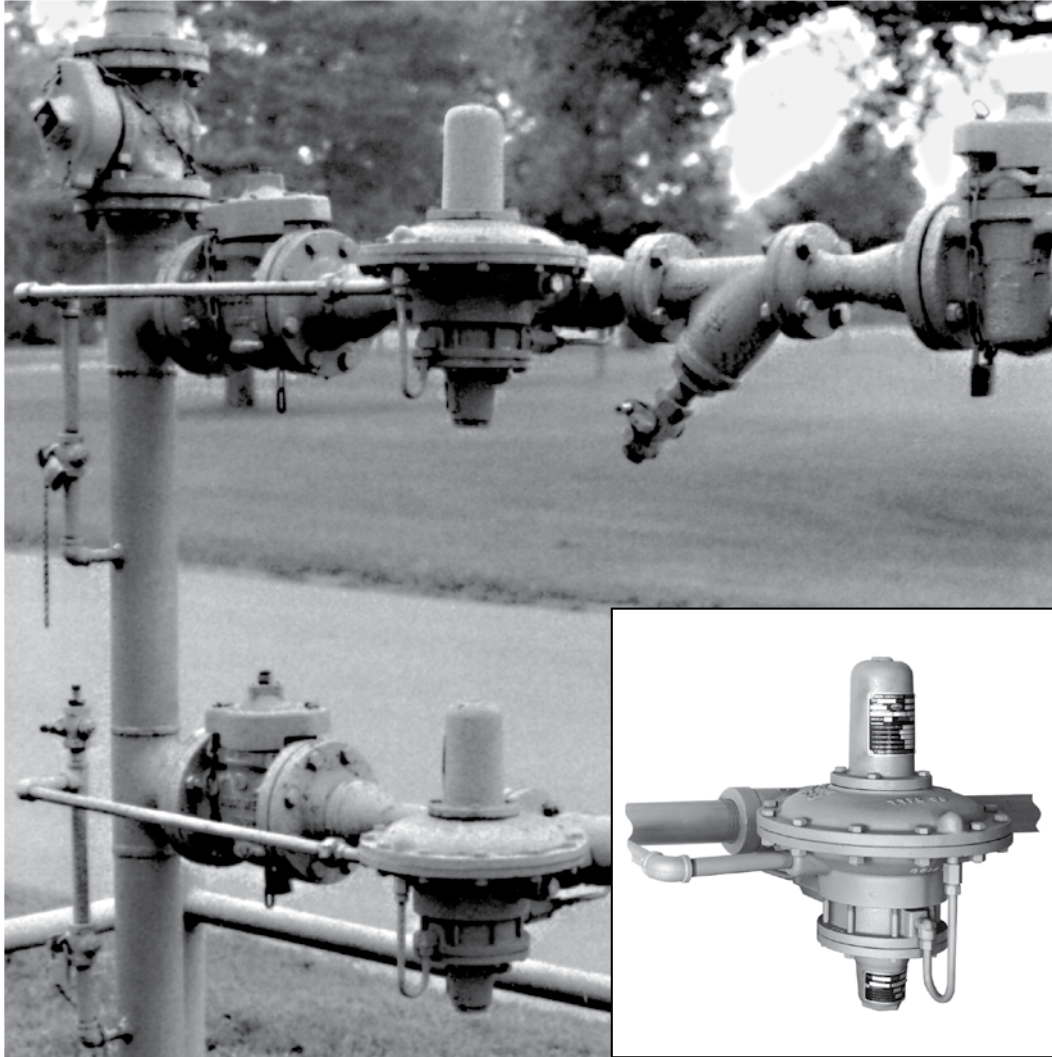


# Type 99 Pressure Reducing Regulator



W6527  
W2676

**Figure 1.** Typical Type 99 Regulator

## Introduction

The Type 99 gas regulators provide a broad capacity for controlled pressure ranges and capacities in a wide variety of distribution, industrial, and commercial applications.

A Type 99 regulator has Types 61L, 61LE, and 61LD (low pressure); Type 61H (high pressure); or

Type 61HP (extra high pressure) pilot integrally mounted to the actuator casing as shown in Figure 1. The Type 99 regulator can handle up to 1000 psig / 69.0 bar inlet pressure (the 1000 psig / 69.0 bar regulator requires a Type 1301F pilot supply regulator and a Type H110 pop relief valve).

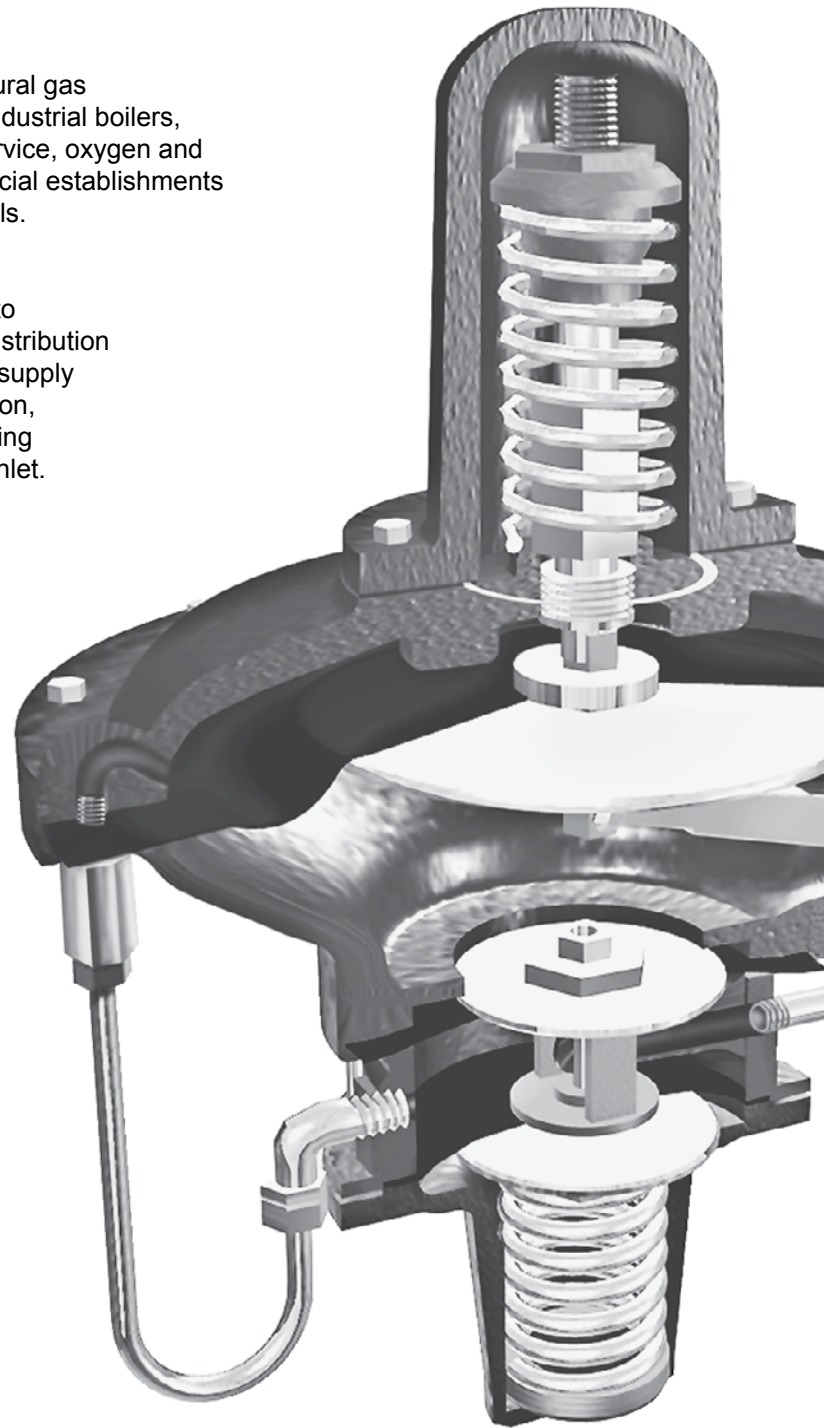


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## Features and Benefits

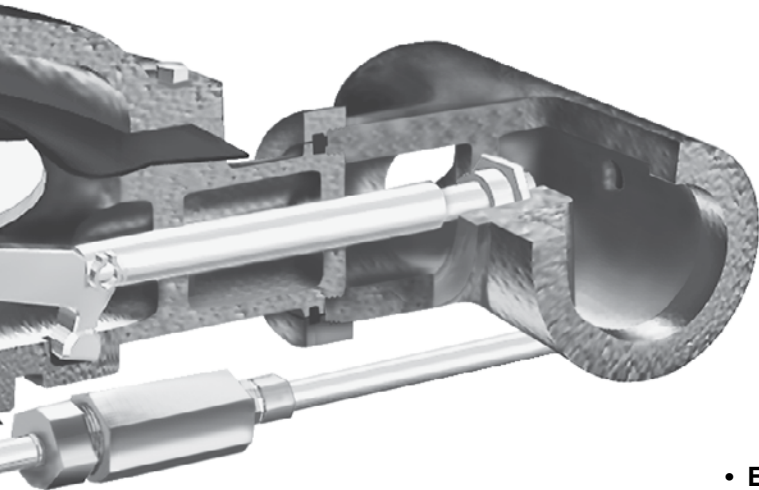
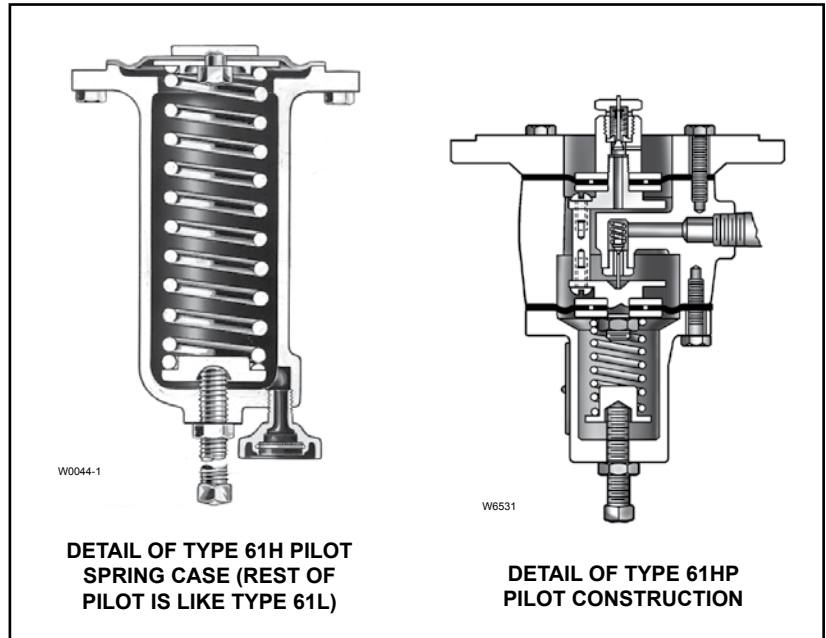
- **Wide Variety of Applications**—Natural gas distribution systems, gas supply to industrial boilers, furnaces, ovens, mixers, plant air service, oxygen and ammonia service, and large commercial establishments such as shopping centers and schools.
- **High Accuracy**—Keeps constant inlet pressures to 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.
- **No Atmospheric Bleed**—Loading pressure bleeds downstream through pilot via downstream control line. No bleed occurs when regulator is shut off.
- **Can Handle High Inlet Pressures**—Up to 1000 psig / 69.0 bar inlet pressures (the 1000 psig / 69.0 bar regulator requires a Type 1301F pilot supply regulator and a Type H110 pop relief valve).
- **Easily Modified for Special Service**—Types 61L and 61H pilot relay parts can be replaced with special orifices and springs for fast opening, fast closing, or monitoring applications.
- **Tight Shutoff**—Heavy main spring working through a lever provides a high seat loading force for tight shutoff.



W6529

**Figure 2.** Typical Type 99 Regulator with Type 61L (low-pressure pilot)

- 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.



- 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.

- Excellent Low Flow Control**—The Type 99 regulator has a wide turn-down range from very low flow to high outlet pressures. Settings range from 2-inches w.c. to 100 psig / 5 mbar to 6.9 bar.

- Easy to Maintain**—Valve disk and orifice can be inspected without removing body from pipeline. Union nut connection permits quick removal of actuator and pilot from body.

- Three Pilots to Choose From**—Type 61L (low pressure), Type 61H (high pressure), or Type 61HP (extra high pressure). Two versions of the Type 61L are available, Types 61LD and 61LE. Refer to Table 2 for approximate proportional bands. Pilots are integrally mounted to the actuator casing.

## Specifications

### Available Construction

**Type 99L:** Type 99 with Type 61L pilot which has 2-inches w.c. to 20 psig / 5 mbar to 1.4 bar pressure range.

**Type 99LD:** Type 99 with Type 61LD pilot which has a narrower proportional band than the standard Type 61L pilot.

**Type 99LE:** Type 99 with Type 61LE pilot which has a broader proportional band than the standard Type 61L pilot.

**Type 99H:** Type 99 with Type 61H pilot which has 10 to 65 psig / 0.69 to 4.5 pressure range.

**Type 99HP:** Type 99 with Type 61HP pilot which has 35 to 100 psig / 2.4 to 6.9 pressure range.

### Body Size and End Connection Styles

NPS 2 / DN 50 body with NPT, CL125 FF, CL150 RF, CL250 RF, CL300 RF end connections

### Maximum Allowable Inlet Pressure<sup>(1)</sup>

**160 psig / 11.0 bar:** Type 61LD pilot

**400 psig / 27.6 bar:** Types 61L, 61LE, and 61H pilots

**1000 psig / 69.0 bar:** Type 61HP pilot, along with Type 1301F pilot supply regulator and Type H110 relief valve (1/2-inch / 13 mm orifice only) See Table 3

### Maximum Pilot Spring Case Pressure for Pressure Loading<sup>(1)(2)</sup>

**Types 61L, 61LD and 61LE:** 50 psi / 3.4 bar with special steel closing cap

**Types 61H and 61HP:** 100 psi / 6.9 bar

### Outlet Pressure Ranges

See Table 1

### Approximate Proportional Bands

See Table 2

### Maximum Allowable Pressure Drop<sup>(1)</sup>

See Table 3

### Minimum Differential Pressure Required for Full Stroke

See Table 3

### Maximum Actuator Pressures<sup>(1)</sup>

**Operating:** 100 psig / 6.9 bar

**Emergency:** 110 psig / 7.6 bar

### Flow and Sizing Coefficients and Orifice Sizes

See Table 5

### Typical Regulating Capacities

See Table 6

### Maximum Rated Travel

1/4-inch / 6.4 mm

### Temperature Capabilities<sup>(1)</sup>

**With Nitrile (NBR) / Neoprene (CR) / Nylon (PA):**

-20 to 180°F / -29 to 82°C

**With Fluorocarbon (FKM):**

0 to 300°F / -18 to 149°C

### Type 99 Control Line and Pilot Connections

See Figure 13

### Approximate Weight

115 pounds / 52 kg

### Construction Materials

**Actuator Casing:** Cast iron

**Pilot Body and Spring Case:** Cast iron

**Actuator Diaphragm:** Nitrile (NBR) or Fluorocarbon (FKM)

**Upper and Lower Pilot Diaphragm**

*Types 61L and 61H:* Nitrile (NBR) or Fluorocarbon (FKM)

*Type 61HP:* Neoprene (CR) or Fluorocarbon (FKM)

**Main Valve Body**

*400 psig / 27.6 bar:* Cast iron or WCC Steel

*1000 psig / 69.0 bar:* WCC Steel

**Metal Trim Parts for Main Valve Body**

*400 psig / 27.6 bar:* Brass or Stainless steel

*1000 psig / 69.0 bar:* Stainless steel

**Elastomer Seats for Main Valve Body**

Neoprene (CR), Nitrile (NBR), Fluorocarbon (FKM)

Nylon (PA), or Polytetrafluoroethylene (PTFE)

**Metal Trim Parts for Pilot:** Steel, Stainless steel, Cast iron, Aluminum, Brass, or Zinc

**Elastomer Seats for Pilot:** Nitrile (NBR) or Fluorocarbon (FKM)

**Pilot Gaskets**

*Type 61L:* Neoprene (CR)

*Types 61H and 61HP:* Composition

**O-Rings:** Nitrile (NBR) or Fluorocarbon (FKM)

**P590 Series Filter**

*Type P594-1:* Brass

*Type P593-1:* Aluminum

*Replaceable Filter:* Cellulose

**Tubing and Fittings**

Copper or Stainless steel tubing and Brass, Steel, or Stainless steel fittings

**Type 1301F Pilot Supply Regulator**

*Body and Spring Case:* Brass

*Valve Disk:* Nylon (PA) / PTFE

*Gasket:* Neoprene (CR)

*Metal Trim Parts:* Brass or Stainless steel

**Type H110 Pop Relief Valve**

*Body:* Brass

*Disk:* Nitrile (NBR)

*Spring:* Stainless steel

### Additional Options

- 1000 psig / 69.0 bar Inlet Pressure Regulator
- O-Ring Stem Seal for Upstream Regulator
- Travel Indicator
- Electronic Remote Control Capability
- Handwheel for Type 61L Pilot

1. The pressure/temperature limits in this Bulletin and any applicable standard or code limitation should not be exceeded.

2. For stability or overpressure protection, a pilot supply regulator may be installed in the pilot supply tubing between the main valve and pilot.

**Table 1. Outlet Pressure Ranges**

PILOT TYPE	MAXIMUM PILOT SUPPLY PRESSURE		OUTLET PRESSURE RANGES		PILOT CONTROL SPRING					
	psig	bar	psig	bar	Part Number	Color Code	Wire Diameter		Free Length	
							Inches	mm	Inches	mm
61L	400	27.6	2 to 4-inches w.c. <sup>(1)</sup> 3 to 12-inches w.c. <sup>(1)</sup> 0.25 to 2	5 to 10 mbar <sup>(1)</sup> 7 to 30 mbar <sup>(1)</sup> 0.02 to 0.14	1B558527052	Orange	0.072	1.83	3.78	96.0
61LD	160	11.0			1 to 5	0.07 to 0.35	1C680627222	Unpainted	0.080	2.03
61LE	400	27.6	2 to 10	0.14 to 0.69	1B886327022	Red	0.109	2.77	2.75	69.9
					1J857827022	Yellow	0.142	3.61	2.75	69.9
					1B886427022	Blue	0.172	4.37	2.88	73.2
61H	400	27.6	10 to 65	0.69 to 4.5	1J857927142	Brown	0.187	4.75	3.03	77.0
					1B886527022	Green	0.207	5.26	3.13	79.5
61HP	600	41.4	35 to 100	2.4 to 6.9	0Y066427022	Green stripe	0.363	9.22	6.00	152
					1D387227022	Blue	0.200	5.08	1.69	42.9

1. Type 61LD pilot only.

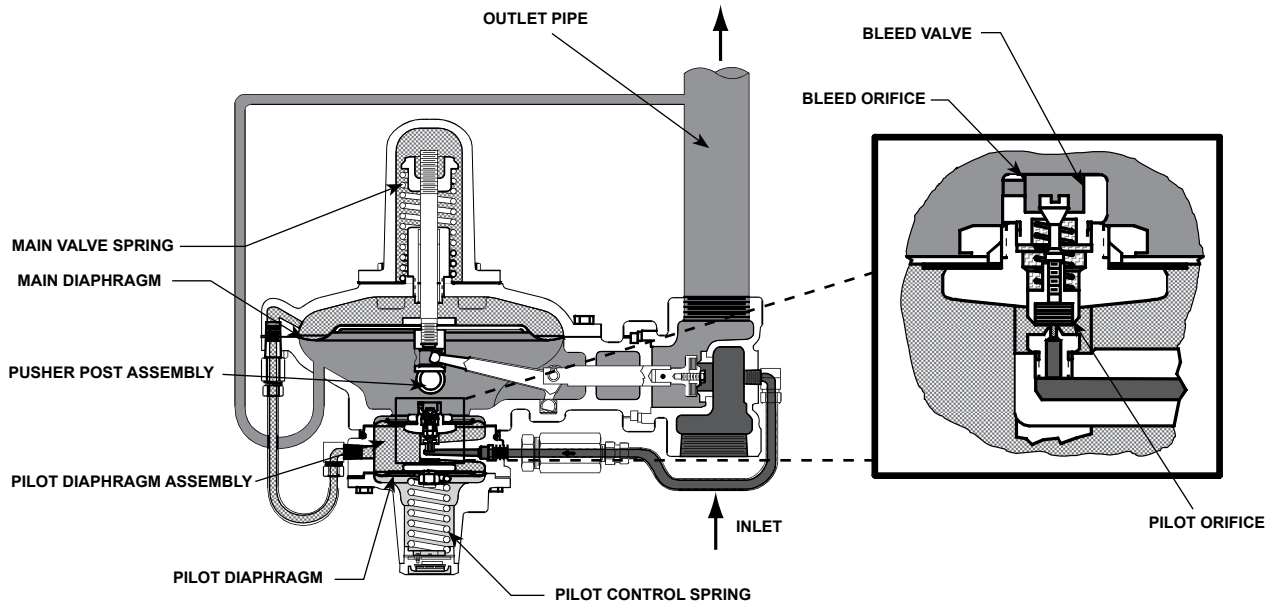
**Table 2. Approximate Proportional Bands**

PILOT TYPES	PILOT CONTROL SPRING						PROPORTIONAL BANDS	
	Part Number	Color Code	Wire Diameter		Free Length		Inches w.c.	mbar
			Inches	mm	Inches	mm		
61LD	1B558527052 1C680627222	Orange Unpainted	0.075 0.080	1.91 2.03	4.13 3.25	105 82.6	0.1 to 0.5	0.25 to 1
61L	1B886327022	Red	0.109	2.77	2.75	69.9	1 to 2	2 to 5
61LD	1B886327022	Red	0.109	2.77	2.75	69.9	0.25 to 1	0.62 to 2
61LE	1B886327022	Red	0.109	2.77	2.75	69.9	5 to 8	12 to 20
61L, 61LD, and 61LE	1J857827022 1B886427022 1J857927142 1B886527022	Yellow Blue Brown Green	0.142 0.172 0.187 0.207	3.61 4.37 4.75 5.26	2.75 2.88 2.88 3.13	69.9 73.2 73.2 79.5	0.1 to 0.3 psi	0.01 to 0.02 bar
61H	0Y066427022	Green stripe	0.363	9.22	6.00	152	0.1 to 0.3 psi	0.01 to 0.02 bar
61HP	1D387227022	Blue	0.200	5.08	1.69	42.9	1 to 2 psi	0.07 to 0.14 bar

**Table 3. Maximum Inlet Pressure, Allowable Pressure Drop, and Minimum Differential Pressures**

MAXIMUM ALLOWABLE INLET PRESSURE / PRESSURE DROP		MAIN VALVE SPRING				MINIMUM DIFFERENTIAL PRESSURE FOR FULL STROKE		DISK MATERIALS		MAXIMUM ORIFICE SIZE <sup>(1)(5)</sup>	
		Part Number	Wire Diameter		Free Length						
psig	bar		Inches	mm	Inches	mm	psig	bar	Inches	mm	
25	1.7	1C277127022	0.148	3.76	6	152	0.75	0.05	Nitrile Disk Type Option (NBR) and Fluorocarbon (FKM)	1-1/8	29
50	3.4	1N801927022	0.156	3.96	7.13	181	1.5	0.10	Neoprene (CR) and Fluorocarbon (FKM)	1-1/8	29
150	10.3	1B883327022	0.187	4.75	6.63	168	3	0.21	Nitrile O-ring Type Option (NBR), Neoprene (CR), and Fluorocarbon (FKM)	1-1/8	29
175 <sup>(2)</sup>	12.1 <sup>(2)</sup>	1B883327022	0.187	4.75	6.63	168	3	0.21	Nitrile O-ring Type Option (NBR), Neoprene (CR), and Fluorocarbon (FKM)	7/8	22
250	17.2	1B883327022	0.187	4.75	6.63	168	3	0.21	Neoprene (CR) and Fluorocarbon (FKM)	7/8	22
300	20.7	0W019127022	0.281	7.22	6	152	10	0.69	Nylon (PA)	1-1/8 <sup>(3)</sup>	29 <sup>(3)</sup>
400	27.6	0W019127022	0.281	7.22	6	152	10	0.69	Nylon (PA) and PTFE	7/8	22
1000	69.0	0W019127022	0.281	7.22	6	152	10	0.69	Nylon (PA)	1/2 <sup>(4)</sup>	13 <sup>(4)</sup>

1. Can use all orifice sizes up to maximum size listed. See Table 5.  
2. CL125 FF flanged body only.  
3. 1-1/8-inch / 29 mm is the only orifice available for 300 psig / 20.7 bar maximum inlet pressure regulator.  
4. 1/2-inch / 13 mm is the only orifice available for 1000 psig / 69.0 bar maximum inlet pressure regulator.  
5. O-ring seat construction is only available for 7/8 and 1-1/8-inch / 22 and 29 mm orifice sizes.



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- INLET PRESSURE
- OUTLET PRESSURE
- ATMOSPHERIC PRESSURE
- LOADING PRESSURE

**Figure 3.** Schematic of Type 99 Regulator with Type 61L (Low Pressure) Pilot

## Principle of Operation

The key to the operation of a Type 99 regulator is the yoked double-diaphragm pilot. Fast response and accuracy are made possible by the amplifying effect of the pressure-balanced 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 a characteristic of a two-path system.

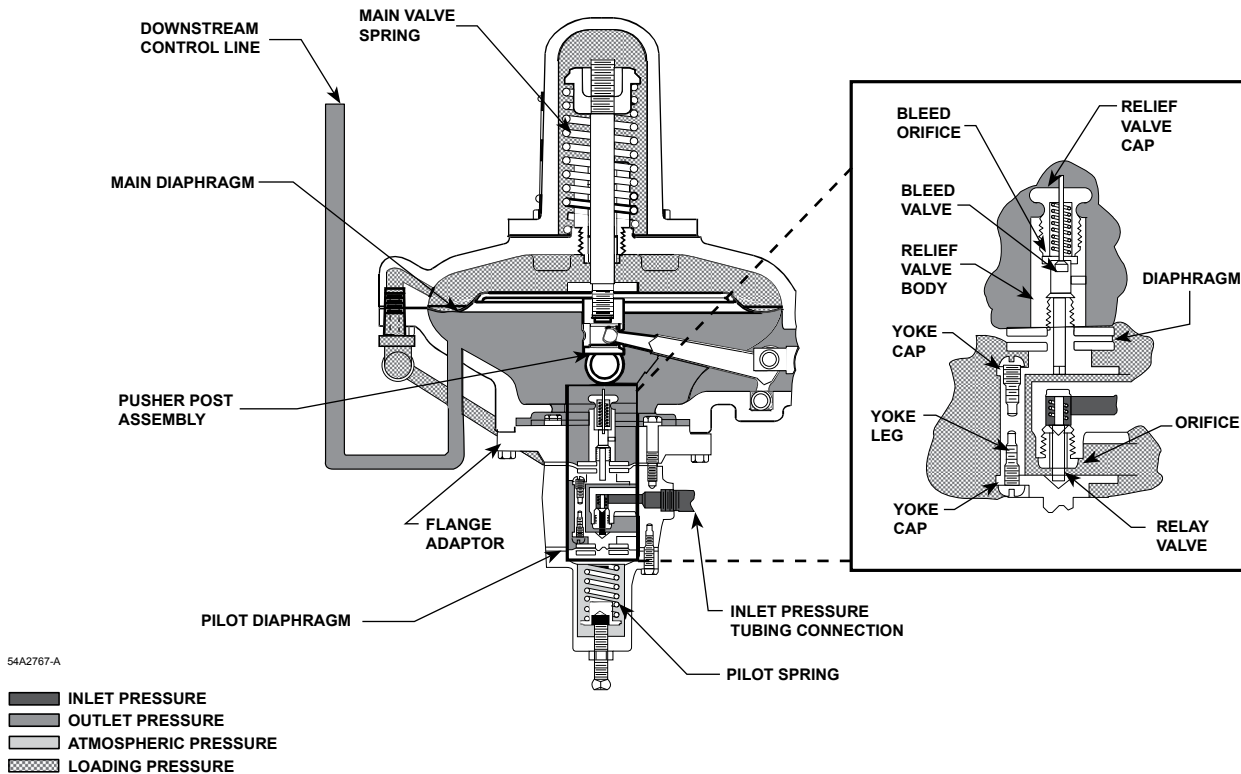
A typical pilot has an approximate gain of 20, which means the outlet pressure needs to droop only 1/20 as much as a direct-operated regulator in order to obtain the same pressure differences across the main diaphragm. Advantages of a pilot-operated regulator are high accuracy and high capacity.

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 through a filter assembly. Downstream or outlet pressure registers underneath the main diaphragm through the downstream control line.

In operation, assume the outlet pressure is less than the setting of the pilot control spring. The top side of the pilot diaphragm assembly will have a lower pressure than the setting of the spring. Spring forces the diaphragm head assembly upward, opening the relay or inlet orifice. Additional loading pressure is supplied to the pilot body and to the top side of the main diaphragm.

This creates a higher pressure on the top side of the main diaphragm 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 head assembly. This pressure exceeds the pilot spring setting and forces the head assembly down, closing orifice. The loading pressure acting on main diaphragm bleeds to the downstream system through a small slot between the pilot bleed valve and bleed orifice.



**Figure 4.** Schematic of Type 99 Regulator with Type 61HP (Extra High Pressure) Pilot

Normally, excess loading pressure slowly escapes downstream around the bleed valve (Figure 3) or through the relief valve body (Figure 4). Since loading pressure needs to exceed outlet pressure only moderately to stroke the main valve fully open, a continued increase in loading pressure differential extends the main diaphragm and the pusher post assembly far enough to separate the bleed valve and the bleed orifice. This action permits quick dumping of excess loading pressure into the downstream system.

With a decrease in loading pressure on top of the main diaphragm, the main spring exerts an upward force on the diaphragm rod connected to the main diaphragm, pulling it in an upwards direction. This moves the main valve towards its seat, decreasing the flow to the downstream system.

The pilot valve diaphragm acts as a sealing member for the loading chamber and as a balancing member to the upper pilot diaphragm. These two diaphragms are connected by a yoke so any pressure change in the pilot chamber has little effect on the position of the pilot valve. Therefore, the active diaphragm in the pilot is the upper pilot diaphragm and the pressure on the top side of this diaphragm opposes the force of the pilot control spring.

## Installation

Although the union nut permits the actuator and pilot to be mounted in any position relative to the body, the typical installation is with the body in a horizontal run of pipe and the pilot hanging vertically from the bottom of the actuator as shown in Figure 1.

Control and vent lines necessary for installation are not supplied with a Type 99 regulator. Control and vent connection locations are shown in Figures 13 to 15. In most applications, good piping practices will require that the outlet piping be swaged up a size 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 Figures 13 to 15.

## Construction Features

### Pilot Interchangeability

When higher or lower pressure control is required, the existing pilot can be changed to one that provides the desired range.

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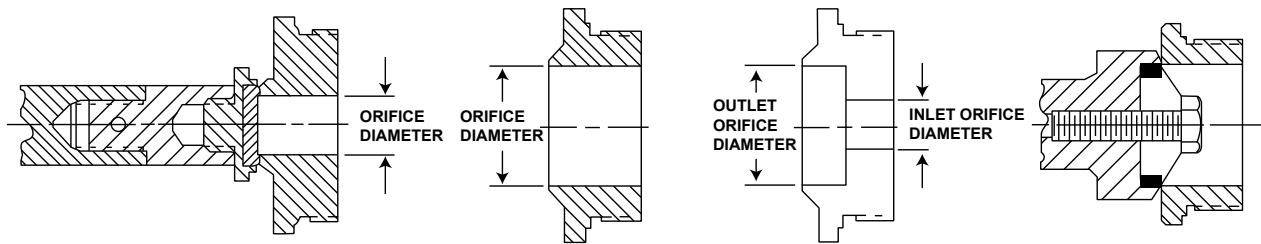
**Table 4. Working Monitor Performance**

Construction	MONITORING PILOT INFORMATION							MINIMUM PRESSURE AT WHICH WORKING MONITOR REGULATOR CAN BE SET
	Spring Range		Part Number	Pilot Spring				
	psig	bar		Wire Diameter		Free Length		
			Inches	mm	Inches	mm		
Type 161AYW with 1/8-inch / 3.2 mm orifice size and 150 psig / 10.3 bar maximum allowable inlet pressure	3 to 12-inches w.c.	7 to 30 mbar	1B653927022	0.105	2.67	3.750	95.2	3-inches w.c. / 7 mbar over normal distribution pressure
	11 to 25-inches w.c.	27 to 62 mbar	1B537027052	0.114	2.90	4.312	109	
	0.9 to 2.5 2.5 to 4.5 4.5 to 7	0.06 to 0.17 0.17 to 0.31 0.31 to 0.48	1B537127022 1B537227022 1B537327052	0.156 0.187 0.218	3.96 4.75 5.54	4.060 3.937 3.980	103 100 101	0.5 psi / 0.03 bar over normal distribution pressure
3/4 NPT Type 627-109 with 1/8-inch / 3.2 mm orifice size and 1000 psig / 69.0 bar maximum inlet pressure / body rating for ductile iron body	5 to 20 15 to 40	0.34 to 1.4 1.0 to 2.8	10B3076X012 10B3077X012	0.170 0.207	4.32 5.26	3.190 3.190	81.0 81.0	3.0 psi / 0.21 bar over normal distribution pressure
	35 to 80 70 to 150	2.1 to 5.5 4.8 to 10.3	10B3078X012 10B3079X012	0.262 0.313	6.65 7.95	3.200 3.070	81.3 78.0	5.0 psi / 0.34 bar over normal distribution pressure

**Table 5. Orifice Sizes and Flow and Sizing Coefficients**

TRIM CONSTRUCTION	ORIFICE SIZE		FOR RELIEF SIZING WIDE-OPEN C <sub>g</sub>	REGULATING C <sub>g</sub>	C <sub>1</sub>	K <sub>m</sub>	IEC SIZING COEFFICIENTS		
	INCHES	mm					X <sub>T</sub>	F <sub>D</sub>	F <sub>L</sub>
Restricted capacity trim, Straight bore — Elastomer disk seat only	1/2 <sup>(1)</sup> 3/4	13 <sup>(1)</sup> 19	200 425	155 330	35	0.79	0.78	0.50	0.89
Restricted capacity trim, Stepped bore — Elastomer disk seat only	7/8 x 3/8 7/8 x 1/2 7/8 x 5/8	22 x 9.5 22 x 13 22 x 16	115 200 300	110 190 280					
Full capacity trim, Elastomer disk, or O-ring seats	7/8 1-1/8	22 29	550 850	408 680					

1. 1/2-inch / 13 mm is the only orifice size available for 1000 psig / 69.0 bar maximum inlet pressure.



TYPICAL OF 1/2<sup>(1)</sup> RESTRICTED DISK SEAT DIAMETER

TYPICAL OF 7/8-INCH / 22 mm, 1-INCH / 25 mm, AND 1-1/8-INCH / 29 mm RESTRICTED DISK SEAT DIAMETERS

TYPICAL OF 7/8 x 3/8-INCH / 22 x 9.5 mm, 7/8 x 1/2-INCH / 22 x 13 mm, AND 7/8 x 5/8-INCH / 22 x 16 mm RESTRICTED DISK SEAT DIAMETERS<sup>(2)</sup>

TYPICAL OF 7/8-INCH / 22 mm AND 1-1/8-INCH / 29 mm O-RING SEAT DIAMETERS

NOTES: (1) 1/2-INCH / 13 mm ORIFICE SIZE CAN BE USED WITH TYPE 61HP PILOT ALONG WITH TYPE 1301F PILOT SUPPLY REGULATOR AND TYPE H110 RELIEF VALVE TO OBTAIN 1000 psig / 69.0 bar MAXIMUM INLET PRESSURE TO THE TYPE 99 MAIN VALVE.  
(2) FOR STEPPED ORIFICES, THE SIZE OF THE ORIFICE OUTLET DIAMETER AFFECTS THE MAXIMUM INLET PRESSURE.

**Figure 5. Type 99 Orifice Construction**



Type 99 lower castings accept either low or high pressure pilots without requiring separate mounting parts for each construction. When converting to an extra high pressure unit, an additional flange adapter will be required.

When a Type 61L (low pressure) pilot is ordered for field conversion to a Type 61H (high pressure) pilot or vice versa, the replacement pilot assembly comes complete with a pilot cover that must be removed before installing the replacement pilot on the existing regulator. The cover can then be installed on the removed pilot to form a complete Type 61L (low pressure) pilot or Type 61H (high pressure) pilot for use elsewhere.

## Choice of Shutoff

The Type 99 regulator body comes with either an elastomer disk that seats against a knife-edged orifice (Figure 3, 4, or 5), or an elastomer O-ring that seats against a flat orifice (Figure 5).

O-ring seats should be used when heavier main springs, larger orifice sizes and higher inlet pressures are encountered. The O-ring adapter will also seat against the orifice face creating a mechanical stop, where the knife-edged orifice can possibly cut through a disk damaging the seat and losing a tight shutoff.

The 1000 psig / 69.0 bar maximum inlet pressure regulator comes standard with a 1/2-inch / 13 mm disk seat. The lower inlet Type 99 regulators have a choice of three different restricted-diameter orifices and five different straight-bore orifices for unusually light loads or for minimizing relief requirements.

## 1000 psig / 69.0 bar Inlet Pressure Capability

The 1000 psig / 69.0 bar maximum inlet pressure regulator must have its Type H110 pop relief valve installed directly, or remotely by means of piping and an internal threaded coupling, into the 1/4 NPT side outlet of the supply regulator. The pilot supply regulator reduces inlet pressure to a usable 200 psig / 13.8 bar for the integral Type 61HP (extra high pressure) pilot. The relief valve is set to relieve if the reduced pressure from the pilot supply regulator exceeds 225 psig / 15.5 bar. This Type 99 regulator comes standard with O-ring seals on the guide bushing and the valve carrier assembly to keep the main valve body outlet pressure from interfering with outlet pressure registration in the lower actuator casing.

## Rugged Service Capability

High-temperature elastomers provide service capabilities up to 300°F / 149°C. Optional brass body and fluorocarbon (FKM) seat can be provided for special service requirements. Optional stainless steel trims and an aluminum filter can be ordered where hydrogen sulfide or other contaminants are present in the gas and where no brass or copper is permitted.

## Travel Indicator

An optional travel indicator (Figure 6) consists of an actuator spring case with an integrally cast indicator housing, an indicator disk enclosed in a clear housing, and an indicator plate graduated in percent of valve opening. This indicator assembly provides the capability to inspect for smooth travel without removing the regulator from service.

## Electronic Remote Control Capability

When remote adjustment of the pilot control spring setting is desired, the Type 662 remote control pilot drive units (Figure 7) are available. This Type 662 unit mounts to the pilot and accept a variety of electrical inputs. The Type 662 remote control pilot drive unit uses electronic signals to switch its motor on and off. This motor, which turns the pilot adjusting screw, changes the spring compression to increase or decrease the pilot's outlet pressure. The design provides a smooth, highly accurate positioning with a positive locking force when the unit is not in motion.

## Pressure Loading Flexibility

Type 99 pilot spring cases can be pressure loaded for applications involving differential pressure control or remote pneumatic adjustment of the downstream pressure setting (Figure 8). If the system loading pressure fails, the pilot's outlet pressure will be maintained by the pilot control spring setting.

Type 99 pilots are provided with a 1/4 NPT tapped connection in the spring case. Low pressure pilots additionally can be furnished with a handwheel (Figure 9) for precise manual trimming of the final pressure setting. Outlet pressure is the sum of the spring setting and the loading pressure.



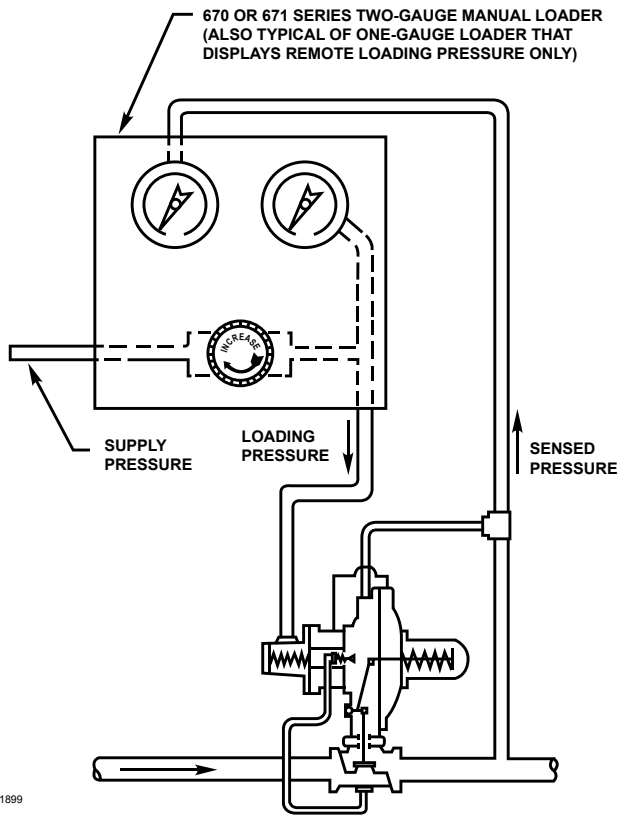
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**Figure 6.** Optional Travel Indicator



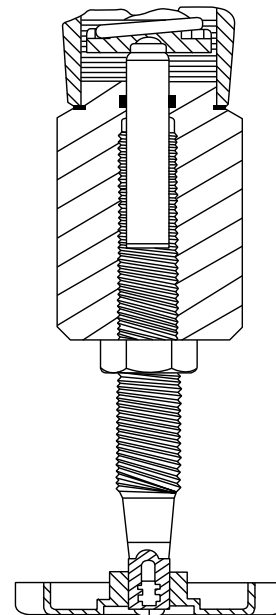
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**Figure 7.** Optional Type 662 Jordan Remote Control Pilot Drive



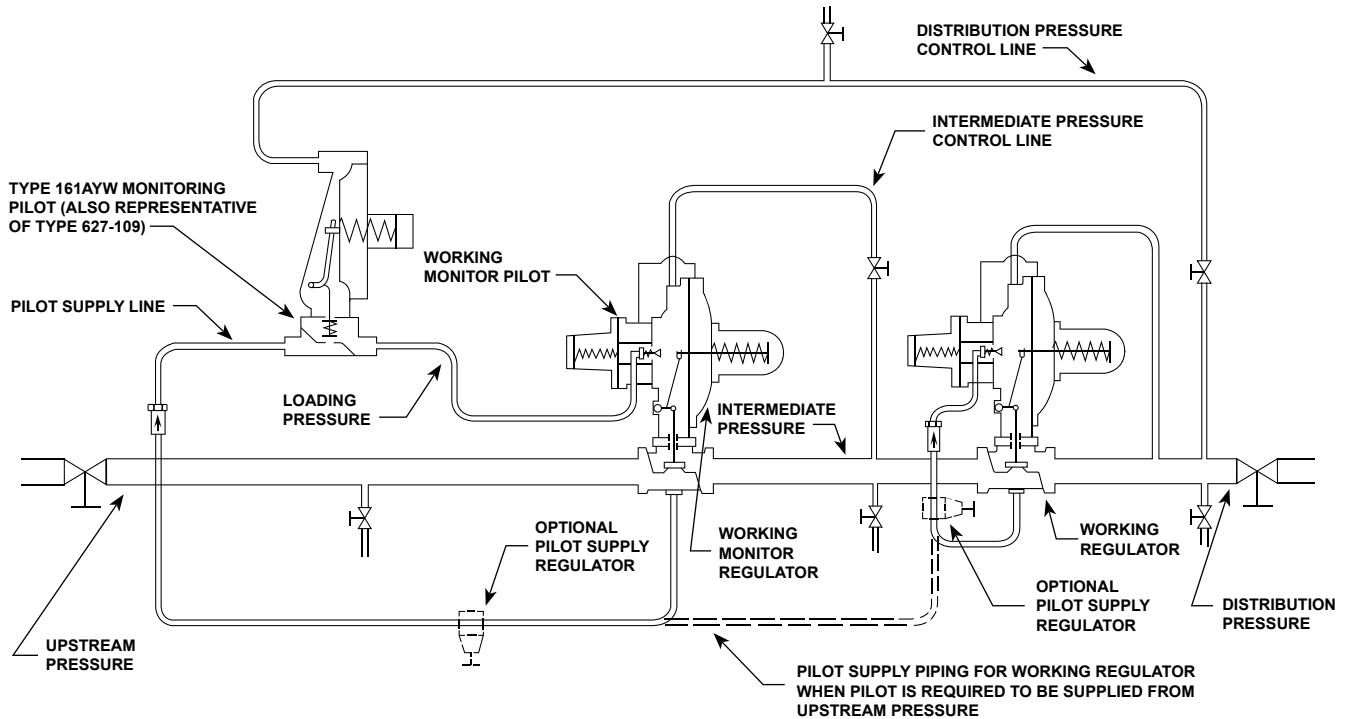
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**Figure 8.** Pneumatic Remote Adjustment Installation



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**Figure 9.** Type 61L (Low Pressure) Handwheel



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Figure 10. Working Monitor Installation

## Monitoring Systems for Safety

Monitoring regulators serve as overpressure protection devices to limit the system's pressure in the event of an open failure of a working regulator feeding the system. Two methods of using Type 99 regulators in monitoring applications are:

### Working Monitor

On a working monitor installation (Figure 10), the control line of the monitoring pilot is connected downstream of the working regulator. During normal operation, distribution pressure causes the monitoring pilot to stand wide open. Full pilot supply pressure enters the working monitor pilot and permits the working monitor regulator to control at its intermediate pressure setting.

Open failure of the working regulator increases intermediate pressure as the working regulator goes wide open. Intermediate pressure is then ignored by the monitoring regulator, which controls downstream pressure at its own pressure setting (slightly higher than the normal control pressure).

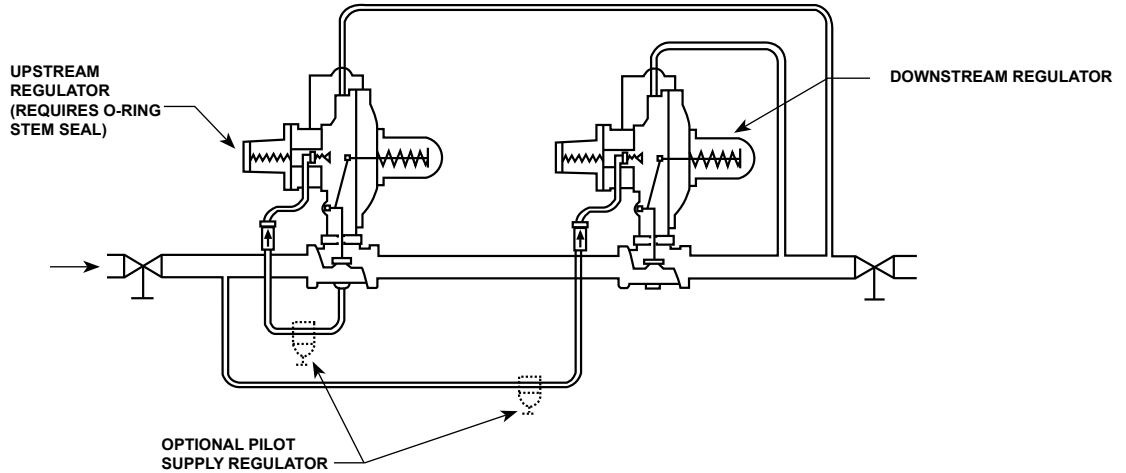
The monitoring pilot should be upstream of the working monitor regulator. This enables a closer

setpoint between the working regulator and the monitoring pilot. Special Types 161AYW and 627-109 monitoring pilots with quick-bleed operation have been designed to give faster response to abnormal downstream conditions. Table 4 gives the spread between normal distribution pressure and the minimum pressure at which the working monitor regulator can be set to take over if the working regulator fails open.

### Wide-Open Monitor

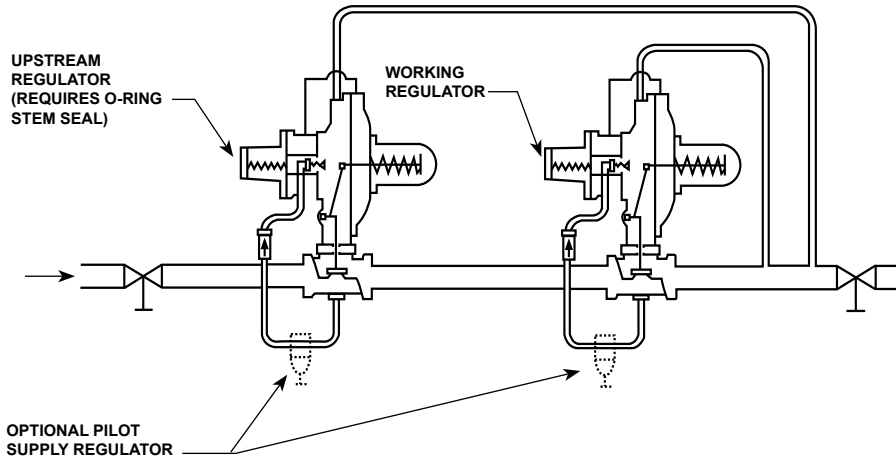
The control line of the upstream regulator is connected to the outlet of the downstream regulator (Figure 11), so that during normal operation the monitoring regulator is standing wide open with the reduction to downstream pressure being taken across the working regulator. Only in case of open failure of the working regulator does the wide-open monitoring regulator take control at its slightly higher setting. The wide-open monitor setup may be used with either the upstream or downstream regulator acting as the monitor.

The upstream regulator must be ordered with an O-ring seal (Figure 12) on the valve carrier assembly. This seals off the leak path that otherwise would let line pressure ahead of the working regulator inlet try to close the wide-open monitoring regulator.



10A1386-A

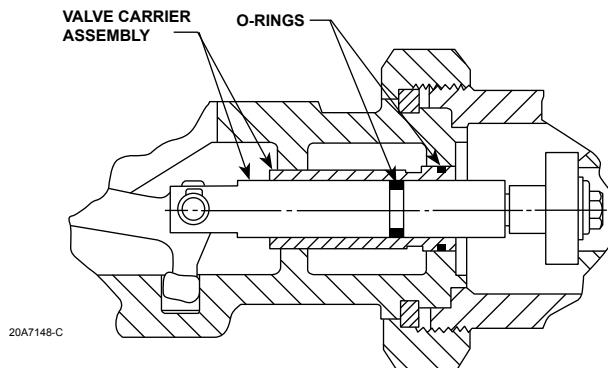
**FLEXIBLE ARRANGEMENT THAT PERMITS WIDE-OPEN MONITOR TO BE EITHER UPSTREAM OR DOWNSTREAM**



10A1388-A

**MINIMUM PIPING WIDE-OPEN MONITOR ARRANGEMENT THAT REQUIRES WIDE-OPEN MONITOR TO ALWAYS BE UPSTREAM**

**Figure 11. Typical Wide-Open Monitor Installations**



20A7148-C

**Figure 12. O-Ring Seal Construction**

## Overpressure Protection

The Type 99 has outlet pressure ratings lower than the inlet pressure ratings. Complete downstream overpressure protection is required if the actual inlet pressure can exceed the regulator outlet pressure rating or the pressure ratings of any downstream equipment.

On the 1000 psig / 69.0 bar maximum inlet pressure regulator, the Type H110 relief valve provides sufficient relief capacity to protect the Type 61HP (extra high pressure) pilot in case the Type 1301F pilot supply regulator fails open. This pressure relief protection is insufficient if the main valve fails open. Downstream overpressure protection is still required.

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.

Refer to the relief sizing coefficients and the capacity information section in Tables 5 and 6 to determine the required relief valve capacity.

## Capacity Information

### Note

**Flow capacities are laboratory verified; therefore, regulators may be sized for 100% flow published capacities. It is not necessary to reduce published capacities.**

Table 6 gives Type 99 natural gas regulating capacities at selected inlet pressures and outlet pressure settings. Flows are in thousands of SCFH (at 60°F and 14.7 psia) and of Nm<sup>3</sup>/h (at 0°C and 1.01325 bar) of 0.6 specific gravity natural gas.

To determine equivalent capacities for air, propane, butane, or nitrogen, multiply the SCFH capacity values in Table 6 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 Nm<sup>3</sup>/h, multiply SCFH by 0.0268.

To obtain the published capacities, the inlet and outlet piping should be the same as the regulator body size.

To find approximate regulating capacities at pressure settings not given in Table 6 or to find wide-open flow capacities for relief sizing at any inlet pressure, perform one of the following procedures. Then, if necessary, convert using the factors provided above.

For critical pressure drops (absolute outlet pressure equal to or less than one-half of absolute inlet pressure), use the following formula:

$$Q = (P_{1abs})(C_g)(1.29)$$

For pressure drops lower than critical (absolute outlet pressure greater than one-half of absolute inlet pressure).

$$Q = \sqrt{\frac{520}{GT}} C_g P_{1abs} \text{SIN} \left( \frac{3417}{C_1} \sqrt{\frac{\Delta P}{P_{1abs}}} \right) \text{DEG}$$

where,

- Q = gas flow rate, SCFH
- P<sub>1abs</sub> = absolute inlet pressure, psia (P<sub>1</sub> gauge + 14.7)
- C<sub>g</sub> = regulating or wide-open gas sizing coefficient from Table 5
- G = specific gravity of the gas
- T = absolute temperature of gas at inlet, °Rankine
- C<sub>1</sub> = flow coefficient (C<sub>g</sub>/C<sub>v</sub>)
- ΔP = pressure drop across the regulator, psi

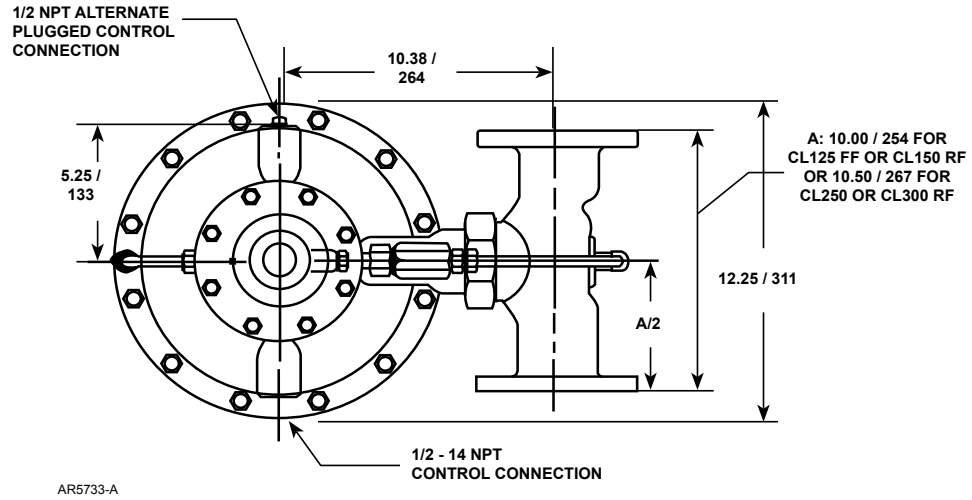
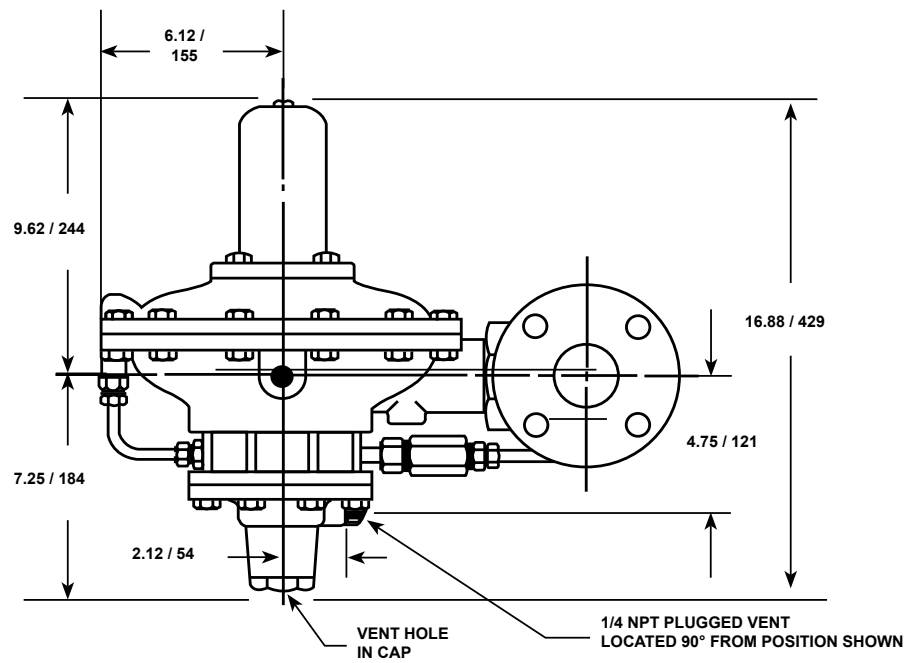
Then, if capacity is desired in Nm<sup>3</sup>/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.



**Table 6. Capacities of Type 99 Regulators (Full Capacity) (continued)**

ORIFICE SIZE		INLET PRESSURE		CAPACITIES <sup>(1)</sup> IN THOUSANDS OF SCFH / Nm <sup>3</sup> /h OF 0.6 SPECIFIC GRAVITY NATURAL GAS <sup>(2)</sup>																																					
INCHES	mm	psig	bar	Outlet Pressure, psig / bar																																					
				15 / 1.0		20 / 1.4		25 / 1.7		30 / 2.1		35 / 2.4		40 / 2.8		45 / 3.1		50 / 3.5		60 / 4.1		75 / 5.2		100 / 6.9																	
				SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h	SCFH	Nm <sup>3</sup> /h																
7/8	22	5	0.34																																						
		6	0.41																																						
		7	0.48																																						
		8	0.55																																						
		9	0.62																																						
		10	0.69																																						
		15	1.0																																						
		20	1.4																	10.8	0.3																				
		25	1.7																	16.2	0.4	12	0.3																		
		30	2.1																	20	0.5	17	0.5	12.5	0.3																
		35	2.4																	24	0.6	21	0.6	18	0.5	13	0.3														
		40	2.8																	28	0.8	26	0.7	23	0.6	19	0.5	14.4	0.4												
		50	3.4																	34	0.9	34	0.9	31	0.8	28	0.8	25	0.7	21	0.6	15.5	0.4								
		60	4.1																	42	1.1	42	1.1	42	1.1	37	1.0	35	0.9	30	0.8	27	0.7	23	0.6						
		75	5.2																	47	1.3	47	1.3	47	1.3	47	1.3	47	1.3	45	1.2	41	1.1	37	1.0	30	0.8				
		100	6.9																	59	1.6	59	1.6	59	1.6	59	1.6	59	1.6	59	1.6	59	1.6	59	1.6	53	1.4	44	1.2		
		125	8.6																	73	2.0	73	2.0	73	2.0	73	2.0	73	2.0	73	2.0	73	2.0	73	2.0	73	2.0	66	1.8	48	1.3
		150	10.3																	86	2.3	86	2.3	86	2.3	86	2.3	86	2.3	86	2.3	86	2.3	86	2.3	86	2.3	86	2.3	72	1.9
		175	12.1																	96	2.6	96	2.6	96	2.6	96	2.6	96	2.6	96	2.6	96	2.6	96	2.6	96	2.6	96	2.6	93	2.5
		200	13.8																	108	2.9	108	2.9	108	2.9	108	2.9	108	2.9	108	2.9	108	2.9	108	2.9	108	2.9	108	2.9	108	2.9
		225	15.5																	123	3.3	123	3.3	123	3.3	123	3.3	123	3.3	123	3.3	123	3.3	123	3.3	123	3.3	123	3.3	123	3.3
		250	17.2																	132	3.5	132	3.5	132	3.5	132	3.5	132	3.5	132	3.5	132	3.5	132	3.5	132	3.5	132	3.5	132	3.5
		300	20.7																	162	4.3	162	4.3	162	4.3	162	4.3	162	4.3	162	4.3	162	4.3	162	4.3	162	4.3	162	4.3	162	4.3
		350	24.1																	188	5.0	188	5.0	188	5.0	188	5.0	188	5.0	188	5.0	188	5.0	188	5.0	188	5.0	188	5.0	188	5.0
400	27.6	215	5.8	215	5.8	215	5.8	215	5.8	215	5.8	215	5.8	215	5.8	215	5.8	215	5.8	215	5.8	215	5.8																		
1-1/8	29	1	0.07																																						
		2	0.14																																						
		3	0.21																																						
		4	0.28																																						
		5	0.35																																						
		6	0.41																																						
		7	0.48																																						
		8	0.55																																						
		9	0.62																																						
		10	0.69																																						
		15	1.0																																						
		20	1.4																	18	0.5																				
		25	1.7																	27	0.7	20	0.5																		
		30	2.1																	34	0.9	28	0.8	21	0.6																
		35	2.4																	40	1.1	35	0.9	30	0.8	22	0.6														
		40	2.8																	47	1.3	43	1.2	38	1.0	32	0.9	24	0.6												
		50	3.4																	57	1.5	57	1.5	52	1.4	47	1.3	42	1.1	35	0.9	26	0.7								
		60	4.2																	65	1.7	65	1.7	65	1.7	62	1.7	58	1.6	50	1.3	45	1.2	38	1.0						
		75	5.2																	78	2.1	78	2.1	78	2.1	78	2.1	78	2.1	74	2.0	68	1.8	50	1.3	32	0.9				
		100	6.9																	99	2.7	99	2.7	99	2.7	99	2.7	99	2.7	99	2.7	99	2.7	99	2.7	99	2.7	88	2.4		
		125	8.6																	122	3.3	122	3.3	122	3.3	122	3.3	122	3.3	122	3.3	122	3.3	122	3.3	122	3.3	122	3.3	80	2.1
		150	10.3																	143	3.8	143	3.8	143	3.8	143	3.8	143	3.8	143	3.8	143	3.8	143	3.8	143	3.8	143	3.8	120	3.2
		175	12.1																	160	4.3	160	4.3	160	4.3	160	4.3	160	4.3	160	4.3	160	4.3	160	4.3	160	4.3	160	4.3	155	4.2
		200	13.8																	180	4.8	180	4.8	180	4.8	180	4.8	180	4.8	180	4.8	180	4.8	180	4.8	180	4.8	180	4.8	180	4.8
225	15.5	205	5.5	205	5.5	205	5.5	205	5.5	205	5.5	205	5.5	205	5.5	205	5.5	205	5.5	205	5.5	205	5.5																		
250	17.2	220	5.9	220	5.9	220	5.9	220	5.9	220	5.9	220	5.9	220	5.9	220	5.9	220	5.9	220	5.9	220	5.9																		
300	20.7	265	7.1	265	7.1	265	7.1	265	7.1	265	7.1	265	7.1	265	7.1	265	7.1	265	7.1	265	7.1	265	7.1																		
		Type 61L Pilot										Type 61H Pilot																													
												Type 61HP Pilot																													

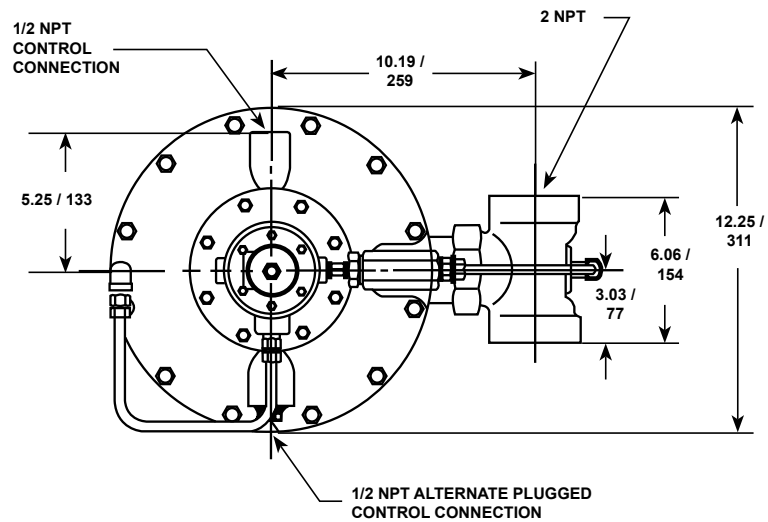
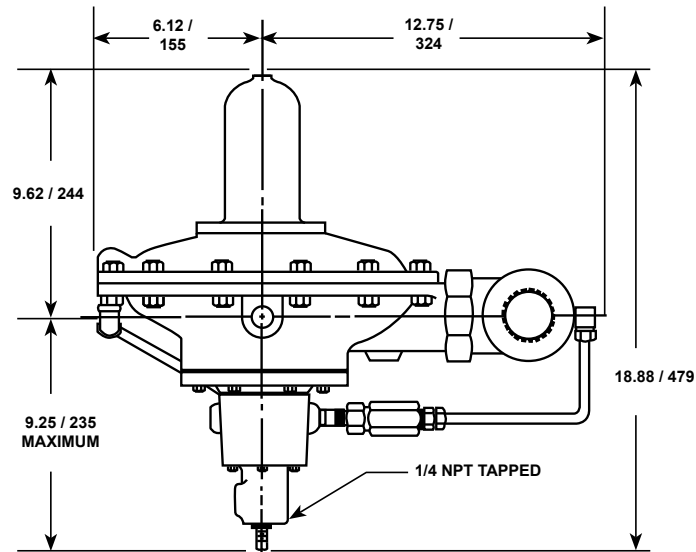
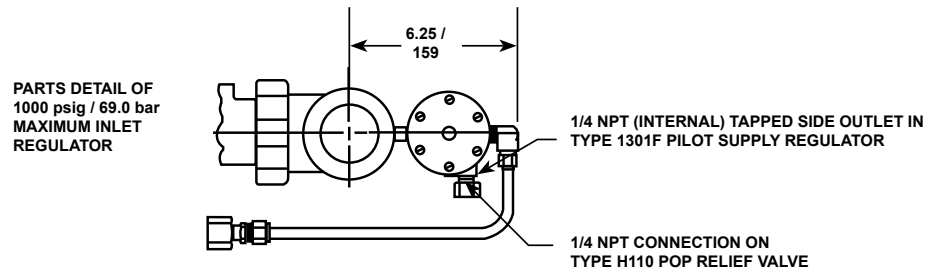
1. When sizing a regulator, always use the lowest inlet pressure, the highest outlet pressure, and the maximum capacity desired.  
 2. Requires 0.75 psig / 0.05 bar minimum differential pressure construction.  
 Black areas show no capacity due to differential pressure requirement.



INCHES / mm

Figure 13. Type 99 (Flanged) with Type 61L Pilot Dimensions

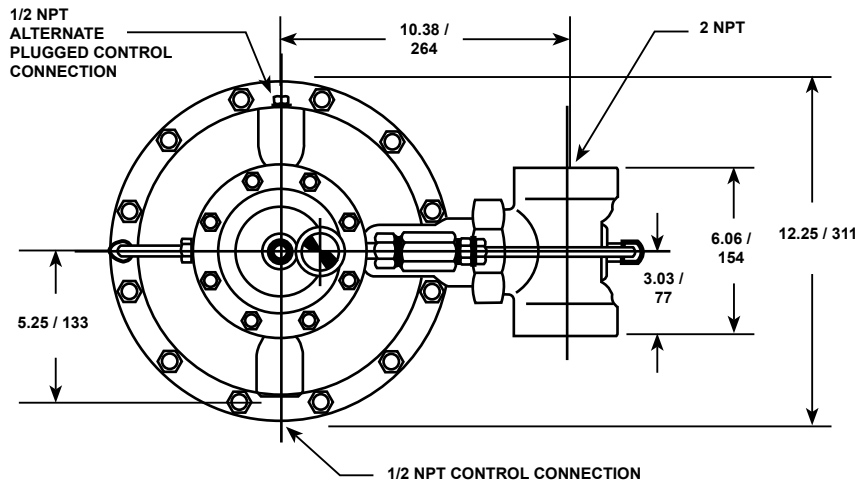
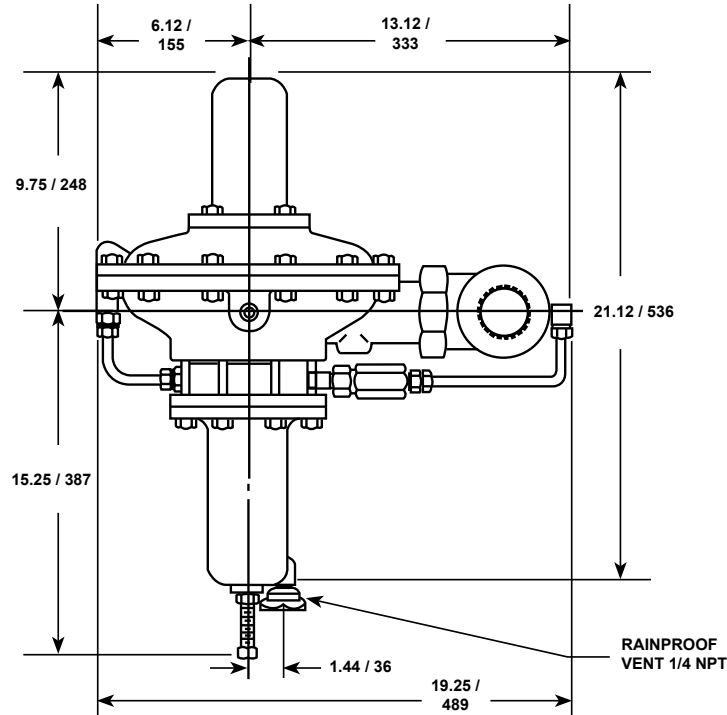




A6800

INCHES / mm

Figure 14. Type 99 (NPT) with Type 61HP Pilot Dimensions



99761

INCHES / mm

**Figure 15.** Type 99 (NPT) with Type 61H Pilot Dimensions

## Ordering Information

Use the Specifications section and carefully review the description to the right of each specification. Use this information to complete the Ordering Guide on

the next page. Specify the desired selection wherever there is a choice to be made. Then send the Ordering Guide to your local Sales Office.

## Ordering Guide

### Body Material and End Connection Style

(Select One)

#### NPS 2 / DN 50 Cast Iron Body

- NPT\*\*\*
- CL125 FF\*\*\*
- CL250 RF\*\*\*

#### NPS 2 / DN 50 WCC Steel Body

- NPT\*\*\*
- CL150 RF\*\*
- CL300 RF\*\*
- SWE\*

#### NPS 2 Brass Body

- NPT\*\*

### Orifice Size (Select One)

- 1/2-inch / 13 mm\*\*\*
- 3/4-inch / 19 mm\*\*\*
- 7/8-inch / 22 mm\*\*\*
- 1-1/8-inch / 29 mm\*\*\*
- 7/8 x 3/8-inch / 22 x 9.53 mm\*
- 7/8 x 1/2-inch / 22 x 13 mm\*\*
- 7/8 x 5/8-inch / 22 x 16 mm\*\*

### Trim Material Main Valve and Pilot (Select One)

- Brass with disk seat (**standard**)\*\*\*
- Stainless steel with disk seat\*\*
- Brass with O-ring seat  
(7/8 and 1-1/8-inch / 22 and 29 mm orifice)\*\*\*
- Stainless steel with O-ring seat  
(7/8 and 1-1/8-inch / 22 and 29 mm orifice)\*\*

### Seat Material (Select One)

- Nitrile (NBR)\*\*\*
- Neoprene (CR)\*\*
- Nylon (PA)\*\*
- Fluorocarbon (FKM)\*\*
- PTFE\*\*

### Main Valve Spring (Select One)

#### Maximum Allowable Drop and Spring Part Number

- 25 psig / 1.72 bar, 1C277127022\*\*\*
- 50 psig / 3.4 bar, 1N801927022\*\*\*
- 100 psig / 6.9 bar, 1B883327022\*\*\*
- 150 psig / 10.3 bar, 1B883327022\*\*\*
- 175 psig / 12.1 bar, 1B883327022\*\*\*

### Main Valve Spring (Select One)

#### Maximum Allowable Drop and Spring Part Number (continued)

- 250 psig / 17.2 bar, 1B883327022\*\*\*
- 300 psig / 20.7 bar, 0W019127022\*\*
- 400 psig / 27.6 bar, 0W019127022\*\*
- 1000 psig / 69.0 bar, 0W019127022\*\*

### Tubing and Fittings (Select One)

- Copper tubing and brass fittings (**standard**)\*\*\*
- Stainless steel tubing and steel fittings\*\*
- Stainless steel tubing and stainless steel fittings\*\*

### Outlet Pressure Ranges (Select One)

- 2 to 4-inches w.c. / 5 to 10 mbar, Orange\*
- 3 to 12-inches w.c. / 7 to 30 mbar, Unpainted\*\*\*
- 0.25 to 2 psig / 0.02 to 0.14 bar, Red\*\*\*
- 1 to 5 psig / 0.07 to 0.34 bar, Yellow\*\*\*
- 2 to 10 psig / 0.14 to 0.69 bar, Blue\*\*
- 5 to 15 psig / 0.34 to 1.0 bar, Brown\*\*\*
- 10 to 20 psig / 0.69 to 1.4 bar, Green\*\*
- 10 to 65 psig / 0.69 to 4.5 bar, Green stripe\*\*\*
- 35 to 100 psig / 2.4 to 6.9 bar, Blue\*\*\*

### Upstream Regulator O-Ring Stem Seal (Optional)

- Yes

### Travel Indicator (Optional)

- Yes

### Electronic Remote Control Capability (Optional)

- Yes

## Ordering Guide (continued)

### Handwheel for Type 61L Pilot (Optional)

- Yes

### Main Valve Parts Kit (Optional)

- Yes, please send me one parts kit to match this order.

### Pilot Parts Kit (Optional)

- Yes, please send me one parts kit to match this order.

Regulators Quick Order Guide	
***	Readily Available for Shipment
**	Allow Additional Time for Shipment
*	Special Order, Constructed from Non-Stocked Parts. Consult your local Sales Office for Availability.
Availability of the product being ordered is determined by the component with the longest shipping time for the requested construction.	

Specification Worksheet	
<b>Application:</b>	
Specific Use	_____
Line Size	_____
Gas Type and Specific Gravity	_____
Gas Temperature	_____
Does the Application Require Overpressure Protection?	
<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, which is preferred:	
<input type="checkbox"/> Relief Valve <input type="checkbox"/> Monitor Regulator <input type="checkbox"/> Shutoff Device	
Is overpressure protection equipment selection assistance desired? _____	
<b>Pressure:</b>	
Maximum Inlet Pressure (P <sub>1max</sub> )	_____
Minimum Inlet Pressure (P <sub>1min</sub> )	_____
Downstream Pressure Setting(s) (P <sub>2</sub> )	_____
Maximum Flow (Q <sub>max</sub> )	_____
<b>Performance Required:</b>	
Accuracy Requirements?	_____
Need for Extremely Fast Response?	_____
<b>Other Requirements:</b> _____	
_____	

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