	
	60	4.1	4820	11090	19280	20190	20840	
	80	5.5	6110	14050	24440	5620		
	100	6.9	5640	5640	5640	6000		
	125	8.8	5640	5640	5640	5900		
	150	10.3	5640	5640	5640			
9 to 20 inches w.c. (22 to 49 mbar) 14-inch w.c. (35 mbar) 1N3112X0012 Silver	2	0.14	700	1430	2480	5040	7440	8460
	5	0.34	1140	2400	4170	8570	13250	11800
	10	0.69	1580	3560	6190	12970	16620	16310
	15	1.0	1920	4410	7670	16480	18990	19050
	20	1.4	2240	5150	8960	19250	20350	19770
	25	1.7	2570	5890	10250	22030	21610	20720
	30	2.1	2890	6640	11540	24800	22040	22330
	40	2.8	3530	8120	14120	24490	22730	23440
	50	3.4	4180	9600	16700	23200	23350	
	60	4.1	4820	11090	19280	22050	22560	
	80	5.5	6110	14050	24440	5620		
	100	6.9	5640	5640	5640	6000		
	125	8.6	5640	5640	5640	6900		
	150	10.3	5640	5640	5640			
16 to 40 inches w.c. (40 to 99 mbar) 28-inch w.c. (70 mbar) 1B413727222 Purple	5	0.34	1110	2320	4020	8250	9800	12020
	10	0.69	1570	3530	6140	12830	16420	17010
	15	1.0	1920	4410	7670	16480	19950	19960
	20	1.4	2240	5150	8960	19250	21410	20390
	25	1.7	2570	5890	10250	22030	22810	21560
	30	2.1	2890	6640	11540	24800	23450	23250
	40	2.8	3530	8120	14120	25780	24170	24800
	50	3.4	4180	9600	16750	26090	24870	
	60	4.1	4820	11090	19280	23910	24280	
	80	5.5	6110	14050	24260	15560		
	100	6.9	7270	7270	7270	10130		
	125	8.6	6670	6670	6670	9580		
	150	10.3	6830	6830	6830			

Table 5. *Regulating Capacities For 2-inch Internal Registration in SCFH (60° F and 14.7 psia) of 0.6 Specific Gravity Natural Gas. (continued)*

OUTLET PRESSURE RANGE AND SETTING, CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
1.0 to 3.25 psig (0.07 to 0.14 bar) 2 psig (0.13 bar) T13593T0012 Light Blue	5	0.34	1020	2100	3640	7440	10980	13800
	10	0.69	1550	3340	5810	12040	15460	17710
	15	1.0	1920	4360	7580	15990	20900	20670
	20	1.4	2240	5150	8960	19250	22470	21620
	25	1.7	2670	5890	10250	22030	24000	22410
	30	2.1	2890	6640	11540	24800	24860	24170
	40	2.8	3530	8120	14120	27070	25610	26160
	50	3.4	4180	9600	16700	28970	26390	
	60	4.1	4820	11090	19280	25770	26000	
	80	5.5	6110	14050	24440	25500		
	100	6.9	7400	17020	29840	14260		
	125	8.6	8170	12360	17520	13260		
	150	10.3	8450	13750	18580			
3.25 to 6 psig (0.14 to 0.41 bar) 5 psig (0.3 bar) T13671T0012 Orange	10	0.69	1390	2910	5050	10350	13200	16070
	15	1.0	1870	4190	7280	15150	21850	21370
	20	1.4	2240	5090	8850	18640	21350	21390
	25	1.7	2570	5890	10250	21260	24540	22740
	30	2.1	2890	6640	11540	24340	26500	25870
	40	2.8	3530	8120	14120	27670	28300	28930
	50	3.4	4180	9600	16700	30570	29870	
	60	4.1	4820	11090	19280	29390	30390	
	80	5.5	6110	14050	24440	31410		
	100	6.9	7400	17020	29600	22150		
	125	8.6	9020	20730	36050	21590		
	150	10.3	10630	17170	26560			
6 to 16 psig (0.41 to 1.10 bar) 10 psig (0.7 bar) T13600T0012 Red	15	1.0	1580	3280	5690	11640	15420	18340
	20	1.4	2130	4720	8210	17000	19500	21000
	25	1.7	2540	5710	9940	20790	25440	23290
	30	2.1	2890	6580	11440	24150	29250	28700
	40	2.8	3530	8120	14120	28660	32780	33540
	50	3.4	4180	9600	16700	33230	35680	
	60	4.1	4820	11090	19280	35410	37700	
	80	5.5	6110	14050	24440	41270		
	100	6.9	7400	17020	29600	35310		
	125	8.6	9020	20730	36050	35740		
	150	10.3	10630	20590	34530			
6 to 16 psig (0.41 to 1.10 bar) 15 psig (1.0 bar) T13771T0012 Zinc	20	1.4	1750	3620	6290	12830	17640	20610
	25	1.7	2360	5220	9070	18700	26350	23850
	30	2.1	2820	6290	10940	22790	31990	31540
	40	2.8	3540	8070	14020	29650	37270	38150
	50	3.4	4180	9600	16700	35890	41490	
	60	4.1	4820	11090	19280	41440	45020	
	80	5.5	6110	14050	24440	51120		
	100	6.9	7400	17020	29600	48470		
	125	8.6	9020	20730	36050	49780		
	150	10.3	10630	24440	42500			
16 to 35 psig (1.10 to 2.4 bar) 20 psig (1.4 bar) T13771T0012 Zinc	25	1.7	1920	3930	6840	13930	20800	21940
	30	2.1	2580	5680	9870	20280	30630	32630
	40	2.8	3480	7830	13610	28440	33040	35700
	50	3.4	4180	9550	16610	35140	41800	
	60	4.1	4820	11090	19280	41440	47530	
	80	5.5	6110	14050	24440	51240		
	100	6.9	7400	17020	29600	52260		
	125	8.6	9020	20730	36050	56710		
	150	10.3	10630	24440	42500			

Table 5. *Regulating Capacities For 2-inch Internal Registration in SCFH (60 _F and 14.7 psia) of 0.6 Specific Gravity Natural Gas. (continued)*

OUTLET PRESSURE RANGE AND SETTING, CONTROL SPRING NUMBER, & COLOR	INLET PRESSURE		ORIFICE SIZE, Inches (mm)					
	psig	bar	1/4 X 3/8 (6.4 X 9.5)	3/8 (9.5)	1/2 (12.7)	3/4 (19.1)	1 (25.4)	1-3/16 (30.2)
16 to 35 psig (1.10 to 2.4 bar) 25 psig (1.7 bar) T13771T0012 Zinc	30	2.1	2070	4230	7360	14980	22310	23270
	40	2.8	3320	7350	12780	23420	40220	33260
	50	3.4	4140	9340	16250	34040	42110	
	60	4.1	4830	11030	19190	40630	50050	
	80	5.5	6110	14050	24440	51360		
	100	6.9	7400	17020	29600	56050		
	125	8.6	9020	20730	36050	63640		
	150	10.3	10630	24440	42500			
16 to 35 psig (1.10 to 2.4 bar) 30 psig (2.1 bar) T13771T0012 Zinc	40	2.8	2980	6520	11330	23190	24580	30810
	50	3.4	4020	8950	15560	32300	42430	
	60	4.1	4800	10850	18870	39600	52560	
	80	5.5	6110	14050	24440	51480		
	100	6.9	7400	17020	29600	59840		
	125	8.8	9020	20730	36050	70570		
	150	10.3	10630	24440	42500			
16 to 35 psig (1.10 to 2.4 bar) 35 psig (2.4 bar) T13771T0012 Zinc	40	2.8	2350	4790	8330	16920	20350	28360
	50	3.4	3770	8300	14430	29690	42740	
	60	4.1	4700	10510	18270	38050	55080	
	80	5.5	6120	14000	24350	51600		
	100	6.9	7400	17020	29600	63630		
	125	8.8	9020	20730	36050	77500		
	150	10.3	10630	24440	42500			

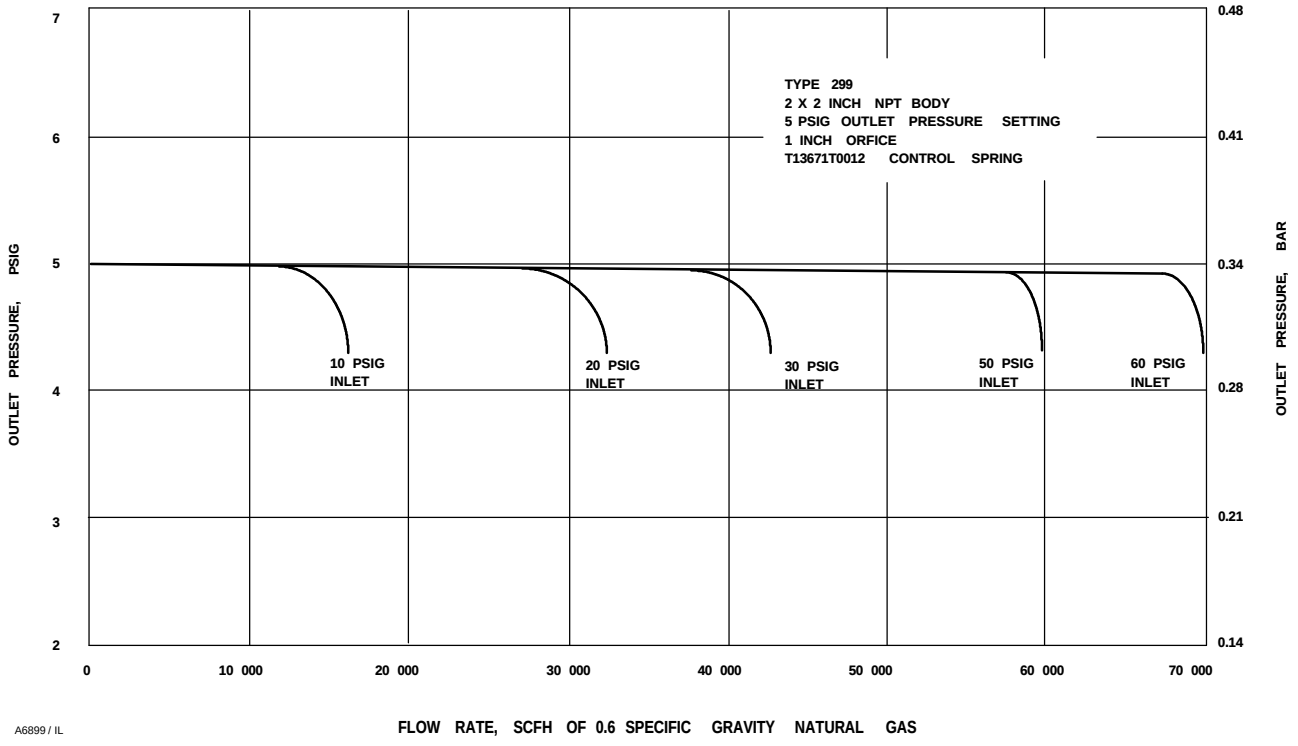
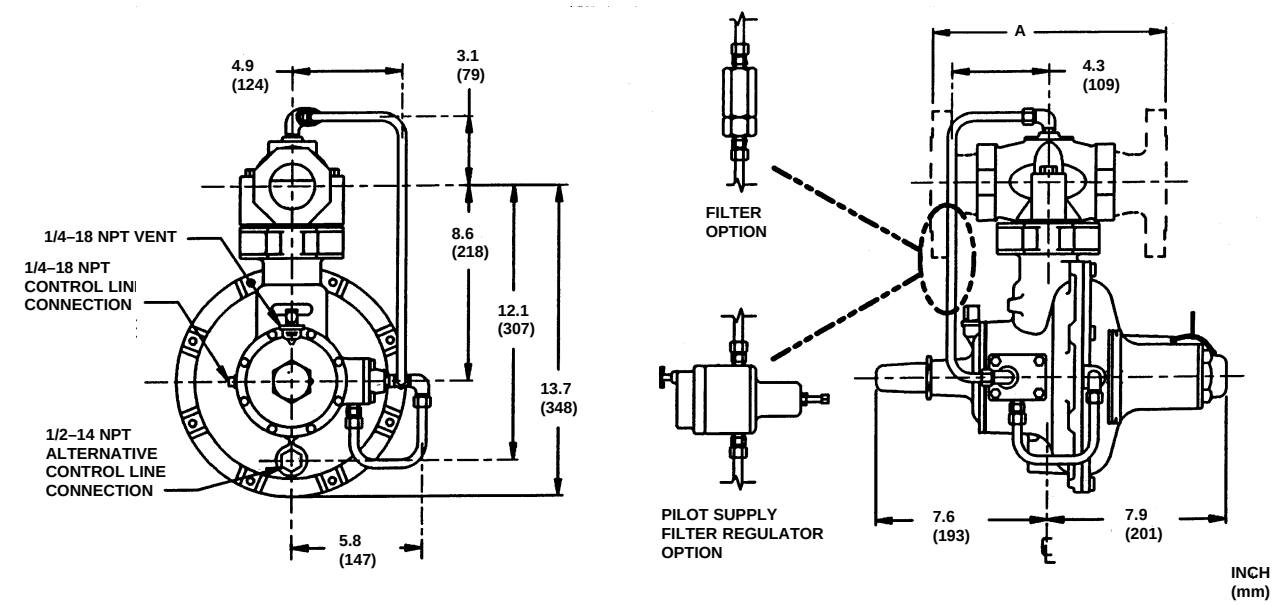


Figure 6. *Typical 5 PSIG (0.34 bar) Performance Curve*



BODY	A
1–1/2 NPT X 1–1/2 NPT	6.12 (155)
2 NPT X 2 NPT	6.12 (155)
2 IN CLASS 125 FF FLG	10.00 (254)
2 IN CLASS 250 RF FLG	10.50 (267)

Figure 7. *Type 299 Dimensions*

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