July 2010

Types 1808 and 1808A Pilot-Operated Relief Valves or Backpressure Regulators

W3716

TYPE 1808

W3507

TYPE 1808A

Figure 1. *Types 1808 and 1808A Pilot-Operated Relief Valves or Backpressure Regulators*

Introduction

The Type 1808 globe-style and the Type 1808A angle-style, pilot-operated relief valves or backpressure regulators are economical, compact devices used in gas or liquid service to maintain pressure on oil and gas separators, and in pressure relief applications in gas distribution systems. The Types 1808 and 1808A are available with either a Type 6358 or 6358B pilot. The Type 6358 pilot is used in gas or liquid backpressure applications throughout the oil and gas production industry. This pilot offers a low bleed construction so it only bleeds when it is repositioning the main valve. Pressure relief applications in the oil and gas industry are typically handled by the Type 6358B pilot. This pilot has a bleed restriction to reduce the buildup pressure required to reach wide-open flow. These units control pressures from 3 to 125 psig (0,21 to 8,6 bar), and the set pressure is varied to individual requirements by the adjusting screw on the pilot. On gas service, the pilot exhaust can be piped into the downstream piping or vented to atmosphere. On liquid service, the pilot exhaust should be piped into the downstream piping or to a safe location.

Features

- **Simple, Reliable Design**—Units have fewer parts for reliable service and minimum spare parts inventory.
- **Compact and Lightweight**—Less than 12-inches (305 mm) tall and weighs 25 pounds (11 kg) or less, these units are easily transported and installed where space is limited.
- **Simplified, Convenient Installation in Any Position**—Pressure connection in diaphragm casings and factory-piped pilot tubing mean no upstream control line is required on standard installations. There are no mounting restrictions to limit service.
- **Versatility in Both Liquid and Gas Service**—Pilot exhaust port and standard tapped pilot spring case (Figure 2) both come with removable vent for remote piping when necessary. The standard tapped pilot spring case comes complete with a gasketed closing cap that permits pressure loading for remote pneumatic adjustment of the set pressure.

D100163X012

Specifications

Available Configurations
See Table 1

Body Size and End Connection Style
2 NPT

Maximum Relief (Inlet) Pressure[1]
150 psig (10,3 bar) including buildup

Set Pressure Range
See Table 2

Differential Pressures
Maximum: 125 psig (8,6 bar)
Minimum: 5 psig (0,34 bar)

Type 6358 Pilot Bleed
Bleeds only when repositioning the main valve

Type 6358B Pilot Bleed
Continuously bleeds while inlet pressure is above set pressure

Flow and Sizing Coefficients
See Table 3

Main Valve Flow Capacities
See Tables 4 and 5 and Capacity Information section

Pressure Registration
Internal **(standard)** or External (optional)

Pilot Tubing and Connections
1/4 NPT with or without P590 Series filter

Temperature Capabilities[1]
-20° to 180°F (-29° to 82°C)

Construction Materials
Main Valve
Type 1808 Body: Cast iron or WCC Steel
Type 1808A Body: Cast iron
Diaphram Plates and Diaphragm Casings: Zinc-plated steel
Diaphragm: Neoprene (CR), Nitrile (NBR)

Construction Materials (continued)
O-Rings: Nitrile (NBR)
Gaskets: Nitrile (NBR)
Back-up Rings: Polytetrafluoroethylene (PTFE)
Spring: Zinc-plated steel **(standard)**
Valve Plug Guide: Stainless steel

6358 Series Pilots
Body: Aluminum or CF8M Stainless steel
Spring Case: Aluminum or Stainless steel
Body Plug: Aluminum or Stainless steel
Valve Plug: Nitrile (NBR) or thermoplastic plug with stainless steel stem
Spring: Zinc-plated steel
Diaphragm: Nitrile (NBR) or Fluorocarbon (FKM)
Spring Seat: Zinc-plated steel
Stem Guide: Stainless steel
Adjusting Screw: Zinc-plated steel
O-Rings: Nitrile (NBR) or Fluorocarbon (FKM)
Closing Cap: Plastic or Stainless steel
Connector Cap: Stainless steel

Mounting Parts
Tubing: Stainless steel
Fittings: Steel or Stainless steel
Pipe Tees: Galvanized steel
Pipe Nipples: Malleable Iron, Galvanized Steel, and Stainless Steel

Options
- Upstream control line construction
- Pressure gauge (0 to 160 psig/0 to 11,0 bar/ 0 to 1,1 MPa)
- P590 Series Pilot Supply Filter

Approximate Weights
Type 1808: 22 pounds (10 kg)
Type 1808A: 25 pounds (11 kg)

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

- **Quick Disassembly**—With the removal of just two nuts, the upper and lower casings lift away, exposing the trim and leaving the main valve body in the line.
- **Optional Upstream Registration for Reduced Buildup**—For gas service with the Type 6358B pilot, upstream control line construction is available to provide wide-open relief flow capacity with less buildup regardless of set pressure.
- **Self-Draining Body**—The Type 1808A angle-body design has increased capacity and provides complete process fluid drainage from body cavity during shut-down period or before disassembly of the main valve.

Specifications

The Specifications section gives some general specifications for the 1808 Series Pilot-Operated Relief Valves or Backpressure Regulators. The nameplates give detailed information for a particular regulator as it comes from the factory.

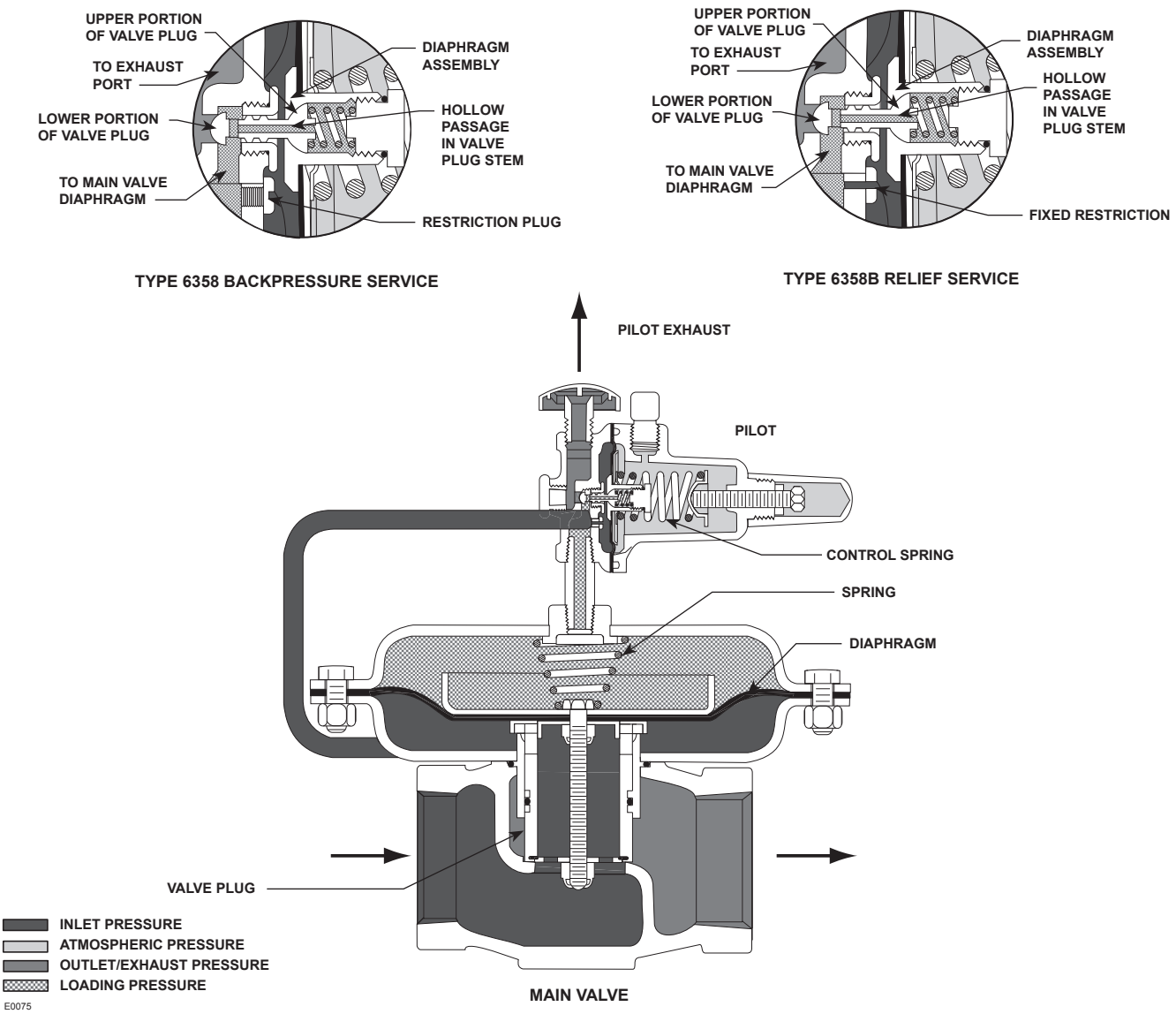

Figure 2. *Type 1808 with 6358 Series Operational Schematic*

Principle of Operation

Refer to Figure 2. A pressure relief valve is a control device that opens to relieve fluid to atmosphere during an overpressure occurrence. A backpressure regulator is a control device that maintains a constant upstream pressure throughout a given flow range. It functions the same as a relief valve in that it opens on increasing upstream pressure. **The Type 1808 or 1808A cannot be used as an ASME safety relief valve.**

Pilots

A 6358 Series pilot is typically used with one of several different main valves in a pressure relief or backpressure application. This pilot is usually used in gas service. It has an easily-installed valve plug that can be removed without removing the valve plug stem guide.

Table 1. *Available Configurations*

TYPE	PILOT	DESCRIPTION
1808	6358	Globe-style body for backpressure applications
	6358B	Globe-style body for relief applications
1808A	6358	Angle-style body for backpressure applications
	6358B	Angle-style body for relief applications

Table 2. *Types 6358 and 6358B Set Pressure Ranges, Pressure Ratings, and Pilot Spring Information*

SET PRESSURE RANGES, PSIG (bar)	PILOT SPRING INFORMATION			
	Part Number	Color	Wire Diameter, Inches (mm)	Free Length, Inches (mm)
3 to 18 (0,21 to 1,2)	1B986027212	Green	0.120 (3,05)	2.12 (54,0)
15 to 40 (1,0 to 2,8)	1E392527022	Yellow	0.148 (3,76)	2.00 (51,0)
35 to 125 (2,4 to 8,6)	1K748527202	Red	0.192 (4,88)	2.19 (55,6)

Table 3. *Flow and Sizing Coefficients*

TYPE	FLOW COEFFICIENTS (WIDE-OPEN)		C_1	K_m	IEC SIZING COEFFICIENTS		
	C_g	C_v			X_T	F_L	F_D
1808	1410	40.1	35.2	0.79	0.78	0.89	0.50
1808A	1800	51.4	35.0	0.76		0.87	

Table 4. *Capacities[1][2] for the Type 1808 Using Standard Internal Control Line and a Type 6358 or 6358B Pilot with High-Gain Restriction*

RELIEF PRESSURE SETTING, PSIG (bar)	CAPACITY IN THOUSANDS OF SCFH (Nm^3/h) OF 0.6 SPECIFIC GRAVITY NATURAL GAS						
	Pressure Buildup In Psig (bar) Over Relief Pressure Setting						
	2 (0,14)	6 (0,41)	10 (0,69)	15 (1,0)	20 (1,4)	25 (1,7)	30 (2,1)
5 (0,34)	32 (0,9)	46 (1,2)	50 (1,3)	61 (1,6)	70 (1,9)	80 (2,1)	89 (2,4)
12 (0,83)	41 (1,1)	55 (1,5)	65 (1,7)	74 (2,0)	84 (2,3)	93 (2,5)	102 (2,7)
20 (1,4)	56 (1,5)	73 (2,0)	80 (2,1)	89 (2,4)	99 (2,7)	108 (2,9)	117 (3,1)
30 (2,1)	67 (1,8)	89 (2,4)	99 (2,7)	108 (2,9)	117 (3,1)	127 (3,4)	136 (3,6)
40 (2,8)	85 (2,3)	105 (2,8)	120 (3,2)	127 (3,4)	136 (3,6)	145 (3,9)	154 (4,1)
50 (3,5)	94 (2,5)	120 (3,2)	137 (3,7)	145 (3,9)	154 (4,1)	163 (4,4)	172 (4,6)
60 (4,1)	- - - -	135 (3,6)	152 (4,1)	163 (4,4)	172 (4,6)	181 (4,8)	190 (5,1)
70 (4,8)	- - - -	150 (4,0)	168 (4,5)	181 (4,8)	190 (5,1)	200 (5,4)	209 (5,6)
80 (5,5)	- - - -	161 (4,3)	180 (4,8)	200 (5,4)	201 (5,4)	218 (5,8)	227 (6,1)
90 (6,2)	- - - -	170 (4,6)	192 (5,1)	213 (5,7)	227 (6,1)	236 (6,3)	245 (6,6)
100 (6,9)	- - - -	183 (4,9)	209 (5,6)	231 (6,2)	245 (6,6)	254 (6,8)	263 (7,0)
110 (7,6)	- - - -	197 (5,3)	223 (6,0)	246 (6,6)	263 (7,0)	272 (7,3)	281 (7,5)
125 (8,6)	- - - -	201 (5,4)	241 (6,5)	267 (7,2)	284 (7,6)	298 (8,0)	- - - -

Shaded areas indicate capacities with main valve wide-open.

1. Capacities based on 0 psig (0 bar) outlet pressure. If outlet pressure is not 0 psig (0 bar), shaded capacities may be recalculated using the wide-open C_g and the desired pressure drop.
2. For Type 1808A capacities, multiply the capacities in this table by 1.27.

Relief Valve

As long as the inlet pressure is below the set pressure, the pilot control spring keeps the pilot valve plug closed. Inlet pressure passes through the pilot restriction and registers as loading pressure on top of the diaphragm. Force from the main spring, in addition to inlet pressure bleeding through the pilot restriction, provide downward loading pressure to keep the main valve closed.

When the inlet pressure rises above the set pressure, the pressure on the pilot diaphragm overcomes the pilot control spring and opens the pilot valve plug. The pilot then exhausts the loading pressure from the top of the main valve diaphragm. The pilot continuously exhausts gas when the inlet pressure is above the set pressure. The inlet pressure unbalance overcomes the main spring force and opens the main valve.

As the inlet pressure drops, the pilot control spring begins to close the pilot valve plug and the exhaust slows. This causes the inlet pressure to build in the main valve diaphragm casing, allowing the control spring to close the main valve. Once the main valve is closed, the pilot valve plug closes and the exhaust stops.

Table 5. *Capacities for the Type 1808 Using Optional External Control Line and Type 6358B Pilot with High-Gain Restriction*

SET PRESSURE RANGE, PSIG (bar)	SET PRESSURE[1], PSIG (bar)	BUILDUP OVER SET PRESSURE TO BEGIN OPENING MAIN VALVE[2], PSIG (bar)	BUILDUP OVER SET PRESSURE TO FULLY OPEN MAIN VALVE[3], PSIG (bar)	PRESSURE DROP BELOW SET PRESSURE TO RESEAT PILOT, PSIG (bar)	CAPACITIES OF 0.6 SPECIFIC GRAVITY NATURAL GAS[4], SCFH (Nm^3/h)
3 to 18 (0,21 to 1,2)	3 (0,21) 5 (0,35) 10 (0,69) 15 (1,0)	0.9 (0,06) 0.7 (0,05) 0.7 (0,05) 0.7 (0,05)	6.0 (0,41) 4.0 (0,28) 1.2 (0,08) 1.0 (0,07)	1.0 (0,07)	37 000 (992) 37 000 (992) 42 000 (1126) 52 000 (1394)
15 to 40 (1,0 to 2,8)	15 (1,0) 20 (1,4) 30 (2,1) 40 (2,8)	0.8 (0,05)	1.1 (0,07)		53 000 (1420) 63 000 (1688) 82 000 (2198) 101 000 (2707)
35 to 125 (2,4 to 8,6)	40 (2,8) 50 (3,5) 60 (4,1) 70 (4,8)	1.4 (0,09)	1.9 (0,13)		102 000 (2734) 121 000 (3243) 139 000 (3725) 157 000 (4208)
	80 (5,5) 90 (6,2) 100 (6,9) 110 (7,6) 125 (8,6)	1.6 (0,11)	2.2 (0,15)		176 000 (4717) 194 000 (5199) 213 000 (5708) 231 000 (6191) 258 000 (6914)

1. Set pressure is defined as the pressure at which the pilot exhaust starts to bubble (discharge).
2. Crack pressure is the inlet pressure at which the main valve starts audible flow.
3. Inlet pressure buildup over the set pressure to achieve wide-open capacity.
4. Capacities with inlet piping equal to body size and without outlet piping.

Backpressure Regulator

As long as inlet pressure remains below setpoint, the pilot spring keeps the pilot valve plug closed. Inlet pressure passes through the upper port around the upper portion of the valve plug then through the hollow passage in that valve plug. Force from the main spring, along with inlet pressure bleeding through the pilot, provide downward loading pressure to keep the main valve closed.

When inlet pressure rises above the set pressure, pressure on the pilot diaphragm overcomes the control spring to close the upper port and stroke the valve plug to open the lower port. The pilot then exhausts loading pressure from the top of the main valve diaphragm. The pilot exhausts only while repositioning the main valve. The inlet pressure unbalance overcomes the spring force and opens the main valve.

As the inlet pressure drops, the pilot control spring begins to close the pilot valve plug and the exhaust slows. This causes the inlet pressure to build in the main valve diaphragm casing, allowing the control spring to close the main valve. Once the main valve is closed, the pilot valve plug closes and the exhaust stops.

Installation

Types 1808 and 1808A relief valves or backpressure regulators may be installed in any position as long as the flow through the main valve corresponds with the flow arrow on the main valve body (Type 1808) or runs in through the bottom connection and out through the side connection (Type 1808A).

An upstream control line is not required because of the integral pilot supply tubing; however, for a more accurate relief valve or backpressure regulator, this tubing may be disconnected for upstream registration, and the main valve diaphragm casing tapping plugged. For liquid service, the pilot exhaust should be piped to the downstream line or to a safe location. For gas service, the pilot must be piped to a safe area because, in enclosed conditions such as inside installations, exhausting gas can accumulate causing a danger of explosion. A vent line or stack must be located to avoid venting gas near buildings, air intakes, or other hazardous locations, and the line or stack opening must be protected against anything that might clog it. The thrust effect of a venting relief valve must be considered when designing relief valve outlet piping and anchoring.

Capacity Information

Gases

Tables 4 and 5 give relief capacities at selected set pressures for the Type 1808 backpressure regulator or relief valve. Flows are in thousands of SCFH (60°F and 14.7 psia) and thousands of Nm^3/h (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 Table 4 or 5 capacity by the following appropriate conversion factor: 0.775 for air, 0.625 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. If capacity is desired for the Type 1808A, multiply by 1.27.

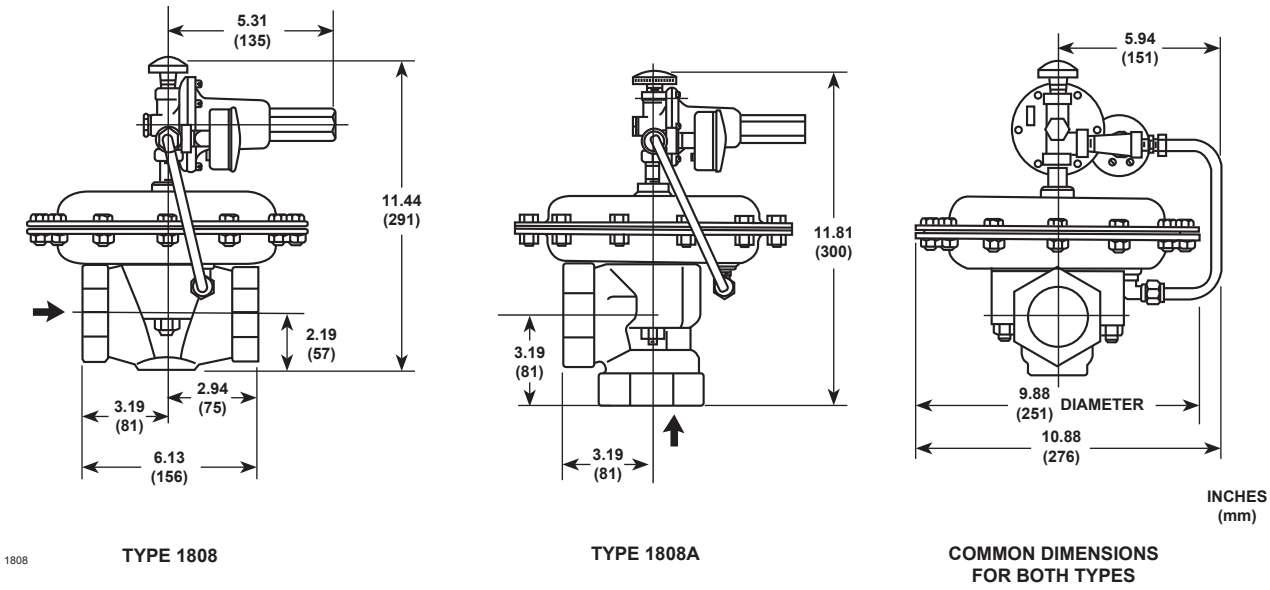

Figure 3. *Dimensions*

1. To determine capacities at set pressures or buildups not given in Tables 4 and 5, use one of the following formulas, and convert according to the factors in the preceding paragraph if necessary:

$$Q = (P_1 + \text{buildup})_{abs} C_g \sqrt{\frac{520}{GT}}$$

2. For pressure drops lower than critical (absolute outlet pressure greater than one-half of absolute inlet pressure), use the following formula:

$$Q = \sqrt{\frac{520}{GT}}\, C_g (P_1 + \text{buildup})_{abs}\, \text{SIN}\left[\frac{3417}{C_1}\sqrt{\frac{\Delta P}{(P_1 + \text{buildup})_{abs}}}\right]^{\text{Deg.}}$$

where,

Q = flow capacity in SCFH
G = specific gravity of gas
T = absolute temperature of gas at inlet in °Rankine (°Rankine = °F + 460)
C_g = sizing coefficient from Table 3
$(P_1 + \text{buildup})_{abs}$ = absolute inlet pressure
= $P_1 + P_{atm}$ + buildup
= P_1 + 14.7 + buildup
C_1 = C_g/C_v (See Table 3)
ΔP = pressure drop across the valve in psig

Liquids

To determine relief capacities in U.S. gallons per minute, use the Catalog 10 liquid sizing procedures in conjunction with the appropriate liquid sizing coefficient (C_v) and recovery coefficient (K_m) from the Specifications section. Then, if capacity is desired in Nm^3/h, multiply U.S. gallons per minute by 0.2271.

Ordering Information

Refer to the Specifications section on page 2. Fill out the order guide on page 7, carefully review the description of each specification. Always specify the type numbers of other desired equipment as well as the main valve and pilot.

Ordering Guide

Type (Select One)
- ☐ 1808 (globe body)***
- ☐ 1808A (angle body)**

Body Material (Select One)
- ☐ Cast iron***
- ☐ WCC Steel (Type 1808 only)*

Pilot (Select One)
- ☐ Type 6358 (for backpressure application)***
- ☐ Type 6358B (for relief application)***

Set Pressure Range (Select One)
- ☐ 3 to 18 psig (0,21 to 1,2 bar), Green***
- ☐ 15 to 40 psig (1,0 to 2,8 bar), Yellow***
- ☐ 35 to 125 psig (2,4 to 8,6 bar), Red***

O-Ring Material (Select One)
- ☐ Nitrile (NBR)***
- ☐ Fluorocarbon (FKM)**

Tubing and Fittings (Select One)
- ☐ Stainless steel tubing and steel fittings***
- ☐ Stainless steel tubing and stainless steel fittings***

Upstream Control Line Construction (Optional)
- ☐ Yes

Gauge (Optional)
- ☐ Yes

Pilot Supply Filter (Optional)
- ☐ Yes

Main Valve Parts Kit (Optional)
- ☐ Yes, please send one parts kit to match this order.

Pilot Parts Kit (Optional)
- ☐ Yes, please send 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

Application:

Specific Use _____

Line Size _____

Gas Type and Specific Gravity _____

Gas Temperature _____

Relief Valve Size:

Brand of upstream regulator? _____

Orifice size of the upstream regulator? _____

Wide-open coefficient of the upstream regulator? _____

Pressure:

Maximum Inlet Pressure (P_{1max}) _____

Minimum Inlet Pressure (P_{1min}) _____

Downstream Pressure Setting(s) (P_2) _____

Maximum Flow (Q_{max}) _____

Performance Required:

Accuracy Requirements? _____

Need for Extremely Fast Response? _____

Other Requirements: _____

_____

Bulletin 71.4:1808

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