Industrial Regulators

Application Guide - Edition VII

The industry standard for pressure regulators and flow control products.

EMERSON

Industrial Regulators Application Guide

Welcome

This Application Guide is designed to help you quickly and easily select pressure regulator products that solve your particular pressure control problems. In addition, the Application Guide provides background information on the principles of various products and their applications to specific industry segments, such as Air, Steam, Liquids, Process Gases, Fuel Gases, Sanitary and Tank Blanketing and Vapor Recovery. A Technical section provides a rich source of general and specific information to aid you in sizing a particular product.

Product Sizing Information

We highly recommend that you keep this book in an easily accessible place for quick reference. If you are an experienced engineer, you will be able to completely size a product from the information presented in this book before calling your local sales representative. For those with a less extensive engineering background, the Quick Selection Guides will be especially useful.

Finding What You Want

A complete Table of Contents and the Index at the back of the book are organized by product type and the common name, which will easily guide you to the appropriate section of the guide to find a product description.

Ordering What You Need

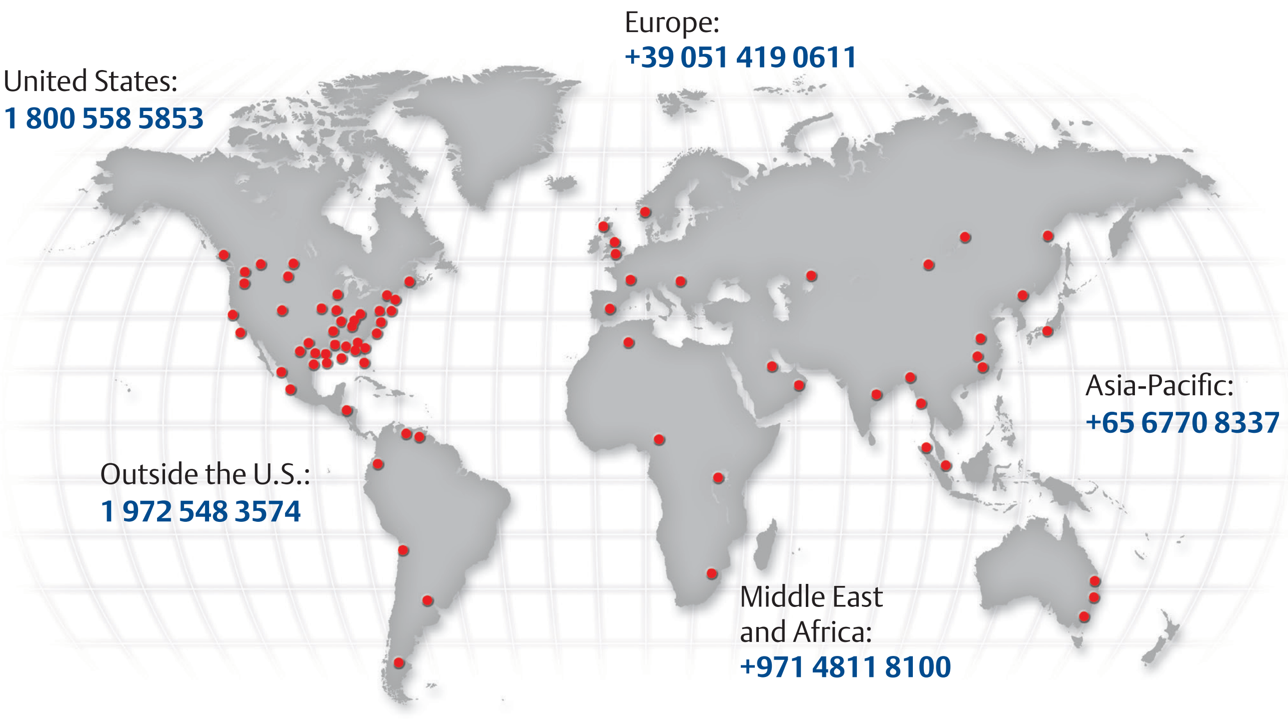
After selecting a product type or sizing that fits your application, contact your local Sales Office to place an order. Your local Sales Office will ensure that you receive the right product in the shortest possible time.

Other Application Guides Available

Should your application or project require natural gas regulators or LP-Gas regulation or storage, please request a Natural Gas Technologies Application Guide or LP-Gas Regulators and Equipment Application Guide. The Natural Gas Technologies Application Guide features detailed information on products used for natural gas applications in transmission, distribution and utilization. The LP-Gas Application Guide offers pressure regulators and valves and related equipment for regulation, transfer and storage of LP-Gas. The Tank Management Catalog offers fully integrated solutions for tank protection.

Additional Information Online

You can view and download pressure regulator bulletins, instruction manuals, product schematics and many other helpful documents at emerson.com. Much of the same information is also available on the Emerson Automation Solutions Regulator Tool Kit.
Download the Regulator Tool Kit:
www.emerson.com/regulatortoolkit



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Quick Reference Guide

AIR

Instrument Supply Regulators
Pressure Reducing Regulators
Relief Valve / Backpressure Regulators
Two-Way Switching Valves (on/off)
Three-Way Switching Valves
Panel Mounted Loading Regulators

FUEL GASES

Pressure Reducing Regulators
Relief Valves
Fuel Gas Valve

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Pressure Reducing Differential Control / Bias Regulators
Relief Valve / Backpressure Differential Control / Bias Regulators
Relief Valves / Backpressure Regulators

PROCESS GASES

Pressure Reducing Regulators
Pressure Reducing Differential Control Regulators
Relief Valve / Backpressure Differential Control Regulators
Relief Valve / Backpressure Regulators
Vacuum Breakers
Vacuum Regulators

SANITARY

Pressure Reducing Regulators
Relief Valve / Backpressure Regulators

STEAM

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Relief Valves / Backpressure Regulators

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Solving Your Toughest Challenges

Industries are under constant pressure to cut costs, increase output, reduce energy use and improve safety and emissions. That is why companies around the world turn to Emerson Automation Solutions for technologies, services and expertise to solve problems and deliver proven results.

EMERSON™

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Emerson Automation Solutions is the automation innovator with the depth of expertise and breadth of technologies to take on our customers' toughest challenges and bring predictable success anytime, anywhere.

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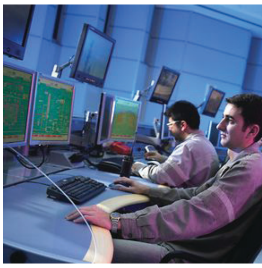
Accelerate ROI and deliver projects confidently with Project Certainty.



Operational Excellence

Safely optimize production with improved reliability and lower emissions.

Industrial IoT

Harness digital transformation for real-time insights and borderless expertise.

Industry Served

Products, Services and Expertise to Meet your Needs

For more than a century we've worked side-by-side with customers to understand their challenges and help implement effective solutions. This wealth of experience enables us to provide a broad range of industry-specific products and services — and the expertise to put them to work for you.

Alternative Energy

Chemical

Food and Beverage

Industrial Energy

Life Sciences

Marine

Metals and Mining

Oil and Gas

Power

Pulp and Paper

Refining

Water and Wastewater

Control Your System with Certainty

Emerson brings together technology and engineering to provide an expanding array of innovative manufacturing and processing solutions for industrial, commercial and consumer markets. We offer the world's largest collection of pressure control, flow control and relief valve solutions for process and specialty gases, liquids, steam, natural gas and liquid propane industries.

Our regulators are renowned for setting industry standards for performance and extended service life, while Emerson product sales, service and technical support teams are unrivaled in their ability to serve you locally from offices located strategically around the globe.

Natural Gas Solutions

Emerson leads the way in providing best in-class natural gas conditioning, metering, pressure regulating products and customized skids to the natural gas industry. From regulators to skids, Emerson products offer design innovation, superior performance and unbeatable reliability and durability under extreme conditions in even the world's most rugged environments. Around the clock, around the world, look to Emerson for natural gas solutions.

LP-Gas Solutions

Throughout the world, Emerson supplies leading liquefied petroleum gas (LP-Gas) suppliers with the broadest available line of Fisher™ commercial service LP-Gas regulators and bulk storage and transport equipment. Renowned as the propane industry standard for reliable pressure regulation, Fisher LP-Gas valves and regulators provide high value solutions across a range of stationary storage and mobile applications. With more than 2,000 technical experts at over 200 locations worldwide, our service and support remains second to none.

Gas, Liquid and Steam Solutions

Emerson offers a dynamic range of direct- and pilot-operated pressure regulators, relief valves and tank management products for industrial gas, liquid and steam applications. Suitable for use in a wide range of environments, from the wellhead to the pharmaceutical plant, their versatility, stability, ease of maintenance and rigorous adherence to ISO-9001 standards for quality and reliability have made them the pressure regulators of choice in tens of thousands of installations worldwide.

A Complete Line of Regulators and Relief Valves

Natural Gas Solutions

- Pressure Reducing Regulators
- Relief Valve / Backpressure Regulators
- Odorant Injection Systems
- Slam-Shut Valves

LP-Gas Solutions

- Regulators / Changeovers / Manifolds
- Valves / Relief Valves
- Bulk Storage and Transport Equipment

Industrial Gas, Liquid and Steam, and Tank Solutions

- Pressure Reducing Regulators
- Backpressure/Relief Regulators
- Vacuum Regulators

See our literature on:

- Steam Traps and Valves
- Flame and Detonation Arrestors
- Tank Vents and Hatches
- Pressure and Safety Relief Valves

www.Emerson.com

Industry Commitment

Quality

Emerson ensures the highest quality and safety standards through our global product brands.

For more than a century we have worked side-by-side with customers to understand their challenges and help implement effective solutions. Our systems, processes and employees are committed to providing defect-free products, information and services that satisfy your expectations on time, every time.

Emerson is dedicated to delivering only the highest product quality and performance utilizing efficient operations. We create value by delivering best-in-class pressure and flow control equipment, systems, services and solutions for an unparalleled range of applications. We execute new product development plans with advanced technologies and solutions that deliver undisputed quality.

To achieve consistent operational and product excellence globally we strive to attract the most talented people and support continuous development of our workforce, products and processes at every level.

Reliability

With more than 125 years of experience, Emerson has built a solid reputation for reliability.

Our regulators, valves and flow control systems are engineered to exacting standards, each carefully designed, thoroughly tested and developed to handle higher pressures while providing increased delivery capacity, reduced noise output and zero emission. We go beyond baseline industry standards to ensure our equipment operates reliably in even the most extreme conditions anywhere in the world.

At Emerson, we are committed to continually raising the bar in our efforts to develop still higher quality, more advanced systems that operate safely and reliably well into the future.

Technology

Emerson's innovative technologies creates pressure and flow control solutions more productive, efficient and cost-effective. Our proven results are what make us the leader in the industry.

Spanning the globe, our test and evaluation facilities provide the engineering expertise required to ensure superior quality product design and high performance results wherever our products are deployed. At these facilities, we test all sizes and types of regulators under real-world plant conditions to ensure production performance, efficiency, environmental compliance and safety before actual installation at your site.

Our test and evaluation facilities are dedicated to tackling the toughest engineering challenges facing today's process manufacturing and energy industries, including helping companies deliver record volumes of natural gas and other forms of energy, consume less energy, reduce costs, operate more quietly and reduce greenhouse emissions.

Service

With over 2,000 local technical experts to serve you from nearly 200 locations around the world, our sales and service network is one of the largest in the industry.

Whether you need an emergency replacement regulator or need expert assistance on a long-range growth and expansion plan, there is a local Sales Office to respond quickly and professionally.

Regulators and Relief Valves Facilities

Real-World Simulation

Flow Testing

- Simulates real-world operating conditions using pipelines up to NPS 32 / DN 800 with compressible and incompressible fluids up to 30,000 psig / 2068 bar
- Ensures product performance, efficiency, environmental compliance, life span and safety

Materials Testing

- Develops and tests materials to improve regulator performance and reliability
- Ensures materials meet customer requirements, national standards, and our own, still higher, brand standards
- Analyzes and troubleshoots field installations for contamination and composition at an elemental level

Environmental Testing

- Simulates real-world operating conditions from the deserts of the Middle East to the Arctic North
- Validates product lifecycles at field conditions to extend service life
- Verifies product corrosion resistance using extended salt-spray exposure to ensure environmental protection of process equipment

You demand products to withstand your toughest conditions, while delivering continued optimal performance, efficiency, reliability and safety.

Our design, test and evaluation technologies and techniques validate a full range of product offerings in each of these critical areas, providing flow, material and environmental testing under real-world operating conditions before you place them in your application.

With more than 130 years of application experience in the process industry, our reputation for solving challenging problems and developing products to specifications exceeding regulatory guidelines. Count on Emerson worldwide to deliver the highest quality products available to your site.

History

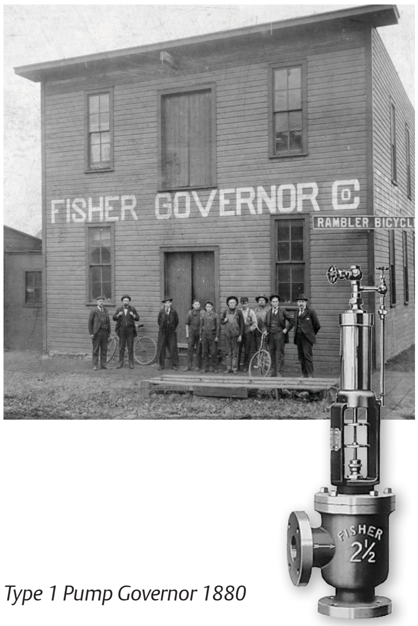
Our Path to Technology Leadership

In 1880, Fisher™ Controls was founded in Marshalltown, Iowa, by William Fisher. Fisher Controls grew steadily over the years, evolving into an industry leader offering customers the most complete range of flow control products in the world.

William Fisher came to America from England as a boy of 14. As his family ventured west in the new land, they settled along the Mississippi in Clinton, Iowa. It was there, as a mechanic in a small engine shop for 10 years, that William learned about steam, the major source of power in the late 1800s. Because of his experience in water and steam, William, who was 24 at the time, was invited to Marshalltown to help install the water works.

The idea of a control device was born in the engineer's mind as a fire raged in the city. Working through the night, William Fisher hand-throttled the steam-driven pumps to maintain pressure in the city's mains. During that fire, he saw a need for a device that would both control the steam-driven pumps and maintain them at a constant pressure. Many months and trials later, William Fisher was finally satisfied with one of his designs and began manufacturing what we know today as the Fisher Type 1 constant pressure pump governor. He was granted a patent in 1884.

One thing remained the same since William Fisher's first Type 1 pump governor: a pledge to unequalled quality. Today, the brand name Fisher is synonymous with quality throughout the world.



Type 1 Pump Governor 1880

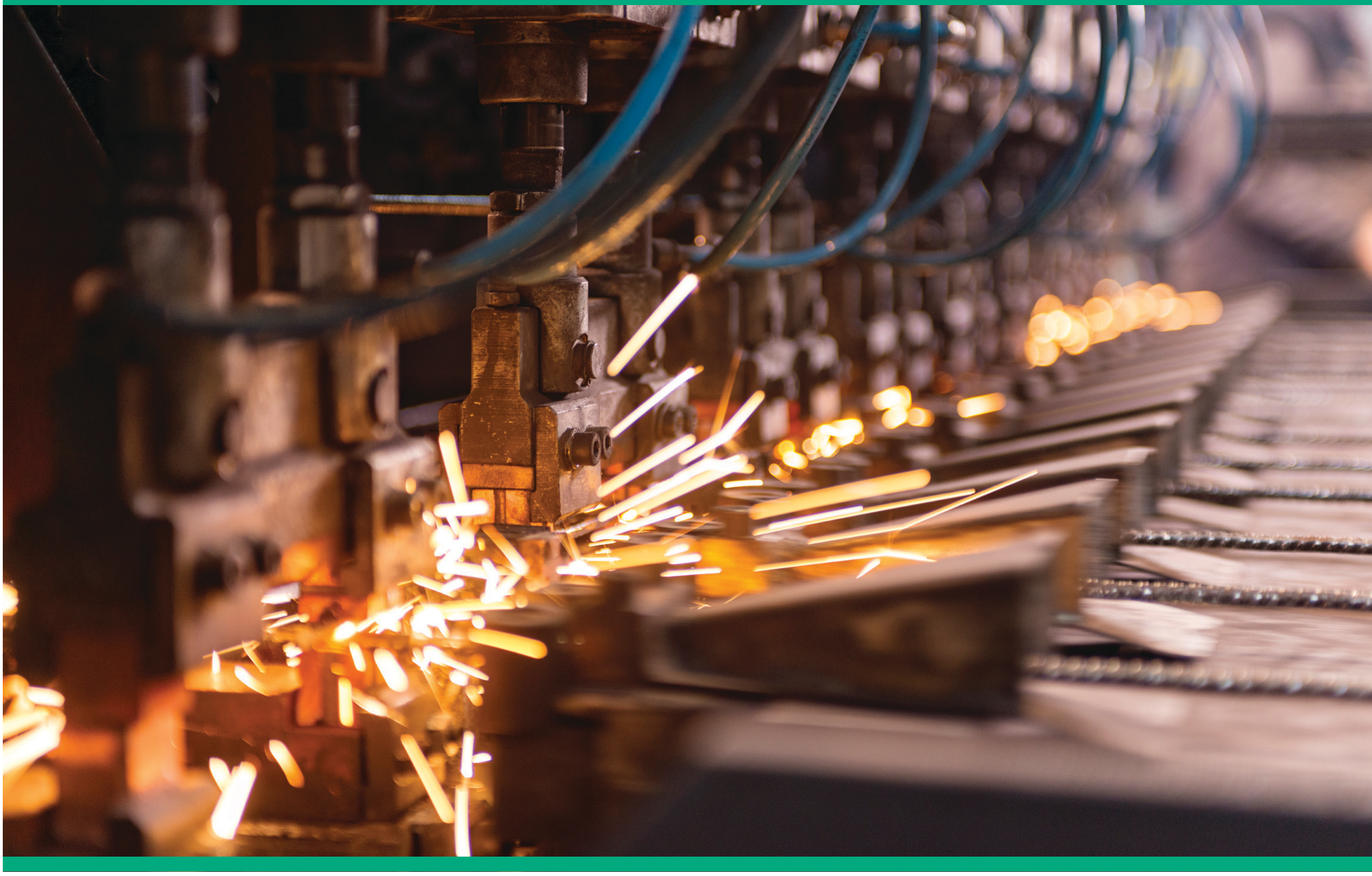
The Fisher Years

1880 Type 1 pump governor is invented by William Fisher.
1888 The Fisher Governor Company is incorporated on Dec. 26.
1906 William Fisher dies. His wife, Martha, becomes president.
1912 Jasper Fisher assumes presidency; first sales offices are established.
1937 Serial number 500,000 assigned to a Type 1 pump governor on Nov. 5.
1938 Jasper Fisher dies.
1940 First Western Union teletype machine is installed to speed communication.
1943 One millionth serial number assigned June 9.
1944 Mrs. J.H. Fisher is elected president.
1946 Sales department holds first school for field representatives.
1950 Two-millionth controller made. Fisher enters licensee agreement with Elliott Automation to manufacture products for England and Europe.
1954 Mrs. J.H. Fisher retires; J.W. (Bill) Fisher is elected president.
1955 New office building opens in Marshalltown.
1960 Ball valves are added to Fisher's product line. Licensing agreement reached to manufacture in Japan.
1965 Gas regulator department moves to McKinney, Texas.
1967 Governor Road facility, the most advanced machine shop of its kind in the world, begins operation in Marshalltown.
1969 Fisher begins manufacturing electronic instrumentation. Bill Fisher remains as Chairman of the Board until 1974.
1970 Our first European facility opens at Cornwall, England, to manufacture electronic instrumentation.
1972 The R.A. Engel Technical Center, Marshalltown, is completed, housing the world's most advanced flow test laboratory.
1975 A new electronics manufacturing facility is opened in Marshalltown.
1976 Production of our new line of rotary valves begins in Sherman, Texas. Fisher Brazil opens its doors.
1979 Fisher Controls Corporation of Delaware forms a stronger manufacturing, sales and service organization.
1980 Fisher celebrates a Century of Control.
1992 ISO 9001 original registration validated, McKinney, Texas

The Emerson Years

1993 Fisher Controls and Rosemount, merge under ownership of Emerson Electric.
1994 Francel™, Gallardon, France, acquired, expanding manufacturing and distribution in Europe, Middle East and Africa.
1996 Type 299 pilot-operated regulator introduced to natural gas market.
1997 The 50th anniversary of the Type 99. The FloBoss™ 503 and Regulator Vault are introduced.
1998 Fisher Regulators FROMEX manufacturing plant opens in Nuevo Laredo, Mexico.
1999 Revolutionary Type EZR pressure regulator introduced.
2001 Tartarini™, Bologna, Italy, acquired, extending Fisher's brand and distribution capability in Europe and Asia.
2003 Manufacturing capability expanded with opening of Shanghai Plant.
2003 New, state-of-the-art flow test laboratory opens in McKinney, Texas.
2004 Introduced digitally controlled odorant injection system.
2004 Jeon, Chengdu, China, acquired, expanding Fisher's presence in China's low-pressure regulator market.
2005 Fisher celebrates its 125th anniversary.
2005 EZ Family product lines, Types EZR, EZH and EZL pressure regulators expanded.
2005 Customer Center opened to display new regulator technology and train customers and sales channel.
2005 Tescom™ Corporation, Elk River, Minnesota and Selmsdorf, Germany, manufacturer of high-pressure, high-purity pressure regulators, acquired.
2006 Type SR stainless steel Sanitary Regulator introduced.
2007 Commercial Service Regulators platform introduced featuring True Monitor™ Protection, Slam-Shut and Secondary Seat™ Protection options.
2007 Cluj, Romania, manufacturing location online.
2008 Regulator Division becomes Emerson Process Management Regulator Technologies, Inc.
2013 Enardo™, Tulsa, Oklahoma, acquired, expands Fisher's storage tank solutions for oil and gas, petrochemical and chemical industries.
2014 New Global Regulator Techologies Headquarters opens in McKinney, Texas.
2015 Type CS804 regulator with integral slam-shut is added to CS800 Series.
2015 New product launches for MR95 and MR98 Series.
2015 Emerson celebrates its 125th year anniversary.
2017 Acquisition of Pentair's valves and controls business positions Emerson as a main valve partner to its customers.

Air



Manufacturing and process plants use compressed air as a power supply for many devices within the plant. Plant air, also called shop air, is used for cooling and as a power source for pneumatic tools, sand blasters, sprayers, conveyors, robotics and other mechanical tools. Instrument air is used to power instruments, such as controllers, positioners, switching valves and panel loaders.

Plant air or shop air runs from the compressor throughout the plant. Pressure reducing regulators control the pressure to devices at each point of use off the air line.

Instrument air lines can come from the plant air line or they may be separate air lines throughout the plant. In either case, the air supplied to the instruments must be cleaned and dried before it enters the instruments. Filters and dryers remove dust, moisture and other debris from the air.

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Application: Air Solutions

Introduction

Fisher™ regulators for plant air applications are available from the smallest to the largest flows and in all pressure ranges.

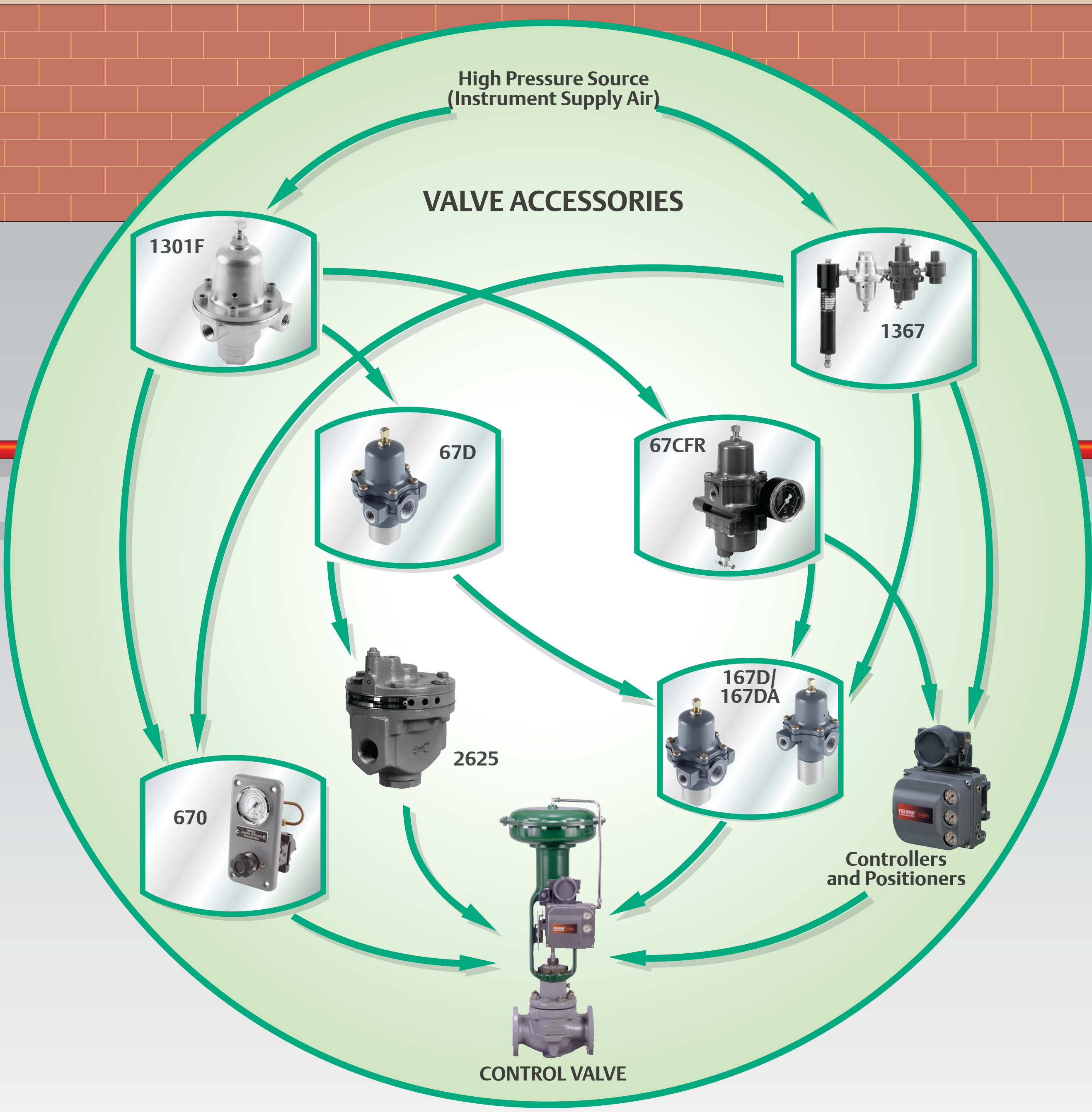
Also available are a variety of control valve accessories, such as air supply regulators, switching valves, panel loaders and controllers. These accessories can be ordered as individual units or they may be included as part of a control valve. Your local Sales Office is available to assist you in selecting the correct control equipment for your application.

Fisher air supply regulators are compact, rugged and easy to maintain. These small volume regulators are available as stand alone units or panel mounted.
They are also available with integral filters and internal relief and offer the ease of in-line maintenance. No special tools are required for maintenance.

Contact your local Sales Office with your plant air application questions. We offer technical support and solutions that will help you better manage your process.

Features

- Integral Filters
- Smallest to Largest Flows
- Compact
- Wide Product Selection
- Built to Last
- Time-Proven Design
- Rugged Construction
- 0 to 6000 psig / 0 to 414 bar



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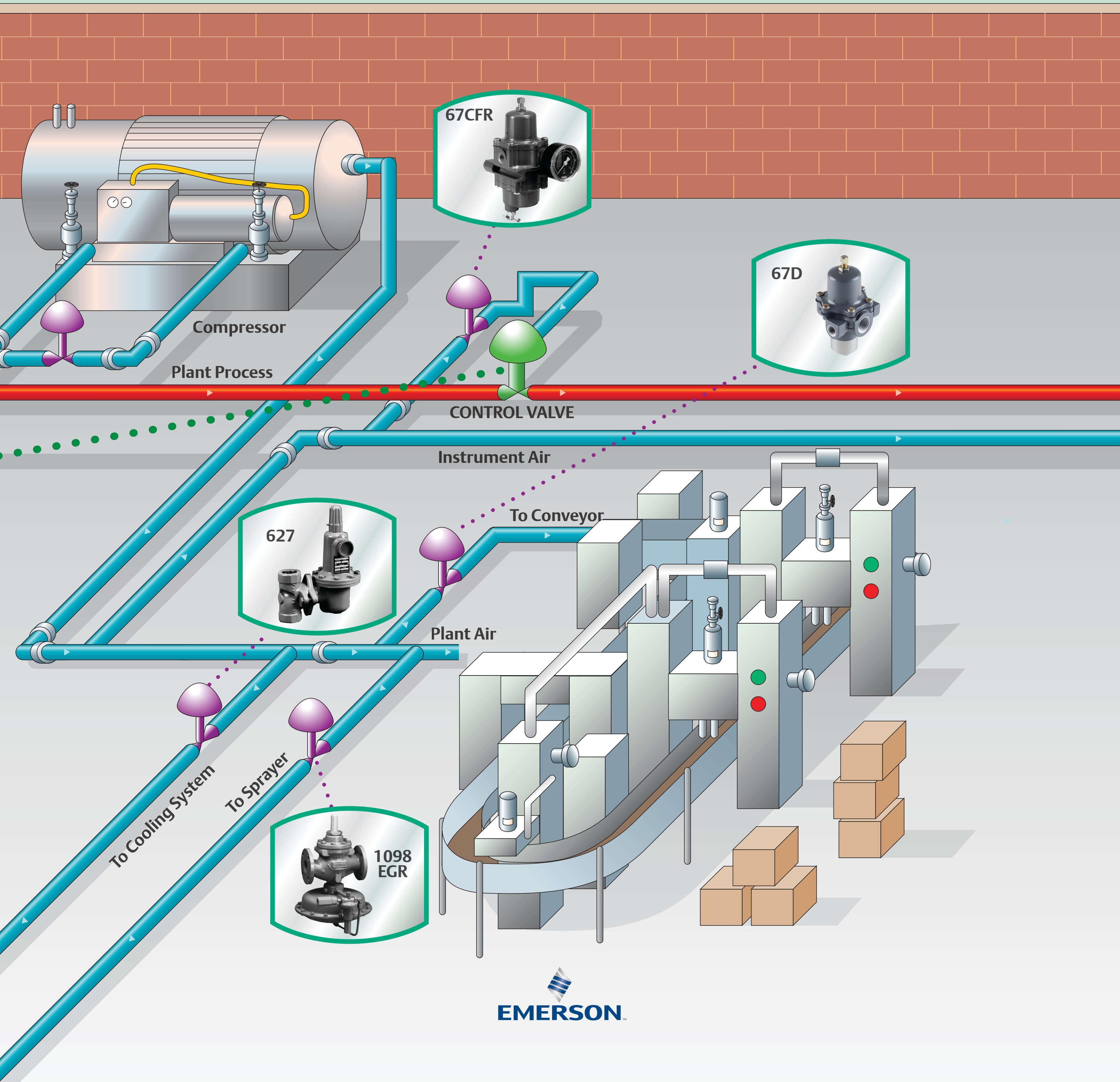
67CFR
67D
Compressor
Plant Process
CONTROL VALVE
Instrument Air
To Conveyor
627
Plant Air
To Cooling System
To Sprayer
1098
EGR

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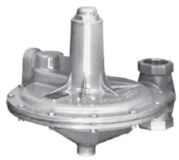
Air Quick Selection Guide

Instrument Supply Regulators

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
400 psig / 27.6 bar	0 to 150 psig / 0 to 10.3 bar	4350 SCFH / 117 Nm^3/h		**67C Series** Page 92
2000 psig / 138 bar	5 to 90 psig / 0.34 to 6.2 bar	1100 SCFH / 29 Nm^3/h		**Type 1367** Page 186
6000 psig / 414 bar	10 to 500 psig / 0.69 to 34.5 bar	4500 SCFH / 121 Nm^3/h		**1301 Series** Page 180

Pressure Reducing Regulators

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
13 psig / 0.90 bar	0 to 3 psig / 0 to 0.21 bar	2500 SCFH / 67.0 Nm^3/h		**Y610 Series** Page 385
150 psig / 10.3 bar	4 in. w.c. to 7 psig / 10 mbar to 0.48 bar	5162 SCFH / 138 Nm^3/h		**Y600A Series** Page 379
300 psig / 20.7 bar	2 to 30 psig / 0.14 to 2.1 bar	23,000 SCFH / 623 Nm^3/h		**Type MR95L** Page 276

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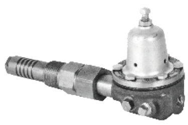
Pressure Reducing Regulators (continued)

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
400 psig / 27.6 bar	5 to 300 psig / 0.34 to 20.7 bar	275,000 SCFH / 7400 Nm^3/h		**Type MR105** Page 312
400 psig / 27.6 bar	4 in. w.c. to 300 psig / 10 mbar to 20.7 bar	8,782,000 SCFH / 235,268 Nm^3/h		**Type 1098-EGR** Page 167
400 psig / 27.6 bar	0 to 150 psig / 0 to 10.3 bar	20,900 SCFH / 560 Nm^3/h		**67D Series** Page 96
1000 psig / 68.9 bar	5 to 400 psig / 0.34 to 27.6 bar	510,000 SCFH / 13,600 Nm^3/h		**Type MR95H** Page 255
2000 psig / 138 bar	5 to 500 psig / 0.34 to 34.5 bar	138,725 SCFH / 3718 Nm^3/h		**627 Series** Page 145
4000 psig / 276 bar	0 to 500 psig / 0 to 34.5 bar	2000 SCFH / 53.6 Nm^3/h		**1305 Series** Page 184

Air Quick Selection Guide

Relief Valve / Backpressure Regulators

Relief Set Pressure Range	Maximum Capacity		Type Number
25 to 300 psig / 1.7 to 20.7 bar	151,125 SCFH / 4050 Nm^3/h		**H200 Series** Page 230
35 to 350 psig / 2.4 to 24.1 bar	26,784 SCFH / 718 Nm^3/h		**Type H120** Page 229
39 to 44 psig / 2.7 to 3.0 bar	4000 SCFH / 107 Nm^3/h		**Type H800** Page 231
15 to 375 psig / 1.0 to 25.9 bar	206,000 SCFH / 5510 Nm^3/h		**MR98H Series** Page 284
5 to 300 psig / 0.34 to 20.7 bar	1,224,000 SCFH / 32,800 Nm^3/h		**Type MR108** Page 323

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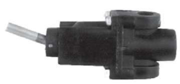
Two-Way Switching Valves (on/off)

Set Pressure Range		Type Number
3 to 60 psig / 0.21 to 4.1 bar		**119 Series** Page 118
3 to 150 psig / 0.21 to 10.3 bar		**167D Series** Page 124

Three-Way Switching Valves

Set Pressure Range		Type Number
3 to 150 psig / 0.21 to 10.3 bar		**Type 122A** Page 120
14 to 125 psig / 0.97 to 8.62 bar		**167DA Series** Page 124
2 to 60 psig / 0.14 to 4.1 bar		**Type 168** Page 126
35 to 150 psig / 2.4 to 10.3 bar		**Type 168H** Page 126
Manual Three-Way Switching Valve		**Type 68-2** Page 126

Air Quick Selection Guide

Panel Mounted Loading Regulators

Set Pressure Range		Type Number
Stand Alone Pressure Reducing Regulator with Handwheel		**67C Series** Page 92
Panel with One Gauge and Type 67CR Pressure Reducing Regulator		**670 Series** Page 163
Panel with Two Gauges and Type 67CR Pressure Reducing Regulator		**Type 670G** Page 163
Panel with Two Gauges, Three-Way or Four-Way Changeover Valve and Type 67CR Pressure Reducing Regulator		**Type 670GV** Page 163

Introduction

This Application Guide briefly explains the air products contained in this section.

Types of Regulators

Instrument Supply Regulators

Instrument supply regulators are used to control air pressure to controllers, positioners, panel loaders, switching valves and other control equipment. Many of these regulators have integral filters to help remove dust, dirt and other particles from the air before it enters the instruments. These regulators can be nipple mounted, bolted to the actuator or panel mounted.

Pressure Reducing Regulators

In some applications, the pipeline pressure may need to be reduced for a process or piece of equipment. Depending upon the accuracy required by the application, a direct- operated or pilot-operated regulator can be used to reduce the air pressure.

Direct-operated regulators are used for lower flow rates. Pilot-operated regulators are used for high flow rates or where precise pressure control is required.

Relief Valves or Backpressure Regulators

A relief valve or backpressure regulator opens when the upstream controlled pressure increases above the setpoint. Relief valves and backpressure regulators are the same devices. The name is determined by the application.

Overpressure protection is provided by relieving pressure when it rises above the setpoint. When upstream pressure rises above the setpoint, the relief valve opens to allow excess upstream pressure to flow downstream into a pressurized system or to atmosphere.

Panel Loaders

Panel-mounted loading regulators are used for remote pressure adjustment of regulators or for manual control of actuators and control valves.

The manual loading regulators are available in four basic configurations: A stand alone regulator; a panel with one gauge and a pressure reducing regulator; a panel with two gauges and a pressure reducing regulator; and a panel with two gauges, a three-way changeover valve and a pressure reducing regulator.

A panel with one gauge and a pressure reducing regulator contains a Type 67CR pressure reducing regulator with token internal relief and a gauge that indicates the regulator’s outlet pressure. A two gauge panel is similar to the single gauge panel with an additional gauge to monitor another pressure, up to 100 psig / 6.9 bar.

A two gauge panel with a three-way changeover valve typically provides manual backup for pneumatic controllers. The changeover valve allows an operator to select either the manual loader output or an automatic controller output as the signal to an actuator and valve.

Switching Valves

Switching valves are used in pneumatic logic systems. These valves are for either two-way or three-way switching.

Two-way switching valves are used for on or off service in pneumatic systems.

Three-way switching valves divert inlet pressure from one outlet port to another whenever the sensed pressure exceeds or drops below a preset limit.

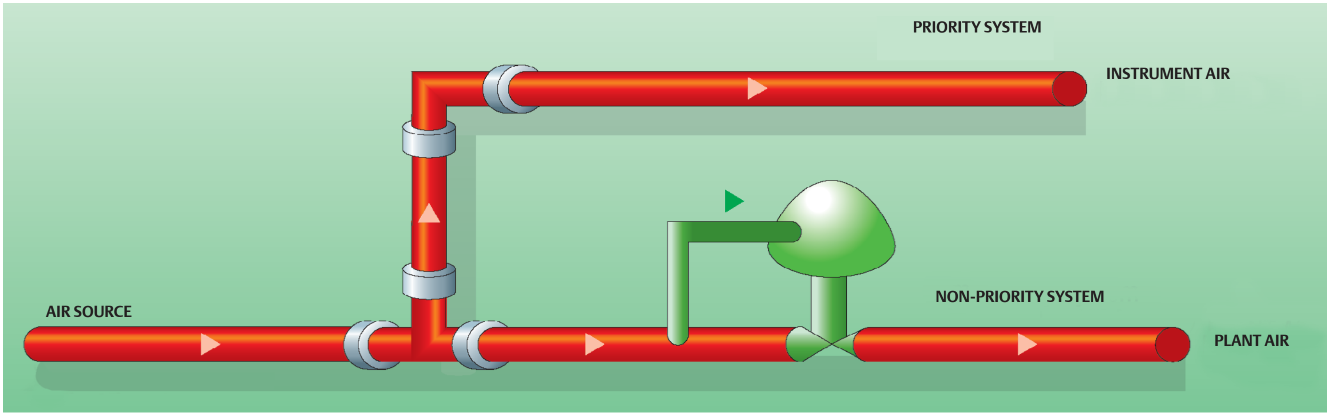


Figure 1. *Backpressure Application to Maintain Air Supply to Priority Systems*
A backpressure regulator can be used to monitor and direct the supply pressure. In normal operation, this regulator is wide-open allowing air supply to all systems. If the supply pressure drops below the backpressure regulator’s setpoint, the backpressure regulator closes to block the air flow to non-priority systems and directs the remaining air supply to the priority systems.

Notes

Fuel gas, either natural gas (methane) or LP-Gas, is the typical energy source for a variety of plant utility and industrial applications requiring heat such as boilers, dryers, evaporators, hot water heaters, plant heating systems, industrial ovens and heat exchangers. Energy efficiency and heat requirements for these industrial applications is highly specific as no two applications are likely to have the same performance characteristics. The regulation of gas flow in these burners is often a challenge as flow requirements are entirely dependant on the demands placed on the heating system itself. The following four factors are critical for assessing energy needs and gas flow requirements in the industrial powerhouse:

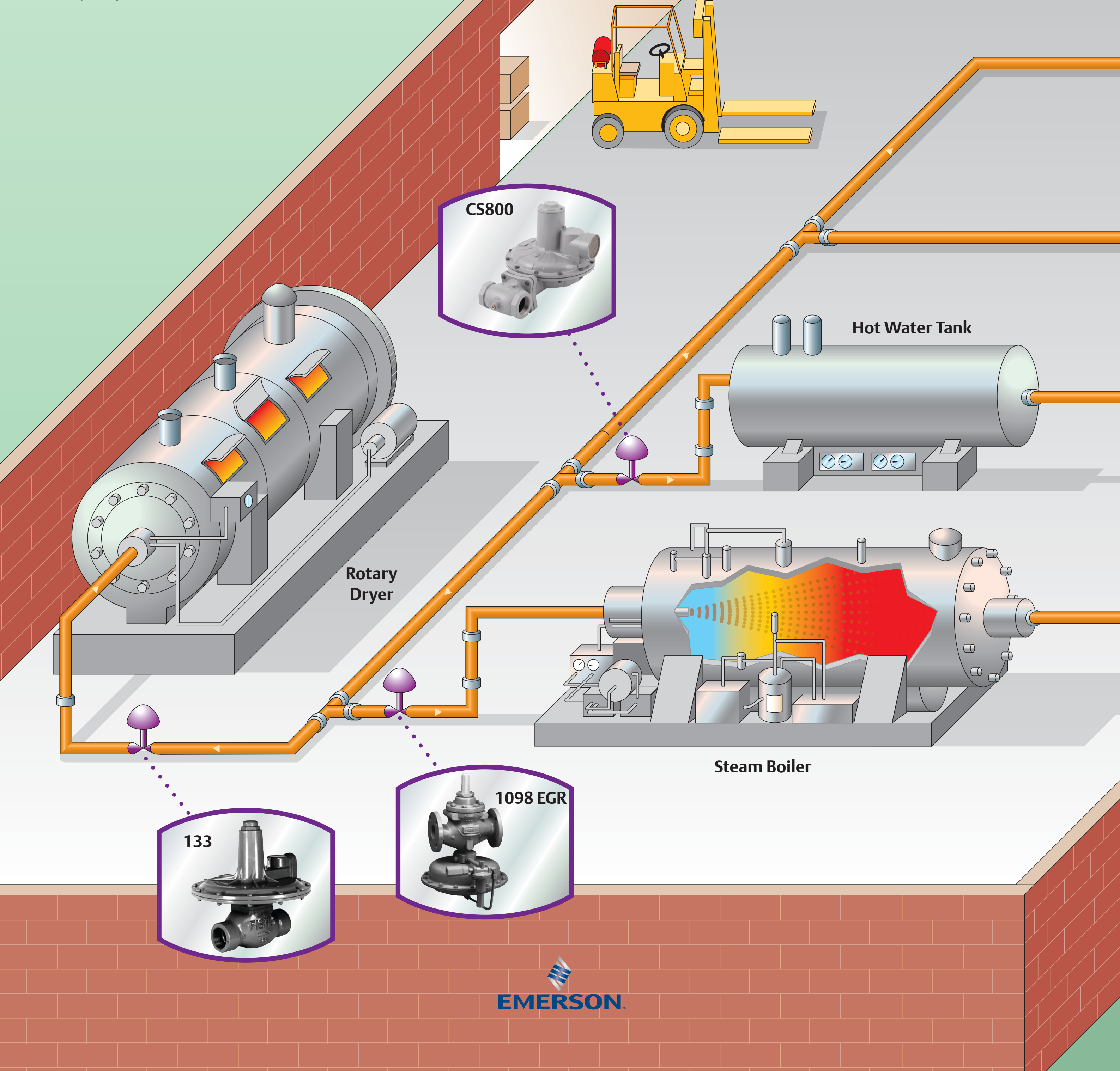
1. Fuel Type
2. Combustion System Criteria
3. Equipment Design
4. System Operation Requirements

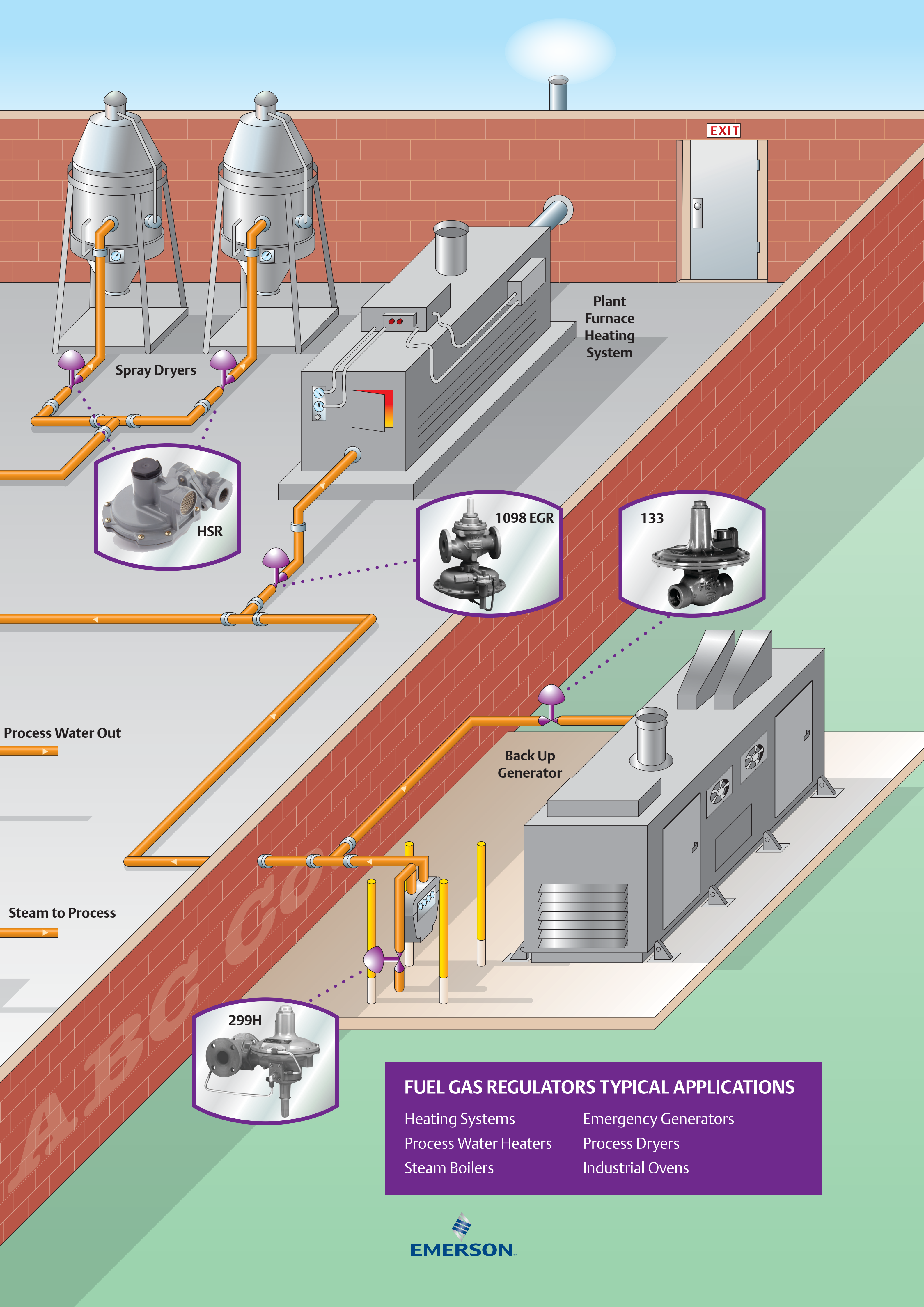
Application: Fuel Gases Solutions

Introduction

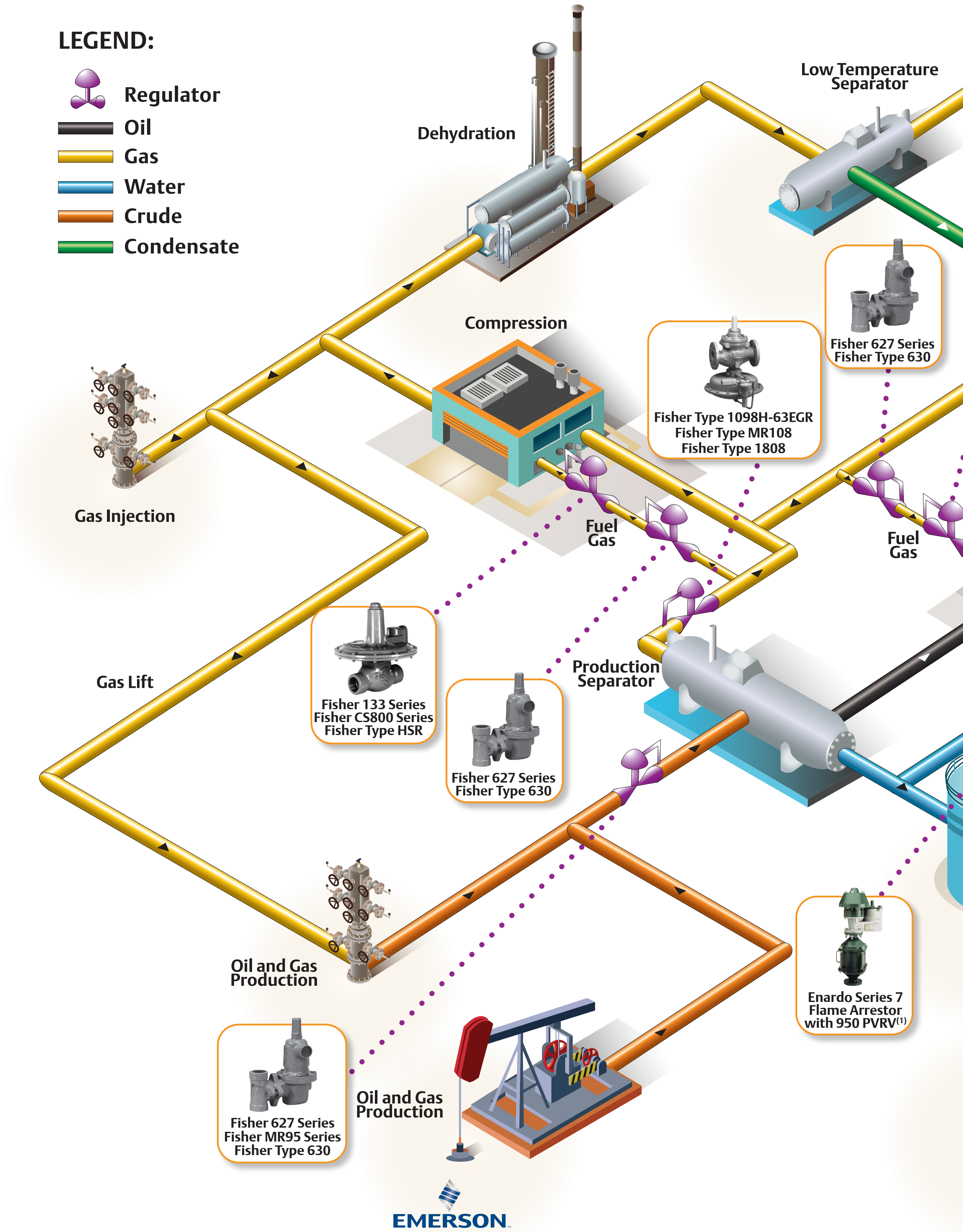
There are a variety of Fisher™ pressure regulators to meet the unique needs of your plant utility or industrial heating applications. This application map shows a selection of typical fuel gas regulators which are available in a variety of materials of construction to fit your specific needs.

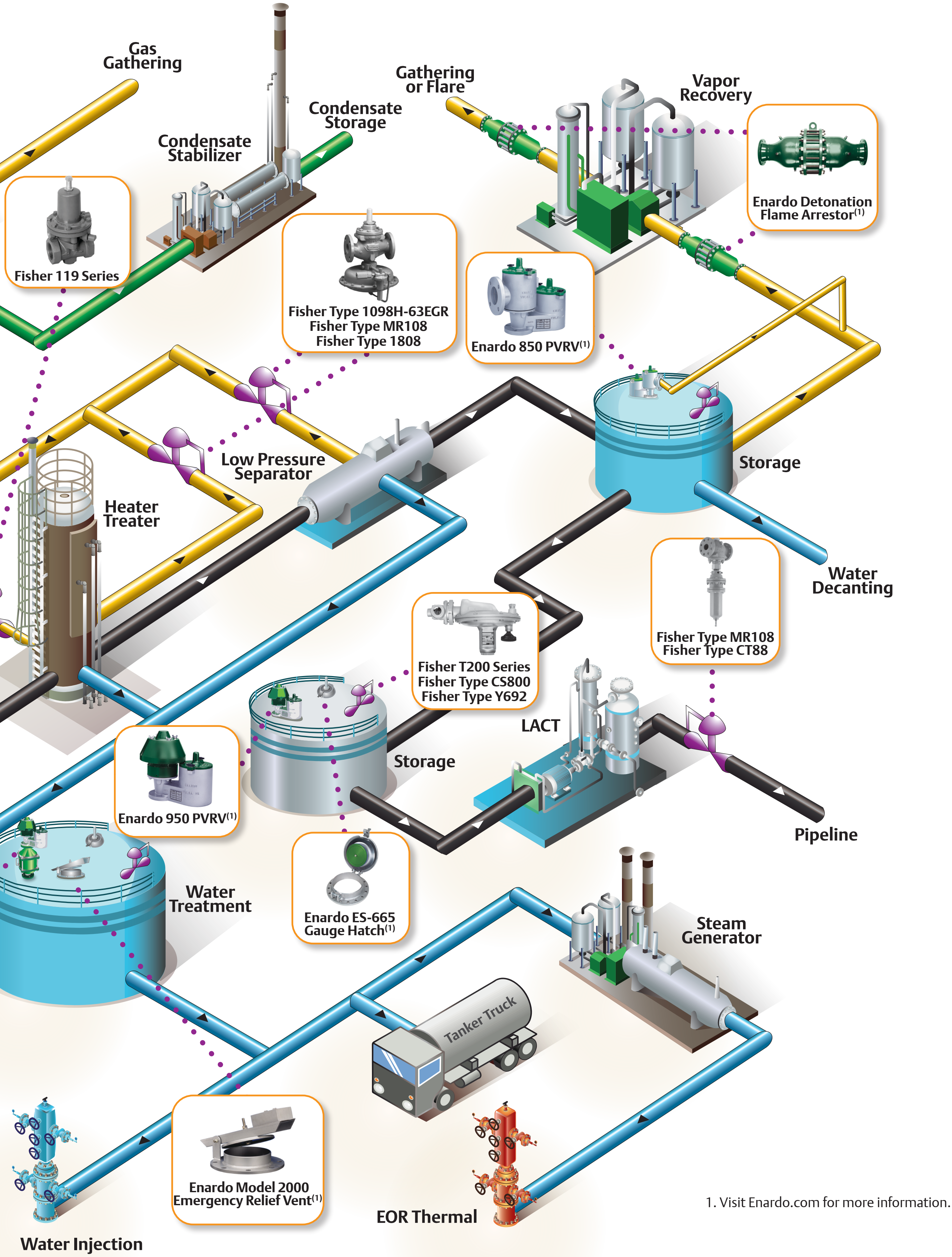
Call your local Sales Office with your plant utility or industrial heating application requirements. We offer fuel gas regulator solutions that will help you better manage your process.




EXIT
Plant Furnace Heating System
Spray Dryers
HSR
1098 EGR
133
Process Water Out
Back Up Generator
Steam to Process
299H
FUEL GAS REGULATORS TYPICAL APPLICATIONS
Heating Systems
Process Water Heaters
Steam Boilers
Emergency Generators
Process Dryers
Industrial Ovens
EMERSON

Application: Upstream Oil and Gas Solutions





1. Visit Enardo.com for more information.

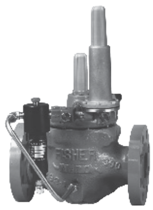
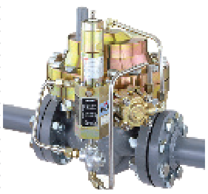
EMERSON

Fuel Gas Quick Selection Guide

Fuel Gas Pressure Reducing Regulators

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
250 psig / 17.2 bar	3 in. w.c. to 5 psig / 7 mbar to 0.34 bar	1030 SCFH / 27.6 Nm³/h		**912N Series** Page 165
125 psig / 8.6 bar	1.8 in. w.c. to 2.2 psig / 4 to 152 mbar	1285 SCFH / 34.4 Nm³/h		**Type R622** Page 337
125 psig / 8.6 bar	4 in. w.c. to 2.2 psig / 10 to 152 mbar	4800 SCFH / 129 Nm³/h		**Type HSR** Page 232
150 psig / 10.3 bar	4 in. w.c. to 7 psig / 10 mbar to 0.5 bar	6660 SCFH / 178 Nm³/h		**Y600A Series** Page 379
125 psig / 8.6 bar	3.5 in. w.c. to 5.5 psig / 9 mbar to 0.38 bar	11,200 SCFH / 301 Nm³/h		**CS400 Series** Page 201
125 psig / 8.6 bar	3.5 in. w.c. to 10 psig / 9 mbar to 0.69 bar	36,270 SCFH / 974 Nm³/h		**CS800 Series** Page 211
150 psig / 10.3 bar	2 in. w.c. to 60 psig / 5 mbar to 4.1 bar	372,000 SCFH / 9967 Nm³/h		**133 Series** Page 121

Fuel Gas Pressure Reducing Regulators (continued)

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
175 psig / 12.1 bar	3.5 in. w.c. to 60 psig / 9 mbar to 4.1 bar	108,120 SCFH / 2898 Nm^3/h		**299H Series** Page 127
2000 psig / 138 bar	5 to 500 psig / 0.3 to 34.5 bar	179,000 SCFH / 4797 Nm^3/h		**627 Series** Page 145
400 psig / 27.6 bar	14 in. w.c. to 300 psig / 35 mbar to 20.7 bar	11,328,780 SCFH / 303,496 Nm^3/h		**Type 1098-EGR** Page 167
1500 psig / 103 bar	6 in. w.c. to 1000 psig / 15 mbar to 69 bar	26,138,000 SCFH / 700,232 Nm^3/h		**EZR Series** Page 227
1500 psig / 103 bar	14.5 to 1160 psig / 1 to 80 bar	57,831,000 SCFH / 1,549,282 Nm^3/h		**EZH and EZHOSX Series** Page 226
1480 psig / 102 bar	14.5 to 1160 psig / 1 to 80 bar	100,535,000 SCFH / 2,693,315 Nm^3/h		**Type FL** Page 228

Fuel Gas Quick Selection Guide

Relief Valves

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
420 psig / 29.0 bar	35 to 350 psig / 2.4 to 24.1 bar	44,571 SCFH / 1195 Nm^3/h		**Type H120** Page 229
400 psig / 27.6 bar	25 to 300 psig / 1.7 to 20.7 bar	251,487 SCFH / 6739 Nm^3/h		**H200 Series** Page 230

Fuel Gas Valve

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
150 psig / 10.3 bar	3 to 60 psig / 0.21 to 4.1 bar	$C_V = 7.2$		**119 Series** Page 118

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Introduction

Fuel Gas can refer to several different gases which are burned in air to release thermal energy. These gases are stable at normal temperatures and can be stored for long periods of time without deterioration. They also can be transported by pipeline over long distances. Natural gas or Methane is the most common fuel gas used, but others include LP-Gas / Propane and Butane, Town gas and Syngas.

Typical Applications

Fuel gases are used for a wide variety of applications from residential heating and cooking to industrial boilers, generators and direct fired processing plant applications. To deliver fuel gas to the end user, suppliers utilize pipelines which typically operate at high pressures. For the consumer to utilize the fuel gas, a pressure regulator is required to reduce the pressure.

Two main types of regulators are used for fuel gas applications, self-operated and pilot-operated regulators. Self-operated regulators are a cost effective solution for most fuel gas applications. They provide fast control, normally accepted accuracy and ease of use and installation. For applications requiring higher capacities or tighter accuracies, pilot-operated regulators are available.

Application Considerations

Tight shutoff is typically required by regulators in fuel gas applications. This is referring to the regulator's capability to completely shut-off the flow of gas downstream when the appliance utilizing the fuel gas is turned off and is not using any fuel. To accommodate this requirement, fuel gas regulators utilize a rubber disc and a very finely machined orifice. Many self-operated regulator designs also incorporate a lever to improve lock-up.

Many fuel gas applications require the regulator to operate with a small pressure drop. This requires the regulator to have a large orifice or port opening to allow flow with minimal restriction. In pilot-operated regulators, special consideration must be given to the pressure drop available in the application. All pilot-operated regulators have a minimum differential pressure required for operation which depends on the construction configuration of the regulator. The Type 1098 is one pilot-operated regulator which can operate with very low pressure drops due to its large main actuator.

Many fuel gas applications have fast load changes including a fast start-up or shut-down of the system. A self-operated regulator is ideal for these types of applications. As soon as a self-operated regulator senses a pressure increase in the downstream piping, it begins to close. Some fast moving applications however, require higher flow rates than self-operated regulators can provide. For these applications, Emerson offers pilot-operated regulators with designed special piloting systems for increased speed of opening and closing; These regulators are listed in the Fuel Gas section. The Type FL is an example of the ideal choice for Turbine startup applications which require a fast opening regulator with high capacity. The Type 1098-EGR regulator can also be equipped with special pilots for fast opening boiler applications where low pressure drops and high capacities are required.

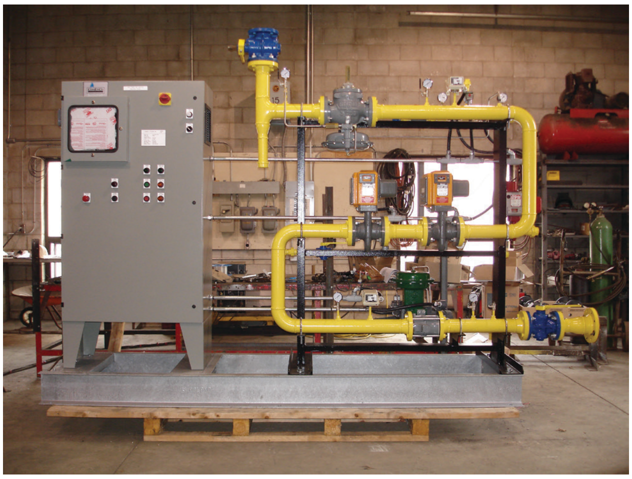


Figure 1. *This turn-key fuel gas skid utilizes the highly accurate Fisher Type 1098-EGR pressure regulator to supply gas to a steam boiler.*

Figure 2. *At the Toronto International Airport power plant Tartarini™ 6 in. Type FL pressure regulators are used to supply boiler fuel gas for steam generation.*

Notes

Liquids

Any substance that is capable of flowing or of being poured is known as a liquid. One of the most common liquids that we come in contact with on a daily basis is water. Other liquids include detergents, paints, aqueous chemicals, fuels and oil.

Liquids differ from gases as they are incompressible and viscous. Because of these characteristics, special consideration must be given when selecting a regulator. Fisher™ regulators have a wide array of configurations and materials of construction to meet many liquid applications.

EMERSON

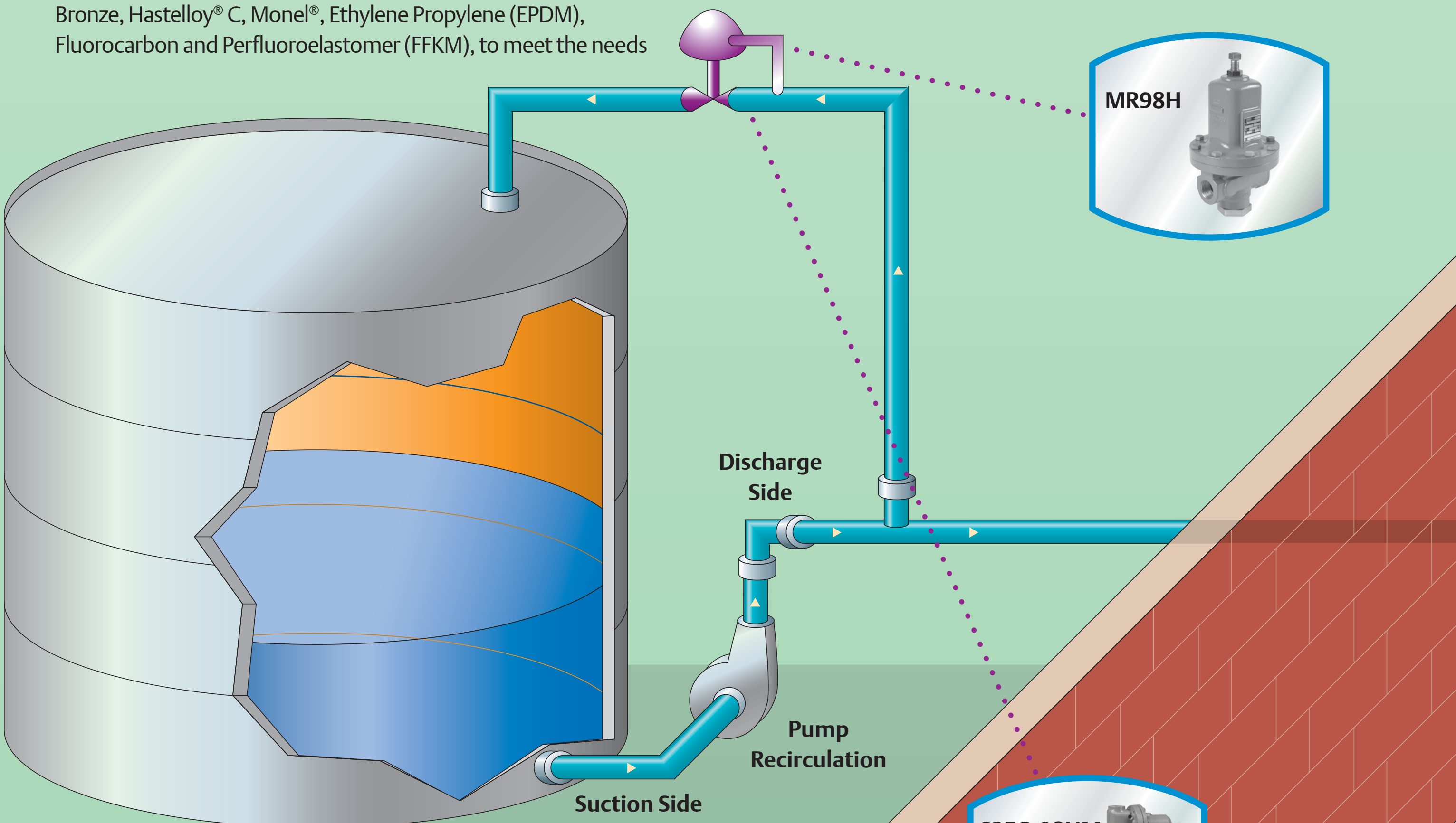
Application: Liquids Solutions

Introduction

There are thousands of liquids manufactured all around the world. Since there are so many liquids with different chemical and corrosive characteristics, viscosities and temperatures, a variety of construction materials need to be available so a regulator can be compatible with the liquid.

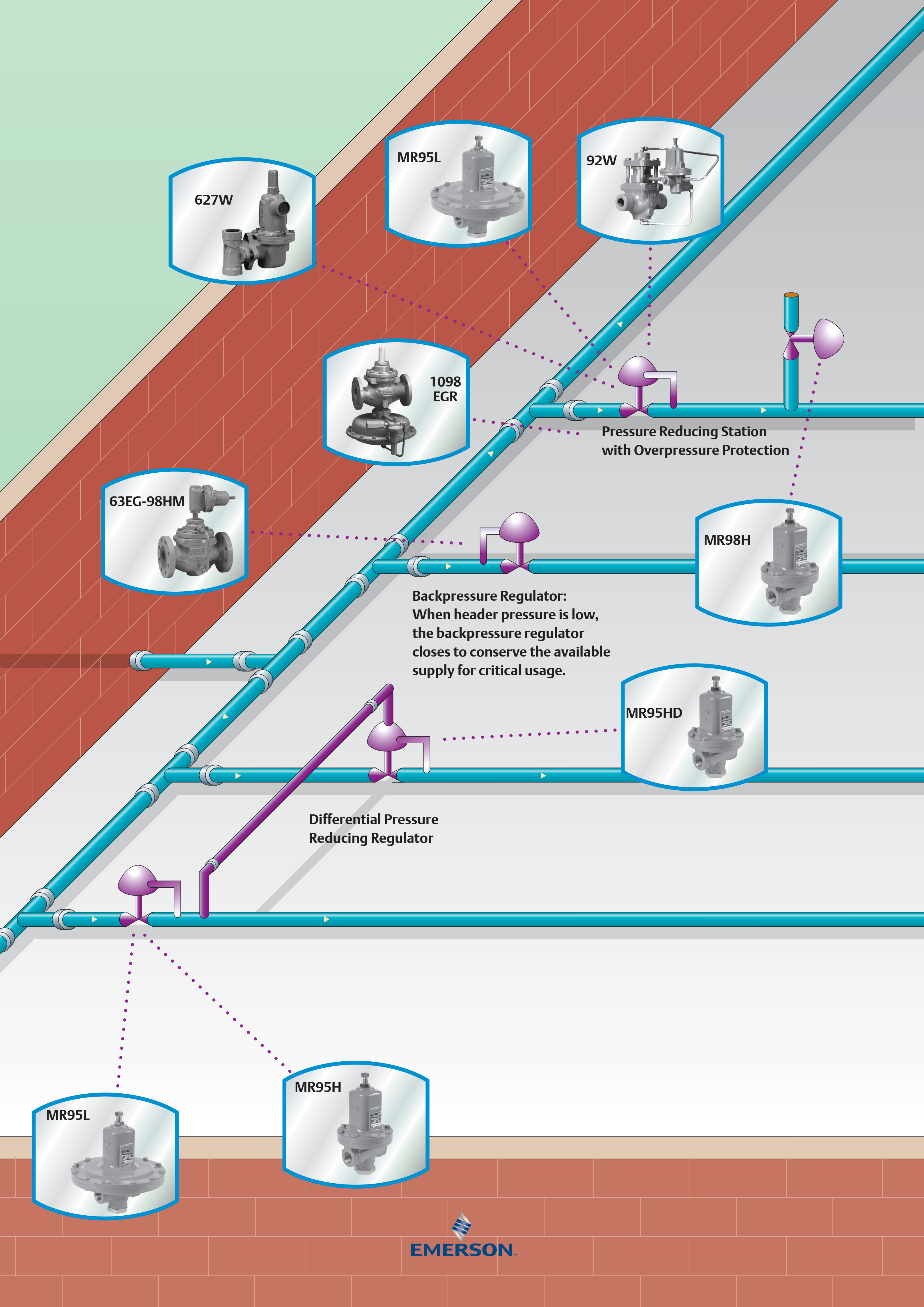
Many liquid applications require the regulator's wetted parts to be compatible with the fluid in the system to prevent corrosion. Emerson offers construction materials, such as Stainless steel Bronze, Hastelloy® C, Monel®, Ethylene Propylene (EPDM), Fluorocarbon and Perfluoroelastomer (FFKM), to meet the needs of most liquid applications. Fisher™ regulators are designed with large turndown ratios to prevent instability at low flow settings when throttling near the seat. This allows you to choose one regulator that will provide adequate control for a wide range of varying flows.

Emerson Sales Representatives and Application Engineers are available to help with your toughest questions and application requirements. Contact your local Sales Office for sales and application support.



Features

- Broad Material Selection:
  Regulators are available in a variety of materials including Cast iron, Carbon steel, Stainless steel, Monel® and Hastelloy® C to address the toughest service conditions.
- Excellent Fluid Capability:
  Special elastomers and metals, such as Fluorocarbon, Ethylene Propylene (EPDM), Stainless steel, Bronze, Monel® and Hastelloy® C, are available for fluid compatibility.
- Wide Product Selection
- Highest Quality Construction
- Time Proven Technology
- Elastomer Seats for Tight Shutoff
- Quick and Easy Maintenance
- Large Turndown Ratios

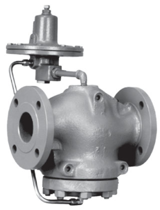

627W
MR95L
92W
1098
EGR
Pressure Reducing Station
with Overpressure Protection
63EG-98HM
MR98H
Backpressure Regulator:
When header pressure is low,
the backpressure regulator
closes to conserve the available
supply for critical usage.
MR95HD
Differential Pressure
Reducing Regulator
MR95H
MR95L
EMERSON

Liquids Quick Selection Guide

Pressure Reducing Regulators

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
2000 psig / 138 bar	10 to 500 psig / 0.69 to 34.5 bar	2.68 GPM / 10.1 l/min		**1301 Series** Page 180
400 psig / 27.6 bar	0 to 150 psig / 0 to 10.3 bar	5.863 GPM / 22.2 l/min		**67CS Series** Page 92
400 psig / 27.6 bar	0 to 150 psig / 0 to 10.3 bar	C_V = 1.33		**67D Series** Page 96
200 psig / 13.8 bar	20 to 80 psig / 1.4 to 5.5 bar	260 GPM / 984 l/min		**Type 75A** Page 100
300 psig / 20.7 bar	2 to 30 psig / 0.14 to 2.1 bar	58 GPM / 219 l/min		**Type MR95L** Page 276
300 psig / 20.7 bar	5 to 250 psig / 0.34 to 17.2 bar	94 GPM / 356 l/min		**Type 92C** Page 105
900 psig / 62.1 bar	10 to 500 psig / 0.69 to 34.5 bar	82 GPM / 310 l/min		**627W Series** Page 159

Pressure Reducing Regulators (continued)

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
1000 psig / 68.9 bar	5 to 400 psig / 0.34 to 27.6 bar	397 GPM / 1500 l/min		**Type MR95H** Page 255
400 psig / 27.6 bar	5 to 300 psig / 0.34 to 20.7 bar	1650 GPM / 6240 l/min		**Type MR105** Page 312
400 psig / 27.6 bar	4 in. w.c. to 300 psig / 10 mbar to 20.7 bar	11,934 GPM / 45,170 l/min		**Type 1098-EGR** Page 167
300 psig / 20.7 bar	2 to 150 psig / 0.14 to 10.3 bar	960 GPM / 3634 l/min		**Type 92W** Page 115
600 psg / 41.4 bar	15 to 400 psig / 1.0 to 27.6 bar	2640 GPM / 9993 l/min		**Type LR125** Page 243

Liquids Quick Selection Guide

Pressure Reducing Differential Control / Bias Regulators

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
300 psig / 20.7 bar	2 to 30 psig / 0.14 to 2.1 bar	58 GPM / 219 l/min		**Type MR95LD** Page 276
300 psig / 20.7 bar	5 to 150 psig / 0.34 to 10.3 bar	295 GPM / 1120 l/min		**Type MR95HD** Page 255

Relief Valve / Backpressure Differential Control / Bias Regulators

Outlet Pressure Range	Maximum Capacity		Type Number
2 to 38 psig / 0.14 to 2.6 mbar	51 GPM / 193 Nm^3/h		**Type MR98LD** Page 303
5 to 200 psig / 0.34 to 13.8 mbar	300 GPM / 1150 Nm^3/h		**Type MR98HD** Page 284

Relief Valves / Backpressure Regulators

Outlet Pressure Range	Maximum Capacity		Type Number
3 to 150 psig / 0.21 to 10.3 bar	$C_v = 4.93$		**Type 122A** Page 120
2 to 38 psig / 0.14 to 2.6 mbar	51 GPM / 193 Nm^3/h		**Type MR98L** Page 303

Relief Valves / Backpressure Regulators (continued)

Outlet Pressure Range	Maximum Capacity		Type Number
5 to 200 psig / 0.34 to 13.8 mbar	300 GPM / 1150 l/min		**Type MR98H** Page 284
150 to 375 psig / 10.3 to 25.9 mbar	133 GPM / 504 l/min		**Type MR98HH** Page 284
5 to 300 psig / 0.34 to 20.7 bar	1460 GPM / 5530 l/min		**Type MR108** Page 323
30 to 145 psig / 2.1 to 10 bar	C_V = 240		**Type CT88** Page 224
15 to 375 psig / 1.0 to 25.9 bar	C_V = 2.75		**Type 63EG-98HM** Page 80
25 to 375 psig / 1.7 to 25.9 bar	3368 GPM / 12,748 l/min		**Type LR128** Page 249

Liquids Applications

Liquid Regulator Application Guide

To control fluid pressure, system designers use regulators in many liquid applications. The purpose of this Application Guide is to familiarize you with the common product applications and system considerations. Most liquid regulators fall into three categories: Pressure reducing, differential/bias or backpressure/relief.

Regulators and backpressure/relief valves used for liquid applications are available in many sizes and materials. Your local Sales Office is available to assist you in the proper regulator selection and sizing for your liquid applications.

Pressure Reducing Regulators

In a liquid application, the pressure may need to be reduced for a process or equipment. Depending upon the accuracy required by the application, a direct-operated or pilot- operated regulator can be used to reduce the fluid pressure.

Direct-operated regulators are used for lower flow rates. Pilot-operated regulators are used for high flow rates or where precise pressure control is required.

Differential/Bias Regulators

A differential or bias regulator maintains a pressure difference between two locations in the system.

Relief Valves/Backpressure Regulators

Relief valves or backpressure regulators open when the upstream controlled pressure increases above the setpoint. These relief valves and backpressure regulators are the same devices that are used for different applications.

Overpressure protection is provided by relieving pressure, usually to atmosphere, when it rises above the setpoint. When upstream pressure rises above the setpoint, the relief valve/backpressure regulator opens to allow excess upstream pressure to flow downstream, typically into a pressurized system.

Liquid Regulators

Liquid regulators are called on to handle all kinds of fluids, pressures and temperatures. When selecting a liquid regulator, choose a regulator that offers the best construction for the intended application.

Usually sizing a regulator is as simple as finding a regulator that meets your pressure and flow requirements. Other requirements, such as viscosity and presence of cavitation, can also influence the type and size of a regulator. The following discusses the special considerations pertaining to liquid applications.

Note: The capacities in this section are given in gallons (liters) of water per minute. When sizing a regulator for a different liquid, use the C_v, when provided, from the regulating flow coefficient table and one of the following formulas to calculate the capacity.

$$Q = C_v \sqrt{\frac{P_1 - P_2}{G}}$$

or

$$C_v = \frac{Q}{\sqrt{\frac{P_1 - P_2}{G}}}$$

where:

Q = Flow in gallons per minute
C_v = Liquid sizing coefficient
P_1 = Inlet pressure, psig
P_2 = Set pressure, psig
G = Specific gravity of the liquid
(water = 1.00 at 60°F)

Viscosity

A fluid is a substance which undergoes continuous deformation when subjected to a shear stress of flow. Viscosity is the measure of a fluid's resistance to flow. The viscosity of a liquid decreases with increasing temperature.

Viscous conditions can result in significant sizing errors when using the basic liquid sizing equation, since published C_v values are based on test data using water as the flow medium. Although the majority of applications will involve fluids where viscosity corrections can be ignored or where the corrections are relatively small, fluid viscosity should be considered in each regulator selection.

For example, a common fluid such as corn syrup has a relatively high viscosity. Therefore, corn syrup has resistance to flow or in other words its flowing velocity is much slower than water at the same pressure and temperature. This resistance to flow will require a larger regulator. Our nomograph and procedure provides a viscosity correction factor. Apply the correction factor to the C_v coefficient to determine a corrected coefficient.

Viscosity also affects the regulator's speed of response. Just as the velocity is slower through the pipe, so is the flow through the registration ports of the regulator. The larger the port, the easier the fluid flows through the port and therefore, better speed of response.

High viscosity fluids can cause very slow response in pilot-operated regulators merely because of the small ports in the pilot. A common rule of thumb is that a pilot-operated regulator should not be used on liquids with a higher viscosity than No. 2 fuel oil.

For assistance with the viscosity sizing procedure, contact your local Sales Office.

Cavitation

The occurrence of either flashing or cavitation within a regulator can have an effect on the regulator sizing procedure. These two related physical phenomena tend to limit flow through the regulator.

Cavitation can cause structural damage to the regulator and adjacent piping. A regulator's design simplicity limits the capability to add anti-cavitation trim. Hardened trim material may be the only precaution available. Also, limit the pressure drop across the regulator or use a control valve when cavitation or flashing presents a problem. K_m values are shown in the product pages of this section. These are used to predict choked flow. Refer to the Technical Reference section for an explanation on how to use these values. If there is a potential problem in your system, contact your local Sales Office for a recommendation.

Incompressible Flow

Since liquids are incompressible, the system design requires special consideration. Shutoff valves, especially snap-acting valves, can cause pressure problems with a regulator. Pressure surges from water hammer can feed back to the regulator, causing damage to parts such as the diaphragm. If a rapid closing valve is required, it should be upstream of the regulator.

Liquids also slow down the response of a regulator, especially a pilot-operated regulator. The liquid is not able to quickly pass through the small ports in the pilot, delaying the response time.

Regulator Construction Materials

Liquid applications require the regulator or relief valve/ backpressure regulator wetted parts to be compatible with the fluid in the system to prevent corrosion in the system. Both elastometric and metal components need to be compatible with the system. An abbreviated fluid compatibility chart is shown below, or refer to the Technical Reference section for a complete chart.

Material selection is usually based on the pressure, temperature, corrosive properties and erosive properties of the flow media. Some service conditions require the use of special materials to withstand particular corrosive properties of the flowing fluid.

Fluid Temperature

Diaphragms and all other parts must meet temperature requirements of the system. Special elastomers and metal trim constructions are available for high and/or low temperature applications.

Liquid Purity

Particles and other debris in the fluid can cause clogging or erosion inside the regulator. Consider installing filters and strainers upstream of regulators.

Accuracy and Speed of Response

It is important to analyze the needs of the application to determine the accuracy and speed of response. Direct-operated regulators offer faster speed of response at a lower cost; however, they are not as accurate as pilot- operated regulators at high flow rates. Take care not to over- specify the accuracy of a regulator to avoid unnecessary expense.

EMERSON

Liquids Applications

Fluid Compatibility of Elastomers					
FLUID	MATERIAL				
	Neoprene (CR)	Nitrile (NBR)	Fluorocarbon (FKM)	Ethylenepropylene (EPDM)	Perfluoroelastomer (FFKM)
Acetic Acid Vapors (30%)	B	C	C	A	A
Acetone	C	C	C	A	A
Air, Ambient	A	A	A	A	A
Air, Hot (200°F / 93°C)	C	B	A	A	A
Alcohol (Ethyl)	A	C	C	A	A
Alcohol (Methyl)	A	A	C	A	A
Ammonia (Anhydrous) (Cold)	A	A	C	A	A
Ammonia (Gas, Hot)	B	C	C	B	A
Beer	A	A	A	A	A
Benzene	C	C	B	C	A
Brine (Calcium Chloride)	A	A	B	A	A
Butadiene Gas	C	C	B	C	A
Butane (Gas)	A	A	A	C	A
Butane (Liquid)	C	A	A	C	A
Carbon Tetrachloride	C	C	A	C	A
Chlorine (Dry)	C	C	A	C	A
Chlorine (Wet)	C	C	B	C	A
Coke Oven Gas	C	C	A	C	A
Ethyl Acetate	C	C	C	B	A
Ethylene Glycol	A	A	A	A	A
Freon 11	C	B	A	C	A
Freon 12	A	A	B	B	A
Freon 22	A	C	C	A	A
Freon 114	A	A	B	A	A
Gasoline (Automotive)	C	B	A	C	A
Hydrogen Gas	A	A	A	A	A
Hydrogen Sulfide (Dry)	A	A(1)	C	A	A
Hydrogen Sulfide (Wet)	B	C	C	A	A
Jet Fuel (JP-4)	B	A	A	C	A
Methyl Ethyl Ketone (MEK)	C	C	C	A	A
MTBE	C	C	C	C	A
Natural Gas	A	A	A	C	A
Nitric Acid (50 to 100%)	C	C	B	C	A
Nitrogen	A	A	A	A	A
Oil (Fuel)	C	A	A	C	A
Propane	B	A	A	C	A
Sulfur Dioxide	C	C	C	A	A
Sulfuric Acid (up to 50%)	C	C	A	B	A
Sulfuric Acid (50% to 100%)	B	C	A	B	A
Water (Ambient)	A	A	A	A	A
Water (at 200°F / 93°C)	C	C	C	A	A

1 - Performance worsens with high temperature.
A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory

Elastomer Information						
FLUID	MATERIAL					
	Neoprene (CR)	Nitrile (NBR)	Fluorocarbon (FKM)	Ethylenepropylene (EPDM)	Perfluoroelastomer (FFKM)	Polytetrafluoroethylene (PTFE)
Ammonia (Anhydrous) (<140°F / 60°C)	A	A	C	A	A	A
Ammonia (Gas, Hot)	B	C	C	B	A	A
Benzene	C	C	B	C	A	A
Butadiene Gas	C	C	B	C	A	A
Butane Gas	B	A	A	C	A	A
Carbon Tetrachloride	C	C	A	C	A	A
Chlorine (Dry)	C	C	A	C	A	A
Chlorine (Wet)	C	C	B	C	A	A
Coke Oven Gas	C	C	A	C	A	A
Ethyl Acetate	C	C	C	B	A	A
Hydrogen Gas	A	A	A	A	A	A
Hydrogen Sulfide (Dry)	A	A(1)	C	A	A	A
Hydrogen Sulfide (Wet)	B	C	C	A	A	A
Nitrogen	A	A	A	A	A	A
Propane	A	A	A	C	A	A
Sulfur Dioxide	C	C	C	A	A	A

1 - Performance worsens with high temperature.
A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory

Corrosion Information

FLUID	MATERIAL						
	WCB Steel	Cast Iron or Ductile Iron	302 or 304 Stainless Steel	CF8M or 316 Stainless Steel	416 Stainless Steel	Monel®	Hastelloy® C
Acetic Acid Vapors (<150°F / 65°C) (2/3)	C	C	A (304 only)	A	C	A	A
Acetone	A	A	A	A	A	A	A
Acetylene	A	A	A	A	A	A	A
Ammonia	A	A	A	A	A	A	A
Benzene (Benzol)	A	A	A	A	A	A	A
Butane	A	A	A	A	A	A	A
Carbon Dioxide (Dry)	A	A	A	A	A	A	A
Carbon Dioxide (Wet)	C	C	A	A	C	A	A
Carbon Disulfide	A	A	A	A	B	B	A
Carbon Tetrachloride	B	B	B	B	C	A	A
Chlorine Gas (Dry)	A	A	A	B	B	A	A
Chlorine (Wet)	C	C	C	C	C	C	A
Coke Oven Gas	A	A	A	A	A	B	A
Ether	B	B	A	A	A	A	A
Ethyl Chloride	C	C	B	B	C	A	A
Ethylene	A	A	A	A	A	A	A
Formaldehyde	B	B	A	A	A	A	A
Freon (Wet)	B	B	B	A	C	A	A
Freon (Dry)	B	B	A	A	A	A	A
Helium	A	A	A	A	A	A	A
Hydrogen	A	A	A	A	A	A	A
Methane	A	A	A	A	A	A	A
Natural Gas	A	A	A	A	A	A	A
Nitrogen	A	A	A	A	A	A	A
Phosphoric Acid Vapors	C	C	B	A	C	B	A
Propane	A	A	A	A	A	A	A
Sulfur Dioxide (Dry)	C	C	C	B	C	C	A
Sulfur Trioxide (Dry)	C	C	C	B	C	B	A

1 - Performance worsens with high temperature.
A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory

Available Construction Materials

TYPE/ SERIES	BODY						INTERNAL METAL PART								DIAPHRAGM								O-RING AND OTHER ELASTOMER PART						
	Brass/Bronze	Hastelloy® C	Iron (Cast or Ductile)	Monel®	Stainless Steel	Steel	Alloy 20	Aluminum	Brass/Bronze	Hastelloy® C	Inconel®	Monel®	Stainless Steel	Steel	Ethylene propylene (EPDM)	Fluorocarbon (FKM)	Hastelloy® C	Monel®	Neoprene (CR)	Nitrile (NBR)	Stainless Steel	PTFE Protector	Ethylene propylene (EPDM)	Fluorocarbon (FKM)	Neoprene (CR)	Nitrile (NBR)	Nylon (PA)	Perfluoroelastomer (FFKM)	PTFE
63EG-98HM		●	●	●	●	●				●		●	●	●	●	●	●	●			●	●	●	●		●		●	
67CS					●								●			●				●				●		●			
67DS					●								●			●				●				●		●			
75A	●								●											●						●			
92C			●		●	●			●				●		●	●			●		●		●	●		●		●	
92W			●		●	●							●								●								●
627W			●		●	●							●		●	●			●	●		●	●	●		●	●	●	
1098-EGR					●	●							●	●	●	●				●			●	●		●			●
1301	●				●				●				●								●		●	●	●		●		●
CT88						●							●			●								●					
LR125					●	●							●			●				●				●		●			●
LR128					●	●							●			●				●				●		●			●
MR95		●	●	●	●	●	●		●	●		●	●		●	●	●	●	●		●	●	●	●	●	●		●	●
MR98		●	●	●	●	●	●		●	●		●	●		●	●	●	●	●		●	●	●	●	●	●		●	●
MR105			●		●	●					●		●	●	●	●				●			●	●		●			
MR108			●			●	●				●			●	●	●				●			●	●		●	●		

Hastelloy® C is a marked owned by Haynes International, Inc.
Inconel® and Monel® are marked owned by Special Metals Corporation.

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Notes

Process Gases

Gases are used in chemical and industrial processes, such as analytical instrumentation, environmental compliance, electronic manufacturing, chemical production, reference gases and medical uses. All the devices in these systems must be compatible to prevent complications, such as corrosion, unwanted chemical reactions, ignition or explosion. Also, some of these process systems operate at very high or very low temperatures. Regulators must be constructed to withstand these temperatures.

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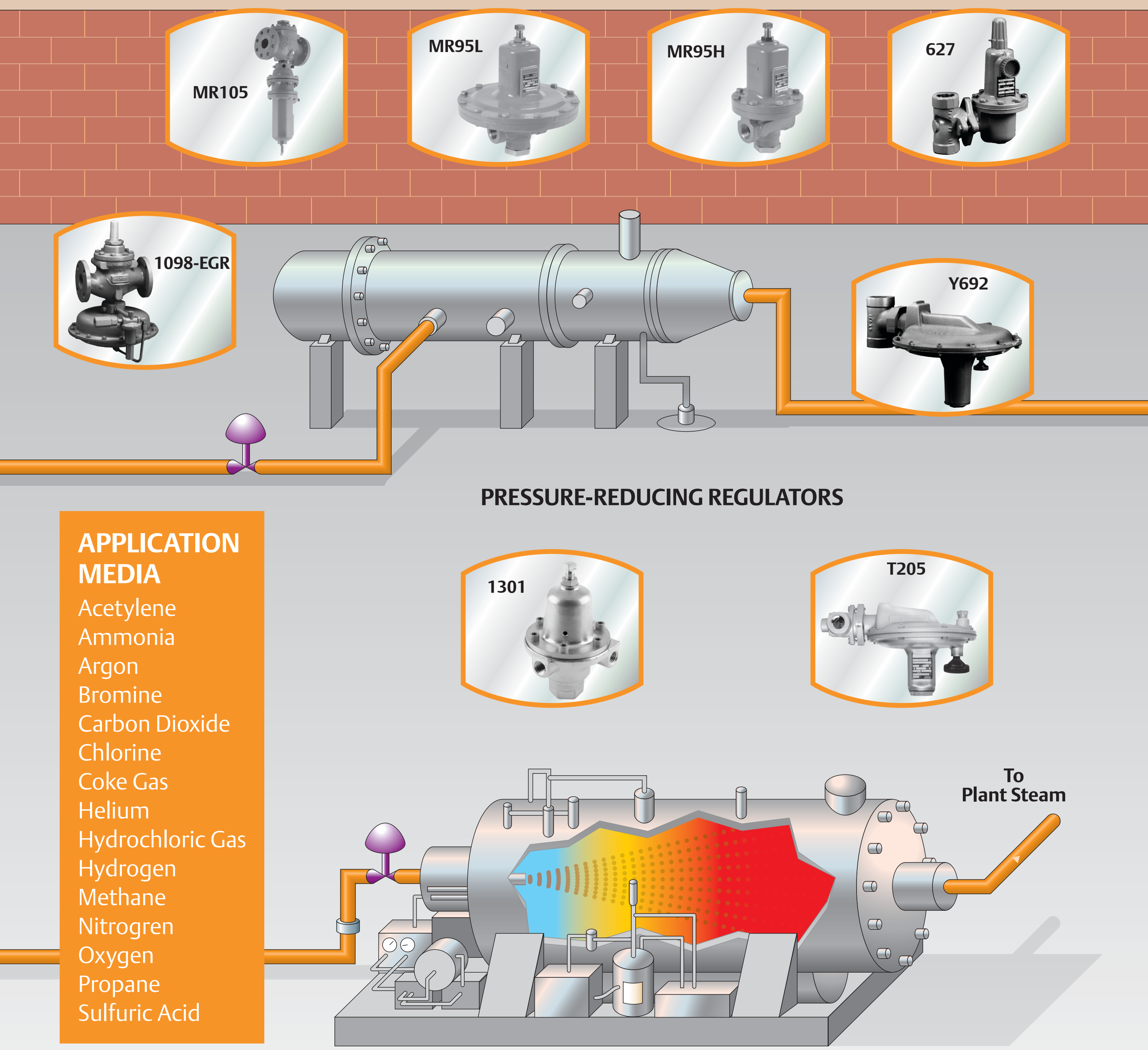
Application: Process Gases Solutions

Introduction

Fisher™ products are available in a variety of construction materials to meet the unique needs of your system. The Process Gases Application Map below shows a selection of regulators and relief valves/ backpressure regulators that offer special body materials.

The products shown below also offer special internal parts, such as stainless steel, Hastelloy® C, Monel® PTFE, ethylene propylene (EPDM), fluorocarbon (FKM) and perfluoroelastomer (FFKM) that are compatible with most systems.

If your system requires a special construction that is not shown in this application guide, contact your local Sales Office for assistance.



APPLICATION MEDIA

Acetylene
Ammonia
Argon
Bromine
Carbon Dioxide
Chlorine
Coke Gas
Helium
Hydrochloric Gas
Hydrogen
Methane
Nitrogren
Oxygen
Propane
Sulfuric Acid

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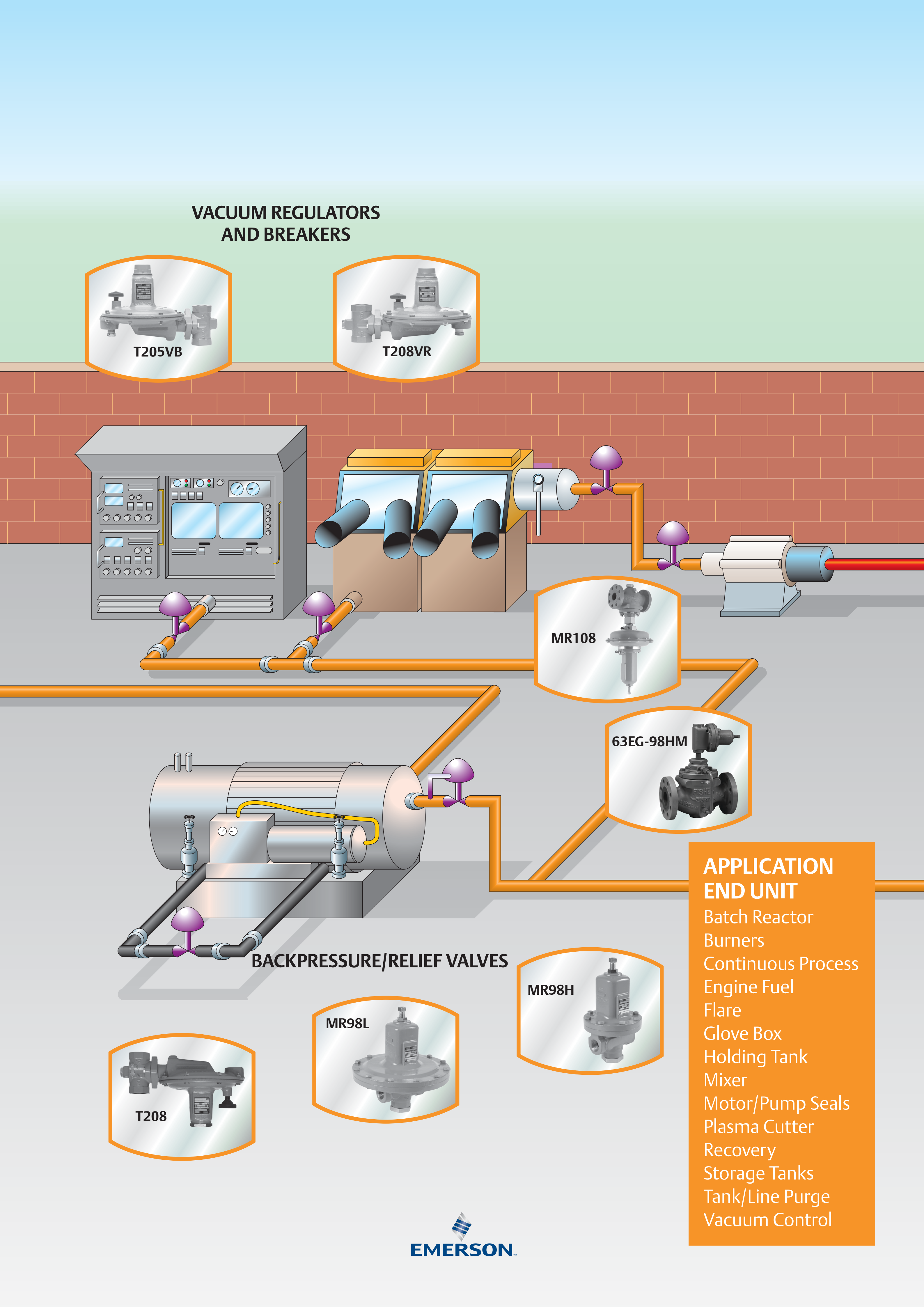
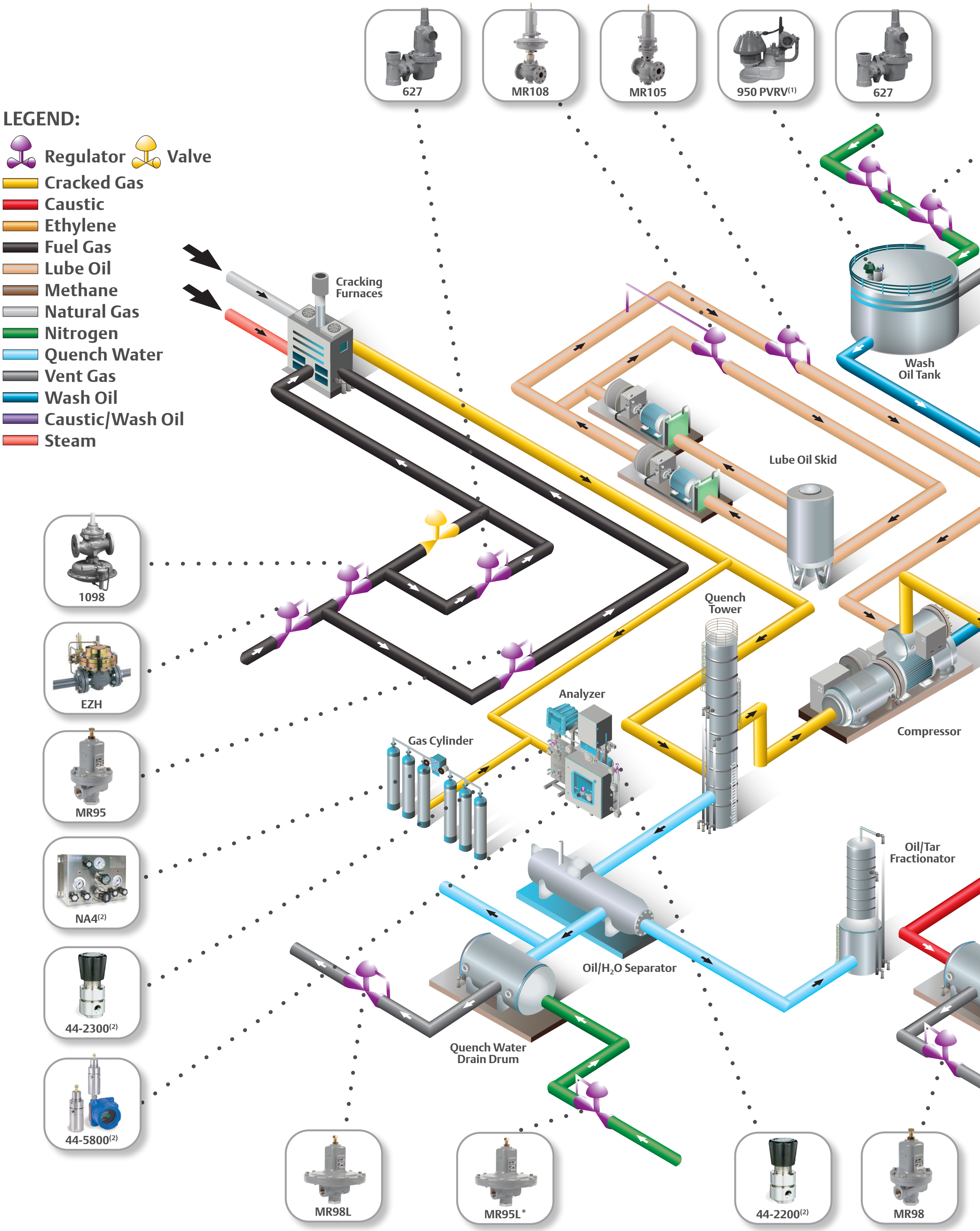

VACUUM REGULATORS
AND BREAKERS
T205VB
T208VR
MR108
63EG-98HM
BACKPRESSURE/RELIEF VALVES
MR98H
MR98L
T208
APPLICATION
END UNIT
Batch Reactor
Burners
Continuous Process
Engine Fuel
Flare
Glove Box
Holding Tank
Mixer
Motor/Pump Seals
Plasma Cutter
Recovery
Storage Tanks
Tank/Line Purge
Vacuum Control
EMERSON

Application: Ethylene



*Other regulator models such as T205 and ACE95 can be used for applications that require lower pressure.
1. Visit Enardo.com for more information.
2. Visit Tescom.com for more information.

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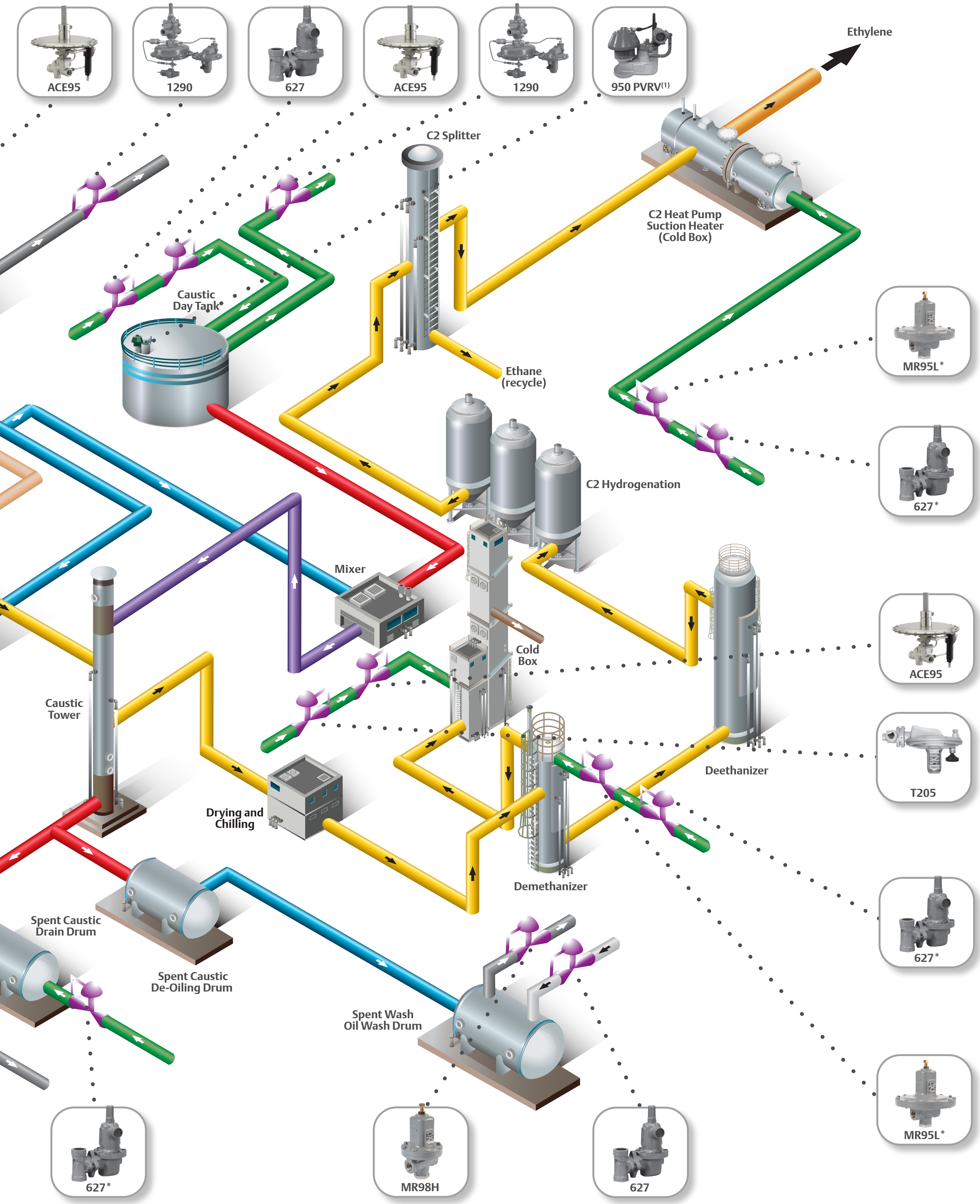
ACE95
1290
627
ACE95
1290
950 PVRV(1)
Ethylene
C2 Splitter
C2 Heat Pump
Suction Heater
(Cold Box)
Caustic
Day Tank*
Ethane
(recycle)
MR95L*
627*
C2 Hydrogenation
Mixer
Cold
Box
ACE95
Caustic
Tower
T205
Deethanizer
Drying and
Chilling
Demethanizer
627*
Spent Caustic
Drain Drum
Spent Caustic
De-Oiling Drum
Spent Wash
Oil Wash Drum
MR95L*
627*
MR98H
627

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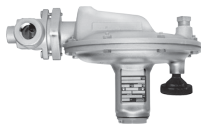
Process Gases Quick Selection Guide

Pressure Reducing Regulators

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
150 psig / 10.3 bar	1 in. w.c. to 10 psig / 2.5 mbar to 0.69 bar	19,523 SCFH / 523 Nm^3/h		**Type Y692** Page 389
200 psig / 13.8 bar	1 in. w.c. to 7 psig / 2.5 mbar to 0.48 bar	24,399 SCFH / 654 Nm^3/h		**T205 Series** Page 363
300 psig / 20.7 bar	2 to 30 psig / 0.14 to 2.1 bar	29,670 SCFH / 795 Nm^3/h		**Type MR95L** Page 276
6000 psig / 414 bar	10 to 500 psig / 0.69 to 34.5 bar	5805 SCFH / 156 Nm^3/h		**1301 Series** Page 180
2000 psig / 138 bar	5 to 500 psig / 0.34 to 34.5 bar	179,000 SCFH / 4797 Nm^3/h		**627 Series** Page 145
600 psig / 41.4 bar	5. to 400 psig / 0.34 to 27.6 bar	657,900 SCFH / 17,625 Nm^3/h		**Type MR95H** Page 255
400 psig / 27.6 bar	70 to 400 psig / 4.8 to 27.6 bar	354,750 SCFH / 9504 Nm^3/h		**Type MR105** Page 312

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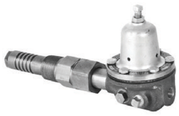
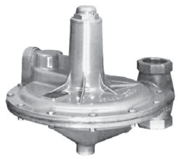
Pressure Reducing Regulators (continued)

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
400 psig / 27.6 bar	14 in. w.c. to 300 psig / 35 mbar to 20.7 bar	11,328,780 SCFH / 303,496 Nm^3/h		**Type 1098-EGR** Page 167
4000 psig / 276 bar	0 to 500 psig / 0 to 34.5 bar	2000 SCFH / 53.6 Nm^3/h		**1305 Series** Page 184
13 psig / 0.90 bar	0 to 3 psig / 0 to 0.21 bar	3225 SCFH / 86.4 Nm^3/h		**Y610 Series** Page 385
5 psig / 0.34 bar	2 in. w.c. to 5 psig / 5 mbar to 0.34 bar	77,500 SCFH / 2077 Nm^3/h		**66 Series** Page 83

Process Gases Quick Selection Guide

Pressure Reducing Differential Control Regulators

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
300 psig / 20.7 bar	2 to 30 psig / 0.14 to 2.1 bar	29,670 SCFH / 795 Nm^3/h		**Type MR95LD** Page 276
300 psig / 20.7 bar	5 to 400 psig / 0.34 to 27.6 bar	657,900 SCFH / 17,625 Nm^3/h		**Type MR95HD** Page 255

Relief Valve / Backpressure Differential Control Regulators

Outlet Pressure Range	Maximum Capacity		Type Number
2 to 38 psig / 0.14 to 2.6 mbar	27,090 SCFH / 726 Nm^3/h		**Type MR98LD** Page 303
5 to 200 psig / 0.34 to 13.8 mbar	157,000 SCFH / 4208 Nm^3/h		**Type MR98HD** Page 284

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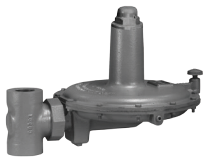
Relief Valve / Backpressure Regulators

Outlet Pressure Range	Maximum Capacity		Type Number
2 in. w.c. to 7 psig / 5 mbar to 0.48 bar	16,658 SCFH / 446 Nm³/h		**Type Y696** Page 401
2 to 38 psig / 0.14 to 2.6 bar	27,090 SCFH / 726 Nm³/h		**MR98L Series** Page 303
5 to 375 psig / 0.34 to 25.9 bar	157,000 SCFH / 4208 Nm³/h		**MR98H Series** Page 284
15 to 375 psig / 1 to 25.9 bar	C_V = 2.75		**Type 63EG-98HM** Page 80
5 to 300 psig / 0.34 to 20.7 bar	1,224,000 SCFH / 32,800 Nm³/h		**Type MR108** Page 323
2 in. w.c. to 7 psig / 5 mbar to 0.48 bar	2500 SCFH / 67.0 Nm³/h		**T208 Series** Page 375
2 in. w.c. to 5 psig / 5 mbar to 0.34 bar	115,000 SCFH / 3082 Nm³/h		**66R Series** Page 87

Process Gases Quick Selection Guide

Vacuum Breakers

Maximum Vacuum	Maximum Inlet Pressure	Vacuum Control Range	Maximum Capacity		Type Number
8 psig / 0.55 bar	30 psig / 2.1 bar	1 in. w.c. to 3 psig / 2 to 207 mbar	2500 SCFH / 67 Nm^3/h		**Type Y692VB** Page 395
12 psig / 0.83 bar	150 psig / 10.3 bar	0 to 5 psig / 0 to 0.34 bar	$C_V = 4.74$		**Type T205VB** Page 373
6 in. w.c. / 15 mbar d vacuum	5 psig / 0.34 bar	-6 to 1.5 in. w.c. / -14.9 to 4 mbar	Contact Local Sales Office		**66 Series** Page 83

Vacuum Regulators

Maximum Vacuum	Maximum Downstream Pressure	Vacuum Control Range	Maximum Capacity		Type Number
Full Vacuum	Full Vacuum	1 in. w.c. to 3 psig / 2 to 207 mbar	6953 SCFH / 186 Nm^3/h		**Type Y696VR** Page 403
Full Vacuum	75 psig / 5.2 bar	0 to 12.8 psig / 0 to 0.88 bar	$C_V = 3.01$		**Type T208VR** Page 377
10 psig / 0.69 bar d vacuum	1 psig / 0.07 bar d change from spring setting	-6 to 1.5 in. w.c. / -14.9 to 4 mbar	12,000 SCFH / 321 Nm^3/h		**66 Series** Page 83

Introduction

Chemical and processing plants use various gases in their process systems. Many of these gases require regulator materials that eliminate or reduce corrosion that can contaminate the system and to increase the service life of the regulator. This Application Guide briefly explains the types of regulators and the construction materials available for these regulators.

Regulator Types

Pressure Reducing Regulators

In some process gas applications, the pipeline pressure may need to be reduced for a process or piece of equipment. Depending upon the accuracy required by the application, a direct-operated or pilot-operated regulator can be used to reduce the gas pressure.

Direct-operated regulators are used for lower flow rates. Pilot-operated regulators are used for high flow rates or where precise pressure control is required.

Differential/Bias Regulators

A differential or bias regulator maintains a pressure difference between two locations in the system.

Relief Valves/Backpressure Regulators

A relief valve or backpressure regulator opens when the upstream controlled pressure increases above the setpoint. Relief valves and backpressure regulators are the same devices. The name is determined by the application. Overpressure protection is provided by relieving pressure when it rises above the setpoint. When upstream pressure rises above the setpoint, the relief/backpressure regulator opens to allow excess upstream pressure to flow downstream, typically into a pressurized system or to atmosphere.

Vacuum Breakers vs. Vacuum Regulators

There are a variety of terms used to describe vacuum, causing confusion when communicating with someone that uses different terminology. Emerson uses the following vacuum terminology:

First, determine whether the units are in absolute pressure or gauge pressure (0 psig or 0 bar g is atmospheric pressure).

For example:

- 5 psig / 0.34 bar g vacuum is 5 psi / 0.34 bar below atmospheric pressure
- -5 psig / -0.34 bar g is 5 psi / 0.34 bar below atmospheric pressure
- 9.7 psia / 0.67 bar a is 9.7 psi / 0.67 bar above absolute zero or 5 psi / 0.34 bar below atmospheric pressure (14.7 psia - 5 psi = 9.7 psia or 1.01 bar a - 0.34 bar = 0.67 bar a).

Just as there are pressure reducing regulators and pressure relief valves for positive pressure service, there are two basic applications for vacuum service. The terms used for each are sometimes confusing. Therefore, it is sometimes necessary to ask further questions to determine the required function of the regulator. Emerson uses the terms vacuum breaker and vacuum regulator to differentiate between the two types.

Vacuum Breakers

Vacuum breakers limit the increase in vacuum. An increase in vacuum (decrease in pressure) beyond the setpoint is sensed on the diaphragm causing the disk to move away from the seat. This permits a higher pressure to enter the system and restore the controlled vacuum to its original pressure setting.

Vacuum Regulators

Vacuum regulators maintain a constant vacuum at the regulator inlet. A decrease in vacuum (increase in pressure) beyond the setpoint registers on the diaphragm causing the disk to move away from the seat, allowing a higher vacuum source to restore the vacuum to its original setting.

Applications

In many cases, piping systems are required to transport the process gas from its storage location outside of the building to the point(s) where it is required within the building. Process gases are supplied from pipelines, cylinders or pressurized tanks. Regulators are used to reduce the pressure to a level that is compatible with the supply pressure design parameters of the downstream system. A combination of regulators and relief valves/backpressure regulators may be required to accomplish these objectives.

Construction Materials

Each process gas has its own set of unique characteristics in terms of its chemical composition, corrosive properties, impurities, flammability, hazardous nature, toxic effect, explosive limits and molecular structure. In some cases special care must be taken to select the proper materials that will come in contact with the process gas.

Material selection for oxygen regulators, for example, must be carefully selected or a fire could result. Oxygen regulators must also be "de-greased or cleaned for oxygen service."

Typical materials for regulator bodies are cast iron, steel, aluminum, brass and stainless steel. Monel® and Hastelloy® C are available in some regulators. Trim materials are typically stainless steel, aluminum or special alloys as mentioned above. The elastomeric parts (diaphragm, disk and O-rings) are usually Nitrile (NBR) or Neoprene (CR). Other elastomers, such as Ethylene Propylene (EPDM), Fluorocarbon (FKM), Perfluoroelastomer (FFKM) and Polytetrafluoroethylene (PTFE), are also available.

Process Gases Applications

All properties of the process gas should be known and a metals corrosion chart should be consulted to ensure the proper selection of the metal parts that come in contact with the gas. Likewise, an elastomer compatibility chart should be consulted for similar issues. An abbreviated version of these charts follows this Application Guide; the complete versions are in the Technical Reference section of this Application Guide.

It should be noted that a mixture of two or more chemicals may be more or less corrosive than one of the chemicals alone. Rely on past experience when selecting materials for handling a chemical mixture. The charts on the following pages do not address chemical concentrations and mixtures which can affect the corrosion rate.

Material Guidelines for Gaseous Oxygen Service

All organic and inorganic materials will react with gaseous or liquid oxygen at certain pressures and temperatures. The reaction that occurs can cause a fire or an explosion. Because of these inherent dangers, process system design and valve material selection are extremely important.

Oxygen service has many inherent hazards and requires careful and knowledgeable design of the process system. The information and guidelines presented here are intended to help the user; however, other factors, such as service conditions and process system design, must be considered to properly select materials that will handle this gas in a safe manner.

Many of the materials commonly used in valves have ignition temperatures above the normal flowing temperatures of gaseous oxygen. Ignition of these materials by normal flowing temperatures is generally not the danger. The danger is in the ignition of these materials by abnormal, localized high temperature. This list has been compiled from the best information available, but does not necessarily contain all the hazardous conditions that might be encountered in oxygen service applications.

Flow Velocity

All valve materials should be suitable for oxygen service and material selection should meet the velocity criteria, such as set by the Compressed Gas Association Pamphlet G-4.4 (copies can be obtained from Compressed Gas Association, Inc., 500 Fifth Avenue, New York, NY 10036). In general, if the velocity through the port of the valve can exceed 200 feet per second (61 meters per second), only copper-base alloy material should be used for valve body and trim parts in contact with the flow stream.

Foreign Particle Impingement

A foreign particle, such as weld spatter, that is being carried in the flow stream and that strikes the valve trim or the valve body wall might have its kinetic energy transformed into sufficient heat to raise the impinging particle or the material it strikes to its respective ignition temperature.

Ignition by Already-Burning Material

An organic valve disk, for example, that has already been ignited by foreign particle impingement will release sufficient heat to ignite surrounding metallic materials, thus initiating a serious fire.

Vibration

A part that is caused to vibrate, usually by the flowing velocity, might generate enough heat from internal friction to raise its temperature to its ignition point.

Rapid Compression of Gas

Opening a valve to pressure the downstream system will result in the compression of the gas in the downstream system. If this is done rapidly, it can result in abnormally high gas temperatures, which might ignite material in the valve and piping system.

Static Electricity Discharger

The flow of gas across the trim of a ball, butterfly or eccentric disk valve might generate a static charge on the trim. Because these valves inherently do not have a good grounding path from the trim to the valve body or from the valve body to the pipeline, use proper provisions and care for their grounding. Failure to do this might allow a discharge spark between the trim and valve body or between the valve body and adjacent piping, igniting the surrounding material.

Conclusion

The list shows that many of the hazards arise from the velocity of the flowing gas. For this reason, it is imperative that the system be designed such that flowing velocities will be low.

Organic Materials

Organic materials have ignition temperatures below those of metals. Use of organic materials in contact with oxygen should be avoided, particularly when the material is directly in the flow stream. When an organic material must be used for parts, such as valve seats, diaphragms or packing, it is preferable to select a material with the highest ignition temperature, the lowest specific heat and the necessary mechanical properties.

Lubricants and sealing compounds should be used only if they are suitable for oxygen service and then used sparingly. Ordinary petroleum lubricants are not satisfactory and are particularly hazardous because of their high heat of combustion and high rate of reaction.

The approximate ignition temperatures in 2000 psig / 138 bar oxygen for a few organic materials are shown in the following table.

Organic Materials		
MATERIAL	TYPICAL IGNITION TEMPERATURE IN 200 PSIG / 138 BAR OXYGEN	
	°F	°C
PTFE and Kel-F	875	468
70% Bronze-filled PTFE	875	468
Fluorocarbon (FKM)	600	316
Nylon	410	210
Polyethelene	360	182
Neoprene and Nitrile (NBR)	300	149

Metals

The selection of metals should be based on their resistance to ignition and rate of reaction. Following is a comparison of these two properties for some commonly used valve materials.

Resistance to Ignition in Oxygen

Materials are listed in order from hardest to ignite to easiest to ignite.

- Copper, copper alloys and nickel-copper alloys (such as Monel®)—most resistant
- Stainless steel (300 Series)
- Carbon steel
- Aluminum—least resistant

Rate of Reaction

Materials are listed in order from slowest rate of combustion to most rapid rate of combustion.

- Copper, copper alloys and nickel-copper alloys (such as Monel®)—do not normally propagate combustion
- Carbon steel
- Stainless steel (300 Series)
- Aluminum—burns very rapidly

Note that stainless steel, once ignited, burns more rapidly than carbon steel. Nevertheless, the austenitic grades (300 Series) of stainless steel are considered to be much better than carbon steel because of their high resistance to ignition.

Corrosion Information							
FLUID	MATERIAL						
	WCB Steel	Cast Iron or Ductile Iron	302 or 304 Stainless Steel	CF8M or 316 Stainless Steel	416 Stainless Steel	Monel®	Hastelloy® C
Acetic Acid Vapors (<150°F / 65°C) (2/3)	C	C	A (304 only)	A	C	A	A
Acetone	A	A	A	A	A	A	A
Acetylene	A	A	A	A	A	A	A
Ammonia	A	A	A	A	A	A	A
Benzene (Benzol)	A	A	A	A	A	A	A
Butane	A	A	A	A	A	A	A
Carbon Dioxide (Dry)	A	A	A	A	A	A	A
Carbon Dioxide (Wet)	C	C	A	A	C	A	A
Carbon Disulfide	A	A	A	A	B	B	A
Carbon Tetrachloride	B	B	B	B	C	A	A
Chlorine Gas (Dry)	A	A	A	B	B	A	A
Chlorine (Wet)	C	C	C	C	C	C	A
Coke Oven Gas	A	A	A	A	A	B	A
Ether	B	B	A	A	A	A	A
Ethyl Chloride	C	C	B	B	C	A	A
Ethylene	A	A	A	A	A	A	A
Formaldehyde	B	B	A	A	A	A	A
Freon (Wet)	B	B	B	A	C	A	A
Freon (Dry)	B	B	A	A	A	A	A
Helium	A	A	A	A	A	A	A
Hydrogen	A	A	A	A	A	A	A
Methane	A	A	A	A	A	A	A
Natural Gas	A	A	A	A	A	A	A
Nitrogen	A	A	A	A	A	A	A
Phosphoric Acid Vapors	C	C	B	A	C	B	A
Propane	A	A	A	A	A	A	A
Sulfur Dioxide (Dry)	C	C	C	B	C	C	A
Sulfur Trioxide (Dry)	C	C	C	B	C	B	A

A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory
The Application Guide gives material compatibility for materials in a specific service. Refer to the applicable service code as to whether a specific material is allowed to be used in that service.

Process Gases Applications

Elastomer Information						
FLUID	MATERIAL					
	Neoprene (CR)	Nitrile (NBR)	Fluorocarbon (FKM)	Ethylene Propylene (EPDM)	Perfluoroelastomer (FFKM)	PTFE
Ammonia (Anhydrous) (<140°F / 60°C)	A	A	C	A	A	A
Ammonia (Gas, Hot)	B	C	C	B	A	A
Benzene	C	C	B	C	A	A
Butadiene Gas	C	C	B	C	A	A
Butane Gas	B	A	A	C	A	A
Carbon Tetrachloride	C	C	A	C	A	A
Chlorine (Dry)	C	C	A	C	A	A
Chlorine (Wet)	C	C	B	C	A	A
Coke Oven Gas	C	C	A	C	A	A
Ethyl Acetate	C	C	C	B	A	A
Hydrogen Gas	A	A	A	A	A	A
Hydrogen Sulfide (Dry)	A	A(1)	C	A	A	A
Hydrogen Sulfide (Wet)	B	C	C	A	A	A
Nitrogen	A	A	A	A	A	A
Propane	A	A	A	C	A	A
Sulfur Dioxide	C	C	C	A	A	A

1. Performance worsens with hot temperature.
A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory

Available Construction Materials

TYPE/ SERIES	BODY							INTERNAL METAL PART								DIAPHRAGM									O-RING AND OTHER ELASTOMER PART						
	Aluminum	Brass/Bronze	Hastelloy® C	Iron (Cast or Ductile)	Monel®	Stainless Steel	Steel	Alloy 20	Aluminum	Brass/Bronze	Hastelloy® C	Inconel®	Monel®	Stainless Steel	Steel	Ethylene Propylene (EPDM)	Fluorinated Ethylene Propylene (FEP)	Fluorocarbon (FKM)	Hastelloy® C	Monel®	Neoprene (CR)	Nitrile (NBR)	Stainless Steel	PTFE Protector	Ethylene Propylene (EPDM)	Fluorocarbon (FKM)	Neoprene (CR)	Nitrile (NBR)	Nylon (PA)	Perfluoroelastomer (FFKM)	PTFE
63EG-98HM			●	●	●	●	●				●		●	●	●	●		●	●	●			●	●	●	●		●		●	
66				●		●	●			●				●				●				●		●	●	●		●			
66R				●		●	●			●				●				●				●		●	●	●		●			
67C	●					●				●				●				●				●		●		●		●			
99				●			●		●	●				●				●				●				●	●	●			
627				●		●	●							●		●		●				●		●	●	●	●	●	●	●	
1098-EGR				●		●	●			●				●	●	●		●				●			●	●		●		●	
1301		●				●								●									●		●	●			●		●
MR105				●		●	●					●		●	●	●		●				●			●	●		●			
MR108				●		●	●					●		●	●	●		●				●			●	●		●			
MR95			●	●	●	●	●	●		●	●		●	●		●		●	●	●	●		●	●	●	●		●		●	●
MR98			●	●	●	●	●	●		●	●		●	●		●		●	●	●	●		●	●	●	●	●	●		●	●
T205			●	●		●	●				●			●			●	●				●			●		●	●		●	
T205VB			●	●		●					●			●				●				●				●		●			
T208			●	●		●	●				●			●			●	●				●			●	●		●		●	
T208VR			●	●		●					●			●				●				●				●		●			
Y692			●	●		●	●				●			●				●				●		●	●	●		●		●	
Y692VB			●	●		●	●				●			●				●				●			●	●		●		●	
Y696			●	●		●	●				●			●				●				●		●	●	●		●		●	
Y696VR			●	●		●	●				●			●				●				●			●	●		●		●	

EMERSON

Sanitary regulators are engineered for pressure control in sanitary, or “clean” environments. The applications include pharmaceutical, biotechnology, food and beverage, cosmetics, chemical and other industries where sanitary process control is required for steam, gases and liquids such as water-for-injection (WFI) systems.

Given the environment in which the regulator operates, special consideration has to be given to the regulator’s construction and body materials.

Application: Sanitary Solutions

Introduction

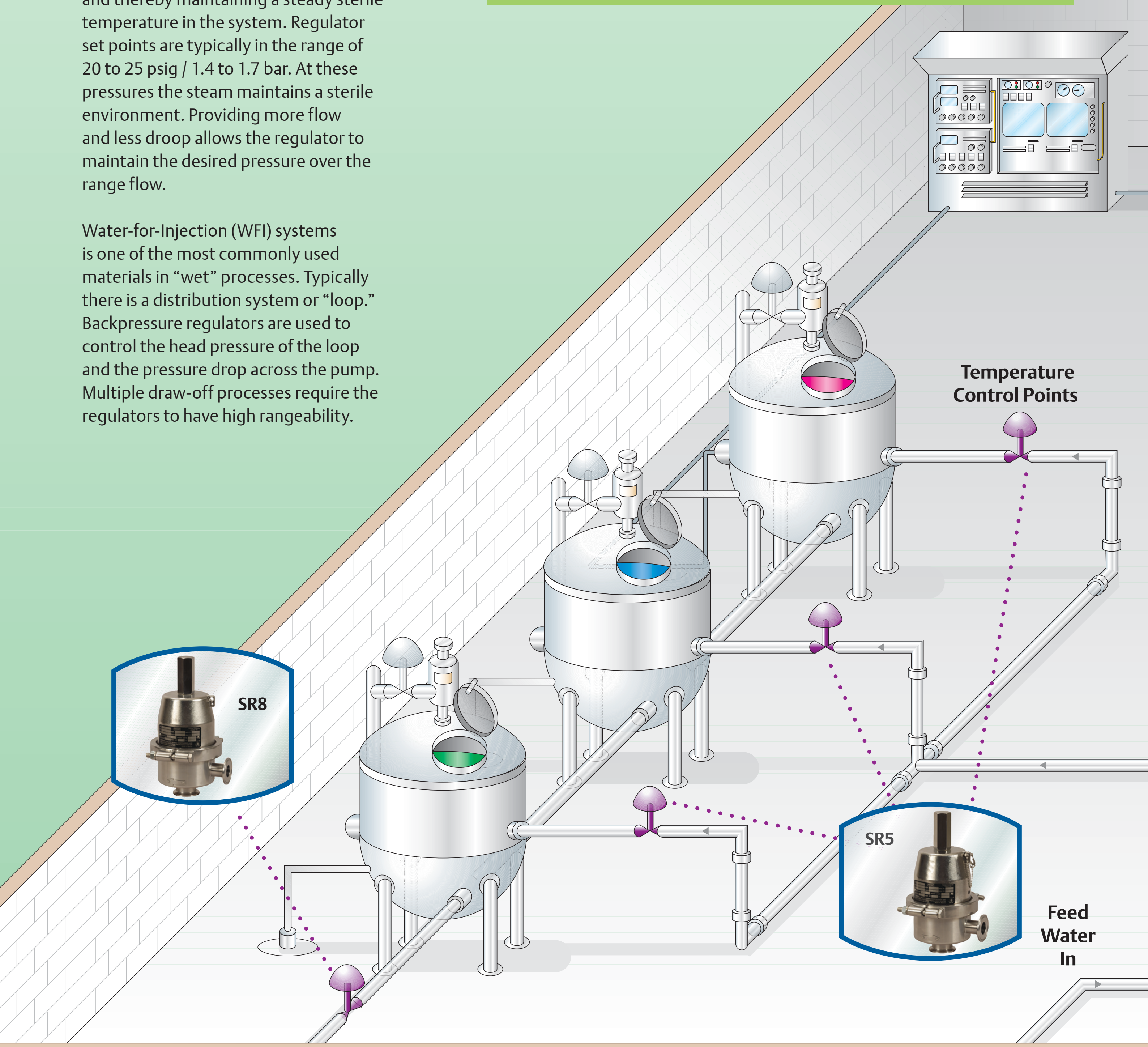
There are two common applications for sanitary regulators in pharmaceutical and biotech facilities. They are clean steam and Water-for-Injection (WFI) systems.

A common application for clean steam is sterilization. A regulator is commonly used to control the pressure of the steam and thereby maintaining a steady sterile temperature in the system. Regulator set points are typically in the range of 20 to 25 psig / 1.4 to 1.7 bar. At these pressures the steam maintains a sterile environment. Providing more flow and less droop allows the regulator to maintain the desired pressure over the range flow.

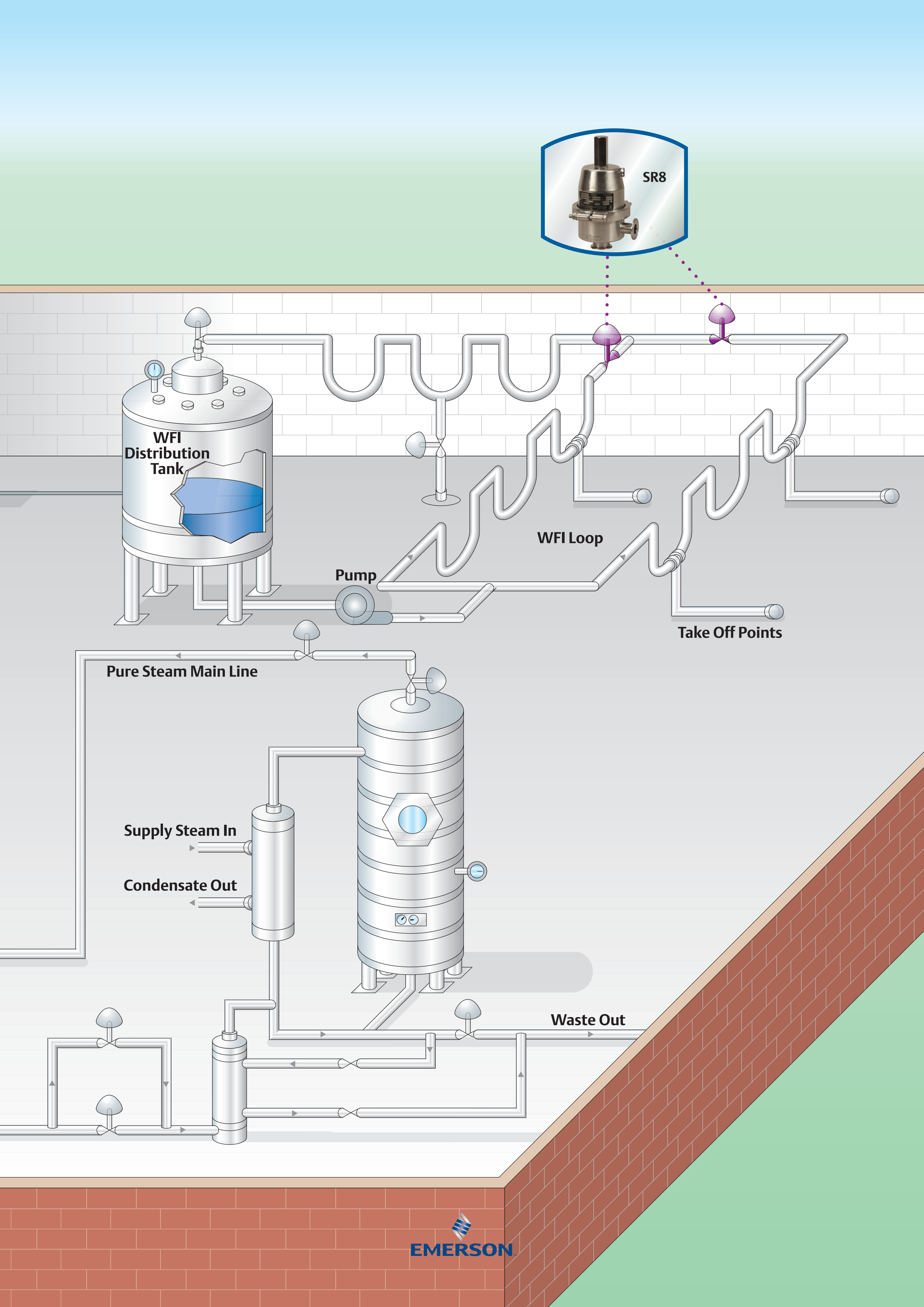
Water-for-Injection (WFI) systems is one of the most commonly used materials in "wet" processes. Typically there is a distribution system or "loop." Backpressure regulators are used to control the head pressure of the loop and the pressure drop across the pump. Multiple draw-off processes require the regulators to have high rangeability.

Features

- Designed exclusively for use in clean/sterile environments
- Superior flow performance and accuracy
- Suitable for clean-in-place (CIP) and sanitize-in-place (SIP) systems
- Self-draining design
- Tri-clamp® end connections
- Designed to meet ASME BPE and European Hygienic Equipment Design Group Criteria



Tri-Clamp® is a mark owned by Tri-Clover Incorporated



SR8
WFI
Distribution
Tank
WFI Loop
Pump
Take Off Points
Pure Steam Main Line
Supply Steam In
Condensate Out
Waste Out
EMERSON

Sanitary Quick Selection Guide

Pressure Reducing Regulator

Maximum Inlet Pressure	Outlet Pressure Range	Maximum C_V at % Droop	Maximum Capacity		Type Number
210 psig / 14.5 bar	2 to 135 psig / 0.2 to 9.3 bar	28.52	6820 lbs/hr / 3096 kg/h		**Type SR5** Page 340

Relief Valve / Backpressure Regulator

Maximum Inlet Pressure	Set Pressure Range	Maximum C_V at % Droop	Maximum Capacity		Type Number
210 psig / 14.5 bar	2 to 125 psig / 0.14 to 8.6 bar	39.21	5460 lbs/hr / 2479 kg/h		**Type SR8** Page 355

EMERSON

Steam

Steam is used throughout industry for process and space heating. Within the process industries, steam is used in oil refineries; pulp and paper mills; chemical production, such as ethylene and ammonia; food and grain processing; and textiles.

Refineries and chemical plants use steam tracing to reduce pumping costs of viscous material and prevent freezing of process piping. Steam is used for heat exchangers and reactors to assist or create process chemical or thermal reactions. Paper mills utilize major steam generation systems to generate power and dry paper products. Steam is widely used for district energy systems found in major municipalities and central plants of universities and hospitals.

To minimize piping cost, steam is generated and distributed at much higher pressures and temperatures than are required by the process load. Fisher™ regulators are utilized in these applications to reduce the steam pressure to a usable level and to accurately maintain process fluid temperatures.

Application: Steam Solutions

Introduction

All Fisher™ brand self-powered steam regulators are designed for maximum performance and reliability that is required of today's modern steam systems.

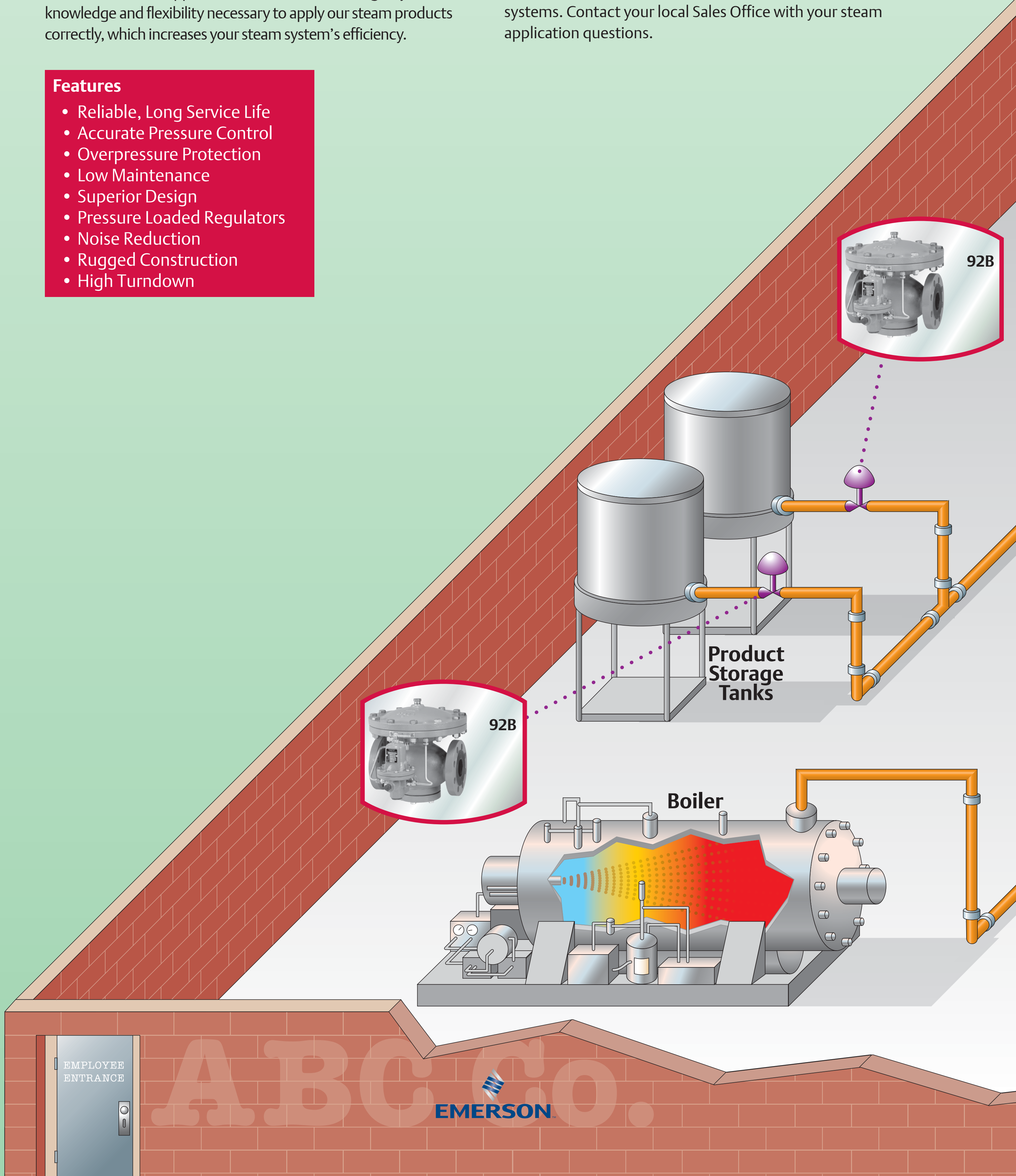
Information in this Application Guide is intended to give you the knowledge and flexibility necessary to apply our steam products correctly, which increases your steam system's efficiency.

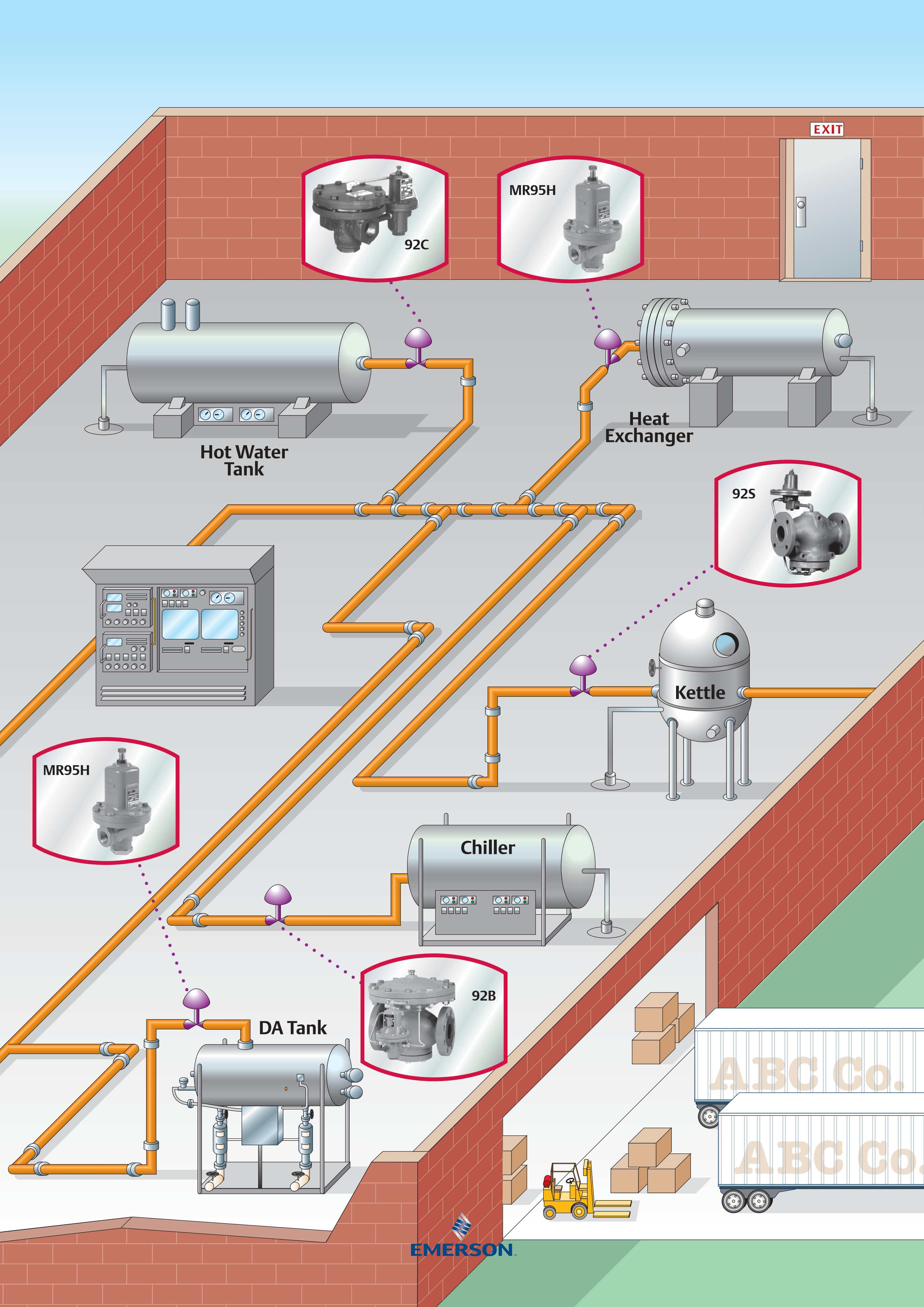
When installed and applied correctly, Fisher brand steam products pay for themselves many times throughout the life of your steam system. In fact, our products may even outlast your boiler.

We offer solutions that will help you manage your steam systems. Contact your local Sales Office with your steam application questions.

Features

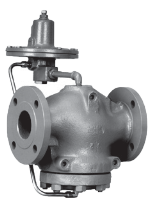
- Reliable, Long Service Life
- Accurate Pressure Control
- Overpressure Protection
- Low Maintenance
- Superior Design
- Pressure Loaded Regulators
- Noise Reduction
- Rugged Construction
- High Turndown




EXIT
92C
MR95H
Hot Water
Tank
Heat
Exchanger
92S
Kettle
MR95H
Chiller
DA Tank
92B
ABC Co.
ABC Co.
EMERSON

Steam Quick Selection Guide

Pressure Reducing Regulators

Maximum Inlet Pressure and Temperature	Outlet Pressure Range	Maximum Flow		Type Number
300 psig / 20.7 bar 450°F / 232°C	2 to 30 psig / 0.14 to 2.1 bar	790 lbs/hr / 360 kg/hr		**Type MR95L** Page 276
300 psig / 20.7 bar 650°F / 343°C	5 to 250 psig / 0.34 to 17.2 bar	3600 lbs/hr / 1633 kg/hr		**Type 92C** Page 105
300 psig / 20.7 bar 450°F / 232°C	5 to 150 psig / 0.34 to 10.3 bar	9400 lbs/hr / 4260 kg/hr		**Type MR95H** Page 255
600 psig / 41.4 bar 650°F / 343°C	15 to 300 psig / 1.0 to 20.7 bar	14,000 lbs/hr / 6430 kg/hr		**Type MR95HT** Page 255
300 psig / 20.7 bar 600°F / 316°C	2 to 250 psig / 0.14 to 17.2 bar	42,400 lbs/hr / 19,234 kg/hr		**Type 92B** Page 101
300 psig / 20.7 bar 650°F / 343°C	2 to 250 psig / 0.14 to 17.2 bar	45,100 lbs/hr / 20,457 kg/hr		**Type 92S** Page 110

Pressure-Loaded Control Valves

Maximum Inlet Pressure and Temperature	Outlet Pressure Range	Maximum Flow		Type Number
300 psig / 20.7 bar 650°F / 343°C	5 to 250 psig / 0.34 to 17.2 bar	3600 lbs/hr / 1633 kg/hr		**Type 92C** Page 105

Pressure Reducing Differential Control Regulators

Maximum Inlet Pressure and Temperature	Outlet Pressure Range	Maximum Flow		Type Number
300 psig / 20.7 bar 450°F / 232°C	2 to 30 psig / 0.14 to 2.1 bar	790 lbs/hr / 360 kg/hr		**Type MR95LD** Page 276
300 psig / 20.7 bar 450°F / 232°C	5 to 150 psig / 0.34 to 10.3 bar	9400 lbs/hr / 4260 kg/hr		**Type MR95HD** Page 255

Steam Quick Selection Guide

Relief Valve / Backpressure Differential Control Regulators

Maximum Temperature	Set Pressure Range	Maximum Flow		Type Number
450°F / 232°C	2 to 38 psig / 0.14 to 2.6 bar	850 lbs/hr / 389 kg/hr		Type MR98LD Page 303
450°F / 232°C	5 to 200 psig / 0.34 to 13.8 bar	7300 lbs/hr / 3300 kg/hr		Type MR98HD Page 284

Relief Valves / Backpressure Regulators

Maximum Temperature	Set Pressure Range	Maximum Flow		Type Number
450°F / 232°C	2 to 38 psig / 0.14 to 2.6 bar	850 lbs/hr / 389 kg/hr		Type MR98L Page 303
450°F / 232°C	5 to 200 psig / 0.34 to 13.8 bar	7300 lbs/hr / 3300 kg/hr		Type MR98H Page 284

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Steam Valves for Heat Transfer Applications

Steam heat transfer is a primary application for Fisher™ steam regulators. Steam heat is transferred to a process fluid through direct injection or non- contacting devices. Examples of direct injection heat transfer equipment are deaerator tanks, humidification devices and autoclaves. Shell and tube heat exchangers, jacketed kettles, coils and steam tracing are examples of non- contacting devices.

There are several methods of controlling the amount of steam required to heat a fluid. The purpose of these control methods is to deliver the proper amount of heat energy to create an energy balance across a heat transfer device and to deliver the heat energy as efficiently as possible. A heat transfer system is balanced when the process fluid's temperature is maintained under all operating conditions. If too much heat energy flows into the system, the process fluid temperature will rise above its desired temperature. When too little heat energy flows into the system, the process fluid temperature will never reach its desired temperature.

Efficiency is achieved when the lowest possible steam pressure is used to transfer steam heat energy. This energy is called latent heat and is the heat required to turn 100% steam into 100% water. Steam's latent heat increases when steam pressure is lowered. Since the energy content (BTU/ lb) of the steam increases, less steam flow is required to achieve an energy balance. Lowering the steam flow reduces the demand on a boiler, which means it will burn less fuel.

There are consequences to be considered when selecting a steam delivery pressure. First, as steam pressure is lowered its temperature is reduced. Although the latent heat has increased, its energy potential or "muscle" required to deliver heat is reduced. Typically, a larger steam heat exchanger will be required to maintain the desired energy balance. Also, the warm-up time will be increased, which may have revenue impact on batch processes. Finally, the fluid mechanics of removing condensate must be considered. When steam loses all of its latent heat in a heat exchanger, the steam turns to water. This water is called condensate and must be removed from the heat exchanger and returned to the boiler. The condensate system must be designed and installed based on the pressure and flow to the heat exchanger. Using lower pressures may require alternative methods to remove and return condensate to the boiler.

Heat Transfer Control Method

In maintaining an energy balance, a process fluid's exit or outlet temperature is usually measured to adjust a valve's position or travel. Several valve configurations are used to achieve the desired result.

Pressure Reducing Valves

Pressure reducing valves are the most common method for reducing steam pressure and controlling steam flow. They are common because they are the most cost-effective valve arrangement. Pressure Reducing Valves only sense and position themselves based on downstream steam pressure. They respond to process temperature changes through the condensation rate in a heat exchanger.

Pressure Reducing Valve with Temperature Control Valve

For more critical applications, Pressure Reducing Valves installed in series with a TCV offers efficiency, accuracy and reliability. In applications with pressure drops greater than 10:1, valve trim erosion and noise can become a problem. Installing two valves in series helps reduce these problems. Although this is the most costly of self-powered valve installations, it is more economical when used in applications that operate 24 hours a day, year round.

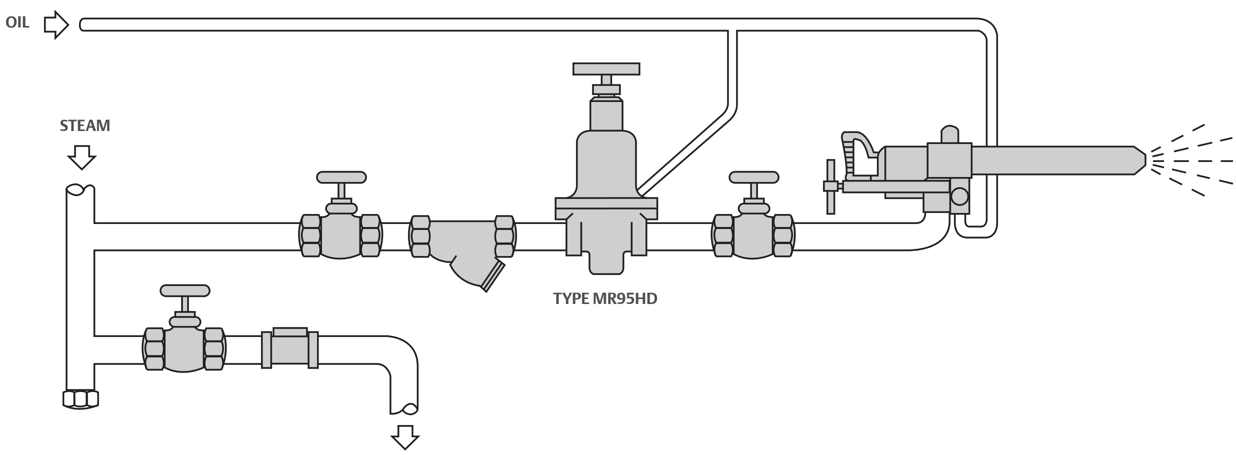


Figure 1. *Steam Atomizing*
Differential regulators are used to ensure steam atomizers operate correctly over varying oil flows and pressures.

Other Important Applications

Differential Regulators

These regulators are used for fuel oil atomizing. As the cost of natural gas and oil fluctuate, many boilers have dual fire capability. They can switch fuels when required to insure the lowest cost fuel is burned. Most fuel oils require preheating and atomizing to insure complete and clean combustion. Oil is typically preheated from 120° to 140°F / 49° to 60°C and then atomized with steam or air. Preheating makes the oil easier to pump and atomize, while atomizing increases the surface area of the oil that is available for combustion.

Atomizing steam is fed into the atomizer at a higher pressure than the oil. Oil pressure may fluctuate due to pumping and combustion conditions so the steam pressure must follow proportionally. In order to do this, oil is tubed to the spring case of the valve to bias the spring setting of the valve. This ensures that proper differential pressure between the steam and the oil occurs before entering the atomizer.

Relief Valves

Fisher™ steam relief valves are not ASME certified. They are used in applications where non-coded devices are acceptable.

Flash Tanks

Flash tanks help improve steam system efficiency. They receive high pressure condensate. Condensate is then exposed to a low pressure steam source. When this occurs a certain percentage of condensate will vaporize or “flash” to steam at the lower pressure. This steam can be used on other low pressure steam heat transfer devices.

A relief valve is used to vent steam when flash steam exceeds the demand of the low pressure system. It is normally set at a lower pressure than the safety relief valve to prevent nuisance pops of the safety valve and build-up of pressure in the low pressure steam header.

Accumulators

Accumulators are one of the most overlooked devices in today’s steam industry. Essentially, they are large high pressure flash tanks that protect boilers from operating under capacity. Most boilers are rated for maximum demand; however, they can not respond to instantaneous demands that often occur in the process industries. When the steam demand is instantaneous, cooler feedwater is pumped into the boiler and must be heated to boiling temperature. Since this process takes time, the boiler will temporarily operate under capacity. Problems associated with under capacity operation are carry over of wet steam,

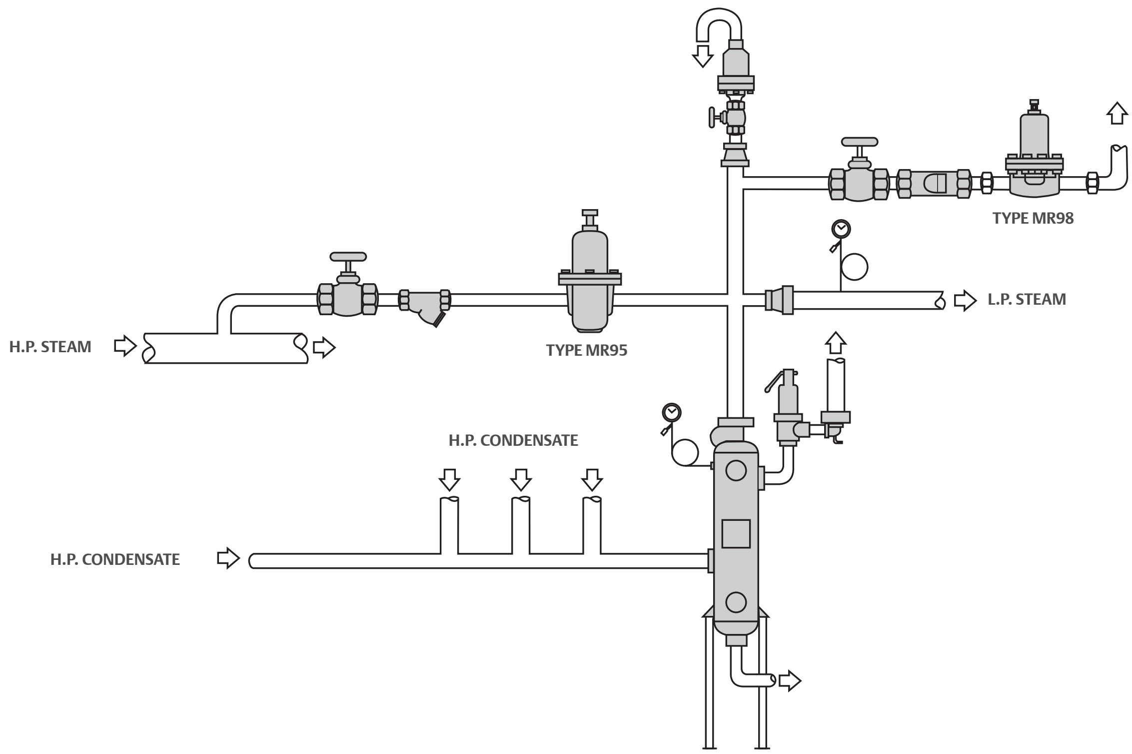


Figure 2. *Flash Tank*
Available energy in high pressure condensate can be recovered by using flash tanks. The steam from the flash tank can supplement low pressure steam heating needs.

dissolved solids and water slugs that occur with the shrink and swell of the water level in the boiler. A worst case scenario occurs when the boiler's water level shrinks below the tube level, exposing tubes to combustion gases.

An accumulator can cushion the instantaneous demand spike by flashing high pressure steam into the main steam header while the boiler catches up to the demand. A pilot operated backpressure relief valve is installed in the steam header to maintain header pressure, which keeps the boiler operating at a constant pressure and stabilizing water level in the boiler. Adverse effects of under capacity operation are avoided as long as there is an appropriate amount of water available for flashing during the demand spike.

When replacing an older boiler, it may be a good idea to save the shell if space permits. It can be filled with feedwater and used as an accumulator.

Determining Steam Flow

A common formula for determining steam flow for heat transfer applications is the LMTD or Log Mean Temperature Difference method:

$$\text{Lbs/hr of steam} = U \times A \times \mathrm{LMTD}/h_{fg}$$

Where:

U = universal heat transfer coefficient (BTU/hr/sq. ft, °F)
A = area (sq. ft)
h_{fs} = latent heat (BTU/lb)
LMTD = Log Mean Temperature Difference (°F)

Where:

$$\mathrm{LMTD} = \frac{(T_s - T_{in}) - (T_s - T_{out})}{\ln\left[\dfrac{(T_s - T_{in})}{(T_s - T_{out})}\right]}$$

T_s = steam temperature (°F)
T_{in} = inlet temperature (°F)
T_{out} = outlet temperature (°F)

This expression is used to find steam flow as the variables in the formula are readily found. It is the most important step in designing a steam heat transfer system as it ensures proper sizing of the equipment in the system.

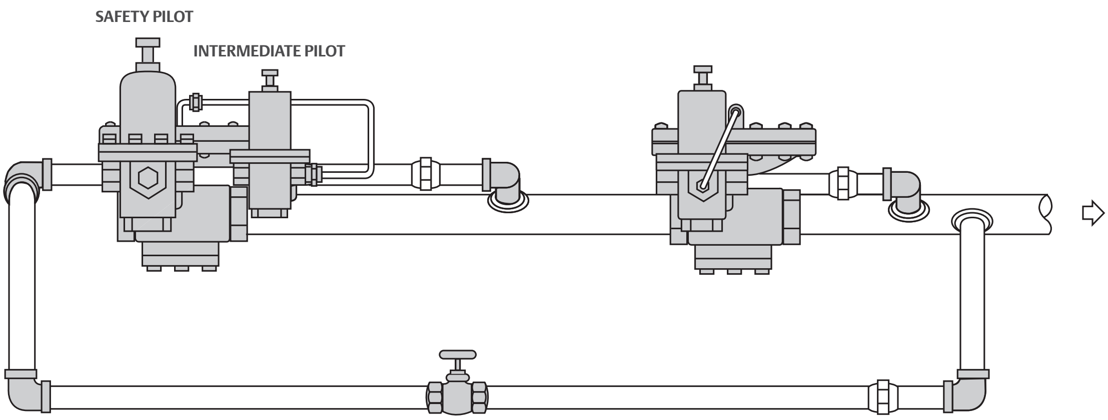


Figure 3. *Series Pressure Reducing Station with Safety Override*
This installation is approved under ASME B31.1, section 122.14.2 and can replace an ASME relief valve when upstream steam pressure does not exceed 400 psig / 27.6 bar.

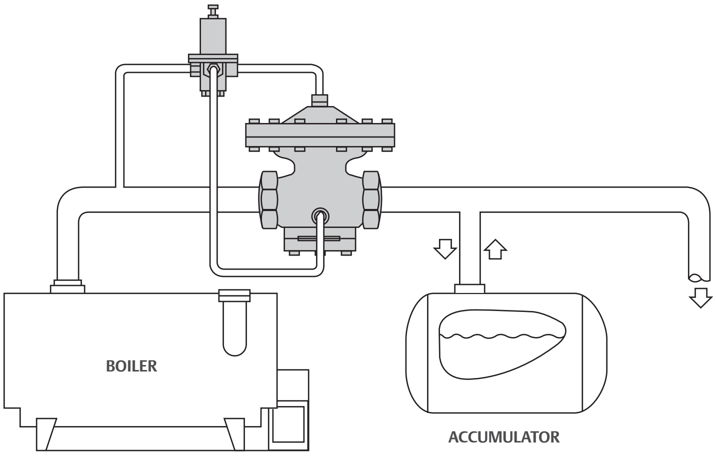


Figure 4. *Accumulators*
Accumulators cushion instantaneous steam demand spikes to boilers by flashing steam into the boiler header as header pressure begins to drop. A backpressure regulator valve maintains boiler pressure preventing carry-over.

Tank Blanketing and Vapor Recovery

Tank blanketing or padding, is the process and practice of covering the surface of a stored commodity, usually a liquid, with a gas. If that commodity is volatile or toxic, tank blanketing can prevent it from harming workers, equipment and the environment. When the commodity is a food or other substance, blanketing protects it from oxidation or contamination through exposure to air or moisture. In most cases, tank blanketing gas is pure, dry nitrogen.

Blanketing can prevent liquids from vaporizing into the atmosphere and can maintain the tank's vapor space above a flammable or combustible liquid to reduce potential ignition while pumping. It can make up the volume of liquid displaced in or out of a tank or it can make up volume caused by thermal changes of the tank's contents, preventing the creation of a vacuum or excess operating pressure.

Vapor recovery systems are mainly used to prevent vapors from escaping into the atmosphere. When adding liquid to the tank or when the outside temperature rises, causing the vapor inside the tank to expand, the vapor recovery system senses the increase in tank pressure and vents the excessive tank pressure to a safe place.

Application: Tank Blanketing and Vapor Recovery Solutions

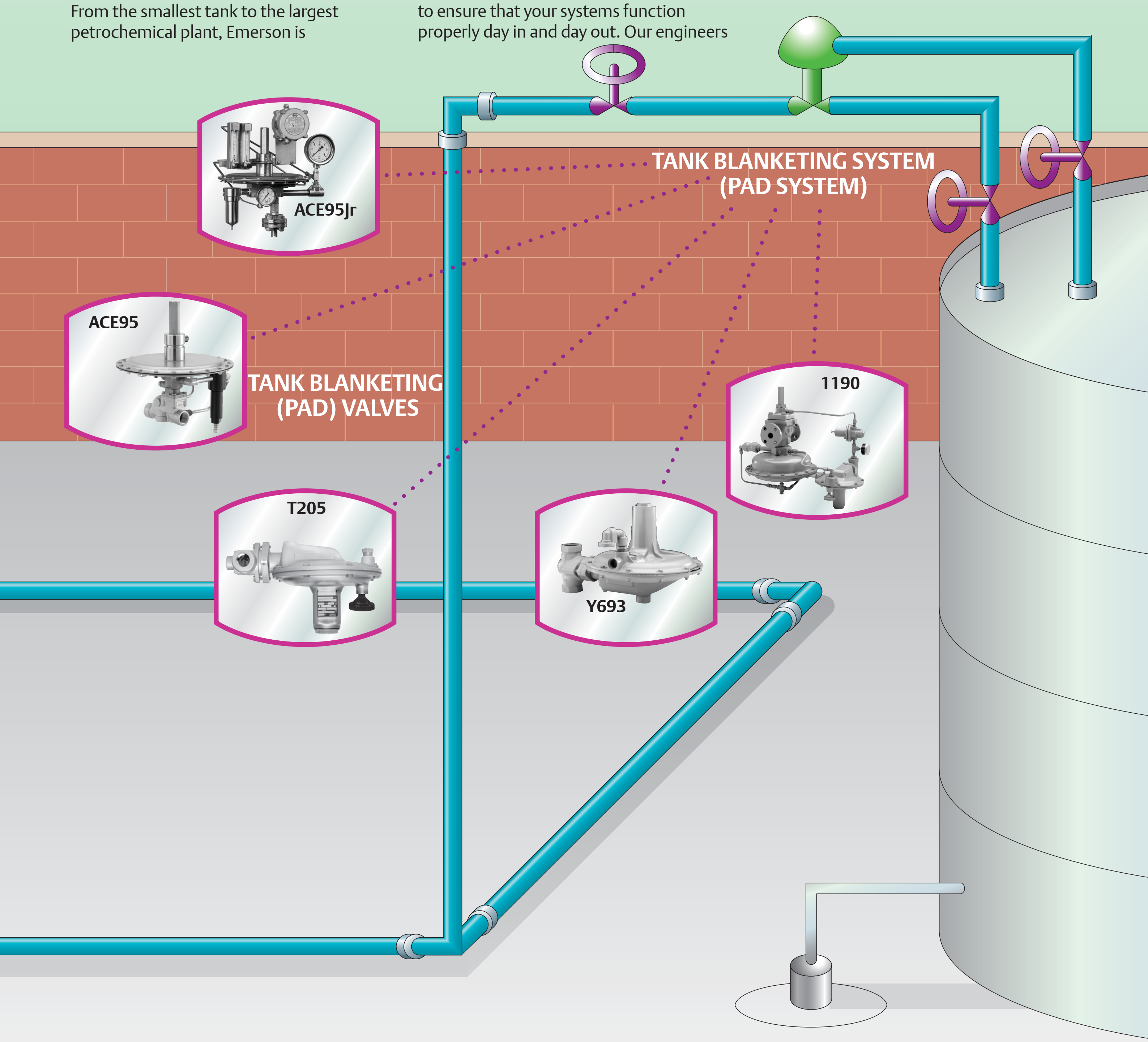
Introduction

Every Fisher™ product, including each casting and seal, is performance tested, calibrated and ready to install. Our products are right the first time, every time. Our diagnostics allow the ability to analyze system performance. You will find our variety of tank blanketing and vapor recovery products are the most economical and efficient vapor conservation solutions.

From the smallest tank to the largest petrochemical plant, Emerson is positioned to give you the attention and response you need. Whether you are checking the status of an order or requesting technical support, you will discover that our quality products are matched only by our personnel and the service that we provide.

Emerson's professional engineering staff is committed to new product development to help meet your requirements and to ensure that your systems function properly day in and day out. Our engineers work closely with the production staff, monitoring quality and continuing product improvement.

Local Sales Offices worldwide are accessible and ready to assist you in solving your technical challenges. We take pride in providing the after-the-sale support that is unrivaled in our industry.



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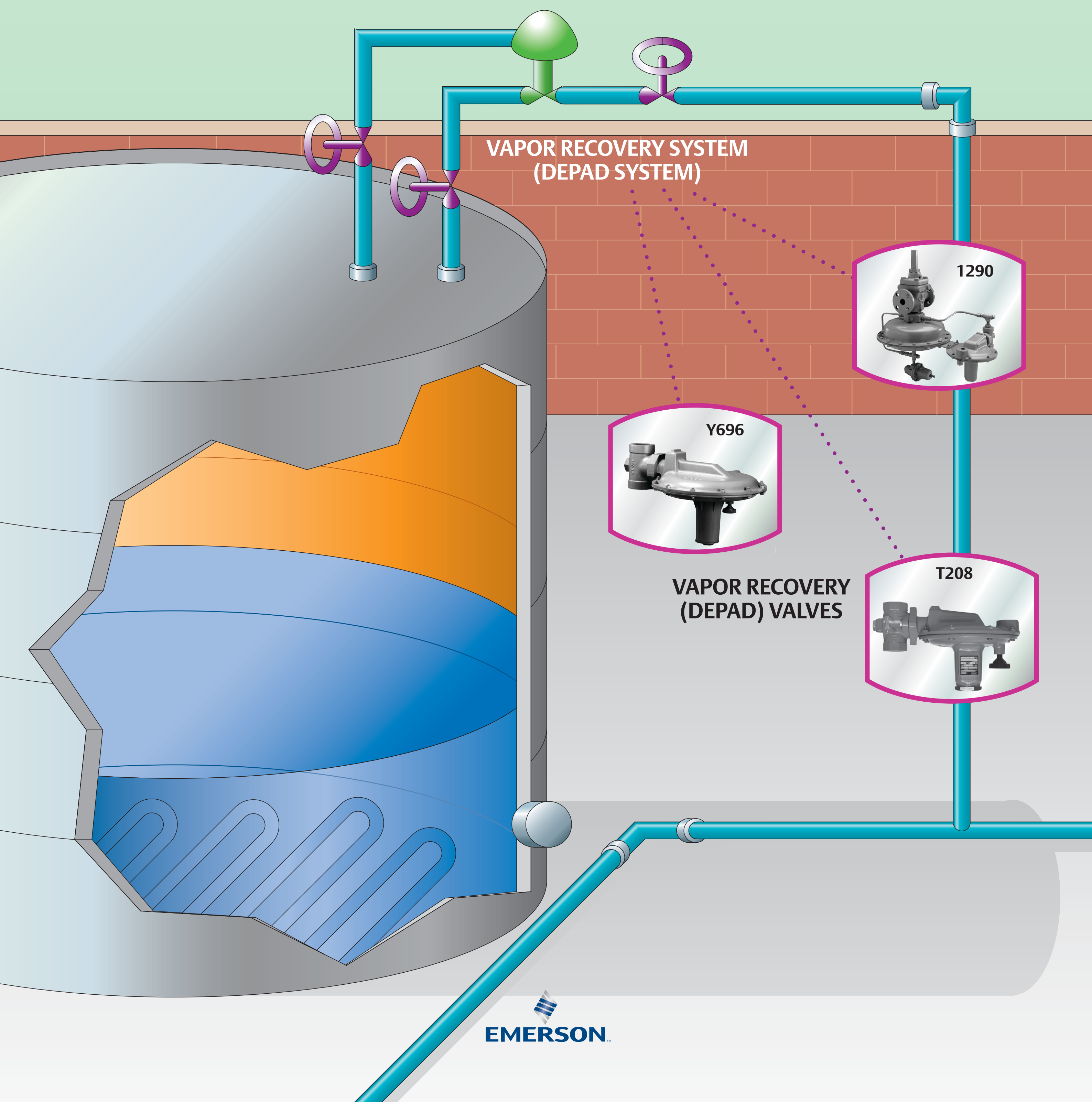
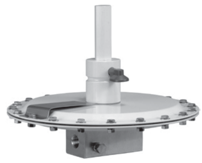
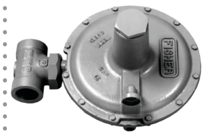

VAPOR RECOVERY SYSTEM
(DEPAD SYSTEM)
1290
Y696
T208
VAPOR RECOVERY
(DEPAD) VALVES

EMERSON

Tank Blanketing and Vapor Recovery Quick Selection Guide

Tank Blanketing (Pad) with Positive Pressure

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
200 psig / 13.8 bar	-5 in. w.c. to 1.5 psig / -12 to 103 mbar	3330 SCFH / 89.2 Nm^3/h		**Type ACE95Jr** Page 189
150 psig / 10.3 bar	1 in. w.c. to 10 psig / 2 to 689 mbar	19,820 SCFH / 532 Nm^3/h		**Type Y692** Page 389
150 psig / 10.3 bar	0.5 in. w.c. to 10 psig / 1.2 to 689 mbar	26,700 SCFH / 716 Nm^3/h		**Type Y693** Page 397
200 psig / 13.8 bar	-5 in. w.c. to 1.5 psig / -12 to 103 mbar	71,900 SCFH / 1927 Nm^3/h		**Type ACE95** Page 187

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Tank Blanketing (Pad) with Positive Pressure (continued)

Maximum Inlet Pressure	Outlet Pressure Range	Maximum Capacity		Type Number
200 psig / 13.8 bar	-5 in. w.c. to 1.5 psig / -12 to 103 mbar	499,600 SCFH / 13,389 Nm^3/h		**Type ACE95Sr** Page 191
300 psig / 20.7 bar	0.25 in. w.c. to 7 psig / 0.6 to 483 mbar	2,811,000 SCFH / 75,335 Nm^3/h		**Type 1190** Page 173
200 psig / 13.8 bar	1 in. w. c. to 7 psig / 2.5 to 483 mbar	86,460 SCFH / 2317 Nm^3/h		**Type T205** Page 363
5 psig / 0.34 bar	2 in. w.c. to 5 psig / 5 mbar to 0.34 bar	77,500 SCFH / 2077 Nm^3/h		**66 Series** Page 83

Tank Blanketing and Vapor Recovery Quick Selection Guide

Vapor Recovery (Depad) with Positive Pressure

Control Pressure Range	Maximum Capacity		Type Number
2 in. w.c. to 7 psig / 5 to 483 mbar	13,100 SCFH / 351 Nm^3/h		**Type Y696** Page 401
2 in. w.c. to 7 psig / 5 to 483 mbar	115,000 SCFH / 3082 Nm^3/h		**66R Series** Page 87
0.5 in. w.c. to 7 psig / 1 to 483 mbar	327,400 SCFH / 8774 Nm^3/h		**Type 1290** Page 176
2 in. w. c. to 7 psig / 5 to 483 mbar	2286 SCFH / 61.3 Nm^3/h		**Type T208** Page 375

Pad-Depad Valve

Control Pressure Range	Maximum Capacity		Type Number
Pad Set Range: 0.5 in. w.c. to 2.2 psig / 1 to 152 mbar Depad Set Range: 4 in. w.c. to 2 psig / 10 to 138 mbar	Pad: 499,600 SCFH / 13,389 Nm^3/h Depad: 106,200 SCFH / 2846 Nm^3/h		**Type ACE97** Page 193

Tank Blanketing and Vapor Recovery Applications

Introduction

Tank blanketing is a method of controlling vapor pressure in a liquid storage tank. The main purpose of tank blanketing is to prevent air and moisture from entering the tank. The tank blanketing process may be used with positive and negative tank pressure.

Tank Blanketing with Positive Pressure

Gas blanketing and vapor recovery are two techniques that can safely and effectively put a cap on volatile vapors in tanks and other process vessels, thus keeping them from escaping into the atmosphere. There are nearly two hundred volatile and hazardous pollutants that must be controlled to prevent the emission of vapors during storage, handling and processing operations.

The combination of gas blanketing and vapor recovery devices maintains a constant pressure in the tank's vapor space above stored liquid. As a result, tanks containing volatile vapors can "breathe" during pumping operations or if the ambient temperature changes (causing the vapor to expand or contract).

Tank Blanketing (also called Pad)

"Tank Blanketing" or "Padding" allows the use of a low-pressure blanket of gas, such as nitrogen, to maintain a protective gaseous environment above any liquid stored in a tank or vessel. The low-pressure gas blanket fills the void vapor space above the liquid stored in the tank. A gas blanketing system reduces the high-pressure source of gas to a lower pressure forming a blanket over the liquid. Low-pressure blanketing systems commonly protect tanks containing volatile organic liquids.

The positive pressure gas blanket helps prevent outside air, moisture and other contaminants from entering the storage tank. In addition, the positive pressure of the system provides a head pressure above the liquid to reduce vapor loss, which helps protect the tank from corrosion. Storage vessels without adequate protection against corrosion or contamination can cause serious problems if left unattended.

When the tank suddenly cools, the vapors inside condense causing the tank pressure to decrease. This causes the regulator to open which allows the blanketing gas into the tank. Blanketing regulators also maintain a constant tank pressure while removing liquid from the tank. The positive pressure prevents the tank from collapsing.

Inlet pressures at the regulator typically range up to 300 psig / 20.7 bar and the blanketing system's set pressure is normally 2 in. w.c. / 5 mbar or less. The set pressure is kept as low as possible to minimize consumption of blanketing gas.

Vapor Recovery (also called Depad)

When pressure inside the vessel rises due to thermal heating or "pump-in" of product, the vapor recovery regulator senses an increase in tank pressure and vents excessive tank pressure to an appropriate vapor-recovery disposal or reclamation system.

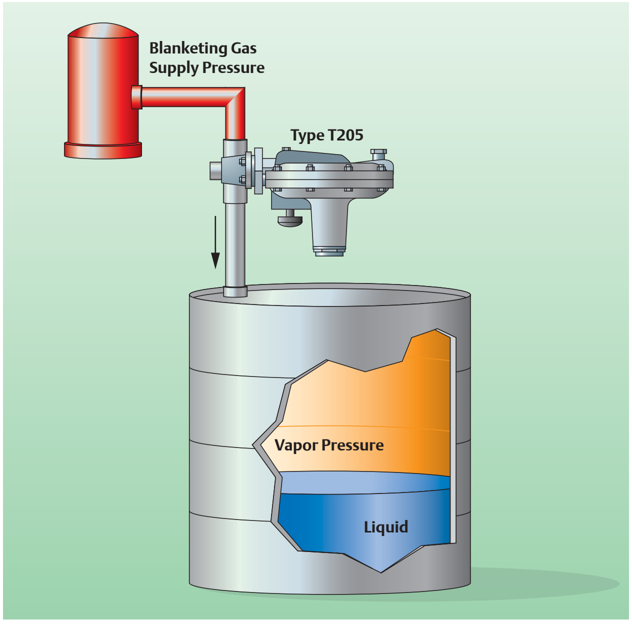


Figure 1. *Tank Blanketing (Padding)*

When the vapor pressure in the tank drops below preset limits, the regulator diaphragm moves the valve disk away from the seat, allowing blanketing gas to flow in.

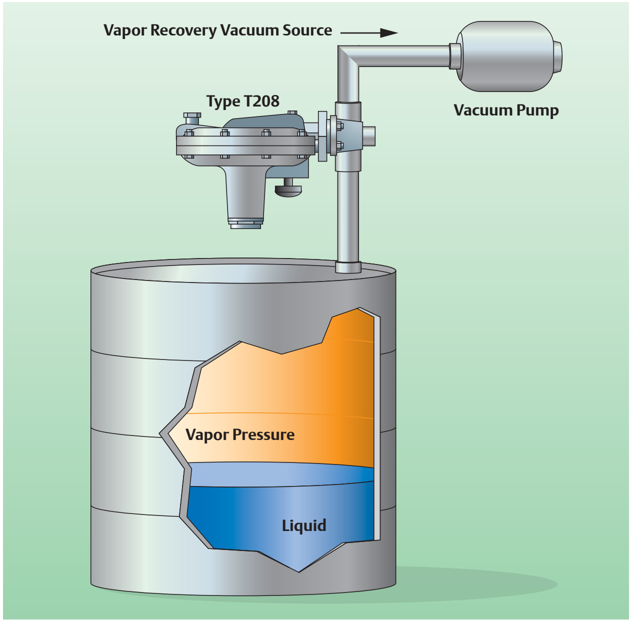


Figure 2. *Vapor Recovery (Depadding)*

In vapor-recovery applications, the regulator moves the valve disk away from the seat in response to high vapor pressures, allowing excess vapor to flow out of the tank.

Tank Blanketing and Vapor Recovery Applications

Vapor recovery systems have several applications, but the most common reason for installing a system is to prevent vapors from escaping into the atmosphere (some vapors can be vented directly to atmosphere).

Setpoints for vapor recovery systems are typically higher than the blanketing system setpoint to minimize consumption of the blanketing gas. Emergency vents are installed to protect the tank from an upset condition, but these function only in the event of regulator failure or other emergency condition.

Tank Blanketing and Vapor Recovery Valve Types

There are two main types of valves used in positive pressure tank blanketing systems: direct-operated and pilot-operated. Direct-operated valves for blanketing sense the tank's vapor pressure and this pressure registers directly on the valve diaphragm. When the tank's vapor pressure decreases below the system's setpoint, the spring moves the valve disk away from its seat, allowing gas to flow into the tank.

The position of the disk relative to the seat regulates the amount of flow. Variable-flow control is called throttling. Here, as vapor pressure in the tank increases, the disk moves closer to the seat and shuts off the flow completely when the pressure rises above the setpoint. Direct-operated systems respond quickly to changes in tank pressure. In vapor recovery, the action of the direct-operated valve is reversed. When the tank's vapor pressure rises above the setpoint, the valve's disk moves away from the seat, allowing the vapor to flow out of the tank. Thus, the higher the pressure buildup above setpoint, the more the disk moves and the greater the flow. The valve shuts off the flow of escaping gas when the vapor pressure in the tank is reduced below the setpoint.

In pilot-operated valves for blanketing, a pilot valve opens in response to a lower tank pressure and a loading pressure is loaded or unloaded to the main valve to open it. When downstream demand is satisfied, the outlet pressure increases slightly, thus acting on the diaphragms of the pilot and main valves. Then, the pilot diaphragm moves to close the pilot valve plug and the loading pressure to the main valve is reduced or increased, allowing it to shutoff. Small changes in vapor pressure in the tank are amplified by the pilot valve, resulting in very accurate pressure control of the gas-vapor blanket.

Pilot-operated systems for vapor recovery utilize components similar to those used for blanketing, but the action is reversed. In this case, supply pressure is equalized on both sides of the main valve's diaphragm. When the tank's vapor pressure reaches the pilot setpoint, it begins to open and unload the supply pressure from one side of the main valve diaphragm. The resulting pressure imbalance allows the main valve to then open.

Selecting a System

In general, direct-operated tank blanketing and vapor recovery valves respond faster and are typically less expensive to purchase, install and maintain. A direct-operated valve should be the first choice if it meets the capacity and accuracy requirements of the system.

Pilot-operated blanketing and vapor-recovery systems may have lower setpoints and greater accuracy than direct-operated systems. Pilot-operated systems are used when the allowable change in controlled pressure is small or if flow capacities are large. They are also the choice if the body size of the valve is larger than two inches. Pilot-operated systems are the best choice where accuracy and capacity are of prime importance.

Tank Blanketing in a Vacuum (Negative Pressure)

When applications arise where the gas blanketing requirements are in vacuum, a combination of a vacuum breaker and a vacuum regulator may be used. Vacuum blanketing is used to prevent vessel leakage to atmosphere when the vapors inside the vessel are harmful. If leakage were to occur, outside air would enter the vessel because of the vacuum in the tank. Therefore, any process vapors in the tank would be contained.

There is a variety of terms used to describe vacuum, causing confusion when communicating with someone that uses different terminology. Fisher™ uses the following vacuum terminology.

First determine whether the units are in absolute pressure or gauge pressure (0 psig or 0 bar g is atmospheric pressure).

For example:

- 5 psig / 0.34 bar g vacuum is 5 psi / 0.34 bar below atmospheric pressure
- 5 psig / -0.34 bar g is 5 psi / 0.34 bar below atmospheric pressure
- 9.7 psia / 0.67 bar a is 9.7 psi / 0.67 bar above absolute zero or 5 psi / 0.34 bar below atmospheric pressure (14.7 psia - 5 psi = 9.7 psia or 1.01 bar a - 0.34 bar = 0.67 bar a).

Just as there are pressure reducing regulators and pressure relief valves for positive pressure service, there are two basic applications for vacuum service. The terms used for each are sometimes confusing. Therefore, it is sometimes necessary to ask further questions to determine the required function of the regulator. The terms vacuum breaker and vacuum regulator are used to differentiate between the two types of Fisher regulators.

Vacuum Breakers

Vacuum breakers limit the increase in vacuum. An increase in vacuum (decrease in absolute pressure) beyond the setpoint is sensed on the diaphragm causing the disk to move away from the seat. This permits the higher pressure to enter the system and restore the controlled vacuum to its original pressure setting.

Vacuum Regulators

Vacuum regulators maintain a constant vacuum at the regulator inlet. A decrease in vacuum (increase in pressure) beyond the setpoint registers on the diaphragm causing the disk to move away from the seat, allowing a higher vacuum source to restore the vacuum to its original setting.

Vacuum Applications

Emerson offers several vacuum regulators and vacuum breakers. For specific product information contact your local Sales Office for application solutions.

Tank Blanketing Accessories

Accessories can be added to a valve. The following is a list of accessories that can be added to a tank blanketing or vapor recovery valve to create a system.

First-Stage Regulator

A first-stage regulator is used to reduce a high inlet pressure to a lower pressure before it enters the blanketing valve.

Pressure Gauge

A permanently installed gauge is placed downstream of the first-stage regulator, on the outlet of the regulator or on the control line connection. These gauges are used to monitor the system and check performance, monitor start-up and make adjustments.

Control Line Purge

The purge flowmeter maintains a very small continued flow of blanketing gas through the control line. This eliminates the backflow of tank vapors into the regulator by constantly sweeping them back to the tank. The purge will protect the valve components against potentially corrosive tank vapors and crystallization of the process.

Main Line Purge

The main line purge serves the same purpose as the control line purge, only it purges tank vapors from the main line. Some systems use both control line and main line purges.

Check Valve

A check valve can be piped to the outlet of the tank blanketing valve. This also prevents backflow from the tank to the valve. A check valve should not be applied to valves with internal pressure registration since it inhibits control.

Diagnostics

A diagnostic port provides the capability to analyze the valve's operation in the field, making servicing simpler and more reliable. This is available on the Types ACE95 and ACE95Sr.

Saving Nitrogen

Plant utility managers, tank farm managers and those with storage vessel maintenance responsibilities can easily reduce their gas blanketing expense by using low-setpoint technology.

Low-setpoint tank blanketing valves allow storage vessel operators to maintain a 1/4 in. w.c. / 0.62 mbar setpoint for blanketing gas. Such low blanketing pressures minimize blanketing gas losses by reducing the volume of gas being forced through poorly sealed breather vents and incidental escape paths. The cumulative effect of using the low-setpoint technology of Fisher™ regulators can result in significant savings.

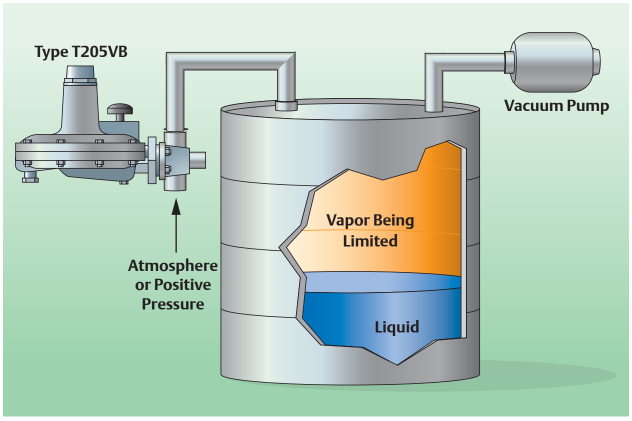


Figure 3. *Vacuum Breakers*

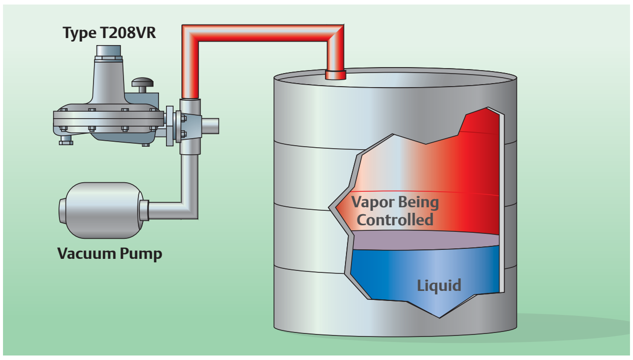


Figure 4. *Vacuum Regulators*

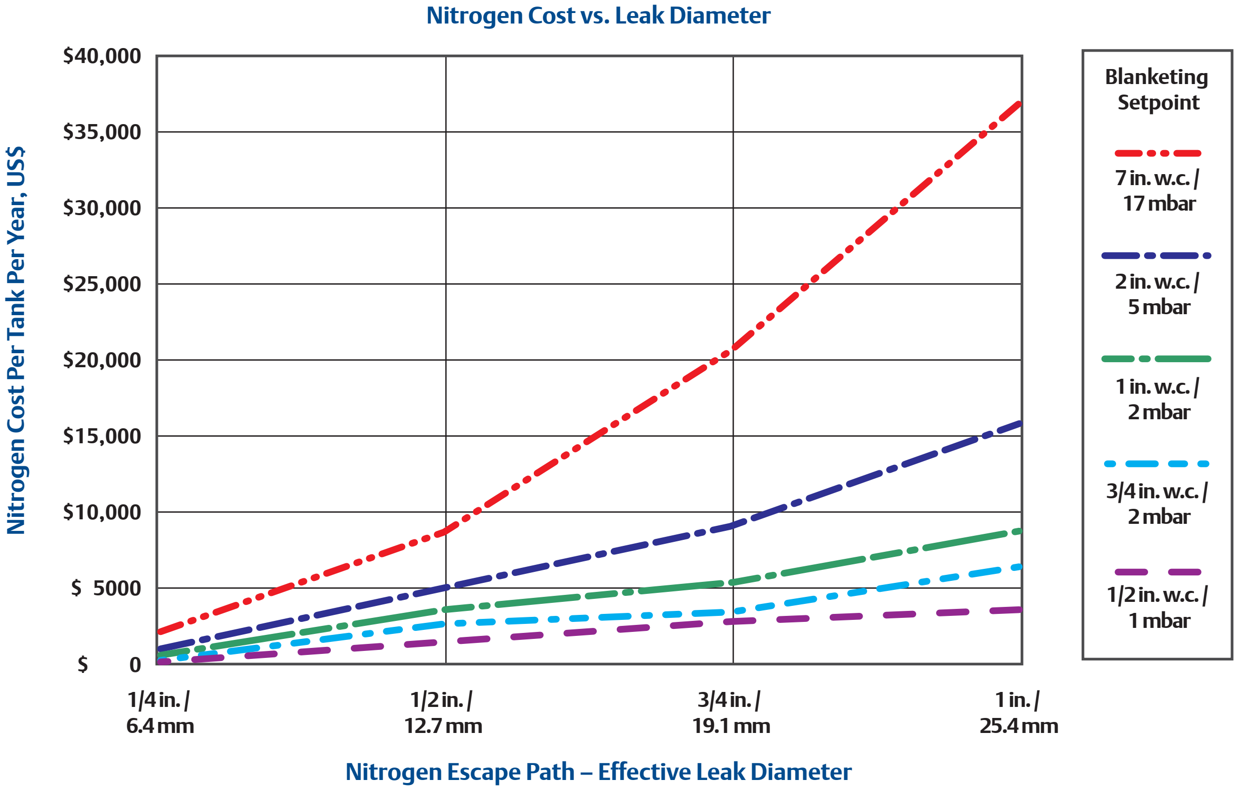


Figure 5. *Annual Savings from a 1/4 in. w.c. / 0.62 mbar Setpoint Versus Higher Setpoints*

Reduce your gas blanketing expense with low-setpoint technology. This chart shows the incremental annual expense of nitrogen where blanketing setpoints are greater than 1/4 in. w.c. / 0.62 mbar.

Escape Paths Lead to Loss

In a typical storage vessel, numerous escape paths, pinholes and seal leaks equal to just 1 in. in diameter will result in up to $8683 of nitrogen gas loss when tank pressures are maintained at 1 in. w.c. / 2 mbar versus 1/4 in w.c. / 0.62 mbar.

How Blanketing Gas is Saved

Escape paths, such as slight roof corrosion or poorly seated vents and pressure/vacuum valves also contribute to blanketing gas consumption. Increased vessel blanketing pressures will cause more gas loss. Decreased pressures, such as 1/4 in. w.c. / 0.62 mbar, minimize nitrogen loss.

Typical Annual Expenses Calculated

The chart shown in Figure 5 demonstrates the typical incremental annual expense of nitrogen lost when using setpoints above 1/4 in. w.c. / 0.62 mbar. To estimate the expense of the annual gas loss, nitrogen was conservatively estimated at US $2.00 / 1000 SCFH and validated with a major nitrogen supplier.

Sizing

In order to size a pad or depad application, the user must decide which method is appropriate for the application. Unfortunately, there are few guidelines available. Basically there are two methods in use: direct displacement and API 2000.

The direct displacement method assumes that the volume of product displaced must be replenished by an equal volume of gas. There are no corrections applied for vaporization of product, thermal expansion/contraction or other variables. This method is appropriate for indoor tanks operating at a constant temperature and handling non-flammable product with low vapor pressures. It allows no room for thermal cycling.

The API 2000 method is more complex. It accounts for all of the variables mentioned above. However, it may oversize equipment in many instances. It was developed for tank venting and oversizing was considered to be acceptable.

It is known that some users practice API 2000 sizing, but apply factors to reduce the calculated volumetric requirements. Only the user can decide what is the appropriate method to use for their application.

The blanketing (pad) and venting (depad) valves are system or process operating valves. Supplemental emergency venting should be considered to protect the tank in case of equipment failure, fire exposure or other conditions that would cause the tank pressure to exceed operating limits. The pad and depad valves are not meant to substitute for emergency tank vents. These vents protect the tank from excessive pressure/vacuum and provide venting for exposure to fire.

Sizing must also take into account applicable codes and standards as they apply to installation.

The reader is encouraged to contact API and obtain a copy of API 2000. (American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. (202) 682-8000)

Terminology

The term “PAD” refers to the make-up or blanketing of tank vapor space contents to maintain pressure. This is to accommodate the effect of removing liquid from the tank and the effects of ambient cooling of the tank.

The term “DEPAD” refers to venting the tank vapor space contents to limit pressure. This is to accommodate the effect of adding liquid into the tank and the effect of warming the tank contents.

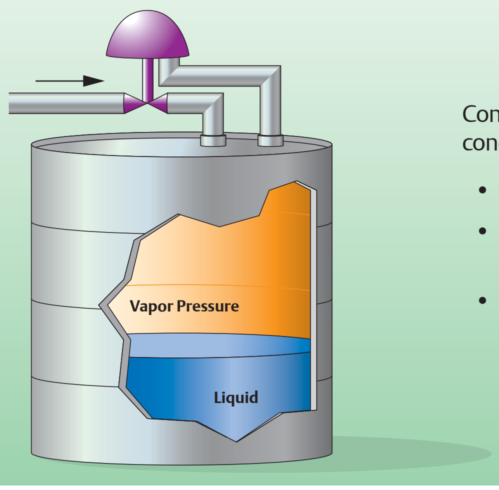
Sizing Method

Significant undersizing is undesirable in that it can result in having a higher than desired pressure when depadding (venting). If the pad (blanketing) valve is undersized it can result in the tank pressure dropping too low and the atmospheric vacuum vent opening. This would allow atmospheric air and moisture into the vapor space. A grossly oversized pad valve could cause overshooting the setpoint, but it is less likely. Pad valves are more tolerant of oversizing than depad valves.

Gross oversizing the depad, however, can result in having the vapor space pressure drop too far below depad setpoint and cause the pad valve to actuate. This is interaction. Oversizing can also increase the cost of the system and result in unnecessary cycling.

When very large tanks are used, the thermal component flow portion of the API methods can be significantly larger than the displacement flow. This means that under conditions of displacement only (no thermal requirement), the valve may be oversized. The depad valve is sized on a differential pressure, which is tank pressure (set pressure + buildup) minus the outlet pressure which is typically a vacuum. Using this information, estimates can be made of the resulting operating pressure of the system, at any flow rate, with any size valve. You can simply look at the capacity tables and determine the differential pressure that would result at a given flow rate. Sizing could maintain a lower pressure under most conditions and a higher pressure under 100% flow conditions. This information could be useful in sizing and could result in a reduced installed cost. *Caution must be exercised to maintain the tank operating pressure within allowable limits under all conditions.*

Oversizing of the depad valve can (but will not always) result in the pressure dropping enough, when the depad opens, to enter the pad pressure region. It is for this reason that we require a *deadband* between the pad and depad operating points. In the case of a displacement flow being significantly less than the thermal portion it may be wise to increase the deadband. Alternately, the depad C_V may be reduced and the tank pressure allowed to rise higher under thermal flow conditions. This modification would require a close examination of the system capabilities including the tank maximum allowable working pressure (MAWP) and the atmospheric vent settings.



Control line should slope downward toward the tank to prevent condensation buildup.

- Make the control line as short and straight as possible.
- Connect the control line to the point where the pressure is to be controlled.
- Increase 1 pipe size for every 10 ft / 3.05 m of control line, with setpoints less than 5 in. w.c. / 12 mbar.

Figure 6. *Control Line Installation Tips*

Type 63EG-98HM

Backpressure/Relief Valve

FISHER

Introduction

The Type 63EG-98HM is a pilot operated backpressure/relief valve and can be used for gas and liquid applications. For applications up to 450°F / 232°C, the Type 63EG-98HM utilizes high temperature Ethylenepropylene (EPR) or Perfluoroelastomer (FFKM) for Class VI shutoff. If used in a corrosive service, Perfluoroelastomer (FFKM) and other elastomers are available options that offer superior resistance to heat and most corrosive chemicals. The Type 63EG-98HM can be constructed with a Linear or Whisper Trim™ III cage depending on the application. The Type MR98HM with an external sensing line is used as a pilot incorporating the wide selection of materials offer by the product line.

When using the Type 63EG-98HM with a corrosive liquid, usually water or a water-containing solution, the valve materials must be selected with care. For aqueous solutions, use a Stainless steel linear cage or Whisper Trim III Cage and body flange to ensure valve plug travel on a corrosion-free surface.

The Type 63EG-98HM is not an ASME certified device.

Main Valve Body Sizes and End Connection Styles[1]

See Table 1

Construction Materials

Type 63EG Main Valve: See Table 2
Type MR98HM Pilot: See Table 3

Maximum Design Pressure[2]

600 psig / 41.4 bar or body rating limit, whichever is lower

Maximum Operating Relief (Inlet) Pressure Including Build-up[2]

450 psig / 31.0 bar or body rating limit, whichever is lower

Maximum Outlet Pressure[2]

450 psig / 31.0 bar

Port Diameter and Valve Plug Travels

See Table 4

Relief Set Pressure/Backpressure Control Ranges[3]

See Table 5

Flow Coefficients

See Table 6

Main Valve IEC Sizing Coefficients

See Table 7

Minimum and Maximum Differential Pressures and Build-up Pressure Requirements

See Table 8

Main Valve Flow Characteristics

Linear **(standard)** or
Whisper Trim III Cage (optional)

Pressure Registration

External

Temperature Capabilities

Fluorocarbon (FKM): 0 to 300°F / -18 to 149°C not acceptable in water or steam in excess of 200°F / 93°C
Ethylenepropylene (EPDM):
Steel: -20 to 350°F / -29 to 177°C
Stainless steel: -40 to 350°F / -40 to 177°C
Perfluoroelastomer (FFKM):
Standard: 0 to 450°F / -18 to 232°C

Pilot Control Line Connection

1/4 NPT

Pilot Spring Case Connection

1/4 NPT

Pilot Wide-Open Flow Coefficients

C_g: 98; C_v: 2.75; C_1: 35

5/64 in. / 2.00 mm Fixed Bleed Restriction Coefficients

C_g: 4.8; C_v: 0.14

Approximate Weights (Including pilot)

NPS 2 / DN 50: 65 lbs / 30 kg
NPS 3 / DN 80: 105 lbs / 48 kg
NPS 4 / DN 100: 155 lbs / 71 kg
NPS 6 / DN 150: 340 lbs / 155 kg
NPS 8 X 6 / DN 200 X 150:
630 lbs / 286 kg

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Liquid
- Process Gas

W6866

Figure 1. *Type 63EG-98HM Pilot-Operated Relief Valve or Backpressure Regulator*

Features

- **Wide Selection of Construction and Elastomer Materials for Application Versatility**
- **Low Build-up Capability to Achieve Wide-Open Flow**
- **Chemically Compatible Elastomers for Greater Corrosion Resistance**
- **High Pilot Gain for Fast Speed of Response**
- **Tight Shutoff**
- **Easily Converted to Differential Control**
- **Easy In-line Maintenance with Labor Saving Trim**
- **Sour Gas Compatibility with NACE Constructions**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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1. Other ratings and end connections can usually be supplied; consult the local Sales Office.
2. Fluorocarbon (FKM) diaphragm is limited to 300 psig / 20.7 bar.
3. Set pressure is defined as the pressure at which the pilot start-to-discharge.

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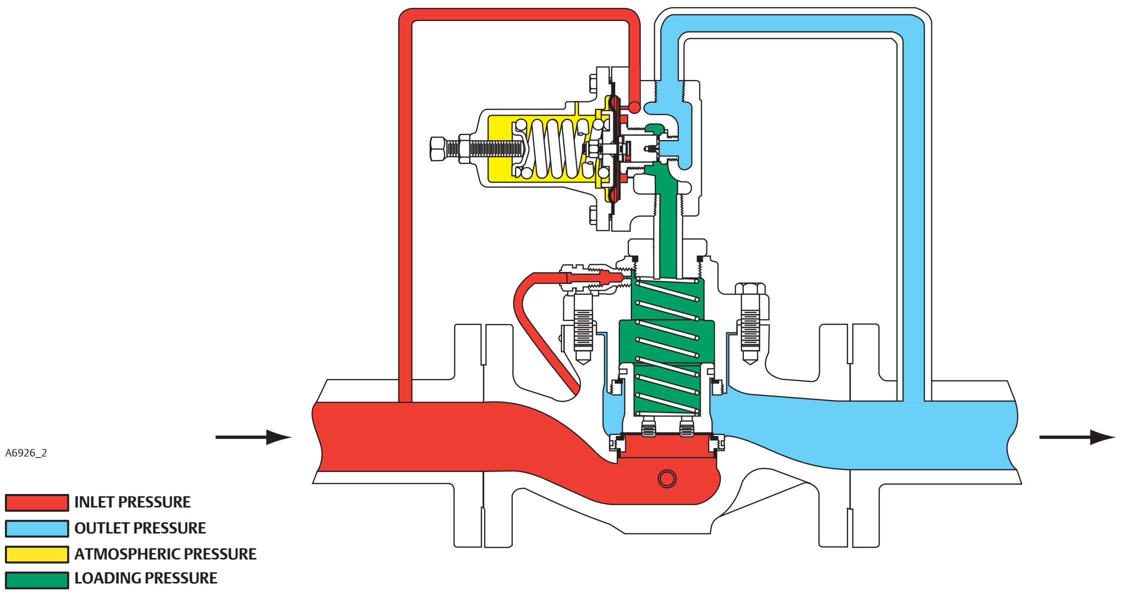

Note: On an actual Type 63EG-98HM, the pilot spring case points downstream

Figure 2. *Type 63EG-98HM Operational Schematic*

Table 1. Main Valve Body Sizes and End Connection Styles

MAIN VALVE BODY SIZE		END CONNECTION STYLE
NPS	DN	
2	50	NPT, CL150 RF, CL300 RF, CL600 RF or PN 16/25/40 flanged
3, 4, 6	80, 100, 150	CL150 RF, CL300 RF, CL600 RF or PN 16/25/40 flanged
8 x 6	200 x 150	CL150 RF, CL300 RF and CL600 RF flanged

Table 2. Type 63EG Main Valve Construction Materials

BODY AND BODY FLANGE	CAGE	SEAT RING AND VALVE PLUG	SPRING	PISTON RING	PIPE PLUG	O-RINGS AND SEALS	GASKETS
WCC steel **(standard)**, CF8M Stainless steel, Hastelloy® C, Monel® or Alloy 20 (optional)	316 Stainless steel **(standard)**, 416 SST, Hastelloy® C, Monel® or Alloy 20 (optional)	416 Stainless steel **(standard)**, 316 Stainless steel, Hastelloy® C, Monel® or Alloy 20 (optional)	Zinc-plated steel **(standard)** or Inconel® X750 (optional)	Polytetrafluoroethylene (PTFE)	Steel **(standard)**, 316 Stainless steel, Hastelloy® C, Monel® or Alloy 20 (optional)	Fluorocarbon (FKM) **(standard)**, Ethylenepropylene (EPR) or Perfluoroelastomer (FFKM) (optional)	Composition **(standard)** or Graphite (optional)

Table 3. Type MR98H Pilot Construction Materials

BODY	SPRING CASE	SPRING	TRIM	DIAPHRAGM	DIAPHRAGM PROTECTOR	DIAPHRAGM GASKETS	SEAT(2)
WCC steel **(standard)**, CF8M Stainless steel, Hastelloy® C, Monel® or Alloy 20 (optional)	WCC steel **(standard)** or CF8M Stainless steel (optional)	Steel **(standard)**, Stainless steel, Inconel® X750 (optional)	416 Stainless steel **(standard)**, 316 Stainless steel, Hastelloy® C, Monel® or Alloy 20 (optional)	302 Stainless steel **(standard)**, Ethylenepropylene (EPR), Hastelloy® C, Monel® or Fluorocarbon(1) (FKM) (optional)	PTFE (optional)	Composition **(standard)** or graphite (optional)	Fluorocarbon (FKM) **(standard)**, Ethylenepropylene (EPR) or Perfluoroelastomer (FFKM) (optional)

1. Fluorocarbon (FKM) diaphragm is limited to 300 psig / 20.7 bar.
2. Adjusting Screw Sealing Washer for Pressure Loaded Pilot: Fluorocarbon (FKM)

Table 4. Port Diameters and Valve Plug Travels

BODY SIZE		PORT DIAMETER		VALVE PLUG TRAVEL	
NPS	DN	In.	mm	In.	mm
2	50	2-3/8	60	1-1/8	29
3	80	3-3/8	86	1-1/2	38
4	100	4-3/8	111	2	51
6	150	7-3/16	183	2	51
8 x 6	200 x 150	7-3/16	183	2	51

Table 5. Relief Set Pressure or Backpressure Control Ranges

CONTROL PRESSURE RANGE[1]		SPRING COLOR	SPRING FREE LENGTH		SPRING WIRE DIAMETER	
psig	bar		In.	mm	In.	mm
15 to 35	1.0 to 2.4	Yellow	2.50	63.5	0.207	5.26
25 to 75	1.7 to 5.2	Green	2.595	65.9	0.234	5.94
70 to 140	4.8 to 9.7	Red	2.44	62.0	0.283	7.19
130 to 200	9.0 to 13.8	Blue	2.250	57.2	0.331	8.41
150 to 375[2]	10.3 to 25.9[2]	Unpainted	5.063	129	0.394	10.0

1. All springs may be backed off to 0 psig / 0 bar. However, highest capacities and best performances are obtained by using these springs in their recommended ranges.
2. 150 to 375 psig / 10.3 to 25.9 bar spring range is for the Type MR98H pilot construction.

Table 6. Flow Coefficients at Maximum Rated Travels

BODY SIZE, NPS / DN	PIPING STYLE													
	Line Size Equals Body Size							2:1 Line Size to Body Size						
	Linear Cage			Whisper Trim™ III Cage			K_m	Linear Cage			Whisper Trim III Cage			K_m
	C_g	C_v	C_1	C_g	C_v	C_1		C_g	C_v	C_1	C_g	C_v	C_1	
2 / 50	2280	63.3	36.0	1970	54.7	36.0	0.71	2050	59.6	34.4	1830	52.2	35.0	0.71
3 / 80	4630	132	35.1	3760	107	35.0	0.71	4410	128	34.4	3630	106	34.2	0.71
4 / 100	7320	202	36.2	6280	180	34.8	0.71	6940	198	35.0	6020	171	35.2	0.71
6 / 150	12,900	397	32.5	9450	295	32.0	0.71	12,100	381	31.7	9240	291	31.7	0.71
8 x 6 / 200 x 150	17,800	556	32.0	10,500	300	35.0	0.71	17,100	534	32.0	10,270	293	35.0	0.71

Table 7. IEC Sizing Coefficients

BODY SIZE, NPS / DN	X_T	F_D	F_L
2 / 50	0.82	0.35	0.84
3 / 80	0.78	0.30	0.84
4 / 100	0.83	0.28	0.84
6 or 8 x 6 / 150 or 200 x 150	0.67	0.28	0.84

Table 8. Minimum and Maximum Differential Pressures and Build-up Required for Wide-Open Flow

BODY SIZE, NPS / DN	MAIN VALVE SPRING RANGE AND SPRING COLOR	MINIMUM DIFFERENTIAL PRESSURE REQUIRED FOR FULL STROKE[1]		BUILD-UP OVER SET PRESSURE REQUIRED FOR FULL STROKE		MAXIMUM DIFFERENTIAL PRESSURE	
		psi	bar	psi	bar	psi	bar
2 / 50	10 to 40 psig / 0.69 to 2.8 bar Yellow	22	1.5	7	0.48	40	2.8
	30 to 125 psig / 2.1 to 8.6 bar Green	30	2.1	9	0.6	125	8.6
	85 to 400 psig / 5.9 to 27.6 bar Red	90	6.2	23	1.6	400	28
3 / 80	10 to 40 psig / 0.69 to 2.8 bar Yellow	19	1.3	5	0.34	40	2.8
	30 to 125 psig / 2.1 to 8.6 bar Green	25	1.7	7	0.48	125	8.6
	85 to 400 psig / 5.9 to 27.6 bar Red	60	4.1	17	1.2	400	28
4 / 100	10 to 40 psig / 0.69 to 2.8 bar Yellow	16	1.1	4	0.28	40	2.8
	30 to 125 psig / 2.1 to 8.6 bar Green	20	1.4	6	0.4	125	8.6
	85 to 400 psig / 5.9 to 27.6 bar Red	55	3.8	16	1.1	400	28
6, 8 x 6 / 150, 200 x 150	10 to 40 psig / 0.69 to 2.8 bar Yellow	16	1.1	4	0.28	40	2.8
	30 to 125 psig / 2.1 to 8.6 bar Green	20	1.4	6	0.4	125	8.6
	85 to 400 psig / 5.9 to 27.6 bar Red	55	3.8	16	1.1	400	28

1. Minimum differential is defined as the difference between the inlet pressure to the main valve body and the exhaust pressure from the pilot outlet. If the pilot exhaust is piped to the immediate downstream system, the differential is between the inlet and outlet pressure of the backpressure regulator. The pilot exhaust also may be discharged to atmosphere.

Introduction

66 Series direct-operated pressure-reducing regulators are widely used in burner control, tank blanketing systems and other applications where precise control of low-pressure industrial gases is needed, while 66 Series direct-operated vacuum service equipment comes in both vacuum regulator and vacuum breaker constructions.

Body Sizes and End Connection Styles

See Table 1

Construction Materials

See Table 2

Outlet (Control) Pressure Ranges

See Table 3

Maximum Operating Inlet Pressure

Type 66, 66Z or 66 Series Vacuum Breakers: 5 psig / 0.34 bar positive pressure
Type 66ZZ: 2 psig / 0.14 bar
66 Series Vacuum Regulator: 6 in. w.c. or 0.4 in. of mercury / 15 mbar d vacuum

Maximum Operating Outlet (Control) Pressure to Avoid Internal Part Damage

Type 66, 66Z or 66ZZ: 1 psig / 0.07 bar d above outlet pressure setting
66 Series Vacuum Regulator: no more than 1 psig / 0.07 bar d change from spring setting

Temperature Capabilities

Nitrile (NBR) (Standard):
-40 to 180°F / -40 to 82°C

Temperature Capabilities (continued)

Fluorocarbon (FKM):
0 to 350°F / -18 to 177°C
Ethylenepropylene (EPDM):
-40 to 275°F / -40 to 135°C

Flow and IEC Sizing Coefficients

See Tables 4 and 5

Flow Capacities

See Tables 6 and 7

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Process Gas
- Tank Blanketing

Features

- Sensitive Response to Pressure Changes
- Seat Protection without Sacrifice in Shutoff Capability
- Tank Blanketing Capability
- Accuracy
- Application Flexibility
- Severe Service Capability
- Positive Guiding
- Sour Gas Service Capability

Figure 1. *66 Series Pressure Reducing Regulator*

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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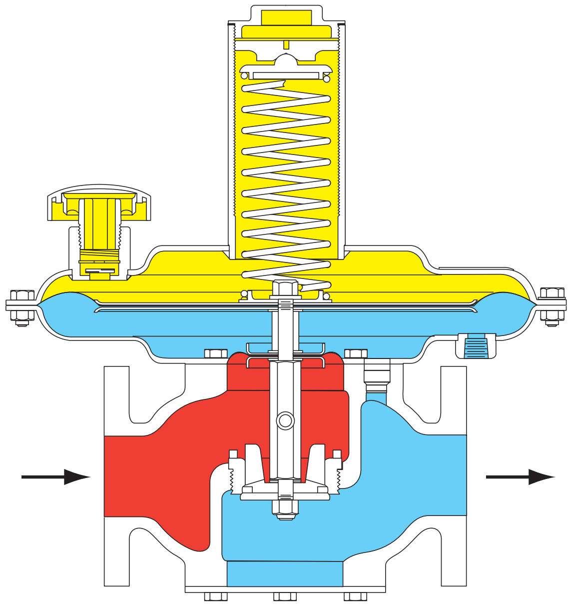
Table 1. Body Sizes and End Connection Styles

TYPE	NOMINAL BODY SIZE		END CONNECTION STYLES AND RATINGS	
	NPS	DN	Standard Cast Iron Body	Optional Steel Body
Type 66, 66Z, 66ZZ or 66 vacuum regulators or breakers	2	50	NPT or CL125 FF	NPT (all types), CL150 RF (all types), CL150 FF, CL300 RF
	3, 4	80, 100	CL125 FF	CL150 RF

Table 2. Construction Materials

BODY	DIAPHRAGM CASE	SPRING CASE	DIAPHRAGM AND VALVE PLUG O-RING
Cast Iron (standard), Steel or 316 Stainless steel (optional)	Plated steel	Steel or 304 Stainless steel (optional)	Nitrile (NBR) (standard), Fluorocarbon (FKM) (high temperature), Ethylenepropylene (EPDM) or PTFE O-ring and diaphragm protectors



INLET PRESSURE
OUTLET/BLANKETING PRESSURE
ATMOSPHERIC PRESSURE

Figure 2. *66 Series Operational Schematic*

Table 3. Outlet (Control) Pressure Ranges

TYPE	OUTLET (CONTROL) PRESSURE RANGE	
	In. w.c.	mbar
66	4 to 11[1] 8 to 28[1]	10 to 27[1] 20 to 70[1]
	2 to 5 4 to 8	5 to 12 10 to 20
	7 to 12 10 to 17 14 to 28	17 to 30 25 to 42 35 to 70
	0.75 to 1.5 psig[2] 1 to 2 psig[2] 1.5 to 3 psig[2] 3 to 5 psig[3]	0.05 to 0.10 bar[2] 0.07 to 0.14 bar[2] 0.10 to 0.21 bar[2] 0.21 to 0.34 bar[3]
66Z	-1 to 2	-2 to 5
66ZZ	-0.25 to 0.25	-0.62 to 0.62
66 Series Vacuum Regulators or Breakers	0 to -2 -0.2 to -0.8[4] -2 to -6 0 to 1.5[5]	0 to -5 -0.74 to -2[4] -5 to -15 0 to 4[5]

1. 1 psig / 0.07 bar minimum differential pressure required with this range.
2. Heavy head construction required.
3. Extra heavy head construction required.
4. Not available for NPS 3 / DN 80
5. Available for NPS 4 / DN 100 only

Table 4. IEC Sizing Coefficients

BODY SIZE		X_T	F_D	F_L
NPS	DN			
2	50	0.775	0.35	0.89
3	80		0.34	
4	100		0.30	

Table 5. Flow Coefficients

OUTLET PRESSURE RANGE, psig / bar	DROOP, psig / bar	REGULATING C_g			REGULATING C_v			WIDE-OPEN C_g			WIDE-OPEN C_v			C_1
		NPS 2 / DN 50	NPS 3 / DN 80	NPS 4 / DN 100	NPS 2 / DN 50	NPS 3 / DN 80	NPS 4 / DN 100	NPS 2 / DN 50	NPS 3 / DN 80	NPS 4 / DN 100	NPS 2 / DN 50	NPS 3 / DN 80	NPS 4 / DN 100	
0.75 to 1.5 / 0.05 to 0.10	0.2 / 0.01 0.3 / 0.02	765 1150	1865 2800	3330 5000	21.9 32.9	53.3 80	95.1 143							
1 to 2 / 0.07 to 0.14	0.3 / 0.02 0.4 / 0.03	825 1100	1650 2200	3150 4200	23.6 31.4	47.1 62.9	90 120							
1.5 to 3 / 0.10 to 0.21	0.4 / 0.03 0.6 / 0.04	665 1000	1165 1750	2500 3750	19 28.6	33.3 50	71.4 107	1260	3400	5250	36	97.1	150	35
3 to 5 / 0.21 to 0.34	0.6 / 0.04 0.8 / 0.06 1.0 / 0.07	540 720 900	725 970 1210	----	15.4 20.6 25.7	20.7 27.7 34.6	----							

Process Gas

Table 6. Selected Type 66 Regulating Capacities in SCFH / Nm^3/h of 0.6 Specific Gravity Natural Gas

BODY SIZE, NPS / DN	SPRING RANGE AND PART NUMBER, IN. W.C. / mbar	OUTLET PRESSURE SETTING, IN. W.C. / mbar	PROPORTIONAL BAND / FROM SETPOINT, IN. W.C. / mbar	INLET PRESSURE, psig / bar							
				0.3 / 0.02	0.5 / 0.03	0.75 / 0.05	1.0 / 0.07	1.5 / 0.10	2.0 / 0.14	3.0 / 0.21	5 to 10 / 0.34 to 0.69
2 / 50	2 to 5 / 5 to 12	2.0 / 5	-1/2 to 3/4 / -1 to 2	4900 / 131[1]	6700 / 180[1]	8250 / 221[1]	10,000 / 268[1]	9300 / 249[2]	9150 / 245[2]	8500 / 228[2]	8500 / 228[2]
		4.0 / 10		3900 / 105[1]	6200 / 166[1]	7850 / 210[1]	9550 / 256[1]	11,750 / 315[2]	10,800 / 289[2]	10,800 / 289[2]	10,300 / 276[2]
	4 to 8 / 10 to 20	6.0 / 15	-3/4 to 1-1/8 / -2 to 3	2840 / 76.1[1]	5800 / 155[1]	7600 / 204[1]	9550 / 256[1]	12,100 / 324[1]	13,500 / 362[2]	10,800 / 289[2]	10,300 / 276[2]
	7 to 12 / 17 to 30	9.0 / 22	-1-1/4 to 1-7/8 / -3 to 5	----	3200 / 85.8[1]	6450 / 173[1]	8700 / 233[1]	11,100 / 297[1]	13,400 / 359[2]	15,100 / 405[2]	13,400 / 359[2]
		12 / 30		----	----	4500 / 121[1]	6450 / 173[1]	10,600 / 284[1]	13,300 / 356[1]	15,500 / 415[1]	13,900 / 373[2]
	10 to 17 / 25 to 42	16 / 40		----	----	----	4650 / 125[1]	9000 / 241[1]	12,900 / 346[1]	16,750 / 449[1]	16,450 / 441[2]
	14 to 28 / 35 to 70	20 / 50	-2 to 3 / -5 to 7	----	----	----	----	8400 / 225[1]	12,250 / 328[1]	16,100 / 431[1]	18,000 / 482[2]
		24 / 60		----	----	----	----	7750 / 208[1]	11,600 / 311[1]	15,500 / 415[1]	20,000 / 536[2]
		28 / 70		----	----	----	----	----	----	12,900 / 346[1]	20,000 / 536[2]
3 / 80	2 to 5 / 5 to 12	2.0 / 5	-1/2 to 3/4 / -1 to 2	9000 / 241[1]	12,900 / 346[1]	15,500 / 415[1]	21,300 / 571[1]	26,400 / 708[1]	29,600 / 793[2]	25,100 / 673[2]	23,200 / 622[2]
		4.0 / 10		8700 / 233[1]	12,900 / 346[1]	15,500 / 415[1]	21,300 / 571[1]	26,400 / 708[1]	29,600 / 793[2]	25,100 / 673[2]	23,200 / 622[2]
	4 to 8 / 10 to 20	6.0 / 15	-3/4 to 1-1/8 / -2 to 3	6125 / 164[1]	12,250 / 328[1]	16,750 / 449[1]	18,000 / 482[1]	23,200 / 622[1]	30,000 / 804[2]	36,100 / 967[2]	31,000 / 831[2]
	7 to 12 / 17 to 30	9.0 / 22	-1-1/4 to 1-7/8 / -3 to 5	----	8250 / 221[1]	12,900 / 346[1]	18,000 / 482[1]	23,200 / 622[1]	33,500 / 898[1]	37,400 / 1002[1]	46,400 / 1244[1]
		12 / 30		----	----	8400 / 225[1]	14,200 / 381[1]	20,600 / 552[1]	28,400 / 761[1]	36,750 / 985[1]	46,400 / 1244[1]
	10 to 17 / 25 to 42	16 / 40		----	----	----	7750 / 208[1]	18,000 / 482[1]	23,200 / 622[1]	36,100 / 967[1]	49,000 / 1313[1]
	14 to 28 / 35 to 70	20 / 50	-2 to 3 / -5 to 7	----	----	----	----	12,900 / 346[1]	20,600 / 552[1]	32,200 / 863[1]	46,400 / 1244[1]
		24 / 60		----	----	----	----	11,600 / 311[1]	19,300 / 517[1]	25,800 / 691[1]	46,400 / 1244[1]
		28 / 70		----	----	----	----	----	----	23,200 / 622[1]	46,400 / 1244[1]

1. Values based on D (droop)
2. Values based on Boost

- continued -

Process Gas

Table 6. Selected Type 66 Regulating Capacities in SCFH / Nm³/h of 0.6 Specific Gravity Natural Gas (continued)

BODY SIZE, NPS / DN	SPRING RANGE AND PART NUMBER, IN. W.C. / mbar	OUTLET PRESSURE SETTING, IN. W.C. / mbar	PROPORTIONAL BAND / FROM SETPOINT, IN. W.C. / mbar	INLET PRESSURE, psig / bar							
				0.3 / 0.02	0.5 / 0.03	0.75 / 0.05	1.0 / 0.07	1.5 / 0.10	2.0 / 0.14	3.0 / 0.21	5 to 10 / 0.34 to 0.69
4 / 100	2 to 5 / 5 to 12	2.0 / 5	-1/2 to 3/4 / -1 to 2	15,500 / 415[1]	23,200 / 622[1]	28,400 / 761[2]	36,100 / 967[2]	36,100 / 967[2]	36,100 / 967[2]	36,100 / 967[2]	36,100 / 967[2]
		4.0 / 10		15,500 / 415[1]	23,200 / 622[1]	28,400 / 761[2]	36,100 / 967[2]	36,100 / 967[2]	36,100 / 967[2]	36,100 / 967[2]	36,100 / 967[2]
	4 to 8 / 10 to 20	6.0 / 15	-3/4 to 1-1/8 / -2 to 3	11,600 / 311[1]	18,000 / 482[1]	24,500 / 657[1]	34,800 / 933[1]	38,700 / 1037[2]	43,800 / 1174[2]	43,000 / 1152[2]	43,800 / 1174[2]
	7 to 12 / 17 to 30	9.0 / 22	-1-1/4 to 1-7/8 / -3 to 5	----	12,900 / 346[1]	20,600 / 552[1]	33,500 / 898[1]	41,300 / 1107[1]	51,500 / 1380[2]	51,500 / 1380[2]	51,500 / 1380[2]
		12 / 30		----	----	12,900 / 346[1]	22,600 / 606[1]	38,700 / 1037[1]	51,500 / 1380[1]	58,000 / 1554[1]	56,700 / 1520[1]
	10 to 17 / 25 to 42	16 / 40		----	----	----	20,600 / 552[1]	36,100 / 967[1]	51,500 / 1380[1]	64,500 / 1729[1]	61,800 / 1656[1]
	14 to 28 / 35 to 70	20 / 50	-2 to 3 / -5 to 7	----	----	----	----	27,000 / 724[1]	46,400 / 1244[1]	61,800 / 1656[1]	71,000 / 1903[1]
		24 / 60		----	----	----	----	----	41,300 / 1107[1]	61,800 / 1656[1]	77,500 / 2077[1]
		28 / 70		----	----	----	----	----	----	58,000 / 1554[1]	77,500 / 2077[1]

1. Values based on D (droop)
2. Values based on Boost

Table 7. Selected Type 66Z Regulating Capacities in SCFH / Nm³/h of 0.6 Specific Gravity Natural Gas

INLET PRESSURE		2 IN. W.C. / 5 mbar OUTLET PRESSURE SETTING					
		NPS 2 / DN 50 Body		NPS 3 / DN 80 Body		NPS 4 / DN 100 Body	
In. w.c.	mbar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
3	7	1930	51.7	3870	104	7750	208
4	10	2320	62.2	5160	138	9000	241
8	20	4900	131	9000	241	15,500	415
14	35	6700	180	12,900	346	23,200	622
1 psig	0.07 bar	10 000	268	21,300	571	36,100	967
2 psig	0.14 bar	9150	245	26,400	708	36,100	967
3 psig	0.21 bar	8500	228	33,500	898	50,000	1340
5 psig	0.34 bar	8500	228	36,100	967	50,000	1340

Natural gas regulating capacities at selected inlet pressures and outlet pressure settings are given in Tables 6 to 7. Flows are in SCFH (60°F and 14.7 psia) and Nm³/h (0°C and 1.01325 bar) of 0.6 specific gravity natural gas. To determine the equivalent capacities for other gases, multiply the table capacity by the following appropriate conversion factor: 0.775 for air, 0.789 for nitrogen, 0.628 for propane, or 0.548 for butane. 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 Nm³/h at 0°C and 1.01325 bar, multiply the values in SCFH by 0.0268.

Introduction

Types 66R and 66RR low-pressure throttling relief valves[1] are used to help protect a system against overpressure, or to maintain an inlet or backpressure. The standard Type 66R direct-operated construction is used for 2 in. w.c. to 2 psig / 5 mbar to 0.14 bar set pressure ranges, while the standard Type 66RR pilot-operated construction with Type T208RR pilot is used for 4 in. w.c. to 4.5 psig / 10 mbar to 0.31 bar set pressure ranges. However, higher set pressure ranges are available with optional springs, diaphragm plates and other internal parts.

Standard Type 66R relief valves have internal registration through a stem guide (Figures 2 and 3) that reduces the need for control line piping, while cast iron body Type 66R relief valves additionally are available with a sealing diaphragm and a tapped connection boss on the diaphragm case for external registration that requires a separate control line. All Type 66RR relief valves come standard with internal registration in the main valve body and tapped connection bosses on the pilot casings for external registration that requires a separate control line.

Body Sizes and End Connection Styles
See Table 1

Maximum Inlet Pressure
Type 66R:
8 psig / 0.55 bar, including build-up
Type 66RR:
10 psig / 0.69 bar, including build-up

Control Pressure Ranges
Type 66R: 2 in. w.c to
5 psig / 5 to 345 mbar in seven ranges, See Table 4
Type 66RR: 4 in. w.c. to
7 psig / 10 to 483 mbar in six ranges, See Table 5

Orifice Sizes
NPS 2 / DN 50 Body: 2 in. / 51 mm
NPS 3 / DN 80 Body: 3 in. / 76 mm
NPS 4 / DN 100 Body: 4 in. / 102 mm

Temperature Capabilities
Standard Elastomers:
-20 to 180°F / -29 to 82°C
High-Temperature Elastomers:
0 to 350°F / -18 to 177°C

IEC Sizing Coefficient
See Table 6

Relief Capacities
See Tables 7 and 8

Pressure Registration
Type 66R: Internal (standard) or external
Type 66RR: External on pilot and internal in main valve

Pressure Connections
Type 66R:
Control Line (if used): 3/4 NPT standard
Spring Case Vent: 3/4 NPT standard with removable Type Y602-10 vent assembly
Type 66RR:
Pilot Body: 3/4 NPT standard
Pilot Lower Casing Assembly: 1/2 NPT standard
Pilot Spring Case: 1/2 NPT standard

Approximate Weights
NPS 2 / DN 50 Body:
NPT:
50 lbs / 23 kg for Type 66R or
65 lbs / 29 kg for Type 66RR
Flanged Ends:
55 lbs / 25 kg for Type 66R or
70 lbs / 32 kg for Type 66RR
NPS 3 / DN 80 Body:
100 lbs / 45 kg for Type 66R or
115 lbs / 52 kg for Type 66RR
NPS 4 / DN 100 Body:
155 lbs / 70 kg for Type 66R or
170 lbs / 77 kg for Type 66RR

Ordering Guide
To order this product, contact your local Sales Office.

Applications
- Process Gas
- Vapor Recovery

Features
- Low Setpoints
- Highly Accurate
- Simple Design
- High Flow Rates
- Application Flexibility


W1953

TYPE 66R RELIEF VALVE


W1908

TYPE 66RR RELIEF VALVE

Figure 1. *Typical Constructions*

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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1. Throttling relief valve defined in ANSI standard B95.1-1972. Not all codes or regulations permit these valves to be used as final overpressure protection devices.

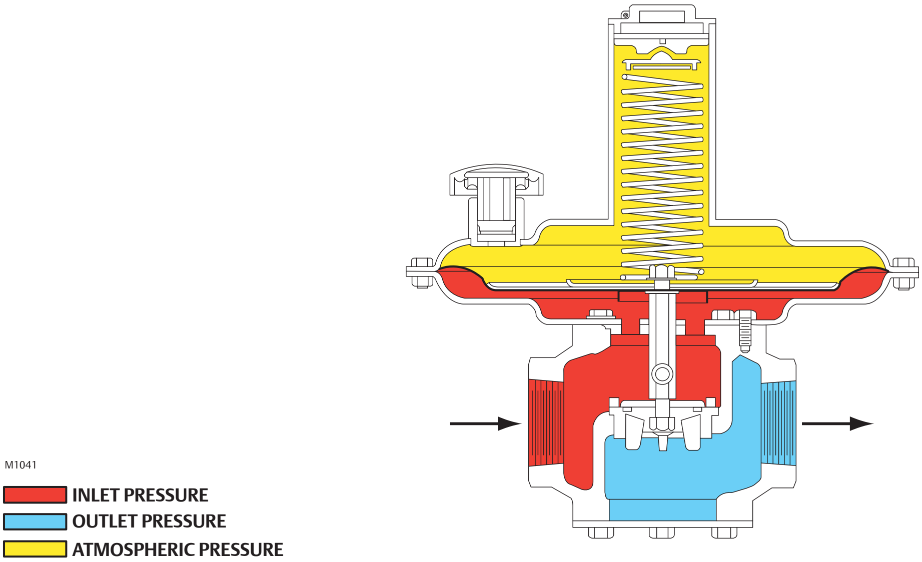

Figure 3. *Type 66R Operational Schematic*

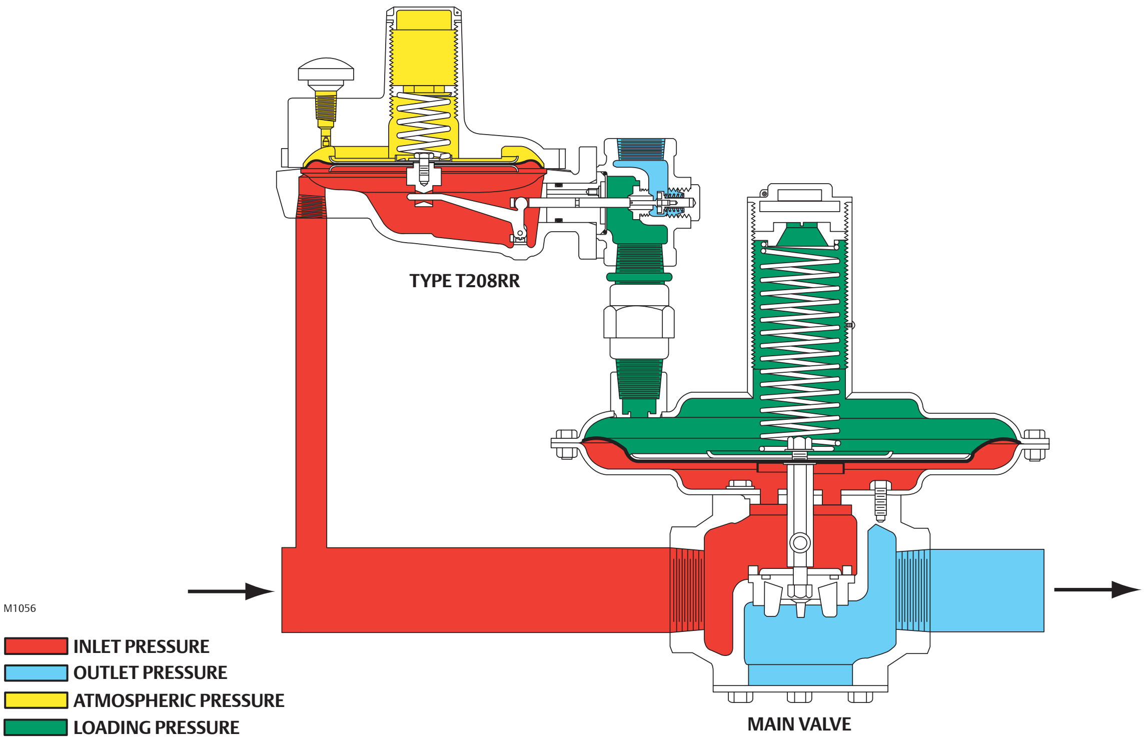

Figure 4. *Type 66RR Operational Schematic*

Table 1. Body Sizes and End Connection Styles

TYPE	TYPE NOMINAL BODY SIZE	END CONNECTION STYLES AND RATINGS	
		Standard Cast Iron Body	**Optional Steel Body**
66R, 66RR	NPS 2 / DN 50	NPT or CL125 FF flanged	NPT, CL150 RF and CL300 RF flanged
	NPS 3, 4 / DN 80, 100	CL125 FF flanged	CL150 RF flanged

Table 2. Types 66R and 66RR Construction Materials				
BODY	DIAPHRAGM CASE	SPRING CASE	DIAPHRAGM AND O-RING	VALVE PLUG AND SEAT RING
Cast iron or Steel	Plated Steel	Steel	Nitrile (NBR) or Fluorocarbon (FKM)	Bronze (standard) or Stainless steel

Table 3. Type T208RR Pilot Construction Materials						
BODY	SPRING CASE	LOWER CASING ASSEMBLY	DIAPHRAGM	DISK	ORIFICE AND DISK HOLDER	LEVER ASSEMBLY
Cast iron, Steel or Stainless steel	Cast iron, Steel or Stainless steel	Cast iron, Steel or Stainless steel	FEP, Nitrile (NBR) or Fluorocarbon (FKM)	Nitrile (NBR) or Fluorocarbon (FKM)	Stainless steel	Stainless steel

Table 4. Spring Selection for Type 66R Control Pressure Ranges								
BODY SIZE NPS / DN	CONSTRUCTION	CONTROL PRESSURE RANGE		SPRING WIRE DIAMETER		SPRING FREE LENGTH		
				In.	mm	In.	mm	
2 / 50	Standard	2 to 8 in. w.c. 6 to 16 in. w.c. 11 in. w.c. to 1 psig 0.75 to 1.5 psig 1 to 2 psig	5 to 20 mbar 15 to 40 mbar 27 mbar to 0.07 bar 0.05 to 0.10 bar 0.07 to 0.14 bar	0.120 0.138 0.177 0.207 0.225	3.05 3.51 4.50 5.26 5.72	6.00 6.00 6.00 6.09 6.00	152 152 152 155 152	
	Special	1.5 to 3 psig 3 to 5 psig	0.10 to 0.21 bar 0.21 to 0.34 bar	0.262 0.283	6.66 7.19	6.25 6.31	159 160	
3 / 80	Standard	2 to 8 in. w.c. 6 to 16 in. w.c. 11 in. w.c. to 1 psig 0.75 to 1.5 psig 1 to 2 psig	5 to 20 mbar 15 to 40 mbar 27 mbar to 0.07 bar 0.05 to 0.10 bar 0.07 to 0.14 bar	0.135 0.162 0.207 0.225 0.283	3.43 4.12 5.26 5.72 7.19	6.00 6.00 6.09 6.00 6.06	152 152 155 152 154	
	Special	1.5 to 3 psig 3 to 5 psig	0.10 to 0.21 bar 0.21 to 0.34 bar	0.306 0.363	7.77 9.22	6.38 6.38	162 162	
4 / 100	Standard	2 to 8 in. w.c. 6 to 16 in. w.c. 11 in. w.c. to 1 psig 0.75 to 1.5 psig 1 to 2 psig	5 to 20 mbar 15 to 40 mbar 27 mbar to 0.07 bar 0.05 to 0.10 bar 0.07 to 0.14 bar	0.135 0.177 0.225 0.262 0.283	3.43 4.50 5.72 6.66 7.19	7.75 7.94 7.75 7.75 7.75	197 202 197 197 197	
	Special	1.5 to 3 psig	0.10 to 0.21 bar	0.331	8.41	7.53	191	

Table 5. Type T208RR Pilot Control Spring Selection For Type 66RR							
MAIN VALVE CONSTRUCTION	CONTROL PRESSURE RANGE		COLOR CODE	WIRE DIAMETER		FREE LENGTH	
				In.	mm	In.	mm
Standard	4 to 9 in. w.c.(1) 5 to 15 in. w.c.(1) 12 to 28 in. w.c.(1) 0.9 to 2.5 psig 1.3 to 4.5 psig	10 to 22 mbar(1) 12 to 37 mbar(1) 30 to 70 mbar(1) 0.06 to 0.17 bar 0.09 to 0.31 bar	Red Cadmium Yellow Light green Light blue	0.085 0.105 0.114 0.156 0.187	2.16 2.67 2.90 3.96 4.75	3.625 3.750 4.188 4.060 3.938	92.1 95.3 106 103 100
Special	3.8 to 7 psig	0.26 to 0.48 bar	Black	0.218	5.54	3.980	101

1. Published ranges are with the spring case pointed up.

Table 6. IEC Sizing Coefficients				
BODY SIZE NPS / DN	X_T	F_D	F_L	K_M
2 / 50	0.78	0.35	0.89	0.79
3 / 80		0.34		
4 / 100		0.30		

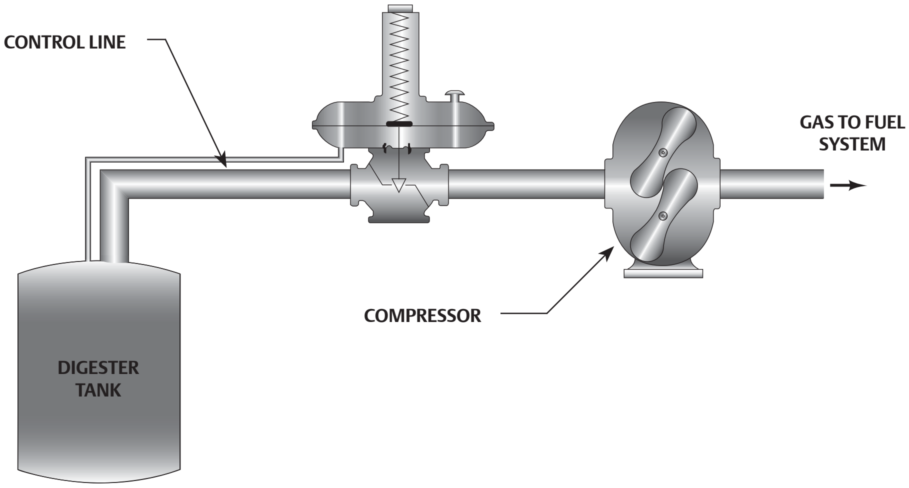

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Figure 5. *Type 66R Relief Valve Installation at Outlet of Sewage Treatment Plant Digester Tank*

Table 7. Selected Type 66R Relief Capacities in SCFH / Nm³/h of 0.6 Specific Gravity Natural Gas[1]

BODY SIZE NPS / DN	RELIEF SET PRESSURE	BUILD-UP OVER RELIEF SET PRESSURE									
		In. w.c. / mbar			psig / bar						
		1 / 2	3 / 7	5 / 12	0.25 / 0.02	0.5 / 0.03	0.75 / 0.05	1 / 0.07	1.5 / 0.10	2 / 0.14	3 / 0.21
2 / 50	5 in. w.c. / 12 mbar	3300 / 88.4	8500 / 228[2]	9500 / 255	10,000 / 268	12,500 / 335	----	----	----	----	----
	10 in. w.c. / 25 mbar	----	7300 / 196	10,800 / 289	12,000 / 322[2]	14,000 / 375	15,300 / 410	----	----	----	----
	14 in. w.c. / 35 mbar	----	----	8200 / 220	11,500 / 308	15,000 / 402[2]	16,800 / 450	18,500 / 496	----	----	----
	1 psig / 0.07 bar	----	----	----	7750 / 208	16,700 / 448	18,500 / 496[2]	20,000 / 536	24,000 / 643	----	----
	1.5 psig / 0.10 bar	----	----	----	----	15,000 / 402	21,000 / 563	24,000 / 643[2]	26,000 / 697	29,000 / 777	----
	2 psig / 0.14 bar	----	----	----	----	----	17,000 / 456	23,000 / 616	29,000 / 777[2]	31,000 / 831	35,000 / 938
3 / 80	5 in. w.c. / 12 mbar	5500 / 147	18,500 / 496[2]	20,000 / 536	22,000 / 590	27,000 / 724	----	----	----	----	----
	10 in. w.c. / 25 mbar	----	11,800 / 316	21,500 / 576	26,000 / 697[2]	31,000 / 831	34,000 / 911	----	----	----	----
	14 in. w.c. / 35 mbar	----	----	11,500 / 308	17,500 / 469	33,000 / 884[2]	36,000 / 965	40,000 / 1072	----	----	----
	1 psig / 0.07 bar	----	----	----	15,000 / 402	29,000 / 777	41,000 / 1099[2]	46,000 / 1233	52,000 / 1394	----	----
	1.5 psig / 0.10 bar	----	----	----	----	18,000 / 482	30,000 / 804	44,000 / 1179	57,000 / 1528[2]	62,000 / 1662	----
	2 psig / 0.14 bar	----	----	----	----	----	27,000 / 724	39,000 / 1045	60,000 / 1608	67,000 / 1796[2]	76,000 / 2037
4 / 100	5 in. w.c. / 12 mbar	10,300 / 276	28,000 / 750[2]	32,000 / 858	34,000 / 911	41,000 / 1099	----	----	----	----	----
	10 in. w.c. / 25 mbar	----	22,000 / 590	36,000 / 965	39,000 / 1045[2]	46,000 / 1233	52,000 / 1394	----	----	----	----
	14 in. w.c. / 35 mbar	----	----	24,000 / 643	35,000 / 938	50,000 / 1340[2]	55,000 / 1474	61,000 / 1635	----	----	----

1. See "Capacity Information" section for conversion to equivalent capacities of other gases and/or normal cubic meters per hour.
2. Valve wide-open

- continued -

Table 7. Selected Type 66R Relief Capacities in SCFH / Nm³/h of 0.6 Specific Gravity Natural Gas[1] (continued)

BODY SIZE NPS / DN	RELIEF SET PRESSURE	BUILD-UP OVER RELIEF SET PRESSURE									
		In. w.c. / mbar			psig / bar						
		1 / 2	3 / 7	5 / 12	0.25 / 0.02	0.5 / 0.03	0.75 / 0.05	1 / 0.07	1.5 / 0.10	2 / 0.14	3 / 0.21
4 / 100	1 psig / 0.07 bar	----	----	----	21,000 / 563	50,000 / 1340	65,000 / 1742[2]	70,000 / 1876	78,000 / 2090	----	----
	1.5 psig / 0.10 bar	----	----	----	----	36,000 / 965	60,000 / 1608	78,000 / 2090	86,000 / 2305[2]	95,000 / 2546	----
	2 psig / 0.14 bar	----	----	----	----	----	40,000 / 1072	60,000 / 1608	90,000 / 2412	102,000 / 2734[2]	115,000 / 3082

1. See "Capacity Information" section for conversion to equivalent capacities of other gases and/or normal cubic meters per hour.
2. Valve wide-open

Table 8. Selected Type 66RR Relief Capacities in SCFH / Nm³/h of 0.6 Specific Gravity Natural Gas[1]

BODY SIZE NPS / DN	TYPE T208RR PILOT CONTROL SPRING	RELIEF SET PRESSURE	BUILD-UP OVER RELIEF SET PRESSURE									
			In. w.c. / mbar			psig / bar						
			1 / 2	3 / 7	5 / 12	0.25 / 0.02	0.5 / 0.03	0.75 / 0.05	1 / 0.07	1.5 / 0.10	2 / 0.14	3 / 0.21
2 / 50	Red	5 in. w.c. / 12 mbar	6200 / 166[2]	7300 / 196	8250 / 221	9000 / 241	11,600 / 311	----	----	----	----	----
	Cadmium	10 in. w.c. / 25 mbar	8750 / 235[2]	9550 / 256	10,200 / 273	10,800 / 289	13,000 / 348	15,100 / 405	----	----	----	----
	Yellow	14 in. w.c. / 35 mbar	10,300 / 276[2]	11,100 / 297	11,700 / 314	12,400 / 332	14,300 / 383	16,100 / 431	17,900 / 480	----	----	----
	Light green	1 psig / 0.07 bar	14,400 / 386[2]	15,200 / 407	15,700 / 421	16,100 / 431	17,700 / 474	19,200 / 515	20,600 / 552	23,200 / 622	----	----
	Light green	1.5 psig / 0.10 bar	----	18,000 / 482	18,500 / 496	19,000 / 509	20,500 / 549	22,000 / 590	23,500 / 630	26,000 / 697	28,000 / 750	----
	Light blue	2 psig / 0.14 bar	----	20,000 / 536	20,500 / 549	21,000 / 563	22,500 / 603	24,000 / 643	25,500 / 683	28,000 / 750	30,000 / 804	33,000 / 884
3 / 80	Red	5 in. w.c. / 12 mbar	15,700 / 421[2]	18,600 / 498	21,200 / 568	23,000 / 616	29,400 / 788	----	----	----	----	----
	Cadmium	10 in. w.c. / 25 mbar	22,700 / 608[2]	24,800 / 665	26,600 / 713	28,400 / 761	34,000 / 911	38,700 / 1037	----	----	----	----
	Yellow	14 in. w.c. / 35 mbar	16,100 / 431[2]	28,200 / 756	29,700 / 796	31,500 / 844	36,400 / 976	42,000 / 1126	45,500 / 1219	----	----	----
	Light green	1 psig / 0.07 bar	35,600 / 954[2]	37,200 / 997	38,200 / 1024	39,800 / 1067	44,000 / 1179	48,000 / 1286	51,500 / 1380	58,800 / 1576	----	----
	Light green	1.5 psig / 0.10 bar	----	45,000 / 1206	46,000 / 1233	47,200 / 1265	50,000 / 1340	54,000 / 1447	56,000 / 1501	59,900 / 1605	62,000 / 1662	----
	Light blue	2 psig / 0.14 bar	----	51,000 / 1367	52,000 / 1394	53,300 / 1428	56,000 / 1501	59,500 / 1595	62,000 / 1662	64,000 / 1715	66,000 / 1769	72,000 / 1930
4 / 100	Red	5 in. w.c. / 12 mbar	25,500 / 683[2]	30,000 / 804	33,600 / 900	36,900 / 989	45,400 / 1217	----	----	----	----	----
	Cadmium	10 in. w.c. / 25 mbar	35,100 / 941[2]	38,200 / 1024	41,300 / 1107	43,800 / 1174	52,600 / 1410	59,800 / 1603	----	----	----	----
	Yellow	14 in. w.c. / 35 mbar	41,300 / 1107[2]	43,800 / 1174	46,500 / 1246	49,000 / 1313	56,700 / 1520	66,500 / 1782	70,600 / 1892	----	----	----
	Light green	1 psig / 0.07 bar	57,400 / 1538[2]	59,300 / 1589	62,000 / 1662	63,200 / 1694	65,000 / 1742	67,700 / 1814	77,800 / 2085	90,000 / 2412	----	----
	Light green	1.5 psig / 0.10 bar	----	64,400 / 1726	66,900 / 1793	67,900 / 1820	69,500 / 1863	72,000 / 1930	86,000 / 2305	93,000 / 2492	96,000 / 2573	----
	Light blue	2 psig / 0.14 bar	----	69,500 / 1863	72,000 / 1930	73,000 / 1956	74,600 / 1999	77,000 / 2064	90,000 / 2412	95,000 / 2546	100,000 / 2680	110,000 / 2948

1. See "Capacity Information" section for conversion to equivalent capacities of other gases and/or normal cubic meters per hour. Shaded capacities are approximate.
2. Valve wide-open

67C Series

Instrument Supply Regulator

FISHER

Introduction

The 67C Series regulators are used to provide constantly controlled, reduced pressures to pneumatic and electro-pneumatic controllers and other instruments. 67C Series are suitable for most air or gas applications. Other applications include providing reduced pressures to air chucks, air jets and spray guns. Types 67CS and 67CSR are used for most liquid applications and stainless steel construction is available for offshore applications.

Available Constructions

See Table 1

Body Size, Inlet and Outlet Connection Style

1/4 NPT

Construction Materials

See Table 2

Maximum Inlet Pressure (Body Rating)

All except Types 67CS and 67CSR: 250 psig / 17.2 bar

Types 67CS and 67CSR: 400 psig / 27.6 bar

Outlet Pressure Ranges

See Table 3

Maximum Emergency Outlet Pressure

50 psi / 3.4 bar over outlet pressure setting

Temperature Capabilities

See Table 4

Flow Capacities

See Tables 5 and 6

Wide-Open Flow Coefficients

Main Valve: C_g: 11.7; C_v: 0.36; C_1: 32.2

Internal Relief Valve: C_g: 1.45; C_v: 0.045; C_1: 32.8

IEC Sizing Coefficients

Main Valve: X_T: 0.66; F_L: 0.89; F_D: 0.50

Types 67CR, 67CSR, 67CFR and 67CFSR Internal Relief Performance

Low capacity for minor seat leakage only, other overpressure protection must be provided if inlet pressure can exceed the maximum pressure rating of downstream equipment or exceeds maximum outlet pressure rating of the regulator.

Smart Bleed™ Check Valve Setpoint

6 psi / 0.41 bar differential

Pressure Registration

Internal

Drain Valve and Spring Case Vent Location

Aligned with inlet standard, other positions optional

Types 67CF, 67CFR, 67CFS and 67CFSR Filter Capabilities

Free Area: 12 times pipe area

Micron Rating:

Polyethylene Filter[1] ***(Standard):*** 5 microns

Glass Fiber Filter (Optional): 5 microns

PVDF Filter (Optional): 40 microns

Stainless Steel Filter (Optional): 40 microns

Approximate Weights

Types 67C, 67CR, 67CF and 67CFR: 1 lb / 0.5 kg

Types 67CS and 67CSR: 2.5 lbs / 1.1 kg

Types 67CFS and 67CFSR: 4 lbs / 1.8 kg

Options

Refer to product bulletin

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Liquid

Features

- Designed for Digital Instrumentation
- Optional Smart Bleed Construction
- Optional Stainless Steel Construction
- Compact and Light Weight
- No Air Loss
- Easy Maintenance
- Optional Integral Filter
- Optional Internal Relief Valve
- Rugged Construction

W8438

Figure 1. *67C Series Instrument Supply Regulator*

P1023

Figure 2. *Type 67CS Pressure Reducing Regulator*

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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1. Do not use in high aromatic hydrocarbon service.

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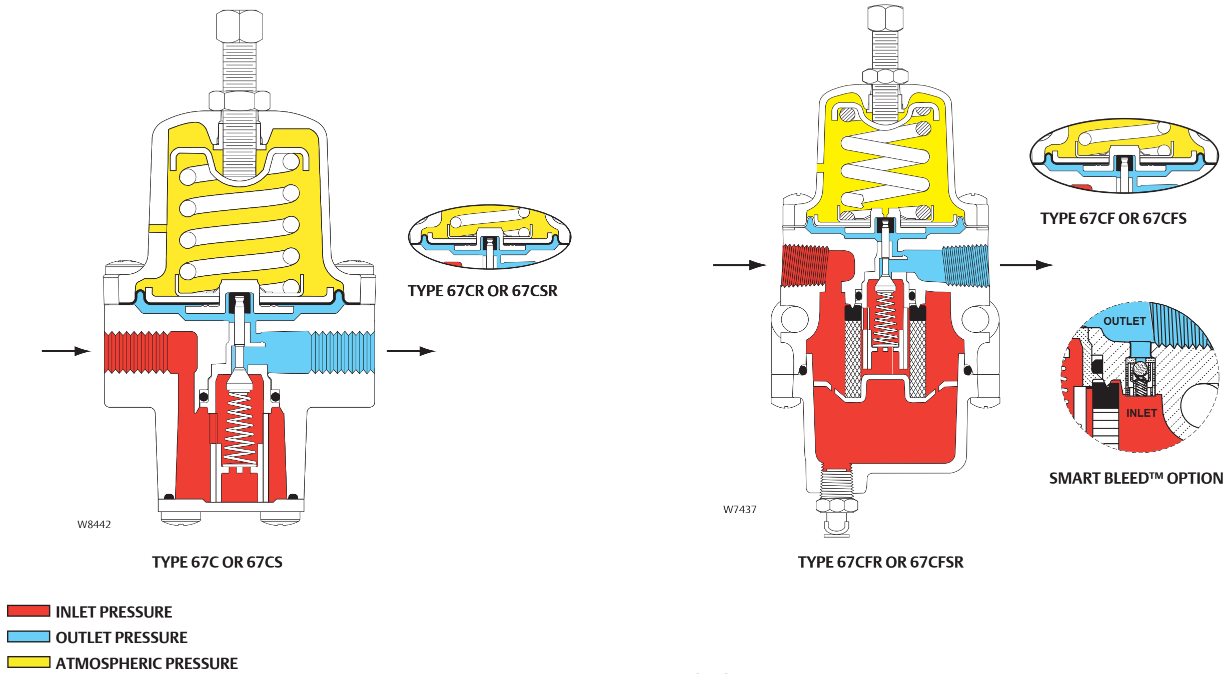

Figure 3. *67C Series Operational Schematics*

Table 1. Available Constructions

TYPE	CONSTRUCTION FEATURES		OPTIONAL FEATURES			BODY MATERIAL	
	With Internal Relief	With Filter	Smart Bleed Internal Check Valve Airset	Drain Valve	Fixed Bleed	Aluminum	Stainless Steel
67C						X	
67CR	X				X	X	
67CS							X
67CSR	X				X		X
67CF		X		X		X	
67CFR	X	X	X	X	X	X	
67CFS		X		X			X
67CFSR	X	X	X	X	X		X

Table 2. Construction Materials

MATERIAL	TYPE			
	67C and 67CR	67CF and 67CFR	67CS and 67CSR	67CFS and 67CFSR
Body and Spring Case	Aluminum (ASTM B85/Alloy 380)		CF8M/CF3M Stainless steel	
Bottom Plate	316 Stainless steel	- - - -	316 Stainless steel	- - - -
Pusher Post and Valve Cartridge	Polyester resin			
Upper Spring Seat	Zinc-plated steel		316 Stainless steel	
Lower Spring Seat and Diaphragm Plate	Chromate conversion coated Aluminum		316 Stainless steel	
Control Spring	Plated Steel or Inconel® (NACE)		Inconel®	
Valve Plug	Brass stem with Nitrile (NBR) plug, Aluminum stem with Nitrile (NBR) or Fluorocarbon (FKM) plug or Stainless steel stem with Nitrile (NBR) plug		316 Stainless steel stem with Nitrile (NBR) or Fluorocarbon (FKM) plug	
Valve Spring	Stainless steel or Inconel® (NACE)		Inconel®	
Diaphragm and O-rings	Nitrile (NBR), Fluorocarbon (FKM) or Silicone (VMQ)(1)			
Soft Seat and Gaskets	Nitrile (NBR) or Fluorocarbon (FKM)			
Bolting, Adjusting Screw, Locknut	Zinc-plated steel or Stainless steel		Stainless steel	
Handwheel	Zinc-plated steel screw with resin handwheel			
Filter Retainer	- - - -	Plated Steel	- - - -	316 Stainless steel
Filter Element	- - - -	Polyethylene, Glass fiber, Stainless steel or PVDF (Plastic)	- - - -	Polyethylene, Glass fiber, 316 Stainless steel or PVDF (Plastic)
Drain Valve	- - - -	Brass or Stainless steel	- - - -	316 Stainless steel or 18-8 Stainless steel
Dripwell	- - - -	Aluminum (ASTM B85/Alloy 380)	- - - -	CF8M/CF3M Stainless steel

1. Silicone (VMQ) diaphragm is only available with internal relief (Types 67CR, 67CSR, 67CFR and 67CFSR).

Table 3. Outlet Pressure Ranges

TYPE	OUTLET PRESSURE RANGE psig	OUTLET PRESSURE RANGE bar	Color	Material	Wire Diameter In.	Wire Diameter mm	Free Length In.	Free Length mm
67C, 67CR, 67CF and 67CFR	0 to 20	0 to 1.4	Green stripe	Music Wire	0.135	3.43	1.43	36.2
	0 to 35	0 to 2.4	Silver		0.156	3.96	1.43	36.2
	0 to 60	0 to 4.1	Blue stripe		0.170	4.32	1.43	36.2
	0 to 125	0 to 8.6	Red stripe		0.207	5.26	1.43	36.2
	0 to 35	0 to 2.4	Silver stripe	Inconel®	0.156	3.96	1.43	36.2
	0 to 60	0 to 4.1	Blue		0.172	4.37	1.43	36.2
	0 to 125	0 to 8.6	Red		0.207	5.26	1.43	36.2
67CS, 67CSR, 67CFS and 67CFSR	0 to 20	0 to 1.3	Green	Inconel®	0.135	3.43	1.50	38.1
	0 to 35	0 to 2.4	Silver stripe		0.156	3.96	1.43	36.2
	0 to 60	0 to 4.1	Blue		0.172	4.37	1.43	36.2
	0 to 125	0 to 8.6	Red		0.207	5.26	1.43	36.2
	0 to 150	0 to 10.3	Black		0.250	6.35	1.77	44.9

Table 4. Temperature Capabilities

CONSTRUCTION	TEMPERATURE °F	TEMPERATURE °C
With Nitrile (NBR)		
Standard Bolting	-20 to 180	-29 to 82
Stainless Steel Bolting	-40 to 180	-40 to 82
With Fluorocarbon (FKM):		
Polyethylene Filter[1] **(standard)**	0 to 180	-18 to 82
Polyvinylidene (PVDF), Stainless Steel or Glass Filter (Optional)	0 to 300	-18 to 149
With Silicone (VMQ)[2] Diaphragm and Low Temperature bolting	-60 to 180	-51 to 82
With Gauges	-40 to 180	-40 to 82

1. Do not use in high aromatic hydrocarbon service.
2. Silicone (VMQ) is not compatible with hydrocarbon gas.

Air

Table 5. 67C Series Air Flow Capacities

OUTLET PRESSURE RANGE AND COLOR CODE	OUTLET PRESSURE psig	OUTLET PRESSURE bar	INLET PRESSURE psig	INLET PRESSURE bar	Types 67C, 67CR, 67CS and 67CSR, 10% Droop SCFH	Types 67C, 67CR, 67CS and 67CSR, 10% Droop Nm^3/h	Types 67C, 67CR, 67CS and 67CSR, 20% Droop SCFH	Types 67C, 67CR, 67CS and 67CSR, 20% Droop Nm^3/h	Types 67CF, 67CFR, 67CFS and 67CFSR, 10% Droop SCFH	Types 67CF, 67CFR, 67CFS and 67CFSR, 10% Droop Nm^3/h	Types 67CF, 67CFR, 67CFS and 67CFSR, 20% Droop SCFH	Types 67CF, 67CFR, 67CFS and 67CFSR, 20% Droop Nm^3/h
0 to 35 psig / 0 to 2.4 bar; Silver; Silver stripe	15	1.0	50	3.4	250	6.7	430	11.5	250	6.7	430	11.5
			75	5.2	340	9.1	610	16.3	300	8.0	690	18.5
			100	6.9	430	11.5	800	21.4	330	8.8	1000	26.8
			150	10.3	680	18.2	1200	32.2	400	10.7	1600	42.9
			250	17.2	1300	34.8	1900	50.9	450	12.1	1800	48.2
			400[1]	27.6[1]	390	10.5	1850	50.0	----	----	----	----
	20	1.4	50	3.4	310	8.3	460	12.3	350	9.4	500	13.4
			75	5.2	420	11.3	700	18.8	530	14.2	820	22.0
			100	6.9	620	16.6	940	25.2	750	20.1	1100	29.5
			150	10.3	960	25.7	1450	38.9	1400	37.5	1600	42.9
			250	17.2	1550	41.5	2150	57.6	2550	68.3	2700	72.4
			400[1]	27.6[1]	1200	32.2	2750	73.7	----	----	----	----
	35	2.4	50	3.4	390	10.5	490	13.1	390	10.4	500	13.4
			75	5.2	590	15.8	850	22.8	640	17.2	820	22.0
			100	6.9	770	20.6	1150	30.8	840	22.5	1100	29.5
			150	10.3	1200	32.2	1750	46.9	1450	38.9	1650	42.9
			250	17.2	2200	58.9	2700	72.4	2450	65.7	2700	72.4
			400[1]	27.6[1]	2850	76.4	3450	92.5	----	----	----	----
0 to 60 psig / 0 to 4.1 bar; Blue stripe; Blue	35	2.4	50	3.4	310	8.3	440	11.8	330	8.8	470	12.6
			75	5.2	440	11.8	670	18.0	500	13.4	730	19.6
			100	6.9	560	15.0	900	24.1	700	18.8	1000	26.8
			150	10.3	780	20.9	1350	36.2	1050	28.1	1550	41.5
			250	17.2	1450	38.9	2200	59.0	2000	53.6	2600	69.7
			400[1]	27.6[1]	770	20.6	2500	67.0	----	----	----	----
	60	4.1	75	5.2	520	13.9	720	19.3	520	13.9	720	19.3
			100	6.9	750	20.1	1050	28.1	770	20.6	1000	26.8
			150	10.3	1100	29.5	1700	45.6	1100	29.5	1600	42.9
			250	17.2	2050	54.9	2850	76.4	2450	65.7	2750	73.7
			400[1]	27.6[1]	3200	85.8	4300	115	----	----	----	----
0 to 125 psig / 0 to 8.6 bar; Red stripe; Red	80	5.5	100	6.9	500	13.4	800	21.4	530	14.2	780	20.9
			150	10.3	750	20.1	1200	32.2	780	20.9	1200	32.2
			250	17.2	1200	32.2	2050	54.9	1250	33.5	2200	59.0
			400[1]	27.6[1]	910	24.4	3700	99.2	----	----	----	----
	125	8.6	150	10.3	900	24.1	1250	33.5	900	24.1	1150	30.8
			250	17.2	1560	41.8	2450	65.7	1650	44.2	2450	65.7
			400[1]	27.6[1]	2200	59.0	4350	117	----	----	----	----
0 to 150 psig / 0 to 10.3 bar[2]; Black	80	5.5	250	17.2	550	14.7	1200	32.2	550	14.7	1200	32.2
			400[1]	27.6[1]	400	10.7	1100	29.5	----	----	----	----
	135	9.3	250	17.2	970	26.0	1800	48.2	1100	29.5	1800	48.2
			400[1]	27.6[1]	840	22.5	2350	63.0	----	----	----	----
	150	10.3	250	17.2	1100	29.5	1850	49.6	1100	29.5	1850	49.6
			400[1]	27.6[1]	940	25.2	2500	67.0	----	----	----	----

1. Inlet pressures above 250 psig / 17.2 bar with a maximum of 400 psig / 27.6 bar are only available on Types 67CS and 67CSR.
2. Available for Types 67CS, 67CSR, 67CFS and 67CFSR only.

Liquid

Table 6. Types 67CS and 67CSR Water Flow Capacities

OUTLET PRESSURE RANGE AND COLOR CODE	OUTLET PRESSURE		INLET PRESSURE		C_v		C_g		CAPACITIES OF WATER			
									10% Droop		20% Droop	
	psig	bar	psig	bar	10%	20%	10%	20%	GPM	l/min	GPM	l/min
0 to 35 psig / 0 to 2.4 bar Silver Silver stripe	15	1.0	50	3.4	0.122	0.209	3.926	6.721	0.737	2.79	1.288	4.88
			75	5.2	0.118	0.211	3.791	6.799	0.925	3.50	1.675	6.34
			100	6.9	0.116	0.217	3.747	6.972	1.079	4.08	2.036	7.71
			150	10.3	0.128	0.226	4.127	7.283	1.468	5.56	2.592	9.81
			250	17.2	0.152	0.223	4.909	7.175	2.211	8.37	3.244	12.28
			400	27.6	0.029	0.138	0.94	4.459	0.528	2.00	2.513	9.51
	20	1.4	50	3.4	0.154	0.227	4.967	7.296	0.871	3.30	1.324	5.01
			75	5.2	0.146	0.243	4.701	7.82	1.102	4.17	1.867	7.07
			100	6.9	0.168	0.254	5.403	8.192	1.521	5.76	2.328	8.81
			150	10.3	0.181	0.273	5.827	8.801	2.076	7.86	3.131	11.85
			250	17.2	0.182	0.252	5.853	8.119	2.647	10.02	3.665	13.87
			400	27.6	0.090	0.206	2.892	6.629	1.639	6.20	3.751	14.20
	35	2.4	50	3.4	0.224	0.267	7.206	8.584	0.963	3.65	1.252	4.74
			75	5.2	0.213	0.302	6.844	9.729	1.405	5.32	2.07	7.84
			100	6.9	0.210	0.313	6.777	10.077	1.738	6.58	2.656	10.05
			150	10.3	0.226	0.330	7.283	10.622	2.46	9.31	3.645	13.80
			250	17.2	0.258	0.317	8.308	10.197	3.753	14.21	4.611	17.45
			400	27.6	0.213	0.258	6.87	8.316	3.878	14.68	4.698	17.78
0 to 60 psig / 0 to 4.1 bar Blue stripe Blue	35	2.4	50	3.4	0.178	0.239	5.728	7.708	0.766	2.90	1.121	4.24
			75	5.2	0.159	0.238	5.104	7.669	1.049	3.97	1.63	6.17
			100	6.9	0.153	0.245	4.928	7.886	1.266	4.79	2.079	7.87
			150	10.3	0.147	0.254	4.734	8.194	1.6	6.06	2.806	10.62
			250	17.2	0.170	0.258	5.476	8.308	2.473	9.36	3.753	14.21
			400	27.6	0.058	0.187	1.856	6.026	1.056	4.00	3.405	12.89
	60	4.1	75	5.2	0.230	0.293	7.421	9.439	1.054	3.99	1.522	5.76
			100	6.9	0.220	0.300	7.09	9.653	1.492	5.65	2.163	8.19
			150	10.3	0.210	0.323	6.759	10.385	2.058	7.79	3.262	12.35
			250	17.2	0.240	0.334	7.742	10.763	3.36	12.72	4.747	17.97
			400	27.6	0.240	0.322	7.714	10.365	4.37	16.54	5.863	22.19
0 to 125 psig / 0 to 8.6 bar Red stripe Red	80	5.5	100	6.9	0.171	0.251	5.498	8.096	0.905	3.43	1.506	5.70
			150	10.3	0.148	0.232	4.759	7.485	1.307	4.95	2.151	8.14
			250	17.2	0.141	0.240	4.538	7.743	1.881	7.12	3.273	12.39
			400	27.6	0.068	0.277	2.193	8.919	1.232	4.66	5.044	19.09
	125	8.6	150	10.3	0.219	0.276	7.065	8.901	1.341	5.08	1.952	7.39
			250	17.2	0.188	0.292	6.059	9.399	2.204	8.34	3.576	13.54
			400	27.6	0.165	0.326	5.305	10.486	2.798	10.59	5.646	21.37
0 to 150 psig / 0 to 10.3 bar Black	80	5.5	250	17.2	0.065	0.141	2.08	4.532	0.867	3.28	1.923	7.28
			400	27.6	0.030	0.082	0.964	2.651	0.543	2.06	1.493	5.65
	135	9.3	250	17.2	0.118	0.216	3.812	6.957	1.338	5.06	2.574	9.74
			400	27.6	0.063	0.176	2.027	5.665	1.051	3.98	3.007	11.38
	150	10.3	250	17.2	0.137	0.225	4.422	7.255	1.469	5.56	2.565	9.71
			400	27.6	0.071	0.187	2.275	6.033	1.156	4.38	3.129	11.84

67D Series
Pressure Reducing Regulator

Introduction
The 67D Series regulators are typically used to deliver constant reduced pressure of gaseous fluids to pilot-operated controllers and other pneumatic instrumentation. As shown in the Available Configurations table, an assortment of regulators is available to meet diverse flow requirements.

Available Configurations
See Table 1

Body Size, Inlet and Outlet Connection Style
1/2 NPT

Construction Materials
See Table 2

Maximum Inlet Pressure (Body Rating)
All filtered models: 250 psig / 17.2 bar
All unfiltered models: 400 psig / 27.6 bar

Outlet Pressure Ranges
See Table 3

Maximum Emergency Outlet Pressure
150 psi / 10.3 bar over outlet pressure setting up to a maximum of 250 psi / 17.2 bar

Temperature Capabilities
See Table 4

Flow Capacities
See Table 5

Wide-Open Flow Coefficients
Main Valve: C_g: 45.24; C_v: 1.33; C_1: 35.02;
Internal Relief Valve: C_g: 1.45; C_v: 0.045; C_1: 32.8

IEC Sizing Coefficients
X_t: 0.75

Types 67DR, 67DSR, 67DFR and 67DFSR Internal Relief Performance
Low capacity for minor seat leakage only, other overpressure protection must be provided if inlet pressure can exceed the maximum pressure rating of downstream equipment or exceeds maximum outlet pressure rating of the regulator.

Smart Bleed™ Check Valve Setpoint
6 psi / 0.41 bar differential

Pressure Registration
Internal

Spring Case Vent Location
Aligned with inlet standard, other positions optional

Types 67DF, 67DFR, 67DFS and 67DFSR Filter Capabilities
Micron Rating:
Polyethylene Filter[1] **(standard):** 5 microns
Glass Fiber Filter (Optional): 5 microns
PVDF Filter (Optional): 40 microns
Stainless Steel Filter (Optional): 40 microns

Approximate Weights
Types 67D and 67DR: 1.2 lbs / 0.5 kg
Types 67DF and 67DFR: 2.0 lbs / 0.9 kg
Types 67DS and 67DSR: 2.8 lbs / 1.2 kg
Types 67DFS and 67DFSR: 4.6 lbs / 2.1 kg

Drain Valve Location
Aligned in the center of the dripwell

Options
Refer to product bulletin

Ordering Guide
To order this product, contact your local Sales Office.

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Features
- Optional Smart Bleed Construction
- Optional Stainless Steel Construction
- Compact and Light Weight
- No Air Loss
- Easy Maintenance
- Optional Integral Filter
- Optional Internal Relief Valve
- Rugged Construction


P1183

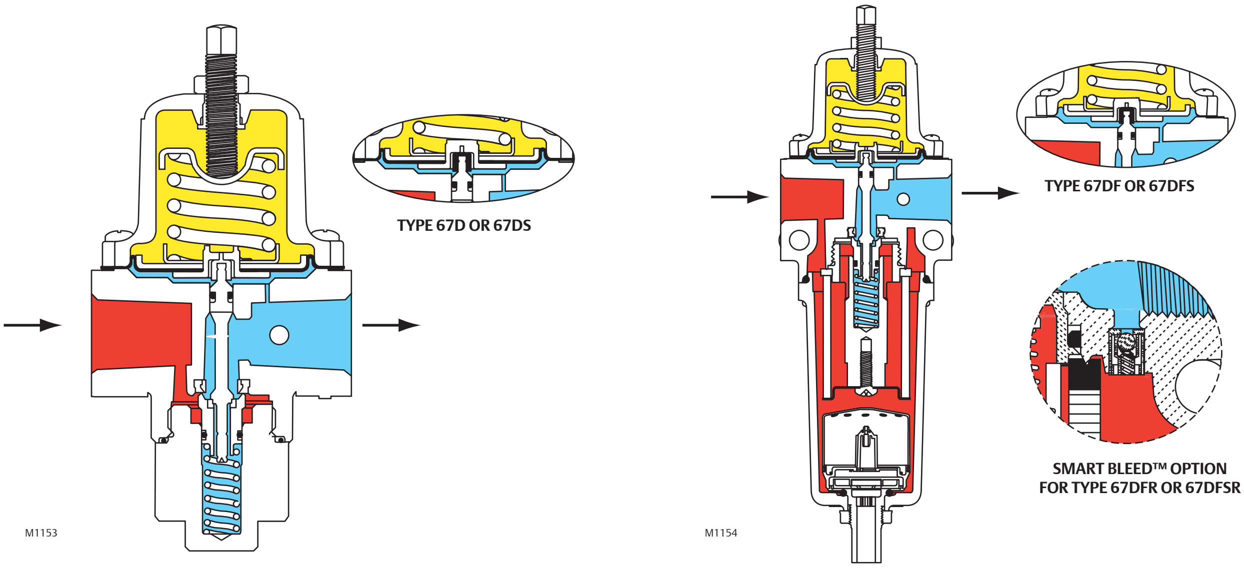
Figure 1. *Type 67D or 67DR Regulator*


P1182

Figure 2. *Type 67DF or 67DFR Filtered Regulator*

Applications
- Air
- Liquid

1. Do not use in high aromatic hydrocarbon service.



INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE

Figure 3. *67D Series Operational Schematics*

Table 1. Available Configurations

TYPE	CONSTRUCTION FEATURE		OPTIONAL FEATURE			BODY MATERIAL	
	With Internal Relief	With Filter	Smart Bleed Internal Check Valve Airset	Drain Valve	External Fixed Bleed	Aluminum	Stainless Steel
67D						X	
67DR	X				X	X	
67DS							X
67DSR	X				X		X
67DF		X		X		X	
67DFR	X	X	X	X	X	X	
67DFS		X		X			X
67DFSR	X	X	X	X	X		X

Table 2. Construction Materials

MATERIAL	TYPE			
	67D and 67DR	67DF and 67DFR	67DS and 67DSR	67DFS and 67DFSR
BODY AND SPRING CASE	Aluminum (ASTM B85/Alloy 380)		CF8M/CF3M Stainless steel	
SPRING RETAINER	Aluminum	Zinc-plated steel	316L Stainless steel	
UPPER SPRING SEAT	Zinc-plated steel		316 Stainless steel	
DIAPHRAGM PLATE	Chromate conversion coated Aluminum			
CONTROL SPRING	Plated steel or Inconel® (NACE)		Inconel®	
VALVE STEM	Brass, Aluminum or Stainless steel		316L Stainless steel	
VALVE PLUG				
VALVE SPRING	Stainless steel or Inconel® (NACE)			
DIAPHRAGM AND O-RINGS	Nitrile (NBR), Fluorocarbon (FKM), Low Temp Nitrile (NBR) or Silicone (VMQ)(1)			
SOFT SEAT AND GASKETS	Nitrile (NBR) or Fluorocarbon (FKM)			
BOLTING AND ADJUSTING SCREW	Zinc-plated steel or Stainless steel			
HANDWHEEL	Zinc-plated steel		Zinc-plated steel or Stainless steel	
FILTER RETAINER	----	316 Stainless steel	----	316 Stainless steel
FILTER ELEMENT	----	Plastic, Glass fiber or Stainless steel	----	Plastic, Glass fiber or Stainless steel
DRAIN VALVE	----	Brass or 18-8 Stainless steel	----	316 Stainless steel or 18-8 Stainless steel
DRIPWELL	----	Aluminum (ASTM B85/Alloy 380)	----	CF8M/CF3M Stainless steel

1. Silicone (VMQ) diaphragm is only available with internal relief (Types 67DR, 67DSR, 67DFR and 67DFSR).

Table 3. Outlet Pressure Ranges and Control Spring Data

TYPE	OUTLET PRESSURE RANGE		MATERIAL	COLOR CODE	WIRE DIAMETER		FREE LENGTH	
	psig	bar			In.	mm	In.	mm
67D, 67DR, 67DF and 67DFR	0 to 20 0 to 35 0 to 60 0 to 125	0 to 1.4 0 to 2.4 0 to 4.1 0 to 8.6	Music Wire	Green stripe Silver Blue stripe Red stripe	0.135 0.156 0.170 0.207	3.43 3.96 4.32 5.26	1.43 1.43 1.43 1.43	36.2 36.2 36.2 36.2
	0 to 35 0 to 60 0 to 125	0 to 2.4 0 to 4.1 0 to 8.6	Inconel®	Silver stripe Blue Red	0.156 0.172 0.207	3.96 4.37 5.26	1.43 1.43 1.43	36.2 36.2 36.2
67DS, 67DSR, 67DFS and 67DFSR	0 to 20 0 to 35 0 to 60 0 to 125 0 to 150	0 to 1.4 0 to 2.4 0 to 4.1 0 to 8.6 0 to 10.3	Inconel®	Green Silver stripe Blue Red Black	0.135 0.156 0.172 0.207 0.250	3.43 3.96 4.37 5.26 6.35	1.50 1.43 1.43 1.43 1.77	38.1 36.2 36.2 36.2 44.9

Table 4. Temperature Capabilities

CONSTRUCTION	TEMPERATURE	
	°F	°C
With Nitrile (NBR) Standard Bolting Stainless Steel Bolting	 -20 to 180 -40 to 180	 -29 to 82 -40 to 82
With Fluorocarbon (FKM): Polyethylene Filter[1] **(standard)** Polyvinylidene (PVDF), Stainless Steel or Glass Filter (Optional)	 0 to 180 0 to 300	 -18 to 82 -18 to 149
With Silicone (VMQ)[2] Diaphragm, Low Temperature Nitrile (NBR) O-rings and Low Temperature Bolting	-60 to 180	-51 to 82
With Gauges	-40 to 180	-40 to 82
With Automatic Drain	40 to 175	4 to 79

1. Do not use in high aromatic hydrocarbon service.
2. Silicone (VMQ) is not compatible with hydrocarbon gas.

Air

Table 5. 67D Series Flow Capacities

OUTLET PRESSURE RANGE AND COLOR CODE	OUTLET PRESSURE		INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF AIR											
					Types 67D, 67DR, 67DS and 67DSR						Types 67DF, 67DFR, 67DFS and 67DFSR					
					5% Droop		10% Droop		20% Droop		5% Droop		10% Droop		20% Droop	
	psig	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
0 to 20 psig / 0 to 1.4 bar Green Stripe Green	5	0.34	25	1.7	320	8.6	530	14.2	950	25.5	320	8.6	400	10.7	600	16.1
			50	3.4	740	19.8	1100	29.5	2200	59.0	400	10.7	540	14.5	1100	29.5
			75	5.2	1000	26.8	2700	72.4	3200	85.8	460	12.3	850	22.8	2600	69.7
			100	6.9	750	20.1	3600	96.5	4100	110	590	15.8	2800	75.0	2900	77.7
			150	10.3	850	22.8	3200	85.8	6100	163	780	20.9	1700	45.6	3900	105
			200	13.8	240	6.4	810	21.7	6300	169	940	25.2	1700	45.6	2200	59.0
			250	17.2	290	7.8	460	12.3	6300	169	1000	26.8	1800	48.2	2200	59.0
			400[1]	27.6[1]	370	9.9	590	15.8	2700	72.4	----	----	----	----	----	----
	10	0.69	25	1.7	450	12.1	790	21.2	1100	29.5	390	10.5	570	15.3	830	22.2
			50	3.4	1100	29.5	1900	50.9	2700	72.4	600	16.1	750	20.1	1700	45.6
			75	5.2	2600	69.7	3200	85.8	3900	105	870	23.3	2100	56.3	3100	83.1
			100	6.9	3900	104	4400	118	5100	137	1100	29.5	3300	88.4	3900	105
			150	10.3	3400	91.1	6600	177	7400	198	2200	59.0	3200	85.8	4800	129
			200	13.8	1200	32.2	7800	209	7800	209	1900	50.9	2300	61.6	4900	131
			250	17.2	850	22.8	8000	214	8000	214	2000	53.6	2400	64.3	3300	88.4
			400[1]	27.6[1]	470	12.6	3400	91.1	4700	126	----	----	----	----	----	----
	20	1.4	50	3.4	1500	40.2	2100	56.3	2600	69.7	870	23.3	1500	40.2	2100	56.3
			75	5.2	2600	69.7	3500	93.8	3800	102	1600	42.9	2600	69.7	3400	91.1
			100	6.9	4500	121	4900	131	5100	137	3600	96.5	4300	115	4600	123
			150	10.3	6700	180	7200	193	7600	204	4000	107	6600	177	6600	177
			200	13.8	9000	241	9400	252	10,000	268	3300	88.4	4700	126	6900	185
			250	17.2	11,200	300	11,200	300	11,200	300	2900	77.7	5100	137	7100	190
			400[1]	27.6[1]	5500	147	6100	163	9100	244	----	----	----	----	----	----

1. Inlet pressures above 250 psig / 17.2 bar with a maximum of 400 psig / 27.6 bar are only available on unfiltered models (Types 67D, 67DR, 67DS and 67DSR).

- continued -

Air

Table 5. 67D Series Flow Capacities (continued)

OUTLET PRESSURE RANGE AND COLOR CODE	OUTLET PRESSURE		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR											
					Types 67D, 67DR, 67DS and 67DSR						Types 67DF, 67DFR, 67DFS and 67DFSR					
					5% Droop		10% Droop		20% Droop		5% Droop		10% Droop		20% Droop	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
0 to 35 psig / 1 to 2.4 bar Silver Silver Stripe	15	1.0	25	1.7	480	12.9	760	20.4	1000	26.8	360	9.7	520	14.0	800	21.4
			50	3.4	860	23.0	1500	40.2	2200	59.0	720	19.3	1300	34.8	2100	56.3
			75	5.2	1200	32.2	2700	72.4	3700	99.2	870	23.3	2100	56.3	3500	93.8
			100	6.9	2000	53.6	3900	104	4800	129	1100	29.5	3700	99.2	4400	118
			150	10.3	5000	134	5900	158	7200	193	3400	91.1	5700	153	6400	172
			200	13.8	1000	26.8	7600	204	8800	236	2600	69.7	4100	110	5900	158
			250	17.2	500	13.4	8900	239	9200	247	2700	72.4	3300	88.4	6000	161
			400[1]	27.6[1]	820	22.0	6400	172	7400	198	----	----	----	----	----	----
	20	1.4	25	1.7	370	9.9	570	15.3	810	21.7	420	11.3	570	15.3	940	25.2
			50	3.4	770	20.6	1200	32.2	1900	50.9	880	23.6	1500	40.2	2300	61.6
			75	5.2	1100	29.5	2600	69.7	3800	102	1100	29.5	2400	64.3	3900	105
			100	6.9	1800	48.2	4500	121	5200	139	1800	48.2	3800	102	4800	129
			150	10.3	6200	166	7000	188	7500	201	3900	104	6600	177	7000	188
			200	13.8	2900	77.7	7500	201	7800	209	5600	150	8700	233	8700	233
			250	17.2	4900	131	11,000	295	11,000	295	4400	118	8800	236	8800	236
			400[1]	27.6[1]	830	22.2	8300	222	8300	222	----	----	----	----	----	----
	35	2.4	50	3.4	1000	26.8	1700	45.6	2200	59.0	840	22.5	1300	34.8	2000	53.6
			75	5.2	2000	53.6	3200	85.8	3700	99.2	1500	40.2	2500	67.0	3300	88.4
			100	6.9	2900	77.7	4500	121	5100	137	2000	53.6	3900	104	4700	126
			150	10.3	6700	180	7100	190	7600	204	6300	169	6800	182	7000	188
			200	13.8	9000	241	9500	255	9900	265	8800	236	9000	241	9000	241
			250	17.2	11,100	297	11,900	319	12,500	335	6000	161	10,000	268	10,000	268
			400[1]	27.6[1]	7600	204	9300	249	12,800	343	----	----	----	----	----	----
0 to 60 psig / 0 to 4.1 bar Blue Stripe Blue	35	2.4	50	3.4	850	22.8	1400	37.5	2100	53.6	690	18.5	1100	29.5	1800	48.2
			75	5.2	1400	37.5	2500	67.0	3600	96.5	1000	26.8	1900	50.9	2900	77.7
			100	6.9	1900	50.9	4100	110	5100	137	1600	42.9	2700	72.4	4300	115
			150	10.3	6600	177	7100	190	7600	204	3100	83.1	5600	150	6600	177
			200	13.8	9200	247	9600	257	10,200	273	7200	193	8400	225	8900	239
			250	17.2	11,200	300	11,500	308	11,500	308	9500	255	9500	255	9500	255
			400[1]	27.6	1100	29.5	11,900	319	11,900	319	----	----	----	----	----	----
	60	4.1	75	5.2	1200	32.2	2200	59.0	3000	80.4	920	24.7	1600	42.9	2600	69.7
			100	6.9	2100	56.3	3600	96.5	4600	123	1500	40.2	2500	67.0	4000	107
			150	10.3	4300	115	6900	185	7600	204	2600	69.7	5200	139	6600	177
			200	13.8	9200	247	9700	260	10,200	273	4300	115	8300	222	8800	236
			250	17.2	11,900	319	12,400	332	12,800	343	9500	255	10,600	284	11,100	297
			400[1]	27.6[1]	4000	107	18,000	482	18,000	482	----	----	----	----	----	----
0 to 125 psig / 0 to 8.6 bar Red Stripe Red	60	4.1	75	5.2	690	18.5	1200	32.2	2000	53.6	670	18.0	1100	29.5	2000	53.6
			100	6.9	1000	26.8	1900	50.9	3000	80.4	1000	26.8	1800	48.2	2900	77.7
			135	9.3	1500	40.2	3000	80.4	4600	123	1300	34.8	2500	67.0	4300	115
			150	10.3	1700	45.6	3500	93.8	5300	142	1400	37.5	2800	75.0	5200	139
			200	13.8	2500	67.0	6000	161	7700	206	1800	48.2	4100	110	7600	204
			250	17.2	5600	150	8100	217	9300	249	2400	64.3	6600	177	10,200	273
			400[1]	27.6	3500	93.8	17,900	480	17,900	480	----	----	----	----	----	----
	80	5.5	100	6.9	1000	26.8	1700	45.6	2900	77.7	960	25.7	1700	45.6	3000	80.4
			135	9.3	1600	42.9	3000	80.4	4600	123	1500	40.2	2800	75.0	4600	123
			150	10.3	1900	50.9	3700	99.2	5400	145	1700	45.6	3100	83.1	5300	142
			200	13.8	2900	77.7	6000	161	7700	206	2200	59.0	4800	129	8000	214
			250	17.2	4200	113	10,200	273	12,200	327	2900	77.7	7100	190	10,600	284
			400[1]	27.6[1]	3700	99.2	19,900	533	10,400	279	----	----	----	----	----	----
	125	8.6	135	9.3	1500	40.2	2500	67.0	3500	93.8	1600	42.9	2700	72.4	4400	118
			150	10.3	2100	56.3	3200	85.8	4300	115	1800	48.2	3200	85.8	5200	139
			200	13.8	3800	102	5600	150	6700	180	2900	77.7	5200	139	8000	214
			250	17.2	5800	155	7800	209	9000	241	4100	110	7800	209	10,400	279
			400[1]	27.6[1]	6800	182	19,400	520	20,900	560	----	----	----	----	----	----
0 to 150 psig / 0 to 10.3 bar[2] Black	110	7.6	150	10.3	1900	50.9	3300	88.4	5500	147	2000	53.6	3400	91.1	5600	150
			200	13.8	2700	72.4	4800	129	8300	222	2600	69.7	4800	129	8000	214
			250	17.2	3400	91.1	6200	166	10,500	281	3400	91.1	6000	161	10,400	279
			400[1]	27.6[1]	4200	113	11,300	303	19,100	512	----	----	----	----	----	----
	135	9.3	150	10.3	1800	48.2	3300	88.4	5600	150	1800	48.2	3200	85.8	5500	147
			200	13.8	3000	80.4	5400	145	8300	222	2800	75.0	5100	137	8200	220
			250	17.2	3900	105	6700	180	10,700	287	3700	99.2	6600	177	11,000	295
			400[1]	27.6[1]	6400	172	13,300	356	19,300	517	----	----	----	----	----	----
	150	10.3	200	13.8	2900	77.7	5200	139	8300	222	2900	77.7	5200	139	8200	220
			250	17.2	4000	107	7400	198	11,000	295	4100	110	7300	196	11,000	295
			400[1]	27.6[1]	6400	172	13,900	373	19,700	528	----	----	----	----	----	----

1. Inlet pressures above 250 psig / 17.2 bar with a maximum of 400 psig / 27.6 bar are only available on unfiltered models (Types 67D, 67DR, 67DS and 67DSR).
2. Available for Types 67DS, 67DSR, 67DFS and 67DFSR only.

Type 75A

Pressure Reducing Regulator

FISHER

Introduction

The Type 75A is a direct-operated pressure reducing regulator designed for general purpose water applications. The Type 75A is a self-contained regulator, requiring no external control line for operation.

Body Size

NPS 1/2, 3/4, 1, and 1-1/2 / DN 15, 20, 25, and 40 with integral cast seats
NPS 2 and 2-1/2 / DN 50 and 65 with threaded-in seats

Maximum Inlet Pressure

200 psig / 13.8 bar

Outlet Pressure Range

20 to 80 psig / 1.4 to 5.5 bar

Maximum Allowable Outlet Pressure

10% above spring setting, or 5 psig / 0.34 bar above setting, whichever is greater

Minimum Operating Differential

5 psi / 0.34 bar

Maximum Operating Temperature

-20 to 150°F / -29 to 66°C

Construction Materials

Body: Bronze
Spring Case: Cast iron
Threaded-in Orifice (NPS 2 and 2-1/2 / DN 50 and 65) units only: Bronze
Valve Disk: Nitrile (NBR)
Valve Holder: Bronze
Diaphragm: Neoprene (CR)

Flow Coefficients

See Table 1

Ordering Guide

To order this product, contact your local Sales Office.

Figure 1. Type 75A Pressure Reducing Regulator

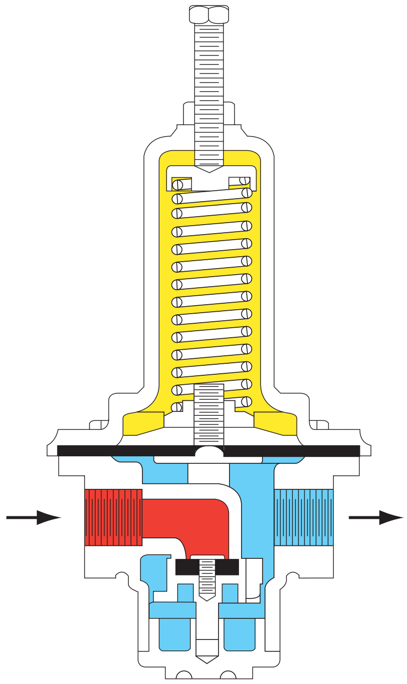


Figure 2. Type 75A Operational Schematic

Application

- Liquid

Features

- High Capacity
- Compact, Rugged Construction
- Easy In-Line Maintenance
- Corrosion Resistance

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Capacities in GPM / l/min of Water

BODY SIZE		DROOP								WIDE-OPEN C_V FOR RELIEF SIZING
		5 psig / 0.34 bar		7 psig / 0.48 bar(1)		10 psig / 0.69 bar		15 psig / 1.0 bar		
NPS	DN	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	
1/2	15	8	30.3	10	37.9	14	53.0	19	71.9	4.3
3/4	20	16	60.6	20	75.7	28	106	40	151	8.4
1	25	25	94.6	33	125	45	170	60	227	13.5
1-1/2	40	50	189	65	246	85	322	115	435	28.0
2	50	75	284	95	360	125	473	175	662	39.0
2-1/2	65	115	435	140	530	185	700	260	984	64.0

1. The 7 psig / 0.48 bar offset pressure and the related capacities are considered the upper limits of flows consistent with good piping practices and maximum fluid velocities of 10 feet per second / 3.05 m/s.

EMERSON

Type 92B

Pressure Reducing Regulator

Introduction

The Type 92B pilot-operated pressure reducing regulator is the standard steam valve for the industry. It can withstand dirty operating environments while providing accurate and stable pressure control. Type 92B steam valve is designed to provide decades of continuous service. Type 92B steam valve is applied as a main pressure reducing valve in industrial process heating applications such as heat exchangers, evaporators, digesters and reactors.

The Type 92B pilot is offered with low and high outlet pressure ranges from 2 to 150 psig / 0.14 to 10.3 bar g. A high temperature pilot construction is also offered for temperatures above 450°F / 232°C and/or set pressures above 150 psig / 10.3 bar.

Available Configurations

Type 92B with low, high pressure or high temperature pilots.

Body Sizes and End Connection Styles

See Table 1

Main Valve and Pilot Material

See Tables 2 and 3

Body Ratings and Maximum Inlet Pressures

See Table 5

Minimum Differential Pressures Required for Full Stroke

20 psig / 1.4 bar with Stainless steel spring; 10 psig / 0.69 bar with Inconel® spring

Maximum Outlet (Casing) Pressure

Cast iron: 150 psig / 10.3 bar or body rating limits, whichever is lower
Steel/Stainless steel: 300 psig / 20.7 bar or body rating limits, whichever is lower

Outlet Pressure Ranges

See Table 4

Flow Coefficients

See Table 6

Flow Capacities

See Table 7

Maximum Temperature Capabilities

See Table 5

Pressure Registration

External

Downstream Control Line Connections

NPS 1 and 1-1/2 / DN 25 and 40: 1/4 NPT
NPS 2 / DN 50: 3/8 NPT
NPS 3 and 4 / DN 80 and 100: 1/2 NPT

Options

- Type 6492HM Safety Override Pilot
- Welded Seat Ring for temperatures over 450°F / 232°C

Ordering Guide

To order this product, contact your local Sales Office.

Application

Steam

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Figure 1. Type 92B Pilot-Operated Regulator

Features

- Elevated Actuator Design
- Two-Ply Construction with Dual Flex Points for Extended Diaphragm Service Life
- Individually-Lapped Valve Seats for Tight Shutoff
- Double Post Stem Guide for Greater Stability
- Standard ANSI Face-to-Face Valve Body

Table 1. Body Sizes and End Connection Styles

BODY SIZES, NPS / DN	END CONNECTION STYLES	
	Cast Iron Body	Steel and Stainless Steel Body
1 / 25	NPT	NPT, SWE[1], CL150 RF, CL300 RF and PN 16/25/40 RF
1-1/2 and 2 / 40 and 50	NPT, CL125 FF and CL250 RF	
3 and 4 / 80 and 100	CL125 FF and CL250 RF	CL150 RF, CL300 RF, PN 16 RF and PN 25/40 RF

1. Available in steel bodies only.

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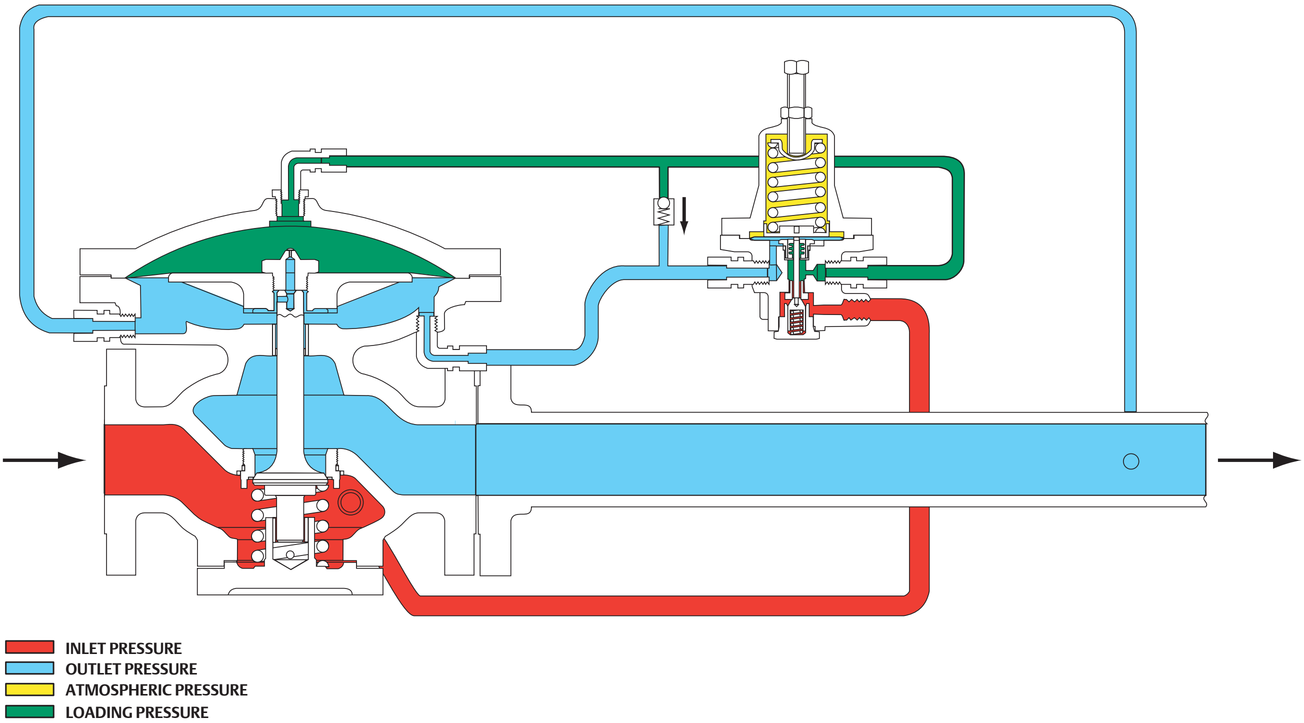

Figure 2. *Operational Schematic*

Table 2. Main Valve Construction Materials

BODY, SPRING CASE, DIAPHRAGM PLATE AND BOTTOM FLANGE	DIAPHRAGM	VALVE PLUG GUIDE BUSHING	TUBING AND FITTINGS	VALVE PLUG	SEAT RING	SPRING
Cast iron, WCC Steel or CF8M Stainless steel	Stainless steel	17-4PH Stainless steel	Copper tubing and Brass fittings for Cast iron construction; Stainless steel tubing for Steel and Stainless steel; Corrosion-resistant steel fittings for Steel; Stainless steel fittings for Stainless steel	410 or 416 Stainless steel	416 Stainless steel **(standard)** or 316 Stainless steel (seal weld option)	17-4PH Stainless steel **(standard)** or Inconel®

Table 3. Pilot Construction Materials

BODY AND SPRING CASE	DIAPHRAGM, VALVE GUIDE AND VALVE SPRING	VALVE STEM AND ORIFICE	BELLOWS AND BELLOWS RETAINER	STRAINER SCREEN
Cast iron, WCC Steel or CF8M Stainless steel	Stainless steel	416 Stainless steel	Bronze **(standard)** or 321 Stainless steel (high temperature/SST pilot construction)	304 Stainless steel

Table 4. Outlet Pressure Ranges

PILOT TYPE	OUTLET PRESSURE		SPRING WIRE DIAMETER		SPRING FREE LENGTH		COLOR CODE
	psig	bar	In.	mm	In.	mm	
Low-Pressure	2 to 6 5 to 15 13 to 25	0.14 to 0.41 0.34 to 1.0 0.90 to 1.7	0.207 0.234 0.283	5.26 5.94 7.19	2.50 2.62 2.44	63.5 66.5 62.0	Yellow Green Black
High-Pressure	15 to 30 25 to 75 70 to 150	1.0 to 2.1 1.7 to 5.2 4.8 to 10.3	0.207 0.234 0.281	5.26 5.94 7.14	2.50 2.62 2.44	63.5 66.5 62.0	Yellow Green Black
High Temperature	15 to 100 80 to 250	1.0 to 6.9 5.5 to 17.2	0.282 0.375	7.16 9.53	2.50 2.50	63.5 63.5	Unpainted Unpainted

Table 5. Maximum Inlet Pressures and Temperatures

BODY MATERIAL	END CONNECTION	MAXIMUM INLET PRESSURE		MAXIMUM TEMPERATURE	
		psig	bar	°F	°C
Cast iron	NPT	250	17.2	406	208
	CL125 FF	125	8.6	353	178
	CL250 RF	250	17.2	406	208
Steel	NPT	300	20.7	450	232
	SWE	300	20.7	450	232
	CL150 RF	185	12.8	450	232
	CL300 RF	300	20.7	600(1)	316(1)
	PN 16/25/40 RF (NPS 1, 1-1/2, 2 and 3 / DN 25, 40, 50 and 80)	300	20.7	600(1)	316(1)
	PN 16 RF (NPS 4 / DN 100)	185	12.8	450	232
	PN 25/40 RF (NPS 4 / DN 100)	300	20.7	600(1)	316(1)
Stainless steel	NPT	300	20.7	450	232
	CL150 RF	175	12.1	450	232
	CL300 RF	300	20.7	600(1)	316(1)
	PN 16/25/40 RF (NPS 1, 1-1/2, 2 and 3 / DN 25, 40, 50 and 80)	300	20.7	600(1)	316(1)
	PN 16 RF (NPS 4 / DN 100)	175	12.1	450	232
	PN 25/40 RF (NPS 4 / DN 100)	300	20.7	600(1)	316(1)

1. 450°F / 232°C with standard seat ring, 600°F / 316°C with seal weld option.

Table 6. Main Valve Coefficients

BODY SIZE		FLOW COEFFICIENTS						C_1	K_m	IEC SIZING COEFFICIENTS		
		Regulating Coefficients			Wide-Open Coefficients							
NPS	DN	C_g	C_s	C_v	C_g	C_s	C_v			F_L	X_T	F_D
1 1-1/2	25 40	330 560	16.5 28	9.4 16	480 921	24 46	13.7 26.3	35 35	0.80 0.80	0.89 0.89	0.78 0.78	0.24 0.25
2 3 4	50 80 100	960 2000 2700	48 100 135	27.4 57.1 77.1	1481 3042 4515	74 152 225	42.3 86.9 129	35 35 35	0.80 0.80 0.80	0.89 0.89 0.89	0.78 0.78 0.78	0.28 0.26 0.20

Table 7. Capacities(1)

INLET PRESSURE		OUTLET PRESSURE		CAPACITIES IN LB/h / KG/h OF SATURATED STEAM (BASED ON 10% DROOP)									
				Body Size									
psig	bar	psig	bar	NPS 1 / DN 25		NPS 1-1/2 / DN 40		NPS 2 / DN 50		NPS 3 / DN 80		NPS 4 / DN 100	
25	1.7	5	0.34	660	299	1060	481	2060	934	3800	1724	4940	2241
		10	0.69	600	272	1080	490	2080	943	3850	1746	5000	2268
		15	1.0	525	238	935	424	1860	844	3260	1479	4520	2050
50	3.4	5	0.34	1080	490	1830	830	3300	1497	6500	2948	8960	4064
		10	0.69	1080	490	1890	857	3390	1538	6650	3016	9110	4132
		20	1.4	1080	490	1860	844	3290	1492	6500	2948	8810	3996
		30	2.1	928	421	1760	798	2940	1334	5740	2604	7730	3506
		40	2.8	710	322	1660	753	2590	1175	4980	2259	6650	3016
75	5.2	5	0.34	1500	680	2510	1138	4610	2091	9080	4119	10,900	4944
		10	0.69	1500	680	2620	1188	4700	2132	9180	4164	11,200	5080
		20	1.4	1500	680	2720	1234	4770	2164	9290	4214	11,300	5126
		30	2.1	1470	667	2680	1216	4680	2123	8880	4028	10,800	4899
		40	2.8	1380	626	2640	1198	4590	2082	8470	3842	10,200	4627
		50	3.4	1240	562	2380	1080	4370	1982	7680	3484	9240	4191
		60	4.1	1020	463	2120	962	4160	1887	6900	3130	8280	3756
100	6.9	5	0.34	1900	862	3400	1542	5710	2590	11,500	5216	16,100	7303
		10	0.69	1920	871	3440	1560	5870	2663	11,700	5307	16,400	7439
		20	1.4	1920	871	3460	1569	5900	2676	11,800	5352	16,400	7439
		40	2.8	1920	871	3500	1588	5930	2690	11,800	5352	16,500	7484
		60	4.1	1700	771	3330	1510	5650	2563	11,000	4990	15,200	6895
		80	5.5	1330	603	2860	1297	4960	2250	9670	4386	13,000	5897
125	8.6	5	0.34	2310	1048	4140	1878	6950	3152	13,900	6305	19,600	8890
		10	0.69	2340	1061	4170	1892	7010	3180	14,100	6396	19,800	8981
		20	1.4	2340	1061	4230	1919	7080	3211	14,100	6396	19,800	8981
		40	2.8	2340	1061	4280	1941	7080	3211	14,200	6441	19,800	8981
		60	4.1	2340	1061	4400	1996	7250	3289	14,400	6532	19,800	8981
		80	5.5	2100	952	4100	1860	6750	3062	13,700	6214	18,500	8392
		100	6.9	1630	739	3250	1474	5400	2449	11,300	5126	15,600	7076
150	10.3	20	1.4	2770	1256	5000	2268	8220	3728	16,700	7575	23,600	10,705
		40	2.8	2770	1256	5070	2300	8260	3747	16,700	7575	23,700	10,750
		60	4.1	2770	1256	5110	2318	8300	3765	16,800	7620	23,800	10,796
		80	5.5	2770	1256	4980	2259	8130	3688	15,900	7212	23,500	10,660
		100	6.9	2360	1070	4600	2086	7740	3511	15,200	6895	21,700	9843
		120	8.3	1950	884	4090	1855	7070	3207	13,700	6214	18,600	8437
200	13.8	20	1.4	3610	1637	6480	2939	10,700	4854	21,900	9934	29,500	13,381
		40	2.8	3610	1637	6500	2948	10,800	4899	21,900	9934	31,000	14,062
		60	4.1	3610	1637	6520	2957	10,900	4944	22,000	9979	31,200	14,152
		80	5.5	3610	1637	6550	2971	11,000	4990	22,500	10,206	31,300	14,198
		100	6.9	3610	1637	6250	2835	10,700	4854	21,700	9843	30,700	13,926
		120	8.3	3280	1488	6300	2858	10,500	4763	20,700	9390	29,700	13,472
		150	10.3	2790	1266	6070	2753	10,200	4628	19,700	8936	28,300	12,837
250	17.2	20	1.4	4460	2023	7850	3561	13,000	5897	27,200	12,338	37,300	16,919
		40	2.8	4460	2023	7920	3592	13,200	5988	27,300	12,383	37,800	17,146
		60	4.1	4460	2023	8100	3674	13,300	6033	27,300	12,383	38,500	17,464
		80	5.5	4460	2023	8130	3688	13,400	6078	27,400	12,429	38,700	17,554
		100	6.9	4460	2023	8150	3697	13,400	6078	27,500	12,474	38,800	17,600
		120	8.3	4160	1887	7860	3565	12,700	5761	26,300	11,930	37,000	16,783
		150	10.3	4050	1837	6780	3075	11,500	5216	23,000	10,433	31,000	14,062
300	21.0	20	1.4	5190	2354	8810	3996	15,100	6849	31,400	14,243	42,400	19,234
		40	2.8	5190	2354	8810	3996	15,100	6849	31,400	14,243	42,400	19,234
		60	4.1	5180	2350	8790	3987	15,000	6804	31,400	14,243	42,300	19,187
		80	5.5	5150	2336	8740	3964	14,900	6759	31,200	14,152	42,100	19,096
		100	6.9	5110	2318	8670	3933	14,800	6713	30,900	14,016	41,800	18,960
		120	8.3	5040	2286	8550	3878	14,600	6623	30,500	13,835	41,200	18,688
		150	10.3	4900	2223	8310	3769	14,200	6441	29,700	13,472	40,000	18,144
		175	12.1	4730	2146	8030	3642	13,700	6214	28,600	12,973	38,700	17,554
		200	13.8	4510	2046	7650	3470	13,100	5942	27,300	12,383	36,800	16,692
		250	17.2	3830	1737	6510	2953	11,100	5035	23,200	10,524	31,400	14,243

1. Printed capacities are for the Type 92B with electropneumatic loading system.

Type 92C

Pressure Reducing Regulator

Introduction

The Type 92C regulator is an economical cast iron, steel or stainless steel pressure reducing regulator used in steam, liquid or hot air service. This regulator is available with a Type 6392 pilot for use as a pilot-operated regulator or without a pilot for use as a pressure-loaded regulator. The pilot-operated version uses inlet pressure as the operating medium; no separate air supply is required. The pressure-loaded version is used where remote adjustment of the regulator pressure setting is required; a Type 67, Type 1301F regulator or a Type 670 panel loader can be used as the loading regulator.

Body Sizes and End Connection Styles

See Table 1

Construction Material

See Table 2

Maximum Allowable Inlet and Pilot Supply Pressures

Cast Iron: 250 psig / 17.2 bar
Steel and Stainless steel: 300 psig / 20.7 bar

Regulator Pressure Drops

Minimum: 15 psi /1.0 bar
Maximum Operating: Do not exceed the pressure drops in the capacity tables
Maximum Emergency
Cast Iron: 250 psi / 17.2 bar
Steel and Stainless steel: 300 psi / 20.7 bar

Outlet Pressure Range

See Table 3

Maximum Outlet Pressures

Maximum Operating Outlet Pressure:
150 psig / 10.3 bar
Maximum Emergency Outlet (Casing) Pressure:
Cast Iron: 250 psig / 17.2 bar
Steel and Stainless steel: 300 psi / 20.7 bar

Orifice Sizes

1/2 In. / DN 15 Main Valve:
9/16 in. / 14 mm
3/4 and 1 In. / DN 20 and 25 Main Valves: 3/4 in. / 19 mm is standard; 9/16 in. / 14 mm is optional

Flow and Sizing Coefficients

See Tables 4 and 5

Flow Capacity

See Tables 8 and 9

Proportional Band

10%

Maximum Material Temperature Capabilities

Metal Diaphragm and Seat
Cast Iron: -40 to 406°F / -40 to 208°C
Steel: -20 to 500°F / -29 to 260°C
Ethylenepropylene (EPDM) Seat: -40 to 275°F / -40 to 135°C
Optional High-Temperature Steel or Stainless Steel Body: 650°F / 343°C

Pressure Registration

With Pilot: External
Without Pilot: Internal

Downstream Control Line Connection

1/4 NPT (internal) in pilot body (downstream control line not required for pressure-loaded regulator)

Loading Pressure Connection

1/4 NPT (internal) in main valve diaphragm flange (this connection is factory-piped to the pilot on pilot-operated regulator)

Pilot Spring Case Vent

3/32 in. / 2.4 mm drilled hole

Approximate Weights

With Pilot: 20 lbs. / 9 kg
Without Pilot: 16 lbs. / 7 kg

Ordering Guide

To order this product, contact your local Sales Office.

Features

- Soft Seats Available for Tight Shutoff
- Outlet Equals Inlet Pressure Ratings
- Ease of Installation
- In-Line Maintenance

Applications

- Liquid
- Steam

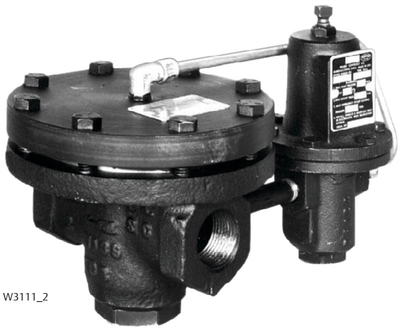

Figure 1. *Type 92C Self-Powered Control Valve with Type 6392 Pilot*

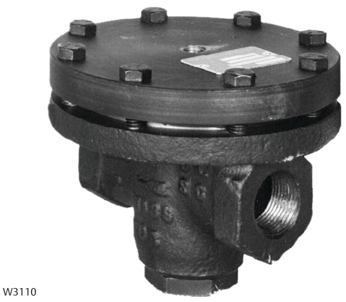

Figure 2. *Type 92C Pressure-Loaded Control Valve*

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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www.Emerson.com

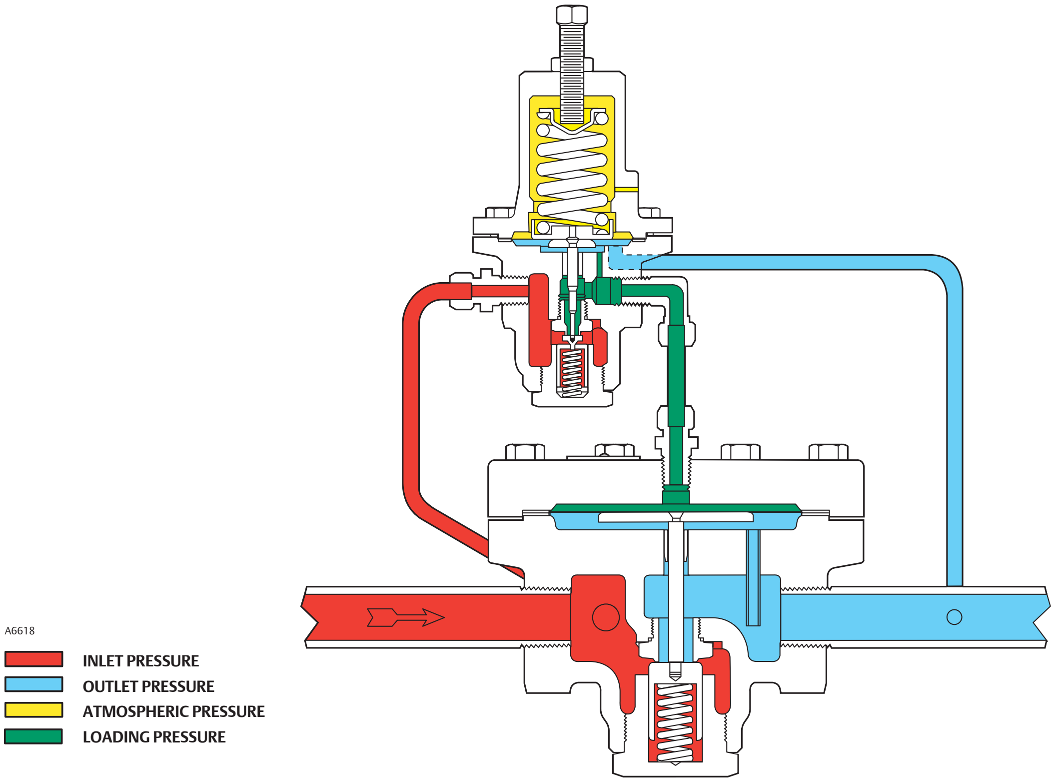

Figure 3. *Type 92C with Type 6392 Pilot Operational Schematic*

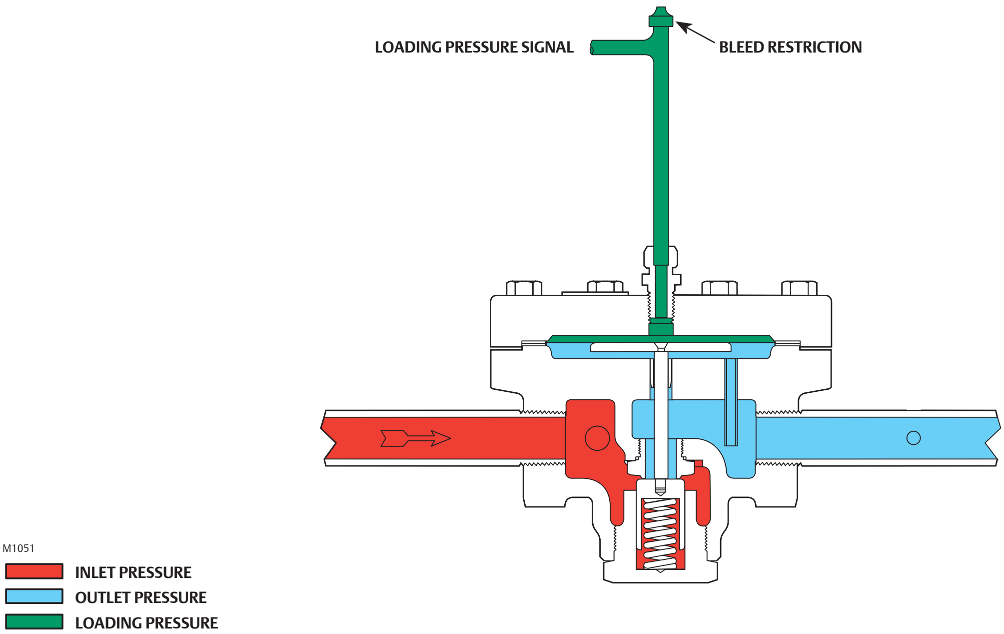

Figure 4. *Type 92C Pressure-Loaded Operational Schematic*

Table 1. Body Sizes and End Connection Styles

BODY SIZE		END CONNECTION STYLE	
IN	DN	Cast Iron Body	Steel or Stainless Steel Body
1/2, 3/4 or 1	15, 20 or 25	NPT	NPT, CL150 RF, CL300 RF or PN 16/25/40

Table 2. Construction Materials

BODY, SPRING CASE AND DIAPHRAGM FLANGE	GASKETS	VALVE PLUG OR DISK HOLDER	ORIFICE	VALVE DISK (WHEN APPLICABLE)	TUBING AND FITTINGS
Cast Iron, WCC Steel, or CF8M Stainless Steel	Composition or Graphite	416 Stainless steel	416 Stainless steel	Ethylenepropylene (EPDM)	Copper tubing and Brass fittings or Stainless steel tubing and fittings

Table 3. Outlet Pressure Ranges

SPRING USAGE	OUTLET PRESSURE RANGE		SPRING COLOR	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	psig	bar		In.	mm	In.	mm
Standard use up to 500°F / 260°C	5 to 70	0.34 to 4.8	Green	0.170	4.3	2.00	50.8
	20 to 150	1.4 to 10.3	Red	0.207	5.3	1.94	49.3
High-Pressure and/or High Temperature over 500°F / 260°C	15 to 100	1.0 to 6.9	Unpainted	0.192	4.9	1.96	49.8
	80 to 250	5.5 to 17.2	Unpainted	0.282	7.2		

Table 4. Flow Coefficients[1]

ORIFICE SIZE		WIDE-OPEN FOR RELIEF SIZING			C_1	K_m
In.	mm	C_g	C_s	C_v		
9/16	14	170	8.5	5	34	0.67
3/4	19	240	12	7.1		

1. $C_v = C_s \times 20 \div C_1$

Table 5. IEC Sizing Coefficients

BODY SIZE		ORIFICE SIZE					
		9/16 in. / 14 mm			3/4 in. / 19 mm		
In.	DN	X_T	F_D	F_L	X_T	F_D	F_L
1/2	15	0.73	0.38	0.82	- - - -		
3/4 or 1	20 or 25		0.44		0.73	0.38	0.82

Table 6. Type 6492 Safety Override Pilot Spring Ranges and Minimum Differential Pressures

TYPE	SPRING RANGES		SPRING COLOR	MINIMUM PRESSURE AT WHICH MONITORING PILOT CAN BE SET
	psig	bar		
6492HM	10 to 30	0.69 to 2.1	Yellow	5 psig / 0.34 bar over normal distribution pressure
	25 to 75	1.7 to 5.2	Green	10 psig / 0.69 bar over normal distribution pressure
	70 to 150	4.8 to 10.3	Red	
6492HTM	80 to 250	5.5 to 17.2	Unpainted	- - - -
	15 to 100	1.0 to 6.9		

Table 7. Capacity Factors for Pressure-Loaded Type 92C Regulators with 3 to 5 psi / 0.21 to 0.35 bar Droop

BODY SIZE		ORIFICE SIZE		CAPACITY FACTOR FOR PRESSURE-LOADED REGULATORS
IN.	DN	In.	mm	
1/2	15	9/16	14	0.50
3/4	20	9/16	14	0.65
		3/4	19	0.60
1	25	9/16	14	0.80
		3/4	19	0.75

FISHER

Steam

Table 8. Saturated Steam Flow Capacities for Pilot-Operated Type 92C Regulator[1] (Based on 10% Proportional Band)

OUTLET PRESSURE SETTING		INLET PRESSURE		NPS 1/2 / DN 15 BODY		NPS 3/4 / DN 20 BODY				NPS 1 / DN 25 BODY			
				9/16 In. /14 mm Orifice Size		3/4 In. / 19 mm Standard Orifice Size		9/16 In. / 14 mm Optional Orifice Size		3/4 In. / 19 mm Standard Orifice Size		9/16 In. / 14 mm Optional Orifice Size	
psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
5[2]	0.34[2]	20	1.4	170	77.1	230	104	180	81.7	300	136	200	90.7
		25	1.7	200	90.7	280	127	210	95.3	380	172	230	104
		30	2.1	240	109	340	154	270	122	410	186	280	127
		50	3.4	250	113	440	200	310	141	680	308	410	186
		75	5.2	370	168	590	268	450	204	880	399	500	227
		100	6.9	370	168	710	322	500	227	980	445	600	272
		150	10.3	400	181	740	336	560	254	1000	454	660	299
10[2]	0.69[2]	25	1.7	210	95.3	300	136	220	99.8	360	163	250	113
		30	2.1	240	109	390	177	280	127	430	195	300	136
		50	3.4	360	163	600	272	410	186	680	308	450	204
		75	5.2	400	181	680	308	500	227	900	408	580	263
		100	6.9	550	249	830	376	680	308	1100	499	770	349
		150	10.3	600	272	880	399	710	322	1150	522	800	363
15[2]	1.0[2]	30	2.1	220	99.8	350	159	260	118	410	186	280	127
		50	3.4	380	172	610	277	430	195	720	327	480	218
		75	5.2	480	218	800	363	570	259	930	422	620	281
		100	6.9	620	281	960	435	750	340	1250	567	830	376
		150	10.3	650	295	1100	499	780	354	1300	590	880	399
20[2]	1.4[2]	35	2.4	240	109	370	168	270	122	420	191	290	132
		50	3.4	380	172	630	286	430	195	720	327	480	218
		75	5.2	550	249	870	395	630	286	950	431	670	304
		100	6.9	700	318	1150	522	800	363	1300	590	900	408
		150	10.3	800	363	1200	544	900	408	1400	635	1000	454
		200	13.8	1000	454	- - - -	- - - -	1150	522	- - - -	- - - -	1300	590
30[2]	2.1[2]	50	3.4	330	150	550	249	400	181	570	259	450	204
		75	5.2	550	249	880	399	630	286	950	431	670	304
		100	6.9	700	318	1150	522	800	363	1300	590	900	408
		150	10.3	950	431	1400	635	1100	499	1600	726	1200	544
		200	13.8	1000	454	- - - -	- - - -	1200	544	- - - -	- - - -	1400	635
40[2]	2.8[2]	55	3.8	330	150	560	254	400	181	580	263	430	195
		60	4.1	390	177	610	277	450	204	670	304	480	218
		75	5.2	480	218	870	395	600	272	930	422	660	299
		100	6.9	700	318	1150	522	800	363	1300	590	900	408
		150	10.3	1000	454	1400	635	1150	522	1700	771	1250	567
		200	13.8	1100	499	- - - -	- - - -	1300	590	- - - -	- - - -	1500	680
		250	17.2	1300	590	- - - -	- - - -	1550	703	- - - -	- - - -	1700	771
50	3.4	65	4.5	370	168	600	272	440	200	650	295	470	213
		75	5.2	480	218	740	336	550	249	820	372	600	272
		100	6.9	700	318	1100	499	800	363	1250	567	850	386
		150	10.3	1000	454	1500	680	1200	544	1900	862	1300	590
		200	13.8	1200	544	1800	816	1350	612	2300	1043	1600	726
		250[3]	17.2[3]	1400	635	- - - -	- - - -	1700	771	- - - -	- - - -	1850	839
60	4.1	75	5.2	360	163	630	286	400	181	740	336	450	204
		80	5.5	430	195	700	318	500	227	850	386	550	249
		100	6.9	640	290	1000	454	700	318	1200	544	800	363
		150	10.3	1000	454	1500	680	1200	544	1900	862	1300	590
		200	13.8	1200	544	2000	907	1500	680	2600	1179	1700	771
		250[3]	17.2[3]	1500	680	- - - -	- - - -	1800	816	- - - -	- - - -	2000	907
80	5.5	100	6.9	500	227	900	408	620	281	950	431	730	331
		150	10.3	1000	454	1500	680	1200	544	1800	816	1200	544
		200	13.8	1300	590	2000	907	1500	680	2500	1134	1700	771
		250	17.2	1500	680	- - - -	- - - -	1800	816	- - - -	- - - -	2000	907
100	6.9	125	8.6	600	272	1000	454	750	340	1100	499	850	386
		150	10.3	850	386	1500	680	1000	454	1600	726	1200	544
		200	13.8	1300	590	2200	998	1600	726	2400	1089	1700	771
		250	17.2	1600	726	2400	1089	2000	907	3000	1361	2100	953
		300	20.7	2000	907	- - - -	- - - -	2400	1089	- - - -	- - - -	2500	1134
125	8.6	150	10.3	700	318	1000	454	800	363	1200	544	850	386
		200	13.8	1200	544	2100	953	1400	635	2200	998	1500	680
		250	17.2	1600	726	2400	1089	2000	907	3000	1361	2100	953
		300	20.7	2000	907	3000	1361	2400	1089	3600	1633	2500	1134
150	10.3	175	12.1	800	363	1100	499	900	408	1400	635	950	431
		200	13.8	1000	454	2000	907	1100	499	2000	907	1300	590
		250	17.2	1500	680	2300	1043	1800	816	2800	1270	1900	862
		300	20.7	2000	907	3000	1361	2400	1089	3600	1633	2500	1134

1. To determine capacities for pressure-loaded Type 92C regulators, multiply the printed value by the appropriate value shown in Table 7.
2. Capacities for outlet pressure settings lower than 50 psig / 3.4 bar are based on a 2 to 1 ratio of outlet pipe size to main valve body size.
3. 20 to 150 psig / 1.4 to 10.3 bar pilot control spring only (red spring).

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Table 9. Water Flow Capacities and Regulating C_v Values for Type 92C Regulator(1) (Based on 10% Proportional Band)

OUTLET PRESSURE SETTING		INLET PRESSURE		NPS 1/2 / DN 15 BODY			NPS 3/4 / DN 20 BODY						NPS 1 / DN 25 BODY					
				9/16 In. / 14 mm Orifice Size			3/4 In. / 19 mm Standard Orifice Size			9/16 In. / 14 mm Optional Orifice Size			3/4 In. / 19 mm Standard Orifice Size			9/16 In. / 14 mm Optional Orifice Size		
psig	bar	psig	bar	GPM	m^3/h	C_v	GPM	m^3/h	C_v	GPM	m^3/h	C_v	GPM	m^3/h	C_v	GPM	m^3/h	C_v
5(2)	0.34(2)	20	1.4	12	2.73	3.13	17	3.86	4.23	13	2.95	3.31	22	5.00	5.62	14	3.18	3.68
		25	1.7	14	3.18	3.11	20	4.54	4.36	15	3.40	3.27	27	6.13	5.91	16	3.63	3.58
		30	2.1	16	3.63	3.26	23	5.22	4.61	19	4.32	3.66	28	6.36	5.56	19	4.32	3.80
		50	3.4	15	3.41	2.28	27	6.13	4.02	19	4.32	2.83	42	9.54	6.21	25	5.68	3.75
		75	5.2	20	4.54	2.43	32	7.27	3.87	25	5.68	2.95	48	10.90	5.77	28	6.36	3.28
		100	6.9	19	4.32	1.90	36	8.18	3.64	25	5.68	2.56	49	11.14	5.03	30	6.81	3.08
		150	10.3	17	3.86	1.43	32	7.27	2.64	24	5.45	2.00	43	9.77	3.57	28	6.36	2.36
10(2)	0.69(2)	25	1.7	14	3.18	3.47	20	4.54	4.95	15	3.40	3.63	24	5.45	5.94	17	3.86	4.13
		30	2.1	16	3.63	3.39	25	5.68	5.50	18	4.10	3.95	28	6.36	6.07	19	4.32	4.23
		50	3.4	21	4.77	3.32	35	7.95	5.54	24	5.45	3.79	40	9.10	6.28	27	6.13	4.15
		75	5.2	21	4.77	2.63	36	8.18	4.47	27	6.13	3.29	48	11.00	5.91	31	7.04	3.81
		100	6.9	27	6.13	2.82	41	9.31	4.26	33	7.50	3.49	54	12.27	5.64	38	8.63	3.95
		150	10.3	25	5.68	2.14	37	8.40	3.14	30	6.81	2.54	49	11.14	4.11	34	7.72	2.86
15(2)	1.0(2)	30	2.1	13	2.95	3.31	21	4.77	5.26	16	3.63	3.91	25	5.68	6.17	17	3.86	4.21
		50	3.4	22	5.00	3.57	35	7.95	5.73	24	5.45	4.04	41	9.31	6.76	27	6.13	4.51
		75	5.2	25	5.68	3.17	41	9.31	5.28	30	6.81	3.76	48	10.91	6.14	32	7.27	4.09
		100	6.9	30	6.81	3.18	46	10.50	4.93	36	8.18	3.85	60	13.64	6.42	40	9.10	4.26
		150	10.3	27	6.13	2.32	46	10.50	3.93	33	7.50	2.79	54	12.27	4.64	37	8.40	3.14
20(2)	1.4(2)	35	2.4	14	3.18	3.32	21	4.77	5.12	15	3.41	3.74	24	5.45	5.81	17	3.86	4.01
		50	3.4	21	4.77	3.66	34	7.72	6.07	23	5.22	4.14	39	8.86	6.94	26	5.91	4.62
		75	5.2	28	6.36	3.66	44	10.00	5.79	32	7.27	4.19	48	10.91	6.32	34	7.72	4.46
		100	6.9	33	7.50	3.60	54	12.27	5.92	37	8.40	4.12	61	13.87	6.69	42	9.54	4.63
		150	10.3	33	7.50	2.86	49	11.14	4.29	37	8.40	3.21	57	12.96	5.00	41	9.31	3.57
		200	13.8	37	8.40	2.74	----	----	----	43	9.77	3.15	----	----	----	48	10.91	3.56
30(2)	2.1(2)	50	3.4	17	3.86	3.47	28	6.36	5.78	20	4.54	4.20	29	6.59	5.99	23	5.22	4.73
		75	5.2	26	6.00	3.78	42	9.54	6.02	30	6.81	4.31	45	10.23	6.50	32	7.27	4.58
		100	6.9	31	7.04	3.66	51	11.59	5.99	36	8.18	4.16	58	13.18	6.77	40	9.09	4.68
		150	10.3	38	8.63	3.40	56	12.73	5.01	44	10.00	3.93	63	14.32	5.72	48	10.91	4.29
		200	13.8	36	8.18	2.74	----	----	----	43	9.77	3.29	----	----	----	50	11.36	3.84
40(2)	2.8(2)	55	3.8	15	3.41	3.51	26	5.91	5.96	19	4.32	4.26	27	6.13	6.17	20	4.54	4.58
		60	4.1	18	4.09	3.66	28	6.36	6.73	21	4.77	4.23	31	7.04	6.29	22	5.00	4.51
		75	5.2	21	4.77	3.44	39	8.86	6.23	27	6.13	4.30	42	9.54	6.66	30	6.81	4.73
		100	6.9	30	6.81	3.72	49	11.14	6.10	34	7.72	4.25	55	12.50	6.90	38	8.63	4.78
		150	10.3	38	8.63	3.59	54	12.27	5.03	44	10.00	4.13	65	14.77	6.11	48	10.91	4.49
		200	13.8	39	8.86	3.02	----	----	----	46	10.46	3.58	----	----	----	53	12.05	4.11
		250	17.2	42	9.54	2.89	----	----	----	50	11.36	3.44	----	----	----	55	12.50	3.78
50	3.4	65	4.5	16	3.63	3.55	26	5.91	5.75	19	4.32	4.22	28	6.36	6.23	20	4.54	4.51
		75	5.2	20	4.54	3.71	31	7.04	5.71	23	5.22	4.25	35	7.95	6.33	25	5.68	4.63
		100	6.9	28	6.36	3.83	45	10.23	6.02	32	7.27	4.38	51	11.59	6.84	34	7.72	4.65
		150	10.3	37	8.40	3.62	56	12.73	5.44	45	10.23	4.35	71	16.14	6.89	48	10.91	4.71
		200	13.8	41	9.31	3.30	62	14.09	4.95	46	10.46	3.71	79	17.96	6.32	55	12.50	4.40
		250(3)	17.2(3)	45	10.23	3.11	----	----	----	54	12.27	3.78	----	----	----	59	13.41	4.11
60	4.1	75	5.2	14	3.18	3.15	25	5.68	5.51	16	3.63	3.50	30	6.81	6.47	18	4.10	3.93
		80	5.5	17	3.86	3.36	28	6.36	5.47	20	4.54	3.91	34	7.72	6.64	22	5.00	4.30
		100	6.9	25	5.68	3.66	39	8.86	5.72	27	6.13	4.01	47	10.68	6.87	31	7.04	4.58
		150	10.3	36	8.18	3.67	54	12.27	5.50	43	9.77	4.40	68	15.46	6.97	47	10.68	4.77
		200	13.8	40	9.09	3.31	67	15.23	5.52	50	11.36	4.14	87	19.78	7.18	57	12.96	4.69
		250(3)	17.2(3)	47	10.68	3.34	----	----	----	56	12.73	4.01	----	----	----	62	14.09	4.45
80	5.5	100	6.9	18	4.09	3.36	32	7.27	6.06	22	5.00	4.17	36	8.18	6.39	26	6.00	4.91
		150	10.3	34	7.72	3.82	51	11.59	5.73	41	9.31	4.59	61	13.86	6.88	41	9.31	4.59
		200	13.8	41	9.31	3.65	63	14.32	5.61	48	10.91	4.21	79	17.96	7.01	54	12.27	4.77
		250	17.2	45	10.23	3.36	----	----	----	54	12.27	4.04	----	----	----	60	13.64	4.48
100	6.9	125	8.6	19	4.32	3.28	32	7.27	5.47	24	5.45	4.10	38	8.64	6.02	28	6.36	4.65
		150	10.3	27	6.13	3.48	48	10.91	6.15	32	7.27	4.10	51	11.59	6.56	38	8.63	4.92
		200	13.8	39	8.86	3.75	67	15.23	6.34	48	10.91	4.61	73	16.59	6.92	51	11.59	4.90
		250	17.2	46	10.46	3.63	69	15.68	5.45	57	12.96	4.54	86	19.55	6.81	60	13.64	4.77
		300	20.7	55	12.50	3.77	----	----	----	66	15.00	4.53	----	----	----	68	15.46	4.72
125	8.6	150	10.3	21	4.77	3.37	29	6.59	4.81	24	5.45	3.85	35	7.95	5.77	25	5.68	4.09
		200	13.8	34	7.72	3.65	60	13.64	6.39	40	9.10	4.26	63	14.32	6.70	43	9.77	4.57
		250	17.2	44	10.00	3.73	66	15.00	5.59	55	12.50	4.66	82	18.64	6.99	57	12.96	4.90
		300	20.7	52	11.82	3.83	79	17.96	5.74	63	14.32	4.59	94	21.37	6.89	66	15.00	4.79
150	10.3	175	12.1	22	5.00	3.44	30	6.81	4.73	24	5.45	3.87	38	8.63	6.02	26	6.00	4.08
		200	13.8	27	6.13	3.33	54	12.27	6.67	30	6.81	3.67	54	12.27	6.67	35	7.95	4.33
		250	17.2	39	8.86	3.64	60	13.64	5.58	47	10.68	4.37	73	16.59	6.80	49	11.14	4.61
		300	20.7	50	11.36	3.91	75	17.05	5.87	60	13.64	4.70	91	20.68	7.05	63	14.32	4.89

1. To determine capacities for pressure-loaded Type 92C regulators, multiply the printed value by the appropriate value shown Table 7.
2. Capacities for outlet pressure settings lower than 50 psig / 3.4 bar are based on a 2 to 1 ratio of outlet pipe size to main valve body size.
3. 20 to 150 psig / 1.4 to 10.3 bar pilot control spring only (red spring).

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Introduction

The Type 92S steam regulator is a pilot-operating pressure reducing device designed for high cycle steam service. The Type 92S is piston actuated and includes a pilot with bellows sealed stems for longer service life. This is the ideal regulator for high cycle steam service for use with only clear, dry or superheated steam. The Type 92S main valve and pilot use lapped seating surfaces that have been proven to minimize seat leakage. The Type 92S also offers a Noise Attenuation Trim option for the reduction of noise from high velocity steam flow.

The pilot Types 6492L (low pressure), 6492H (high pressure) or 6492HT (high temperature) are included in the product offering and depend on the application. The pilots are all metal internal parts with bellow sealed stem to eliminate stem guide friction in steam service.

Main Valve Body Sizes and End Connection Styles

See Table 1

Maximum Inlet and Pilot Supply Pressure

Cast Iron Main Valve and Pilot:
250 psig / 17.2 bar[1]
Steel Main Valve and Pilot:
300 psig / 20.7 bar[1]

Outlet (Control) Pressure Ranges

See Table 2

Construction Materials

See Tables 3 and 4

Minimum and Maximum Differential Pressures

See Table 5

Maximum Inlet and Outlet Pressures

See Table 6

Maximum Allowable Loading Pressure for Pilot with Tapped Spring Case

Combination of pilot control spring setting and spring case loading pressure cannot exceed
Type 6492H Pilot: 150 psig / 10.3 bar
Type 6492L Pilot: 25 psig / 1.7 bar
Type 6492HT: 250 psig / 17.2 bar

Main Valve Orifice Sizes, Flow and Sizing Coefficients

See Table 7

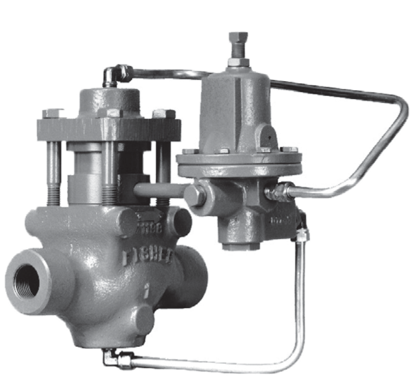

Figure 1. 1 NPT Steel Main Valve with Type 6492H or 6492HT Pilot

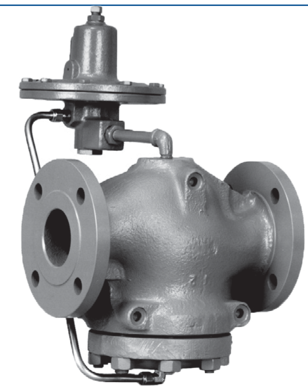

Figure 2. NPS 3 / DN 80 Flanged Cast Iron Main Valve with Type 6492L Pilot

Typical Regulating Capacities

See Table 9 and Figure 4

Noise Level Data

See Table 10

Maximum Temperature Capabilities

Cast Iron Main Valve and Pilot: 406°F / 208°C
Steel/Stainless Steel Main Valve and Pilot: 500°F / 260°C
High Temperature Optional Steel and Stainless steel Main Valve and Pilot: 650°F / 343°C

Downstream Control Line Connection

NPS 1, 1-1/2 and 2 / DN 25, 40 and 50 Main Valve Sizes:
1/4 NPT in main valve cylinder spacer
NPS 2-1/2, 3, 4 and 6 x 4 / DN 65, 80, 100 and 150 x 100 Main Valve Sizes:
1/4 NPT in pilot body

Pilot Spring Case Vent

Standard: 1/8 in. / 3.18 mm drilled hole
Optional: 1/4 NPT tapping for pressure loading or on-off service

Pressure Registration

External through downstream control line

Approximate Weights

See Table 8

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Steam

Features

- Reliable and Dependable in High Cycle Steam Service with Time-Proven Piston Actuation Design
- Machine-Lapped Seating Surfaces for Good Shutoff at Low Downstream Pressure Build-up
- Ease of Installation
- Ease of Pilot Maintenance
- Increased Sensitivity to Downstream Pressure Changes
- Noise Attenuation Trim Without Decrease in Capacity

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
www.Emerson.com
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Table 1. Main Valve Body Sizes and End Connection Styles

BODY SIZES	END CONNECTION STYLES AND RATINGS	
	Cast Iron Body	Steel or Stainless Steel Body
NPS 1, 1-1/2 and 2	NPT	NPT or PN 16/25/40
NPS 1, 1-1/2, 2, 2-1/2, 3 and 4 / DN 25, 40, 50, 65, 80 and 100	CL125 FF or CL250 RF	CL150 RF, CL300 RF, CL600 RF or PN 16/25/40
NPS 6 x 4 / DN 150 x 100	Not available	CL300 RF, CL600 RF or PN 16/25-40/64/100

1. If body rating limit is lower then use body rating limit as Maximum Inlet and Pilot Supply Pressure.

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Table 3. Main Valve Construction Materials

BODY AND BODY FLANGE	VALVE PLUG	CAGE	PISTONS, SEAT RING AND CYLINDERS	PISTON RING	TUBING AND FITTINGS	NOISE ATTENUATION TRIM
Cast iron, WCC Steel or CF8M Stainless steel	Heat-treated 17-4 PH Stainless steel	Cast Iron (Cast Iron and Steel bodies) or Stainless Steel (Stainless Steel body)	Heat-treated 416 Stainless steel	Polytetrafluoroethylene (PTFE)	Copper tubing with brass fittings or Stainless steel tubing and fittings	Stainless steel

Table 4. Pilot Construction Materials

BODY AND SPRING CASE	SEAT RING AND STEM	BELLOWS AND BELLOWS RETAINER	PLUG, PLUG GUIDE AND PLUG SPRING	DIAPHRAGMS	INLET STRAINER SCREEN
Cast iron, WCC Steel or CF8M Stainless Steel	Heat-treated 416 Stainless steel	Brass (Cast Iron or Steel Bodies) or Stainless Steel (Stainless Steel Body)	Stainless steel	Stainless steel	Stainless steel

Table 5. Minimum and Maximum Differential Pressures

BODY SIZES	MINIMUM DIFFERENTIAL PRESSURE	MAXIMUM DIFFERENTIAL PRESSURE
NPS 1, 1-1/2 and 2 / DN 25, 40 and 50	15 psi / 1.0 bar	200 psi / 13.8 bar or body rating limit, whichever is lower
NPS 2-1/2, 3, 4 and 6 x 4 / DN 65, 80,100 and 150 x 100	20 psi / 1.4 bar	175 psi / 12.1 bar or body rating limit, whichever is lower

Table 6. Maximum Inlet and Outlet Pressures

CONSTRUCTION	MAXIMUM ALLOWABLE INLET PRESSURE				MAXIMUM OPERATING OUTLET PRESSURE		MAXIMUM EMERGENCY OUTLET PRESSURE	
	Cast Iron		Steel and Stainless Steel				Cast Iron Main Valve and Pilot Body	Steel or Stainless Steel Main Valve and Pilot Body
	psig	bar	psig	bar	psig	bar		
With Type 6492HT pilot	- - - -				250	17.2	- - - -	300 psig / 20.7 bar or main valve body rating limit, whichever is lower
With Type 6492H pilot	250	17.2	300	20.7	150	10.3	250 psig / 17.2 bar or main valve body rating limit, whichever is lower	300 psig / 20.7 bar or main valve body rating limit, whichever is lower
With Type 6492L pilot					25	1.7	100 psig / 6.9 bar	100 psig / 6.9 bar

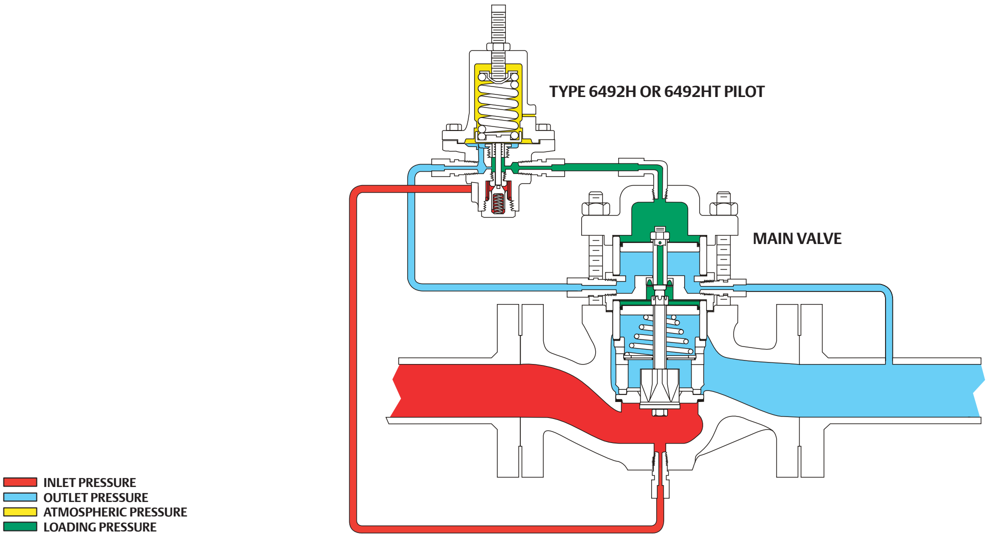
Table 7. Flow and Sizing Coefficients(1)

BODY SIZE		ORIFICE SIZE		REGULATING C_s	WIDE-OPEN C_s FOR RELIEF SIZING	C_1	K_M	IEC SIZE COEFFICIENTS		
NPS	DN	In.	mm					X_T	F_D	F_L
1	25	7/8	22	16	17.5				0.51	
1-1/2	40	1-1/8	29	30	33		0.62		0.47	0.79
2	50	1-29/64	37	48	52				0.48	
2-1/2	65	1-5/8	41	74	78	34		0.73	0.48	
3	80	2-1/16	52	100	110		0.71		0.47	0.84
4	100	2-3/8	60	140	145				0.46	
6 x 4	150 x 100	2-3/8	60	150	155				0.46	

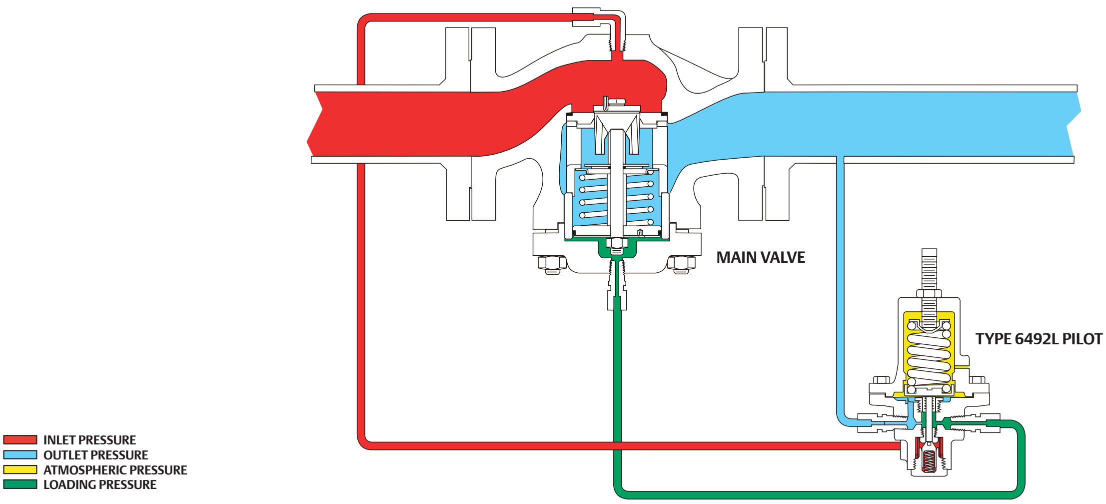
1. $C_v = C_s \times 20 \div C_1$

Table 8. Approximate Weights

BODY SIZE		END CONNECTION STYLE		APPROXIMATE WEIGHTS	
NPS	DN			Lbs	kg
1 1-1/2	25 40	NPT or flanged NPT or flanged		32 44	15 20
2	50	NPT Flanged		55 67	25 30
2-1/2 3 4	65 80 100	Flanged Flanged Flanged		90 115 165	41 52 75
6 x 4	150 x 100	Flanged	CL300	335	152
			CL600	435	197



NPS 1, 1-1/2 OR 2 / DN 25, 40 OR 50 MAIN VALVE BODY AND TYPE 6492H OR 6492HT PILOT



NPS 2-1/2, 3, 4 OR 6 x 4 / DN 65, 80, 100 OR 150 x 100 MAIN VALVE BODY AND TYPE 6492L PILOT

Figure 3. *Type 92S Pressure Reducing Regulator Operational Schematics*

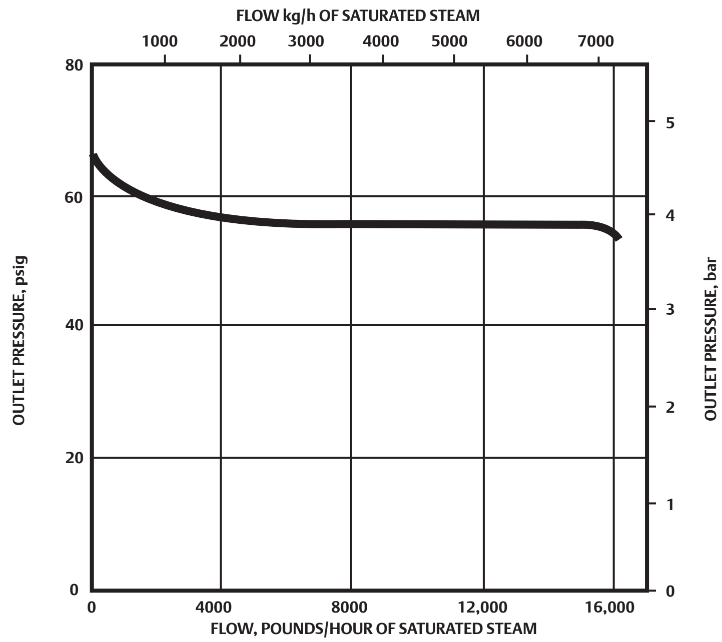
Table 2. Outlet (Control) Pressure Ranges

PILOT TYPE	OUTLET PRESSURE RANGES		COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	psig	bar		In.	mm	In.	mm
6492L	2 to 6 5 to 15 13 to 25	0.14 to 0.41 0.35 to 1.0 0.90 to 1.7	Yellow Green Red	0.207 0.234 0.283	5.26 5.94 7.19	2.50 2.62 2.44	63.5 66.6 62.0
6492H	10 to 30 25 to 75 70 to 150	0.69 to 2.1 1.7 to 5.2 4.8 to 10.3	Yellow Green Red	0.207 0.234 0.283	5.26 5.94 7.19	2.50 2.62 2.44	63.5 66.6 62.0
6492HT	15 to 100 80 to 250	1.0 to 6.9 5.5 to 17.2	Unpainted	0.282 0.375	7.16 9.53	2.50 2.50	63.5 63.5

Table 9. Flow Capacities in Pounds per Hour / kg/h of Saturated Steam

OUTLET PRESSURE SETTING(1)		PILOT TYPE NUMBER	INLET PRESSURE		MAIN VALVE BODY SIZE, NPS / DN														DROOP
					1 / 25		1-1/2 / 40		2 / 50		2-1/2 / 65		3 / 80		4 / 100		6 X 4 / 150 X 100		
psig	bar		psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	
5	0.35	6492L	25	1.7	575	261	950	431	1750	794	1000	454	1225	556	2510	1139	2600	1179	1 psi / 0.07 bar
			30	2.1	700	318	1150	522	1880	853	1500	680	2200	998	4000	1814	4100	1860	
			50	3.5	950	431	1800	816	2950	1338	4180	1896	6550	2971	8500	3856	8600	3901	
			75	5.2	1350	612	2375	1077	4100	1860	6000	2722	8400	3810	12,600	5715	12,900	5851	
			100	6.9	1725	782	3050	1383	5600	2540	8500	3856	10,300	4672	14,300	6486	15,100	6849	
			150	10.3	1800	816	4050	1837	6150	2790	11,900	5398	16,900	7666	23,000	10433	23,600	10,705	
10	0.69	6492H or 6492L	30	2.1	700	318	1200	544	2050	930	3050	1383	4300	1950	5800	2631	5800	2631	
			50	3.5	1040	472	1800	816	3100	1406	4700	2132	6250	2835	8920	4046	9200	4173	
			75	5.2	1440	653	2600	1179	4400	1996	6000	2722	9000	4082	11,000	4990	11,500	5216	
			100	6.9	1800	816	3300	1497	5600	2540	8600	3901	10,700	4854	16,300	7394	17,100	7757	
			150	10.3	2350	1066	4500	2041	8000	3629	12,000	5443	17,000	7711	19,600	8891	20,200	9163	
			200	13.8	2150	975	5100	2313	9200	4173									
15	1.0	6492L, 6492H or 6492HT	35	2.4	710	322	1300	590	2100	953	2300	1043	3200	1452	4600	2087	4600	2087	
			50	3.5	1040	472	1800	816	2950	1338	4550	2064	6200	2812	7700	3493	8100	3674	
			75	5.2	1440	653	2650	1202	4300	1950	6300	2858	8900	4037	11,900	5398	12,200	5534	
			100	6.9	1820	826	3400	1542	5450	2472	8100	3674	11,800	5352	16,100	7303	16,800	7620	
			150	10.3	2600	1179	4800	2177	7800	3538	12,100	5489	16,900	7666	23,100	10,478	23,800	10,796	
			200	13.8	3400	1542	6200	2812	10,200	4627									
20	1.4	6492L, 6492H or 6492HT	50	3.5	1040	472	1800	816	2950	1338	4590	2082	6250	2835	7570	3434	7700	3493	
			75	5.2	1440	653	2700	1225	4300	1950	6450	2926	9100	4128	11,000	4990	11,800	5352	
			100	6.9	1820	826	3450	1565	5450	2472	8650	3924	11,900	5398	16,200	7348	16,900	7666	
			150	10.3	2650	1202	4900	2223	7950	3606	12,300	5579	17,150	7779	23,500	10,660	24,100	10,932	
			200	13.8	3450	1565	6400	2903	10,300	4672									
30	2.1	6492H, 6492HT	50	3.5	900	408	1650	748	2700	1225	4040	1833	5350	2427	7770	3524	8100	3674	
			75	5.2	1440	653	2700	1225	4300	1950	6580	2985	8800	3992	12,000	5443	12,500	5670	
			100	6.9	1820	826	3450	1565	5450	2472	8400	3810	11,800	5352	19,000	8618	19,600	8891	
			150	10.3	2650	1202	4900	2223	7950	3606	12,000	5443	17,000	7711	23,100	10,478	23,800	10,796	
			200	13.8	3450	1565	6500	2948	10,000	4536	15,700	7122	22,100	10,025	30,100	13,653	30,600	13,880	
40	2.8	6492H, 6492HT	60	4.1	1100	499	1750	794	3300	1497	4500	2041	6400	2903	8800	3992	9000	4082	10% of outlet pressure setting
			75	5.2	1440	653	2500	1134	4300	1950	6300	2858	8350	3788	11,300	5126	11,900	5398	
			100	6.9	1820	826	3450	1565	5450	2472	8500	3856	11,400	5171	15,300	6940	16,100	7303	
			150	10.3	2650	1202	4900	2223	7950	3606	12,600	5715	17,000	7711	23,000	10,433	24,000	10,886	
			200	13.8	3450	1565	6500	2948	10,300	4672	16,700	7575	22,650	10,274	30,600	13,880	31,400	14,243	
50	3.5	6492H, 6492HT	75	5.2	1250	567	2250	1021	3750	1701	4950	2245	7950	3606	10,800	4899	11,500	5216	
			100	6.9	1820	826	3200	1452	5450	2472	8400	3810	11,800	5352	16,100	7303	17,000	7711	
			150	10.3	2650	1202	4900	2223	7950	3606	12,200	5534	17,000	7711	23,100	10,478	24,000	10,886	
			200	13.8	3450	1565	6500	2948	10,300	4672	15,695	7119	22,100	10,025	30,100	13,653	31,000	14,062	
			250	17.2	4300	1950	8000	3629	12,900	5851									
60	4.1	6492H, 6492HT	80	5.5	1365	619	2300	1043	4080	1851	5500	2495	7700	3493	10,500	4763	11,000	4990	
			100	6.9	1780	807	3100	1406	5300	2404	7880	3574	10,600	4808	14,200	6441	15,000	6804	
			150	10.3	2650	1202	4900	2223	7950	3606	12,300	5579	16,750	7598	22,700	10,297	23,000	10,433	
			200	13.8	3450	1565	6500	2948	10,300	4672	16,400	7439	22,450	10,183	30,200	13,699	31,000	14,062	
			250	17.2	4300	1950	8000	3629	12,900	5851									
80	5.5	6492H, 6492HT	100	6.9	1450	658	2600	1179	4350	1973	6270	2844	9250	4196	11,900	5398	12,300	5579	
			150	10.3	2600	1179	4650	2109	7800	3538	11,700	5307	15,850	7190	21,400	9707	22,000	9979	
			200	13.8	3450	1565	6500	2948	10,300	4672	15,600	7076	21,750	9866	29,600	13,427	30,200	13,699	
			250	17.2	4300	1950	8000	3629	12,900	5851	19,300	8754	27,750	12,587	38,000	17,237	39,000	17,690	
100	6.9	6492H, 6492HT	125	8.6	1900	862	3300	1497	5700	2586	8470	3842	11,400	5171	14,400	6532	15,200	6895	
			150	10.3	2490	1129	4350	1973	7450	3379	11,000	4990	14,900	6759	19,900	9027	20,500	9299	
			200	13.8	3450	1565	6250	2835	10,300	4672	15,700	7122	21,350	9684	28,700	13,018	29,100	13,200	
			250	17.2	4300	1950	8000	3629	12,900	5851	20,100	9117	26,800	12,156	35,700	16,194	36,500	16,556	
			300	20.7	5050	2291	9400	4264	15,100	6849									
125	8.6	6492H, 6492HT	140	9.7	1600	726	3100	1406	4800	2177									
			150	10.3	1900	862	3650	1656	5700	2586	9200	4173	13,100	5942	16,400	7439	16,900	7666	
			200	13.8	3150	1429	5750	2608	9450	4287	14,600	6623	19,950	9049	27,000	12,247	28,000	12,701	
			250	17.2	4300	1950	8000	3629	12,900	5851	19,500	8845	27,000	12,247	37,500	17,010	38,300	17,373	
			300	20.7	5050	2291	9400	4264	15,100	6849	23,800	10,796	32,500	14,742	44,300	20,094	45,100	20,457	
150	10.3	6492H, 6492HT	175	12.1	2450	1111	4000	1814	7300	3311	10,000	4536	14,000	6350	19,100	8664	20,100	9117	
			200	13.8	3050	1383	5250	2381	9100	4128	13,400	6078	18,200	8256	30,800	13,971	31,000	14,062	
			250	17.2	4150	1882	7400	3357	12,400	5625	18,600	8437	25,750	11,680	34,100	15,468	35,200	15,967	
			300	20.7	5050	2291	9400	4264	15,100	6849	23,400	10,614	31,900	14,470	42,900	19,459	43,300	19,641	

- Shaded areas show where maximum differential pressure is exceeded.
1. Standard pilot or combination of setting plus loading pressure or optional pilot.



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NOTE: INITIAL OUTLET PRESSURE SETTING IS 60 psig / 4.1 bar

Figure 4. *Typical Performance Curve for NPS 2-1/2 / DN 65 Type 92S Pressure Reducing Regulator with Type 6492H Pilot*

Table 10. Noise Level Data in Decibels with Schedule 40 Downstream Piping and No Insulation(1)

P_1		$\Delta P / P_{1abs}$	PERCENTAGE OF MAXIMUM REGULATOR FLOW RATE	NOISE LEVEL, DBA							
				NPS 2 / DN 50 MAIN VALVE BODY WITH 2 IN. / 51 mm DOWNSTREAM PIPING		NPS 2-1/2 / DN 65 MAIN VALVE BODY WITH 4 IN. / 102 mm DOWNSTREAM PIPING		NPS 3 / DN 80 MAIN VALVE BODY WITH 4 IN. / 102 mm DOWNSTREAM PIPING		NPS 4 / DN 100 MAIN VALVE BODY WITH 8 IN. / 203 mm DOWNSTREAM PIPING	
psig	bar			Without Attenuator	With Attenuator	Without Attenuator	With Attenuator	Without Attenuator	With Attenuator	Without Attenuator	With Attenuator
50	3.5	0.2	100	73	72	66	64	72	68	78	76
			30	62	61	59	56	63	60	71	68
		0.3	100	79	77	72	68	78	72	83	78
			30	68	66	61	57	65	61	73	70
		0.4	100	82	79	76	69	80	74	86	81
			30	71	68	65	61	69	65	76	73
		0.5	100	84	80	78	72	82	76	88	83
			30	73	69	67	63	73	67	79	75
		0.6	100	87	80	81	75	82	79	90	84
			30	76	70	70	65	74	68	80	76
		0.7	100	88	82	84	79	88	83	92	87
			30	78	71	73	69	80	71	83	79
100	6.9	0.2	100	78	77	71	69	77	73	83	81
			30	67	66	64	61	68	65	76	73
		0.3	100	84	82	77	73	83	77	88	83
			30	73	71	66	62	70	66	78	75
		0.4	100	86	84	81	74	85	79	91	86
			30	76	72	70	66	74	70	80	78
		0.5	100	89	85	83	77	87	81	93	88
			30	78	74	72	68	78	72	84	80
		0.6	100	92	86	86	80	87	84	95	89
			30	81	75	75	70	79	73	85	81
		0.7	100	82	75	78	74	85	76	88	84
			30	93	86	89	84	93	88	97	92
250	17.2	0.2	100	84	81	78	76	84	80	90	88
			30	73	71	71	68	75	72	83	80
		0.3	100	90	85	84	80	90	84	95	90
			30	80	77	73	69	77	73	85	82
		0.4	100	93	88	88	81	92	86	98	93
			30	82	78	77	73	81	77	88	85
		0.5	100	95	91	90	84	94	88	100	95
			30	85	80	79	75	85	79	91	87
		0.6	100	98	92	93	87	94	91	102	96
			30	88	82	82	77	86	80	92	88
		0.7	100	101	94	96	91	100	95	104	99
			30	89	83	85	81	92	83	95	91

1. Overall noise levels determined at a point 39 in. / 991 mm downstream of the regulator outlet and 39 in. / 991 mm from piping surface.

Introduction

The Type 92W pilot-operated, pressure reducing regulator is used in applications that require close control and high capacity. This dependable regulator is piston actuated for better performance in high cycle applications.

The Type 92W designed for liquid service includes either a Type 6492H or a Type 6492L pilot (Figure 1). Both pilots have a friction-reducing bellows seal on the stem and offer precise pressure-setting adjustment plus high sensitivity to downstream pressure changes.

Body Size and End Connection Styles
See Table 1

Maximum Inlet and Pilot Supply Pressure(1)
Cast Iron Main Valve and Pilot:
250 psig / 17.2 bar or body rating limit, whichever is lower
Steel Main Valve and Pilot:
300 psig / 20.7 bar or body rating limit, whichever is lower

Maximum Differential Pressure
150 psig / 10.3 bar or body rating limit, whichever is lower

Minimum Differential Pressure
20 psig / 1.4 bar

Outlet (Control) Pressure Ranges
See Table 2

Maximum Outlet Pressures
See Table 3

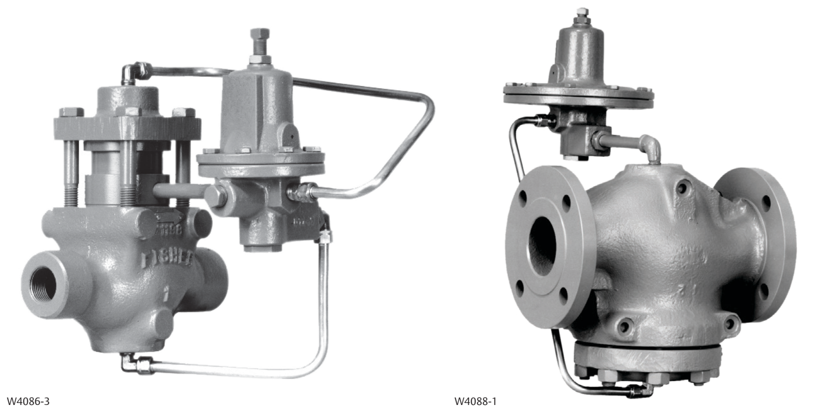
Pressure Registration
External

Maximum Allowable Loading Pressure For Pilot With Tapped Spring Case
Combination of pilot control spring setting and spring case loading pressure cannot exceed:
Type 6492H pilots: 150 psig / 10.3 bar
Type 6492L pilots: 25 psig / 1.7 bar

Pilot Spring Case Vent
Standard Pilot: 1/8 in. / 3.18 mm drilled hole
Pressure Loading Pilot: 1/4 FNPT

Main Valve Port Diameters and Flow Coefficients
See Table 4

Construction Materials
See Tables 6 and 7



NPT STEEL TYPE 92W PRESSURE REDUCING REGULATOR WITH TYPE 6492H PILOT

FLANGED CAST IRON TYPE 92W PRESSURE REDUCING REGULATOR WITH TYPE 6492L PILOT

Figure 1. *Type 92W Liquid Regulators*

Temperature Capabilities
Cast Iron Main Valve and Pilot:
-40 to 406°F / -40 to 208°C
Steel/Stainless Steel Main Valve and Pilot:
-20 to 500°F / -29 to 260°C

Flow Capacities
See Tables 8

Ordering Guide
To order this product, contact your local Sales Office.

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Application
Liquid

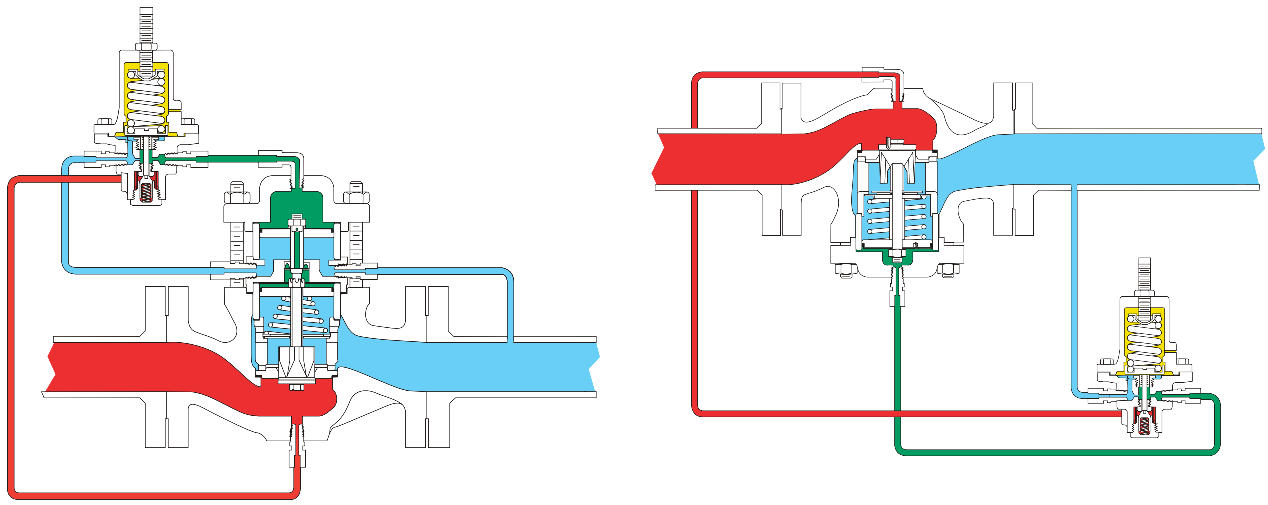
Features
- Reliable and Dependable with Time-Proven Piston Actuation design
- Machine-Lapped Seating Surfaces for Good Shutoff at Low Downstream Build-up
- Resistance to Piping Stresses
- Ease of Installation
- Increased Sensitivity to Downstream Pressure Changes
- Ease of Pilot Maintenance
- Application Flexibility

Table 1. Body Size and End Connection Styles

BODY SIZE	END CONNECTION STYLE AND RATING	
	Cast Iron Body	Steel or Stainless Steel Body
1, 1-1/2, and 2 in.	NPT	NPT
NPS 1, 1-1/2, 2, 2-1/2, 3, and 4 / DN 25, 40, 50, 65, 80, and 100	CL125 FF and CL250 RF Flanged	CL150 RF, CL300 RF, and CL600 RF Flanged
NPS 6 x 4 / DN 150 x 100	Not Available	CL300 RF, CL600 RF or PN 16/25-40/64/100

Table 2. Outlet (Control) Pressure Ranges

OUTLET (CONTROL) PRESSURE RANGE				PILOT SPRING COLOR CODE
Type 6492L Pilot		Type 6492H Pilot		
psig	bar	psig	bar	
2 to 6	0.14 to 0.41	10 to 30	0.69 to 2.1	Yellow
5 to 15	0.34 to 1.0	25 to 75	1.7 to 5.2	Green
13 to 25	0.90 to 1.7	70 to 150	4.8 to 10.3	Red



M1228 TYPE 92W WITH TYPE 6492H PILOT
NPS 1 THROUGH 2 / DN 25 THROUGH 50 MAIN VALVE

M1229 TYPE 92W WITH TYPE 6492L PILOT
NPS 2-1/2 THROUGH 4 / DN 65 THROUGH 100 MAIN VALVE

INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE
LOADING PRESSURE

Figure 2. *Type 92W Operational Schematics*

Table 3. Maximum Outlet Pressures

PILOT TYPE	MAXIMUM OPERATING OUTLET PRESSURE	MAXIMUM EMERGENCY OUTLET PRESSURE (IF EXCEEDED, PRESSURE VESSEL INTEGRITY MAY NOT BE RETAINED AND PERSONAL INJURY OR PROPERTY DAMAGE COULD RESULT)	
		Cast iron Main Valve and Pilot Body	Steel Main Valve and Pilot Body
With Type 6492H Pilot	150 psig / 10.3 bar	250 psig / 17.2 bar or main valve body rating limit, whichever is lower	300 psig / 20.7 bar or main valve body rating limit, whichever is lower
With Type 6492L Pilot	25 psig / 1.7 bar	50 psig / 3.4 bar	125 psig / 8.6 bar

Table 4. Main Valve Port Diameters and Flow Coefficients

BODY SIZE		PORT DIAMETER		REGULATING C_v	WIDE-OPEN C_v	K_m
NPS	DN	In.	mm			
1 1-1/2 2	25 40 50	7/8 1-1/8 1-29/64	22 29 37	10 20 35	11 22 39	0.62
2-1/2 3 4	65 80 100	1-5/8 2-1/16 2-3/8	41 52 60	48 66 78	53 73 86	0.71
6 x 4	150 x 100	2-3/8	60	85	92	

Table 5. Downstream Control Line Connection

BODY SIZE, NPS / DN	CONNECTION SIZE	LOCATION FOR CONTROL LINE
1, 1-1/2 or 2 / 25, 40 or 50	1/4 FNPT	Main Valve Cylinder Spacer
2-1/2, 3 or 4 / 65, 80 or 100		Pilot Body

Table 6. Pilot Construction Materials

BODY AND SPRING CASE	SEAT RING AND STEM	BELLOWS AND BELLOWS RETAINER	PLUG, PLUG GUIDE, PLUG SPRING, DIAPHRAGMS, BLEED RESTRICTION, AND INLET SCREEN	TUBING AND FITTINGS
Cast Iron, WCC Steel or CF8M Stainless Steel	Heat-treated 416 Stainless steel	Brass (Cast Iron and Steel bodies) or 312 Stainless Steel with Stainless Steel Body	416 Stainless Steel	Copper tubing with Brass fittings or Stainless Steel tubing and fittings

Table 7. Main Valve Construction Materials

BODY AND BODY FLANGE	VALVE PLUG	CAGE	PISTONS, SEAT RING, AND CYLINDERS	PISTON RINGS AND STEM SEAL	PISTON RING RETAINER(S)
Cast Iron, WCC Steel, or CF8M Stainless Steel	Heat-treated 17-4 PH Stainless steel	Cast Iron (Cast Iron and Steel bodies) or Stainless Steel (Stainless Steel body)	Heat-treated 416 Stainless steel	Polytetrafluroethylene (PTFE)	302 Stainless steel

Table 8. Flow Capacities(1) in U.S. Gallons per Minute / L/min(2) of Water

OUTLET PRESSURE SETTING (STANDARD PILOT) OR COMBINATION OF SETTING PLUS LOADING PRESSURE (OPTIONAL PILOT)(2)	PILOT TYPE NUMBER	INLET PRESSURE(3)		CAPACITY											
				NPS 1 / DN 25				NPS 1-1/2 / DN 40				NPS 2 / DN 50			
				Minimum		Maximum		Minimum		Maximum		Minimum		Maximum	
		psig	bar	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min
10 psig / 0.69 bar	6492H or 6492L	30	2.1	2.2	8.33	45	170	4.5	17.0	89	337	8.9	33.7	160	606
		60	4.1	3.5	13.2	67	254	7.1	26.9	140	530	14	53.0	230	871
		160	11.0	6.1	23.1	100	379	12	45.4	210	795	24	90.8	360	1363
20 psig / 1.4 bar	6492H or 6492L	40	2.8	2.2	8.33	45	170	4.5	17.0	89	337	8.9	33.7	160	606
		70	4.8	2.5	9.46	67	254	7.1	26.9	130	492	14	53.0	230	871
		170	11.7	6.1	23.1	110	416	12	45.4	210	795	24	90.8	370	1400
50 psig / 3.4 bar	6492H	70	4.8	2.2	8.33	45	170	4.5	17.0	89	337	8.9	33.7	160	606
		100	6.9	3.5	13.2	67	254	7.1	26.9	130	492	14	53.0	230	871
		130	9.0	4.5	17.0	89	337	8.9	33.7	180	681	18	68.1	310	1173
		150	10.3	5.0	18.9	100	379	10	37.9	200	757	20	75.7	350	1325
		200	13.8	6.1	23.1	110	416	12	45.4	230	871	24	90.8	400	1514
80 psig / 5.5 bar		100	6.9	2.2	8.33	45	170	4.5	17.0	89	337	8.9	33.7	160	606
		130	9.0	3.5	13.2	67	254	7.1	26.9	130	492	14	53.0	230	871
		160	11.0	4.5	17.0	89	337	8.9	33.7	180	681	18	68.1	310	1173
		200	13.8	5.5	20.8	110	416	11	41.6	220	833	22	83.3	380	1438
		230	15.9	6.1	23.1	120	454	12	45.4	240	908	24	90.8	430	1628
100 psig / 6.9 bar		120	8.3	2.2	8.33	45	170	4.5	17.0	89	337	8.9	33.7	160	606
		150	10.3	3.5	13.2	67	254	7.1	26.9	130	492	14	53.0	230	871
		200	13.8	5.0	18.9	100	379	10	37.9	200	757	20	75.7	350	1325
		250	17.2	6.1	23.1	120	454	12	45.4	240	908	24	90.8	430	1628
150 psig / 10.3 bar		170	11.7	2.2	8.33	45	170	4.5	17.0	89	337	8.9	33.7	160	606
		200	13.8	3.5	13.2	67	254	7.1	26.9	130	492	14	53.0	230	871
		250	17.2	5.0	18.9	100	379	10	37.9	200	757	20	75.7	350	1325
		300	20.7	6.1	23.1	120	454	12	45.4	240	908	24	90.8	430	1628

1. Capacities are measure at 10% of outlet pressure setting (droop)
2. If capacities are desired on m^3/h, multiply U.S. GPM by 0.2271.
3. Values shown do not consider the maximum effective pressure drop. The maximum effective pressure drop should be checked for each set of specific application conditions, where $\Delta P_{eff} = K_m P_{1abs}$. Choked flow will occur if the maximum effective pressure drop is exceeded.

Table 8. Flow Capacities(1) in U.S. Gallons per Minute / L/min(2) of Water (continued)

OUTLET PRESSURE SETTING (STANDARD PILOT) OR COMBINATION OF SETTING PLUS LOADING PRESSURE (OPTIONAL PILOT)(2)	PILOT TYPE NUMBER	INLET PRESSURE(3)		CAPACITY											
				NPS 2-1/2 / DN 65				NPS 3 / DN 80				NPS 4 / DN 100			
				Minimum		Maximum		Minimum		Maximum		Minimum		Maximum	
		psig	bar	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min
10 psig / 0.69 bar	6492H or 6492L	30	2.1	11	41.6	210	795	16	60.6	300	1136	----	----	----	----
		60	4.1	18	68.1	340	1287	25	94.6	470	1779	28	106	550	2082
		160	11.0	31	117	530	2006	43	163	730	2763	49	185	860	3255
20 psig / 1.4 bar	6492H or 6492L	40	2.8	11	41.6	210	795	16	60.6	300	1136	18	68.1	350	1325
		70	4.8	18	68.1	340	1287	25	94.6	470	1779	28	106	550	2082
		170	11.7	31	117	550	2082	43	163	750	2839	49	185	890	3369
50 psig / 3.4 bar	6492H	70	4.8	11	41.6	210	795	16	60.6	300	1136	18	68.1	350	1325
		100	6.9	18	68.1	340	1287	25	94.6	470	1779	28	106	550	2082
		130	9.0	22	83.3	430	1628	31	117	590	2233	36	136	700	2650
		150	10.3	25	94.6	480	1817	35	132	660	2498	40	151	780	2952
		200	13.8	31	117	590	2233	43	163	810	3066	49	185	960	3634
80 psig / 5.5 bar		100	6.9	11	41.6	210	795	16	60.6	300	1136	18	68.1	350	1325
		130	9.0	18	68.1	340	1287	25	94.6	470	1779	28	106	550	2082
		160	11.0	22	83.3	430	1628	31	117	590	2233	36	136	700	2650
		200	13.8	27	102	230	871	38	144	720	2725	44	167	850	3217
		230	15.9	31	117	590	2233	43	163	810	3066	49	185	960	3634
100 psig / 6.9 bar		120	8.3	11	41.6	210	795	16	60.6	300	1136	18	68.1	350	1325
		150	10.3	18	68.1	340	1287	25	94.6	470	1779	28	106	550	2082
		200	13.8	25	94.6	480	1817	35	132	660	2498	40	151	780	2952
		250	17.2	31	117	590	2233	43	163	810	3066	49	185	960	3634
150 psig / 10.3 bar		170	11.7	11	41.6	210	795	16	60.6	300	1136	18	68.1	350	1325
		200	13.8	18	68.1	340	1287	25	94.6	470	1779	28	106	550	2082
		250	17.2	25	94.6	480	1817	35	132	660	2498	40	151	780	2952
		300	20.7	31	117	590	2233	43	163	810	3066	49	185	960	3634

1. Capacities are measure at 10% of outlet pressure setting (droop)
2. If capacities are desired on m^3/h, multiply U.S. GPM by 0.2271.
3. Values shown do not consider the maximum effective pressure drop. The maximum effective pressure drop should be checked for each set of specific application conditions, where $\Delta P_{eff} = K_m P_{1abs}$. Choked flow will occur if the maximum effective pressure drop is exceeded.

119 Series

Fuel Gas Valve

Introduction

The 119 Series fuel gas valve is used for on-off or throttling control of non-corrosive or mildly corrosive flow media. It is designed to meet low-pressure application requirements in many varied industries.

If the control valve requires maintenance, the trim can be exposed by removing two bolts and lifting the actuator assembly off the valve body without disassembling the actuator.

Available Configuration

Type 119: Direct-operated valve used for on-off or throttling control of non-corrosive or mildly corrosive liquids and gases
Type 119EZ: Direct-operated valve with adjustable opening speed for reliable startup operation on gas burner systems
Type 119EZS: Type 119EZ equipped with solenoid for valve to be operated by local control system

Body Sizes and End Connection Style

Type 119: 3/4, 1 or 1-1/4 NPT
Types 119EZ and 119EZS: 1 NPT

Orifice Size and Flow Coefficients

See Table 2

Maximum Inlet Pressure

150 psig / 10.3 bar

Maximum Control Pressure to Diaphragm

150 psig / 10.3 bar

Maximum Pressure Drop

150 psig / 10.3 bar for all port diameters
115 psig / 7.9 bar for Type 119EZS with ASCO® 8320 Series solenoid

Outlet Pressure Ranges

3 to 60 psig / 0.21 to 4.1 bar in four ranges
See Table 1

Type 119EZS Solenoid Specifications

Electric Train: Refer to ASCO® 8320 Series General Service Solenoid Valve Catalog (Document Number: 8320R2)
Low Power/ Solar: Refer to ASCO® Low Power Solutions Catalog (Document Number: V7704)

Valve Plug Travel

3/16 in. / 4.8 mm

Actuator Control Line Connection

1/4 FNPT

Spring Case and Bonnet Vents

1/4 FNPT

Body Construction Materials

Type 119: Cast Iron, WCC Steel
Types 119EZ and 119EZS:
Cast Iron, CF8M Stainless Steel

Material Temperature Capabilities

Type 119
Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM): 0 to 250°F / -18 to 121°C
Types 119EZ and 119EZS
Nitrile (NBR)[1]: -40 to 180°F / -40 to 82°C
Fluorocarbon (FKM): 0 to 250°F / -18 to 121°C

Type 119EZS Solenoid Temperature Capabilities

ASCO® 8320 Series Solenoid:
32 to 125°F / 0 to 52°C
ASCO® 8314 Series Solenoid:
-13 to 131°F / -25 to 55°C

Approximate Weight

6 lbs / 3 kg

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Fuel Gas

Features

- Easy Installation
- Easy Leak Detection
- Easily Adjusted Spring
- Easy Maintenance
- Low Leakage
- Sour Gas Service Capability
- Variable Opening Speed

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
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Figure 1. *Type 119*


P1739

Figure 2. *Type 119EZ*

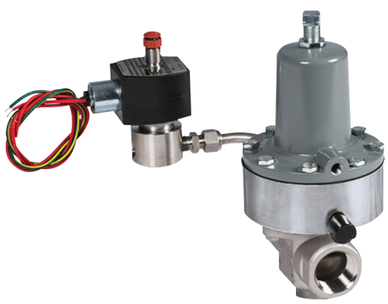
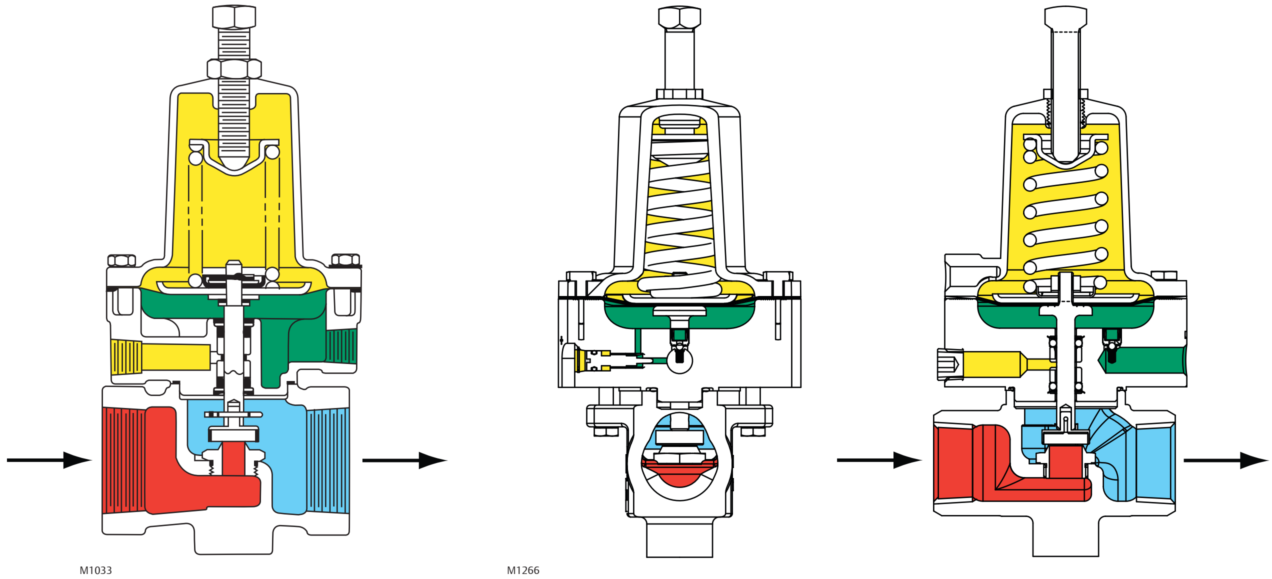


Figure 3. *Type 119EZS*

1. Minimum temperature for CI body is -20°F / -29°C.



TYPE 119

TYPE 119EZ[1]

INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE
LOADING PRESSURE

1. Solenoid valve connects to loading pressure port.

Figure 4. *119 Series Operational Schematics*

Table 1. Outlet Pressure Range

OUTLET PRESSURE RANGE		SPRING COLOR	FREE LENGTH		WIRE DIAMETER	
psig	bar		In.	mm	In.	mm
3 to 15	0.21 to 1.0	Red	2.94	75	0.168	4.27
5 to 20	0.34 to 1.4	Silver	2.81	71	0.187	4.75
5 to 35	0.34 to 2.4	Blue	2.50	64	0.218	5.54
30 to 60	2.1 to 4.1	Green	2.60	66	0.234	5.94

Table 2. 119 Series Valve Flow Coefficients

VALVE TRAVEL		ORIFICE SIZE		BODY SIZE[1]								
				3/4 In. Body			1 In. Body			1-1/4 In. Body		
In.	mm	In.	mm	C_v	C_g	C_1	C_v	C_g	C_1	C_v	C_g	C_1
3/16	4.8	1/8	3.2	0.43	12.5	29.1	0.43	12.5	29.1	0.43	12.5	29.1
		3/16	4.8	0.95	27.8	29.3	0.95	27.8	29.3	0.95	27.8	29.3
		1/4	6.4	1.70	48.3	28.4	1.70	48.3	28.4	1.70	48.3	28.4
		5/16	7.9	2.64	76.5	29.0	2.64	76.5	29.0	2.64	76.5	29.0
		3/8	9.5	3.22	104	32.3	3.3	105	31.8	3.57	106	29.7
		1/2	13	4.7	176	37.4	5.0	178	35.6	5.75	183	31.8
		9/16	14	5.6	213	38.0	5.9	218	36.8	7.2	230	31.9

1. Types 119EZ and 119EZS only available in 1 in. body size.

Type 122A
Three-Way Switching Valve

FISHER

Introduction

The Type 122A valve is a high-capacity, economical three-way pneumatic switching valve for on-off applications. This valve can be used for diverging or converging gaseous service, diverging liquid service with gas-loaded liquids, and converging liquid service. Six spring ranges are available for control pressures from 3 to 150 psig / 0.21 to 10.3 bar.

Body Sizes and End Connection Style

Connections A and C: 3/4 or 1 NPT
Connection B: 3/4 NPT

Maximum Inlet Pressure

150 psig / 10.3 bar

Maximum Control Pressure to Diaphragm

150 psig / 10.3 bar

Set Pressure Ranges

3 to 150 psig / 0.21 to 10.3 bar in six ranges

Temperature Capabilities

-20 to 150°F / -29 to 66°C

Control Connection

1/4 NPT internal

Vent Connection

1/4 NPT internal with screen

Flow Coefficients

C_g[1]
Connection A to B: 138
Connection A to C: 131
C_1
Connection A to B: 28.0
Connection A to C: 32.5

Construction Materials

Valve Body: Cast iron
Bottom Connector: Steel
Spring Case: Aluminum
Lower Diaphragm Case: Cast iron
Disk and Disk Holder Assembly: Nitrile (NBR) and Aluminum, or Nitrile (NBR) and Stainless steel
Orifice: Aluminum or Stainless steel
Diaphragm: Neoprene (CR)
Gaskets: Composition
O-Rings: Nitrile (NBR)
Washers: Zinc-plated steel and 302 Stainless steel
Spring: Zinc-plated steel

Approximate Weight

5 lbs / 2 kg

Ordering Guide

To order this product, contact your local Sales Office.

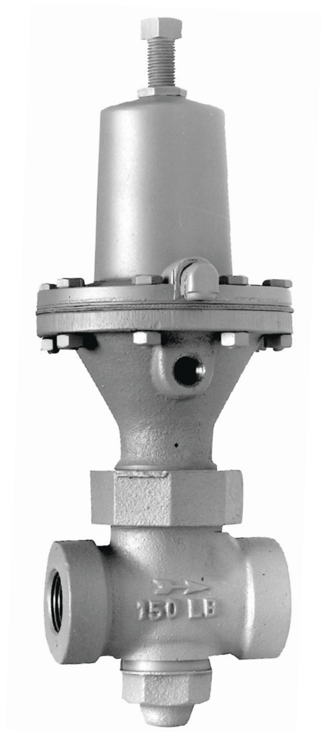


Figure 1. *Type 122A*

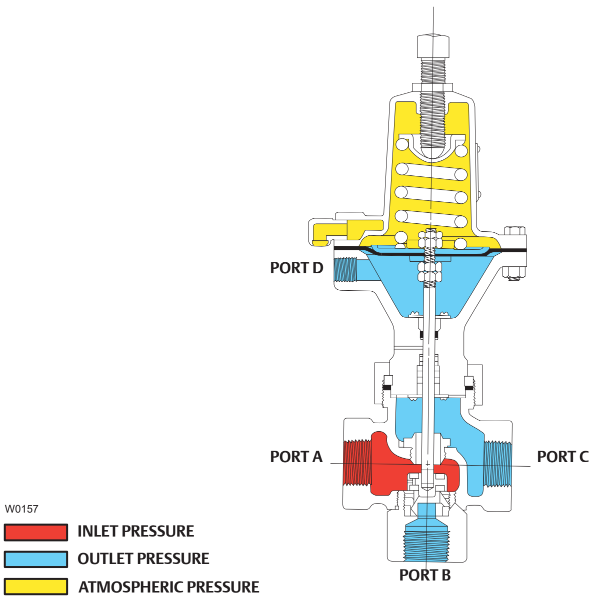


Figure 2. *Type 122A Three-Way Switching Valve Operational Schematic*

Applications

- Air
- Liquid

Features

- **Convenient Installation**
- **Easy Leak Detection**
- **Easy Maintenance**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
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1. At an inlet pressure of 25 psig / 1.7 bar and with full pressure drop across the body.

EMERSON

Introduction

The 133 Series direct-operated gas regulators are primarily designed for industrial and commercial applications supplying gas to furnaces, burners and other appliances. The 133 Series balancing system enables the regulator to provide accurate control of gas pressure for maximum combustion efficiency despite varying inlet pressure conditions. The single port construction provides bubble-tight shutoff. An external downstream control line is required for the operation of the regulator. 133 Series regulators are available in a 2 in. / DN 50 body size with either NPT or flanged end connections.

An optional restriction collar can be installed if wide-open capacity is too high for applications using a relief valve as overpressure protection. The collar reduces wide-open capacity to 25%, 40% or 60% of standard wide-open capacity.

Body Construction Materials, Body Size and End Connection Styles

Cast Iron Body: NPS 2 / DN 50, NPT or CL125 FF flanged
WCC Steel Body: NPS 2 / DN 50, NPT or CL150 RF flanged

Pressure Registration

External; downstream control line is required

Outlet Pressure Ranges

See Table 2

Maximum Inlet Pressures

See Table 3

Maximum Emergency Outlet (Casing) Pressure

See Table 3

Flow Capacities

See Tables 4 through 6

Flow and Sizing Coefficients

See Table 7

Temperature Capabilities

-20 to 150°F / -29 to 66°C

Options

Restriction collar to reduce wide-open capacity to approximately 25%, 40% or 60% of standard wide-open capacity

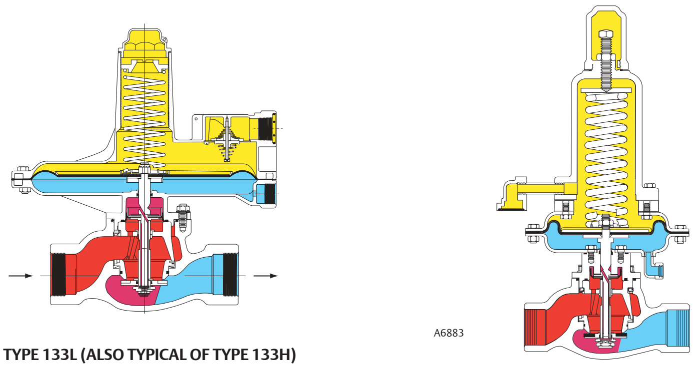
Ordering Guide

To order this product, contact your local Sales Office.

W1327
TYPE 133L (ALSO TYPICAL OF TYPE 133H)

W5803
TYPE 133HP

Figure 1. *Types 133H, 133L and 133HP Regulators*



A6555
TYPE 133L (ALSO TYPICAL OF TYPE 133H)

A6883
TYPE 133HP

INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE
BOOST PRESSURE

Figure 2. *133 Series Operational Schematics*

Table 1. Available Configurations

TYPE	CONFIGURATION
133H	High pressure construction for outlet pressure range of 1.5 to 10 psig / 0.10 to 0.69 bar. The Type 133H can also use the 2 in. w.c. to 2 psig / 5 mbar to 0.14 bar springs of the Type 133L. The maximum operating inlet pressure is 60 psig / 4.1 bar with a maximum emergency inlet pressure of 125 psig / 8.6 bar.
133HP	Extra high pressure construction for outlet pressure range of 2 to 60 psig / 0.14 to 4.1 bar. The maximum operating and emergency inlet pressure rating is 150 psig / 10.3 bar.
133L	Low pressure construction for outlet pressure range of 2 in. w.c. to 2 psig / 5 mbar to 0.14 bar. The maximum operating inlet pressure is 60 psig / 4.1 bar with a maximum emergency inlet pressure of 125 psig / 8.6 bar.
133Z	Zero governor construction for outlet pressure range of -1 to 4 in. w.c. / -2 to 10 mbar. The maximum operating inlet pressure is 20 psig / 1.4 bar with a maximum emergency inlet pressure of 125 psig / 8.6 bar.

Features

- **Wide Pressure Range Capability**
- **Types 133L, 133H and 133HP Suitable for Monitoring Applications**
- **Excellent Shock Characteristics and Fast Speed of Response**
- **Bubble-Tight Shutoff**
- **Easy Access to Trim Parts**
- **Reusable Pressure Seals**

Application

Fuel Gas

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 2. Outlet Pressure Range

TYPE	OUTLET PRESSURE RANGE		SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	psig	bar		In.	mm	In.	mm
133H[1]	1.5 to 3	0.10 to 0.21	Orange	0.250	6.35	6.91	176
	2 to 5	0.14 to 0.34	Yellow	0.283	7.19	6.47	164
	5 to 10	0.34 to 0.69	Blue	0.375	9.53	6.19	157
133HP[1]	2 to 5	0.14 to 0.34	Yellow	0.282	7.16	8.5	216
	4.5 to 10	0.31 to 0.69	Orange	0.343	8.71	8.5	216
	6 to 20	0.41 to 1.4	Silver	0.375	9.52	8.25	210
	16 to 30	1.1 to 2.1	Red	0.438	11.1	8.25	210
	26 to 40	1.8 to 2.8	Blue	0.500	12.7	8.25	210
	36 to 50	2.5 to 3.4	Green	0.500	12.7	8.25	210
	45 to 60	3.1 to 4.1	White	0.531	13.5	8.25	210
133L[1] and 133H[2]	2 to 4 in. w.c.	5 to 10 mbar	Brown	0.109	2.77	6.12	156
	3.5 to 6 in. w.c.	9 to 15 mbar	Red	0.112	2.84	7.53	191
	5 to 9 in. w.c.	12 to 22 mbar	Black	0.130	3.30	7.88	200
	8.5 to 18 in. w.c.	21 to 45 mbar	White	0.156	3.96	7.50	190
	14 to 28 in. w.c.	35 to 70 mbar	Green	0.182	4.62	7.25	184
	0.75 to 2	0.05 to 0.14	Blue	0.225	5.72	7.09	180

1. Pressure ranges shown are correct if the regulator is installed with the actuator portion above the body portion. If the regulator is installed with the actuator portion below the body, the pressure ranges will be lowered by approximately 2 in. w.c. / 5 mbar for the Type 133L and by approximately 3 in. w.c. / 7 mbar for Type 133H.
2. If the 2 in. w.c. / 5 mbar to 2 psig / 0.14 bar springs (all 6 ranges) are used in the Type 133H, the pressure ranges will increase by approximately 1 in. w.c. / 2 mbar due to the weight of the Type 133H parts (assuming that the actuator is installed above the body).

Table 3. Maximum Inlet and Outlet Pressure

PRESSURE	TYPE					
	133H		133HP		133L	
	psig	bar	psig	bar	psig	bar
Maximum Operating Inlet Pressure	60	4.1	150	10.3	60	4.1
Maximum Emergency Inlet Pressure	125	8.6			125	8.6
Maximum Operating Outlet Pressure[1]	10	0.69	Setpoint plus 40	Setpoint plus 2.8	2	0.14
Maximum Outlet Pressure Over Outlet Pressure Setting	3	0.21			3	0.21
Maximum Emergency Outlet (Casing) Pressure	15	1.0	150	10.3	15	1.0

1. With highest spring range available only.

Table 4. Full-Capacity Type 133H Regulated Flow in Thousands of SCFH of 0.6 Specific Gravity Gas at 14.7 psia and 60°F

INLET PRESSURE		OUTLET PRESSURE SETTING[1] AND OUTLET PRESSURE RANGE																			
		3 psig / 0.21 bar 1.5 to 3 psig / 0.10 to 0.21 bar				2 psig / 0.14 bar 2 to 5 psig / 0.14 to 0.34 bar				5 psig / 0.34 bar 2 to 5 psig / 0.14 to 0.34 bar				5 psig / 0.34 bar 5 to 10 psig / 0.34 to 0.69 bar				10 psig / 0.69 bar 5 to 10 psig / 0.34 to 0.69 bar			
psig	bar	10% Droop		20% Droop		10% Droop		20% Droop		10% Droop		20% Droop		10% Droop		20% Droop		10% Droop		20% Droop	
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
3	0.21	----	----	----	----	6.5	0.17	11.5	0.31	----	----	----	----	----	----	----	----	----	----	----	----
5	0.34	14	0.38	22	0.59	11	0.30	18	0.48	----	----	----	----	----	----	----	----	----	----	----	----
7	0.48	21.5	0.58	31	0.83	13	0.35	22	0.59	15.5	0.42	24	0.64	9	0.24	15	0.40	----	----	----	----
10	0.69	28	0.75	42	1.13	15	0.40	27	0.72	24	0.64	35	0.94	14	0.38	22	0.59	----	----	----	----
15	1.0	40	1.07	57	1.53	25.5	0.68	39	1.04	35	0.94	51	1.37	19	0.51	31.5	0.84	21	0.56	35	0.94
20	1.4	52	1.39	72	1.93	35	0.94	52	1.39	46	1.23	67	1.80	24	0.64	41	1.10	31	0.83	51	1.37
30	2.1	76	2.04	96	2.57	49	1.31	73	1.96	68	1.82	95	2.55	35	0.94	58	1.55	44	1.18	74	1.98
40	2.8	98	2.63	119	3.19	66	1.77	97	2.60	88	2.36	117	3.14	44	1.18	73	1.96	56	1.50	97	2.60
50	3.4	118	3.16	141	3.78	84	2.25	112	3.00	103	2.76	138	3.70	57	1.53	89	2.38	74	1.98	117	3.14
60	4.1	136	3.64	165	4.42	104	2.79	132	3.54	122	3.27	156	4.18	65	1.74	106	2.84	91	2.44	136	3.64

1. Outlet pressure setting was made at approximately 10% of the maximum capacity for the listed conditions.

Table 5. Full-Capacity Type 133L Regulated Flow in Thousands of SCFH of 0.6 Specific Gravity Gas at 14.7 psia and 60°F

INLET PRESSURE		OUTLET PRESSURE SETTING[1] AND OUTLET PRESSURE RANGE																					
		4 in. w.c. / 10 mbar 2 to 4 in. w.c. / 5 to 10 mbar		6 in. w.c. / 15 mbar 3.5 to 6 in. w.c. / 8.7 to 15 mbar		7 in. w.c. / 17 mbar 5 to 9 in. w.c. / 12 to 22 mbar		14 in. w.c. / 35 mbar 8.5 to 18 in. w.c. / 21 to 45 mbar				14 in. w.c. / 35 mbar 14 to 28 in. w.c. / 35 to 70 mbar				1 psig / 0.07 bar 14 to 28 in. w.c. / 35 to 70 mbar				2 psig / 0.14 bar 0.75 to 2 psig / 0.05 to 0.14 bar			
psig	bar	1 in. w.c. / 3 mbar Droop		1 in. w.c. / 3 mbar Droop		1 in. w.c. / 3 mbar Droop		1 in. w.c. / 3 mbar Droop		2 in. w.c / 5 mbar Droop		1 in. w.c. / 3 mbar Droop		2 in. w.c. / 5 mbar Droop		10% Droop		20% Droop		10% Droop		20% Droop	
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1	0.07	14	0.38	13	0.35	12	0.32	5	0.13	8.4	0.22	----	----	----	----	----	----	----	----	----	----	----	----
2	0.14	20.8	0.56	20	0.54	17	0.46	8.2	0.22	15.2	0.41	----	----	----	----	11.5	0.31	16	0.43	----	----	----	----
3	0.21	26	0.70	24.5	0.66	21	0.56	12	0.32	19.5	0.52	----	----	----	----	15.5	0.42	21.5	0.58	12.5	0.34	18.5	0.50
5	0.34	35	0.94	33	0.88	32	0.86	16	0.43	28	0.75	14	0.38	23	0.62	24	0.64	31.5	0.84	20.5	0.55	28	0.75
10	0.69	52	1.39	52	1.39	48	1.29	34	0.91	45	1.21	26	0.70	38	1.02	37.5	1.00	44	1.18	38	1.02	46	1.23
20	1.4	78	2.09	77	2.06	79	2.12	69	1.85	76	2.04	60	1.61	69	1.85	70	1.88	77	2.06	62	1.66	76	2.04
30	2.1	101	2.71	100	2.68	100	2.68	91	2.44	97	2.60	87	2.33	93	2.49	90	2.41	101	2.71	87	2.33	101	2.71
40	2.8	124	3.32	122	3.27	124	3.32	109	2.92	116	3.11	107	2.87	115	3.08	110	2.95	122	3.27	105	2.81	121	3.24
50	3.4	146	3.91	144	3.86	145	3.89	130	3.48	136	3.64	132	3.54	137	3.67	127	3.40	145	3.89	124	3.32	145	3.89
60	4.1	170	4.56	168	4.50	166	4.45	155	4.15	161	4.32	152	4.07	158	4.23	149	3.99	167	4.48	145	3.89	170	4.56

1. Outlet pressure setting was made at approximately 10% of the maximum capacity for the listed conditions.

Table 6. Type 133HP Regulator 100% Capacities in Thousands of SCFH of 0.6 Specific Gravity Gas at 14.7 psia and 60°F

OUTLET PRESSURE RANGES AND SPRING COLOR	OUTLET PRESSURE SETTING[1]		INLET PRESSURE		2 IN. / DN 50 BODY SIZE 1.91 IN. / 48.5 mm ORIFICE SIZE — Droop from Setpoint					
					10%		20%		30%	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
2 to 5 psig / 0.14 to 0.34 bar, Yellow	2	0.14	10	0.69	10.4	0.28	18.9	0.51	27.5	0.74
			20	1.4	16.4	0.44	29.8	0.80	43.3	1.16
			60	4.1	37.1	0.99	67.5	1.81	97.9	2.62
			100	6.9	57.1	1.53	103.9	2.78	150.6	4.04
			150	10.3	82.0	2.20	149.1	4.00	216.3	5.80
	5	0.34	10	0.69	20.2	0.54	41.5	1.11	42.8	1.15
			40	2.8	59.6	1.60	121.3	3.25	121.5	3.26
			60	4.1	82.4	2.21	167.9	4.50	168.0	4.50
			80	5.5	104.9	2.81	213.6	5.72	213.6	5.72
			150	10.3	182.7	4.90	371.8	9.96	371.8	9.96
4.5 to 10 psig / 0.31 to 0.69 bar, Orange	5	0.34	10	0.69	11.4	0.31	21.4	0.57	32.0	0.86
			20	1.4	19.6	0.52	36.4	0.98	53.4	1.43
			60	4.1	45.7	1.22	84.7	2.27	123.7	3.32
			100	6.9	70.5	1.89	130.6	3.50	190.7	5.11
			150	10.3	101.2	2.71	187.5	5.02	273.8	7.34
	10	0.69	25	1.7	40.3	1.08	80.5	2.16	81.7	2.19
			40	2.8	59.9	1.60	119.1	3.19	119.7	3.21
			60	4.1	84.0	2.25	166.8	4.47	167.1	4.48
			80	5.5	107.4	2.88	213.0	5.71	213.2	5.71
			150	10.3	187.5	5.02	371.8	9.96	371.8	9.96
6 to 20 psig / 0.41 to 1.4 bar, Silver	10	0.69	15	1	16.4	0.44	32.0	0.86	51.9	1.39
			40	2.8	39.9	1.07	75.4	2.02	111.0	2.98
			80	5.5	71.4	1.91	134.0	3.59	198.0	5.31
			100	6.9	86.8	2.33	163.0	4.37	240.0	6.43
			150	10.3	125.0	3.35	235.0	6.30	344.0	9.22
	20	1.4	25	1.7	38.8	1.39	65.0	1.74	70.0	1.88
			60	4.1	102.0	4.15	163.0	4.37	164.0	4.40
			80	5.5	133.0	5.31	211.0	5.66	211.0	5.66
			150	10.3	234.0	9.22	372.0	9.97	372.0	9.97
16 to 30 psig / 1.1 to 2.1 bar, Red	20	1.4	25	1.7	24.8	0.66	50.4	1.35	70.0	1.88
			60	4.1	63.8	1.71	122.0	3.27	164.0	4.40
			80	5.5	83.0	2.22	158.0	4.23	211.0	5.66
			150	10.3	146.0	3.91	277.0	7.42	372.0	9.97
	30	2.1	35	2.4	43.0	1.15	80.6	2.16	88.2	2.36
			80	5.5	117.0	3.14	207.0	5.55	208.0	5.57
			125	8.6	178.0	4.77	313.0	8.39	314.0	8.42
			150	10.3	211.0	5.66	371.0	9.94	371.0	9.94
26 to 40 psig / 1.8 to 2.8 bar, Blue	30	2.1	35	2.4	28.9	0.78	59.6	1.60	88.2	2.36
			80	5.5	76.4	2.05	146.0	3.91	208.0	5.57
			125	8.6	116.0	3.11	220.0	5.90	314.0	8.42
			150	10.3	137.0	3.67	260.0	6.97	371.0	9.94
	40	2.8	45	3.1	43.5	1.17	96.2	2.58	106.0	2.84
			80	5.5	95.4	2.56	186.0	4.98	204.0	5.47
			100	6.9	120.0	3.22	232.0	6.22	253.0	6.78
			150	10.3	177.0	4.74	341.0	9.14	370.0	9.92
36 to 50 psig / 2.5 to 3.4 bar, Green	40	2.8	45	3.1	36.2	0.97	76.1	2.04	106.0	2.84
			80	5.5	78.1	2.09	150.0	4.02	204.0	5.47
			100	6.9	97.9	2.62	187.0	5.01	253.0	6.78
			150	10.3	145.0	3.89	276.0	7.40	370.0	9.92
	50	3.4	55	3.8	50.4	1.35	112.0	3.00	124.0	3.32
			100	6.9	116.0	3.11	227.0	6.08	248.0	6.65
			150	10.3	176.0	4.72	338.0	9.06	368.0	9.86
45 to 60 psig / 3.1 to 4.1 bar, White	50	3.4	55	3.8	43.5	1.17	92.7	2.48	124.0	3.32
			100	6.9	99.0	2.65	191.0	5.12	248.0	6.65
			150	10.3	149.0	3.99	285.0	7.64	368.0	9.86
	60	4.1	65	4.5	57.5	1.54	127.0	3.40	143.0	3.83
			100	6.9	112.0	3.00	236.0	6.32	242.0	6.49
			150	10.3	174.0	4.66	336.0	9.00	365.0	9.78

- Gray areas indicate maximum flow capacity.
1. Outlet pressure setting was made at approximately 10% of the maximum capacity for the listed conditions.

Table 7. Flow and Sizing Coefficient

PERCENT CAPACITY	WIDE-OPEN C_g	WIDE-OPEN C_v	C_1	IEC SIZING COEFFICIENT X_T	IEC SIZING COEFFICIENT F_D	IEC SIZING COEFFICIENT F_L
25%[1]	490	17.4	28.2	0.78	0.72	0.89
40%[1]	760	26.1	29.1			
60%[1]	1150	36.2	31.8			
100%	1800	51.4	35.0			

1. Using optional restriction collar.

See 133 Series Product Bulletin for restricted capacities in 25%, 40% or 60% of standard wide-open capacity.

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167D Series

Switching Valve

Introduction

The 167D Series switching valves are typically used to deliver constant reduced pressure of gaseous fluids to pilot-operated controllers and other pneumatic instrumentation.

Available Configurations

Types 167D and 167DS:
Two-way switching valves
Types 167DA and 167DAS:
Three-way switching valves

Body Size, Inlet, and Outlet Connection Style

Ports A and C: 1/4 or 1/2 NPT
Vent and Control Pressure Connections (Port D) and Port B: 1/4 NPT

Maximum Operating Inlet Pressure

Types 167D and 167DS:
400 psig / 27.6 bar
Types 167DA and 167DAS:
125 psig / 8.6 bar
Types 167DA and 167DAS (NACE):
100 psig / 6.9 bar

Set Pressure Ranges

See Tables 1 and 2

Maximum Diaphragm Pressure

150 psi / 10.3 bar over outlet pressure setting up to a maximum of 250 psi / 17.2 bar

Flow and Sizing Coefficients

See Table 3

Spring Case Vent Location

Aligned with inlet standard, other positions optional

Temperature Capabilities

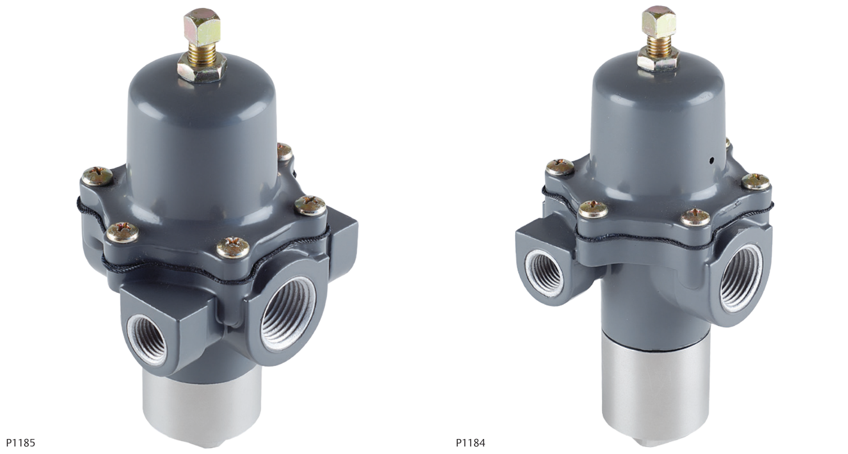
Nitrile (NBR)
Standard Service (Types 167D and 167DA only): -20 to 180°F / -29 to 82°C
Low Temperature Service (Types 167D and 167DA only) and Standard Service (Types 167DS and 167DAS only):
-40 to 180°F / -40 to 82°C
Fluorocarbon (FKM)
High Temperature Service:
0 to 300°F / -18 to 149°C

Approximate Weights

Types 167D and 167DA:
1.2 lbs / 0.5 kg
Types 167DS and 167DAS:
2.8 lbs / 1 kg

Ordering Guide

To order this product, contact your local Sales Office.



TYPE 167D TWO-WAY SWITCHING VALVE

TYPE 167DA THREE-WAY SWITCHING VALVE

Figure 1. *167D Series Switching Valves*

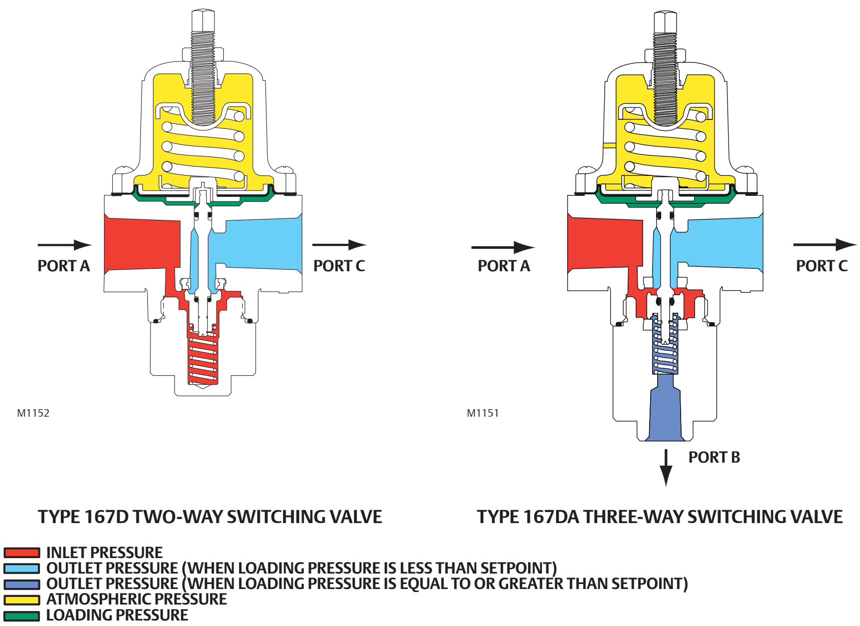


Figure 2. *167D Series Operational Schematics (Port D not shown)*

Features

- Compact
- Easy, Accurate Adjustment
- Sour Gas Service Capability
- Optional Stainless Steel Construction
- Ease of Maintenance
- Rugged Construction
- Corrosion Resistant Fasteners
- Optional Handwheel Adjusting Screw

Application

Air

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Three-Way Switching Valves Set Pressure Ranges and Control Spring Data

TYPE	SET PRESSURE RANGE				CONTROL SPRING DATA						MAXIMUM PRESSURE CHANGE ON TO SHIFT FROM PORT B CLOSED TO PORT C CLOSED	
	Port A or C as Inlet		Port B as Inlet		Color Code	Material	Wire Diameter		Free Length			
	psig	bar	psig	bar			Inch	mm	Inch	mm	psid	bar d
167DA	14 to 20 16 to 35	0.97 to 1.4 1.1 to 2.4	7 to 20 10 to 30	0.48 to 1.4 0.69 to 2.1	White stripe Purple stripe	Zinc-plated Music Wire	0.145 0.156	3.68 3.96	1.425	36.2	10 13	0.69 0.90
	25 to 60 40 to 125	1.7 to 4.1 2.8 to 8.6	25 to 50 40 to 90	1.7 to 3.4 2.8 to 6.2	Brown stripe Pink stripe	Chrome Silicon	0.172 0.207	4.37 5.26			17 35	1.2 2.4
167DAS	14 to 20 16 to 35 25 to 60 40 to 125	0.97 to 1.4 1.1 to 2.4 1.7 to 4.1 2.8 to 8.6	7 to 20 10 to 30 25 to 50 40 to 90	0.48 to 1.4 0.69 to 2.1 1.7 to 3.4 2.8 to 6.2	White Purple Brown Pink	Inconel® X-750	0.148 0.162 0.177 0.218	3.76 4.12 4.50 5.54	1.750	44.4	8 12 16 31	0.55 0.83 1.1 2.1

Table 2. Two-Way Switching Valves Set Pressure Ranges and Control Spring Data

TYPE	SET PRESSURE RANGE		CONTROL SPRING DATA					
	Port A as Inlet		Color Code	Material	Wire Diameter		Free Length	
	psig	bar			Inch	mm	Inch	mm
167D	3 to 15 5 to 20 5 to 35	0.21 to 1.0 0.34 to 1.4 0.34 to 2.4	Yellow stripe White stripe Purple stripe	Zinc-plated Music Wire	0.142 0.145 0.156	3.61 3.68 3.96	1.425	36.2
	25 to 60 40 to 125	1.7 to 4.1 2.8 to 8.6	Brown stripe Pink stripe	Chrome Silicon	0.172 0.207	4.37 5.26		
167DS	5 to 20 5 to 35 25 to 60 40 to 125 50 to 150	0.34 to 1.4 0.34 to 2.4 1.7 to 4.1 2.8 to 8.6 3.4 to 10.3	White Purple Brown Pink Gold	Inconel® X-750	0.148 0.162 0.177 0.218 0.234	3.76 4.12 4.50 5.54 5.94	1.750	44.4

Table 3. Flow and Sizing Coefficients

TYPES	BODY SIZE	PORT	WIDE-OPEN FLOW COEFFICIENTS		C_1	IEC SIZING COEFFICIENT
			C_g	C_v		X_t
167D, 167DS	1/4 NPT	C	41.46	1.09	37.56	0.89
	1/2 NPT		46.50	1.18	39.03	0.96
167DA, 167DAS	All sizes	B	27.79	0.96	28.74	0.52
	1/4 NPT	C	49.35	1.60	30.58	0.59
	1/2 NPT		58.86	1.81	32.22	0.66

Table 4. Construction Materials

PART NAME	TYPES	
	167D and 167DA	167DS and 167DAS
BODY AND SPRING CASE	Aluminum (ASTM B85/Alloy 380)	CF8M/CF3M Stainless steel
SPRING RETAINER	Aluminum	316L Stainless steel
UPPER SPRING SEAT	Zinc-plated steel	316 Stainless steel
DIAPHRAGM PLATE	Chromate conversion coated Aluminum	
CONTROL SPRING	Zinc-plated steel and Chrome Silicon	Inconel® X-750
VALVE STEM	Brass or 316L Stainless Steel	316L Stainless steel
VALVE PLUG		
VALVE SPRING	302 Stainless steel or Inconel® X-750 (NACE)	
DIAPHRAGM, O-RINGS, AND SOFT SEAT	Nitrile (NBR) or Fluorocarbon (FKM)	
BOLTING, ADJUSTING SCREW	Zinc-plated steel	Zinc-plated steel or 316 Stainless steel
HEXNUT	Zinc-plated steel or 316 Stainless steel	316 Stainless steel
HANDWHEEL	Zinc-plated steel screw with resin handwheel	

Types 168, 168H and 68-2

Three-Way Switching Valve

FISHER

Introduction

The Types 168 and 168H three-way, snap-acting switching valves provide fast, positive switching of pneumatic pressures in response to a predetermined change in a pneumatic input signal. These switches can be used to open and close pneumatically operated control valves, to load or exhaust pneumatic systems, or to operate a variety of pneumatic equipment.

The Type 68-2 is a three-way, snap-acting switching valve that forms the valve body portion of the Types 168 and 168H switching valves. A manual reset switch may be adapted to the Types 168 and 168H switching valves to provide for manual reset. An extension of the trip lever allows the Type 68-2 to be used as a manual switching valve.

Available Configurations

Type 68-2: Manual 3-way switching valve
Types 168 and 168H: Pneumatically operated 3-way, snap-acting switching valve; See Table 1

Pressure Connections

1/4 NPT internal

Port Diameter

3/32 in. / 2.4 mm

Diaphragm Pressure Ranges

Type 168: 2 to 60 psig / 138 mbar to 4.1 bar in four ranges.
Type 168H: 35 to 150 psig / 2.4 to 10.3 bar in four ranges.

Maximum Allowable Pressures

See Table 1

Flow Coefficients

C_g: 7
Representative C_1: 35

Temperature Capabilities

-10 to 150°F / -23 to 66°C

Approximate Weights

Type 68-2: 0.5 lb / 0.23 kg
Type 168: 3 lbs / 1.36 kg
Type 168H: 5 lbs / 2.27 kg

Ordering Guide

To order this product, contact your local Sales Office.

Features

- **Fast, Positive Switching Action**
- **Full Adjustability**
- **Three-Way or On/Off Action**
- **Suitable for Sour Gas Service**
- **Automatic or Manual Reset**

Figure 1. *Type 168 Switching Valve and Type 68-2 Trip Lever*

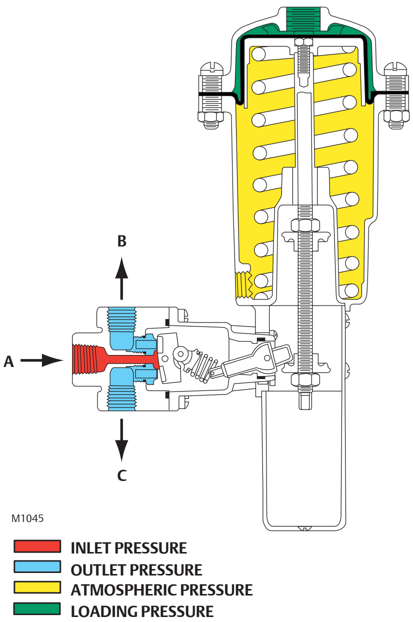

Figure 2. *Type 168 Operational Schematic*

Application

- Air

Table 1. Maximum Pressures and Spring Colors

TYPE	DIAPHRAGM PRESSURE CHANGE BETWEEN SWITCHING POINTS, psig / bar		DIAPHRAGM PRESSURE RANGES	DIAPHRAGM SPRING COLOR	MAXIMUM ALLOWABLE BODY PRESSURE	BODY SPRING COLOR
	min	max				
68-2	----	----	----	----	150 psig / 10.3 bar	Unpainted
168-1	10 / 0.69	58 / 4.0	2 to 60 psig / 0.14 to 4.1 bar	Green	150 psig / 10.3 bar	Unpainted
168-2	10 / 0.69	38 / 2.6	2 to 40 psig / 0.14 to 2.8 bar	Yellow	150 psig / 10.3 bar	Unpainted
168-3	10 / 0.69	58 / 4.0	2 to 60 psig / 0.14 to 4.1 bar	Green	40 psig / 2.8 bar	Yellow
168-4	7 / 0.48	38 / 2.6	2 to 40 psig / 0.14 to 2.8 bar	Yellow	40 psig / 2.8 bar	Yellow
168H-1	20 /1.38	100 / 6.9	50 to 150 psig / 3.4 to 10.3 bar	Green	150 psig / 10.3 bar	Unpainted
168H-2	20 / 1.38	65 / 4.5	35 to 100 psig / 2.4 to 6.9 bar	Yellow	150 psig / 10.3 bar	Unpainted
168H-3	20 / 1.38	100 / 6.9	50 to 150 psig / 3.4 to 10.3 bar	Green	40 psig / 2.8 bar	Yellow
168H-4	16 / 1.10	65 / 4.5	35 to 100 psig / 2.4 to 6.9 bar	Yellow	40 psig / 2.8 bar	Yellow

Table 2. Construction Materials

PART	MATERIAL
Body and Cases	Aluminum
Diaphragm	Dacron® covered with Nitrile (NBR)
Seat Rings, Stem and Adjusting Nuts, Valve Spring, Trip Lever	Stainless steel
Stem Bushing	Steel and Polytetrafluoroethylene (PTFE)
Rocker Assembly	Glass-filled Nylon (PA) with polyurethane valve disks
O-rings	Nitrile (NBR)
Actuator Spring	Steel
Stem Protector	Plastic

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Introduction
The 299H Series pressure reducing regulators provide a broad capacity of controlled pressure ranges and capacities in a wide variety of distribution, industrial and commercial applications. A 299H Series regulator has a pilot integrally mounted to the actuator casing. The 299H Series regulators can handle inlet pressures up to 175 psig / 12.1 bar depending on orifice size.

Available Configuration
See Table 1

Body Size and End Connection Styles
See Table 2

Construction Materials
See Table 3

Maximum Operating Inlet Pressure by Orifice Size
See Table 4

Maximum Casing and Emergency Outlet Pressure
66 psig / 4.5 bar

Outlet (Control) Pressure Ranges[1]
See Table 5

Flow Coefficients
See Table 6

Flow Capacities
See Tables 7 to 12

Pressure Control Accuracy (Fixed Factor) (PFM)
±1%[2] of absolute control pressure

Token Relief Start-To-Discharge
See Figure 5

Minimum Differential Pressure For Full stroke
1.5 psid / 0.10 bar d

Temperature Capabilities[2]
-20 to 150°F / -29 to 66°C

Approximate Weight
21 lbs / 10 kg

Pressure Registration
Internal, External or Dual Registration
See Figures 3 and 4

Fixed Restriction Sizes
0.044 In. / 1.1 mm, Red (**standard** gain)
0.071 In. / 1.8 mm, Green (low gain)
0.082 In. / 2.1 mm, Blue (lower gain)

Maximum Set Pressure for Types 299HS and 299HV
16 psig / 1.1 bar

Types VSX2 and VSX8 Sensing Line Connection
1/4 NPT

Slam-Shut Configurations
See Types VSX2, VSX8 and 299H Instruction Manuals for spring ranges and maximum/minimum pressure ratings

Additional Options
Filter[3]: A P590 Series filter installed in the pilot supply tubing between main body and pilot
Filtered pilot supply regulator[3][4]: A Type 67CF supply regulator with integral 5 micron Polyethylene filter

Ordering Guide
To order this product, contact your local Sales Office.

Features
- **Inlet Pressure up to 175 psig / 12.1 bar**
- **Compact**
- **Integral Pilot**
- **Rugged Construction**
- **Easy to Maintain**
- **High Capacity**
- **Robust**
- **Outlet Pressures up to 60 psig / 4.1 bar**
- **Optional Slam-Shut Configuration**
- **No Bleed Monitor**
- **External, Internal or Dual Registration**
- **Optional Token Relief**

Figure 1. *299H Series Pressure Reducing Regulators*

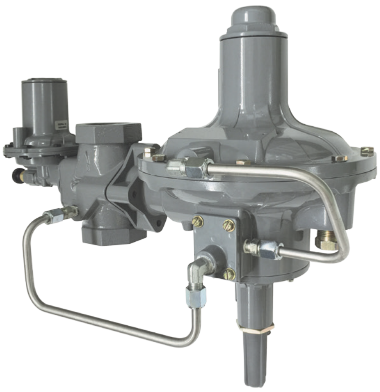

Figure 2. *299HS/299HV Series Pressure Reducing Regulators*

Application
Fuel Gas

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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1. For optimum performance, a pilot supply regulator may be installed in the pilot supply tubing between the main valve and pilot.
2. Product has passed Emerson testing for lockup, relief start-to-discharge and reseal down to -40°.
3. A pilot supply regulator or a P590 Series filter (only one may be used, not both) may be ordered with the Type 299H, but not both.
4. For In. w.c., use a pilot supply regulator if actual inlet pressure varies more than ±20 psi / ±1.4 bar and published accuracy is required.

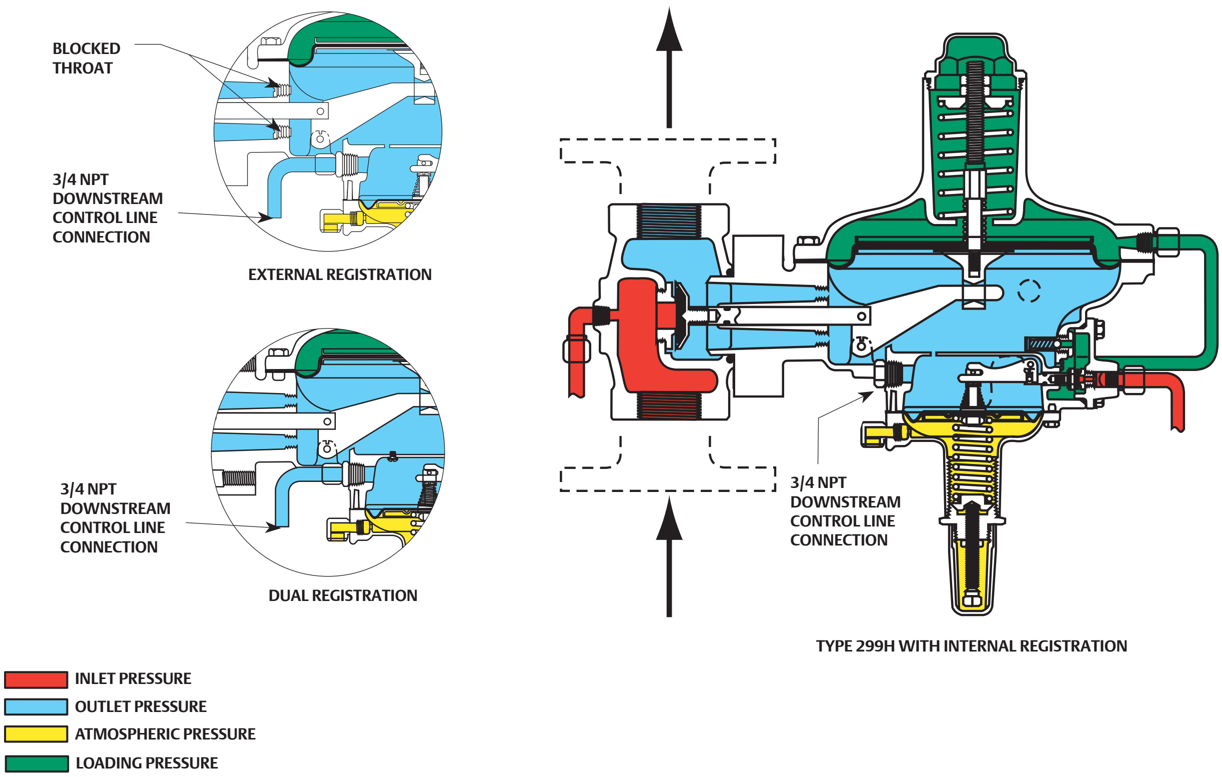

Figure 3. *Type 299H Operational Schematic*

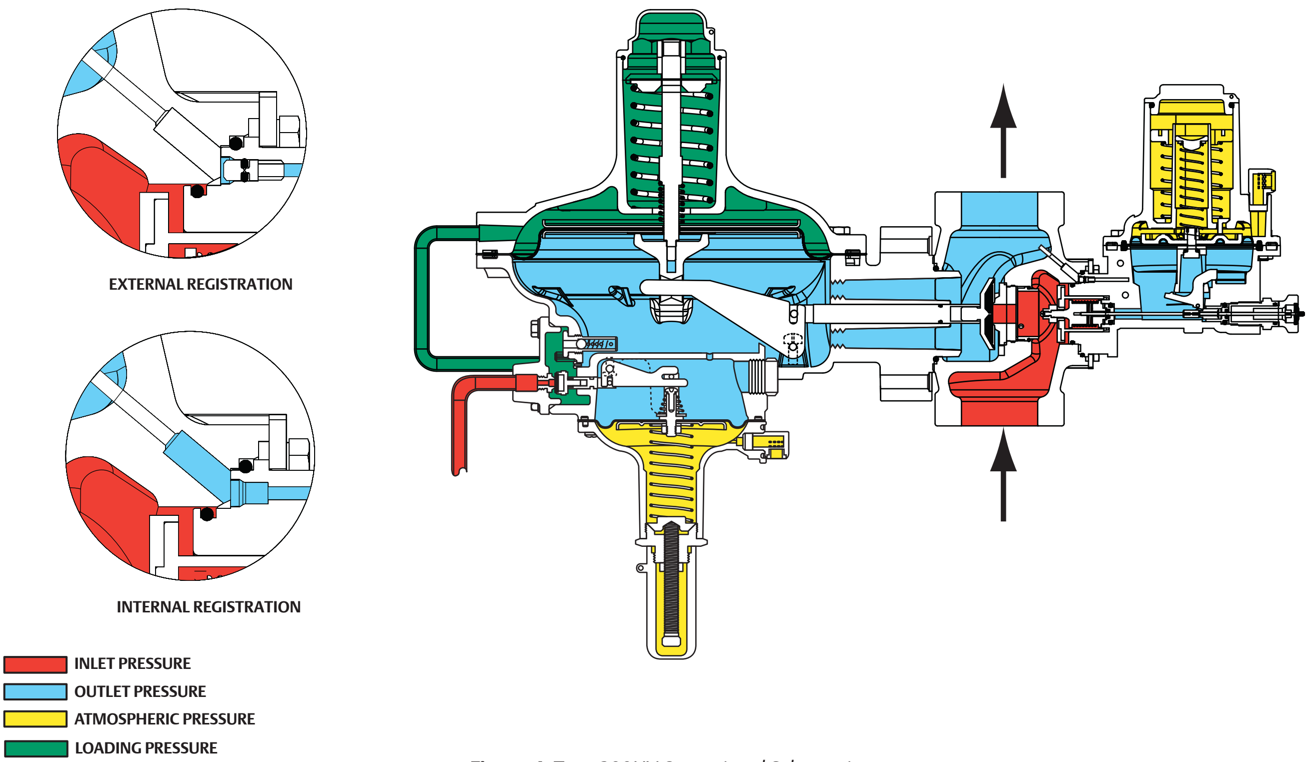

Figure 4. *Type 299HV Operational Schematic*

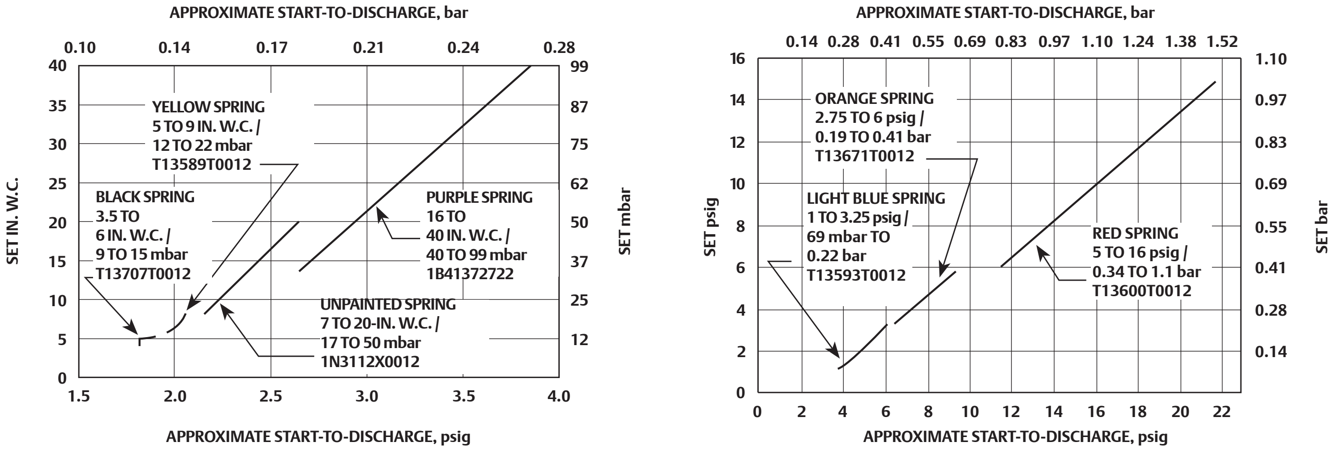

Figure 5. *Type 299HR Approximate Start-to-Discharge*

Table 1. Available Configurations

TYPE	CONFIGURATION
299H	Pilot-operated pressure reducing regulator with a pilot integrally mounted to the actuator casing.
299HR	A Type 299H with a token internal relief valve to relieve minor overpressure caused by thermal expansion.
299HS	Same as the Type 299H with a Type VSX2 slam-shut valve which provides overpressure or overpressure and underpressure protection.
299HV	Same as the Type 299H with a Type VSX8 slam-shut valve which provides overpressure or overpressure and underpressure protection.
299HSR	Same as the Type 299HS with an internal token relief valve.
299HVR	Same as the Type 299HV with an internal token relief valve.

Table 2. Body Size and End Connection Style

BODY SIZE, NPS / DN	BODY MATERIAL AND END CONNECTION STYLE		
	Cast Iron (For Types 299H and 299HR only)	Ductile Iron	Steel (For Types 299H and 299HR only)
1-1/4 1-1/2	NPT NPT	- - - - NPT	- - - - NPT
2 / 50	NPT, CL125 FF Flanged(1)	NPT, CL125 FF and CL250 RF Flanged, PN 10/16 Flanged	NPT, CL150 RF Flanged

1. This flange is available with a face-to-face dimension of 7.5 or 10 In. / 191 or 254 mm.

Table 3. Construction Materials

VALVE BODY	ACTUATOR CASING AND PILOT SPRING CASE	DIAPHRAGM, DISK AND O-RING	ORIFICE, VALVE STEM AND DISK HOLDER	TUBING AND FITTING
Cast iron, Ductile iron or Steel	Aluminum	Nitrile (NBR)	Aluminum	Stainless steel tubing with steel fittings (**Standard**) or Stainless steel tubing and fittings

Table 4. Maximum Operating Inlet Pressure(1)

ORIFICE SIZE		MAXIMUM OPERATING INLET PRESSURE	
In.	mm	psig	bar
1/4 x 3/8	6.4 x 9.5	175	12.1
3/8	9.5	175	12.1
1/2	13	175	12.1
3/4	19	150	10.3
7/8(2)	22(2)	125	8.6
1(2)	25(2)	100	6.9
1-3/16(2)	30(2)	80	5.5

1. The pressure/temperature limits in this document and any applicable standard or code limitation should not be exceeded.
2. This orifice size is not available for Types 299HS, 299HV, 299HSR and 299HVR .

Table 5. Outlet Pressure Ranges

OUTLET (CONTROL) PRESSURE RANGE		TYPE		PILOT CONTROL SPRING				
					Free Length		Wire Diameter	
in. w.c.	mbar	299H	299HR, 299HS, 299HSR, 299HV and 299HVR	Color	In.	mm	In.	mm
3.5 to 6[1]	9 to 15[1]	X	X	Black	1.86	47.2	0.055	1.40
5 to 9[1]	12 to 22[1]	X	X	Yellow	2.05	52.1	0.051	1.30
7 to 20[1]	17 to 50[1]	X	X	Unpainted	2.18	55.4	0.075	1.90
16 to 40[1]	40 to 99[1]	X	X	Purple	2.12	53.8	0.092	2.34
1 to 3.25 psig	69 mbar to 0.22 bar	X	X	Light blue	2.12	53.8	0.105	2.67
2.75 to 6 psig	0.19 to 0.41 bar	X	X	Orange	2.40	61.0	0.120	3.05
5 to 16 psig	0.34 to 1.1 bar	X	X	Red	2.10	53.3	0.142	3.61
14 to 35 psig	0.97 to 2.4 bar	X	- - - -	Zinc	2.15	54.6	0.207	5.26
30 to 60 psig	2.1 to 4.1 bar	X	- - - -	Green	2.75	69.8	0.225	5.71

1. Use a pilot supply regulator if actual inlet pressure varies more than ±20 psi / ±1.4 bar and the published accuracy is required.

Table 6. Flow Coefficients

TYPE	ORIFICE DIAMETER		WIDE-OPEN		REGULATING[1]		C_1 WHEN $\Delta P < 10$ PSI / 0.69 BAR	C_1 WHEN $\Delta P > 10$ PSI / 0.69 BAR
	In.	mm	C_g	C_v	C_g	C_v		
299H/299HR	1/4 x 3/8	6.4 x 9.5	53	2.0	50	1.9	26	26
	3/8	9.5	117	4.2	115	4.0	30	28
	1/2	13	203	7.0	200	6.9	30	28
	3/4	19	437	14.1	430	13.9	32	30
	7/8	22	544	16.5	534	16.2	34	32
	1	25	725	20.7	710	20.3	36	34
	1-3/16	30	910	25.3	885	24.6	37	35
299HS, 299HV, 299HSR and 299HVR	1/4 x 3/8	6.4 x 9.5	53	2.0	50	1.9	26	26
	3/8	9.5	117	4.1	115	4.0	30	28
	1/2	13	184	5.0	180	4.9	38	36
	3/4	19	421	11.9	415	11.7	36	35

1. For external/dual registration only.

Table 7. Types 299H and 299HR Flow Capacities[1] for 1-1/2 NPT and NPS 2 / DN 50 External/Dual Registration

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS													
			Orifice Size, In. / mm													
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		7/8 / 22		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
3.5 to 6 in. w.c. / 9 to 15 mbar; 3.5 in. w.c. / 9 mbar; -1 to 2 in. w.c. / -2 to 5 mbar; T13707T0012 Black	2	0.14	760	20.4	1560	41.8	2700	72.4	5490	147	6460	173	8170	219	9940	266
	5	0.34	1160	31.1	2460	65.9	4270	114	8790	236	10,350	277	13,310	357	16,250	436
	10	0.69	1590	42.6	3580	95.9	6230	167	13,060	350	15,270	409	20,300	544	24,900	667
	15	1.0	1920	51.4	4410	118	7670	206	16,480	442	19,450	521	25,780	691	31,730	850
	20	1.4	2240	60.0	5150	138	8960	240	19,250	516	24,110	646	31,790	852	39,620	1062
	25	1.7	2570	68.9	5890	158	10,250	275	22,030	590	27,110	727	36,370	975	45,330	1215
	30	2.1	2890	77.4	6640	178	11,540	309	24,800	665	31,110	834	40,950	1097	51,040	1368
	40	2.8	3530	94.6	8120	218	14,120	378	30,350	813	38,100	1021	50,100	1343	62,450	1674
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	59,260	1588	73,870	1980
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
5 to 9 in. w.c. / 12 to 22 mbar; 7 in. w.c. / 17 mbar; -1 to 2 in. w.c. / -2 to 5 mbar; T13589T0012 Yellow	2	0.14	750	20.1	1520	40.7	2650	71.0	5380	144	6270	168	8000	214	9730	261
	5	0.34	1160	31.1	2440	65.4	4240	114	8730	234	10,250	275	13,220	354	16,130	432
	10	0.69	1590	42.6	3580	95.9	6220	167	13,040	349	15,220	408	20,250	543	24,830	665
	15	1.0	1920	51.4	4410	118	7670	206	16,480	442	19,420	520	25,750	690	31,690	849
	20	1.4	2240	60.0	5150	138	8960	240	19,250	516	24,110	646	31,790	852	39,620	1062
	25	1.7	2570	68.9	5890	158	10,250	275	22,030	590	27,110	727	36,370	975	45,330	1215
	30	2.1	2890	77.4	6640	178	11,540	309	24,800	665	31,110	834	40,950	1097	51,040	1368
	40	2.8	3530	94.6	8120	218	14,120	378	30,350	813	38,100	1021	50,100	1343	62,450	1674
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	59,260	1588	73,870	1980
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

- continued -

Table 7. Types 299H and 299HR Flow Capacities[1] for 1-1/2 NPT and NPS 2 / DN 50 External/Dual Registration (continued)

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS														
			Orifice Size, In. / mm														
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		7/8 / 22		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
7 to 20 in. w.c. / 17 to 50 mbar 14 in. w.c. / 35 mbar ±2 in. w.c./ ±5 mbar 1N3112X0012 Unpainted	2	0.14	700	18.8	1430	38.3	2480	66.5	5040	135	5850	157	7480	200	9090	244
	5	0.34	1140	30.5	2400	64.3	4170	112	8570	230	10,040	269	12,950	347	15,800	423
	10	0.69	1580	42.3	3560	95.4	6190	166	12,970	348	15,110	405	20,110	539	24,640	660
	15	1.0	1920	51.4	4410	118	7670	206	16,480	442	19,350	519	25,660	688	31,560	846
	20	1.4	2240	60.0	5150	138	8960	240	19,250	516	24,110	646	31,790	852	39,620	1062
	25	1.7	2570	68.9	5890	158	10,250	275	22,030	590	27,110	727	36,370	975	45,330	1215
	30	2.1	2890	77.4	6640	178	11,540	309	24,800	665	31,110	834	40,950	1097	51,040	1368
	40	2.8	3530	94.6	8120	218	14,120	378	30,350	813	38,100	1021	50,100	1343	62,450	1674
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	59,260	1588	73,870	1980
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
16 to 40 in. w.c. / 40 to 99 mbar 28 in. w.c. / 70 mbar ±4 in. w.c. / ±10 mbar 1B413727222 Purple	5	0.34	1110	29.7	2320	62.2	4020	108	8250	221	9580	257	12,430	333	15,150	406
	10	0.69	1570	42.1	3530	94.6	6140	165	12,830	344	14,870	399	19,830	531	24,290	651
	15	1.0	1920	51.4	4410	118	7670	206	16,170	433	19,220	515	25,480	683	31,320	839
	20	1.4	2240	60.0	5150	138	8960	240	19,250	516	24,110	646	30,670	822	37,820	1014
	25	1.7	2570	68.9	5890	158	10,250	275	22,030	590	27,110	727	36,370	975	45,330	1215
	30	2.1	2890	77.4	6640	178	11,540	309	24,800	665	31,110	834	40,950	1097	51,040	1368
	40	2.8	3530	94.6	8120	218	14,120	378	30,350	813	38,100	1021	50,100	1343	62,450	1674
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	59,260	1588	73,870	1980
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
1 to 3.25 psig / 69 mbar to 0.22 bar 2 psig / 0.14 bar ±1% psia / bar T13593T0012 Light Blue	5	0.34	1020	27.3	2100	56.4	3640	97.5	7440	199	8650	232	11,140	299	13,560	363
	10	0.69	1550	41.5	3340	89.5	5810	156	12,040	323	14,410	386	18,460	495	22,570	605
	15	1.0	1920	51.4	4360	117	7580	203	15,990	429	18,950	508	25,050	671	30,760	824
	20	1.4	2240	60.0	5150	138	8960	240	19,250	516	24,110	646	30,380	814	37,410	1003
	25	1.7	2570	68.9	5890	158	10,250	275	22,030	590	27,110	727	36,370	975	45,330	1215
	30	2.1	2890	77.4	6640	178	11,540	309	24,800	665	31,110	834	40,950	1097	51,040	1368
	40	2.8	3530	94.6	8120	218	14,120	378	30,350	813	38,100	1021	50,100	1343	62,450	1674
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	59,260	1588	73,870	1980
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
2.75 to 6 psig / 0.19 to 0.41 bar 5 psig / 0.34 bar ±1% psia / bar T13671T0012 Orange	10	0.69	1390	37.2	2910	78.0	5050	135	10,350	277	12,700	340	15,600	418	19,030	510
	15	1.0	1870	50.1	4190	112	7280	195	15,150	406	17,950	481	23,310	625	28,530	765
	20	1.4	2240	60.0	5090	136	8850	237	18,640	500	22,970	616	29,180	782	35,820	960
	25	1.7	2570	68.9	5890	158	10,250	275	22,030	590	27,110	727	34,550	926	42,530	1140
	30	2.1	2890	77.4	6640	178	11,540	309	24,800	665	31,110	834	40,950	1097	51,040	1368
	40	2.8	3530	94.6	8120	218	14,120	378	30,350	813	38,100	1021	50,100	1343	62,450	1674
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	59,260	1588	73,870	1980
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

- continued -

Table 7. Types 299H and 299HR Flow Capacities(1) for 1-1/2 NPT and NPS 2 / DN 50 External/Dual Registration (continued)

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS													
			Orifice Size, In. / mm													
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		7/8 / 22		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 16 psig / 0.34 to 1.1 bar 10 psig / 0.69 bar ±1% psia / bar T13600T0012 Red	15	1.0	1580	42.3	3280	87.9	5690	152	11,640	312	12,640	339	17,470	468	21,280	570
	20	1.4	2130	57.1	4720	126	8210	220	17,000	456	20,380	546	25,940	695	31,690	849
	25	1.7	2540	68.1	5710	153	9930	266	20,790	557	24,570	658	32,220	863	39,480	1058
	30	2.1	2890	77.4	6640	178	11,540	309	24,150	647	29,540	792	37,900	1016	46,550	1248
	40	2.8	3530	94.6	8120	218	14,120	378	30,350	813	38,100	1021	50,100	1343	62,450	1674
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	59,260	1588	73,870	1980
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
5 to 16 psig / 0.34 to 1.1 bar 15 psig / 1.0 ba ±1% psia / bar T13600T0012 Red	20	1.4	1750	46.9	3620	97.0	6290	169	12,830	344	15,830	424	19,190	514	23,360	626
	25	1.7	2360	63.2	5220	140	9070	243	18,700	501	22,040	591	28,360	760	34,610	928
	30	2.1	2820	75.6	6290	169	10,940	293	22,790	611	27,870	747	35,050	939	42,890	1149
	40	2.8	3530	94.6	8120	218	14,120	378	29,650	795	36,530	979	46,610	1249	57,270	1535
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	44,100	1182	57,080	1530	70,350	1885
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	68,420	1834	85,290	2286
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
14 to 35 psig / 0.97 to 2.4 bar 20 psig / 1.4 bar ±1% psia / bar 19B0432X012 Zinc	25	1.7	1920	51.4	3930	105	6840	183	13,930	373	14,960	401	20,800	557	25,310	
	30	2.1	2580	69.1	5680	152	9870	265	20,280	544	24,090	646	30,630	821	37,340	
	40	2.8	3480	93.3	7830	210	13,610	365	28,440	762	34,480	924	43,980	1179	53,880	
	50	3.4	4180	112	9600	257	16,700	448	35,140	942	41,940	1124	55,310	1482	67,980	
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	51,090	1369	65,780	1763	81,060	
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
14 to 35 psig / 0.97 to 2.4 bar 25 psig / 1.7 bar ±1% psia / bar 19B0432X012 Zinc	30	2.1	2070	55.5	4230	113	7360	197	14,980	401	18,330	491	22,310	598	27,140	727
	40	2.8	3320	89.0	7350	197	12,780	343	26,420	708	32,120	861	40,220	1078	49,120	1316
	50	3.4	4140	111	9340	250	16,250	436	34,040	912	40,400	1083	52,830	1416	64,770	1736
	60	4.1	4820	129	11,090	297	19,280	517	40,630	1089	48,920	1311	64,010	1715	78,690	2109
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	86,740	2325	108,120	2898
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
14 to 35 psig / 0.97 to 2.4 bar 30 psig / 2.1 bar ±1% psia / bar 19B0432X012 Zinc	40	2.8	2980	79.9	6520	175	11,330	304	23,190	621	27,330	732	34,790	932	42,370	1136
	50	3.4	4020	108	8950	240	15,560	417	32,300	866	37,410	1003	49,460	1326	60,480	1621
	60	4.1	4800	129	10,850	291	18,870	506	39,600	1061	46,980	1259	61,630	1652	75,590	2026
	80	5.5	6110	164	14,050	377	24,440	655	52,540	1408	65,080	1744	83,170	2229	102,470	2746
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
14 to 35 psig / 0.97 to 2.4 bar 35 psig / 2.4 bar ±1% psia / bar 19B0432X012 Zinc	40	2.8	2350	63.0	4790	128	8330	223	16,920	453	20,530	550	25,150	674	30,580	820
	50	3.4	3770	101	8300	222	14,430	387	29,690	796	34,220	917	44,890	1203	54,750	1467
	60	4.1	4700	126	10,510	282	18,270	490	38,050	1020	44,960	1205	58,520	1568	71,620	1919
	80	5.5	6110	164	14,050	377	24,440	655	51,600	1383	62,470	1674	81,400	2182	100,090	2682
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	79,060	2119	105,060	2816		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	96,050	2574				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

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Table 7. Types 299H and 299HR Flow Capacities[1] for 1-1/2 NPT and NPS 2 / DN 50 External/Dual Registration (continued)

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — Orifice Size, In. / mm													
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		7/8 / 22		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
30 to 60 psig / 2.1 to 4.1 bar 40 psig / 2.8 bar ±1% psia / bar 19B0432X022 Green	50	3.4	3340	89.5	7290	195	12,670	340	25,840	693	30,500	817	38,590	1034	46,950	1258
	60	4.1	4500	121	9970	267	17,340	465	35,820	960	42,700	1144	54,480	1460	66,530	1783
	80	5.5	6100	163	13,840	371	24,070	645	50,670	1358	61,300	1643	79,160	2121	97,160	2604
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	77,250	2070	100,560	2695		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	95,700	2565				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
30 to 60 psig / 2.1 to 4.1 bar 50 psig / 3.4 bar ±1% psia / bar 19B0432X022 Green	60	4.1	3680	98.6	7990	214	13,900	373	28,290	758	33,300	892	42,110	1129	51,210	1372
	80	5.5	5900	158	13,170	353	22,900	614	47,570	1275	57,000	1528	72,950	1955	89,220	2391
	100	6.9	7400	198	16,830	451	29,260	784	61,700	1654	74,800	2005	96,630	2590		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077	94,400	2530				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								
30 to 60 psig / 2.1 to 4.1 bar 60 psig / 4.1 bar ±1% psia / bar 19B0432X022 Green	80	5.5	5380	144	11,810	317	20,540	550	42,160	1130	50,000	1340	63,540	1703	77,440	2075
	100	6.9	7260	195	16,270	436	28,290	758	59,000	1581	70,900	1900	90,970	2438		
	125	8.6	9020	242	20,730	556	35,860	961	75,900	2034	92,300	2474				
	150	10.3	10,630	285	24,440	655	42,500	1139	91,360	2448						
	175	12.1	12,240	328	28,150	754	48,950	1312								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

Table 8. Types 299H and 299HR Flow Capacities[1] for 1-1/2 NPT Internal Registration

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — ORIFICE SIZE, IN. / mm											
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
3.5 to 6 in. w.c. / 9 to 15 mbar 3.5 in. w.c. / 9 mbar -1 to 2 in. w.c. / -2 to 5 mbar T13707T0012 Black	2	0.14	760	20.4	1560	41.8	2700	72.4	4050	109	4340	116	4540	122
	5	0.34	1200	32.2	2600	69.7	4500	121	8490	228	10,690	286	7290	195
	10	0.69	1700	45.6	3800	102	6500	174	7140	191	8570	230	10,570	283
	15	1.0	2000	53.6	4600	123	8000	214	7120	191	10,860	291	9020	242
	20	1.4	2350	63.0	5300	142	9250	248	7060	189	11,250	302	9810	263
	25	1.7	2700	72.4	6000	161	10,010	268	7100	190	11,170	299	9760	262
	30	2.1	3040	81.5	6740	181	10,330	277	8030	215	11,660	312	9700	260
	40	2.8	3700	99.2	8200	220	11,640	312	9610	258	10,790	289	11,150	299
	50	3.4	4400	118	9700	260	11,650	312	10,530	282	9460	254	10,100	271
	60	4.1	5100	137	11,200	300	11,380	305	11,590	311	9010	241	10,200	273
	80	5.5	4700	126	4680	125	4510	121	15,210	408	6250	168	8900	239
	100	6.9	4300	115	3040	81.5	3990	107	14,510	389	7700	206		
	125	8.6	4300	115	3200	85.8	4390	118	8640	232				
	150	10.3	4320	116	3200	85.8	4810	129	2650	71.0				
	175	12.1	5600	150	5050	135	7300	196						
5 to 9 in. w.c. / 12 to 22 mbar 7 in. w.c. / 17 mbar -1 to 2 in. w.c. / -2 to 5mbar T13589T0012 Yellow	2	0.14	750	20.1	1520	40.7	2650	71.0	5380	144	5610	150	5790	155
	5	0.34	1300	34.8	2600	69.7	4250	114	7110	191	7600	204	6620	177
	10	0.69	1600	42.9	3800	102	6500	174	8150	218	8210	220	10,320	277
	15	1.0	2000	53.6	4400	118	8000	214	6180	166	10,770	289	9040	242
	20	1.4	2300	61.6	5100	137	9500	255	6520	175	11,510	308	9510	255
	25	1.7	2600	69.7	5800	155	10,660	286	6190	166	10,920	293	9850	264
	30	2.1	2970	79.6	6600	177	10,410	279	7420	199	10,850	291	10,080	270
	40	2.8	3700	99.2	8200	220	10,170	273	12,030	322	10,310	276	10,170	273
	50	3.4	4400	118	9700	260	11,170	299	12,160	326	10,430	280	10,000	268
	60	4.1	5100	137	11,200	300	11,710	314	10,620	285	8230	221	10,200	273
	80	5.5	4850	130	4700	126	4570	122	3610	96.7	8000	214	8500	228
	100	6.9	4600	123	2800	75.0	3790	102	3380	90.6	6400	172		
	125	8.6	4600	123	3200	85.8	4190	112	3440	92.2				
	150	10.3	4600	123	3640	97.5	4590	123	2400	64.3				
	175	12.1	5400	145	5050	135	7300	196						

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

- continued -

Table 8. Types 299H and 299HR Flow Capacities[1] for 1-1/2 NPT Internal Registration (continued)

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
			ORIFICE SIZE, IN. / mm											
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
7 to 20 in. w.c. / 17 to 50 mbar 14 in. w.c. / 35 mbar ±2 in. w.c. / ±5 mbar 1N3112X0012 Unpainted	2	0.14	700	18.8	1430	38.3	2480	66.5	5040	135	6900	185	7050	189
	5	0.34	1100	29.5	2200	59.0	4000	107	7180	192	7280	195	8860	237
	10	0.69	1700	45.6	3600	96.5	6500	174	8310	223	9330	250	10,320	277
	15	1.0	1900	50.9	4600	123	8000	214	7000	188	11,940	320	9530	255
	20	1.4	2150	57.6	5300	142	8500	228	7410	199	11,850	318	11,060	296
	25	1.7	2400	64.3	6000	161	9000	241	6900	185	11,330	304	11,080	297
	30	2.1	2740	73.4	6740	181	10,000	268	6500	174	11,270	302	10,780	289
	40	2.8	3400	91.1	8200	220	10,900	292	9220	247	10,820	290	11,220	301
	50	3.4	4250	114	9700	260	10,210	274	12,580	337	10,820	290	10,450	280
	60	4.1	5100	137	11,000	295	9650	259	11,750	315	8840	237	11,100	297
	80	5.5	5250	141	5210	140	4060	109	4970	133	8550	229	9400	252
	100	6.9	5400	145	4580	123	4410	118	4970	133	6780	182		
	125	8.6	5400	145	4400	118	5290	142	4330	116				
	150	10.3	5900	158	5020	135	6170	165	3130	83.9				
	175	12.1	555	149	5200	139	6500	174						
16 to 40 in. w.c. / 40 to 99 mbar 28 in. w.c. / 70 mbar ±4 in. w.c. / ±10 mbar 1B413727222 Purple	5	0.34	1200	32.2	2400	64.3	4000	107	6010	161	9210	247	9070	243
	10	0.69	1600	42.9	3700	99.2	6500	174	8130	218	10,300	276	10,650	285
	15	1.0	2000	53.6	4400	118	8000	214	10,340	277	13,020	349	12,890	345
	20	1.4	2300	61.6	5100	137	9250	248	11,980	321	14,790	396	13,170	353
	25	1.7	2600	69.7	5800	155	10,500	281	12,390	332	14,570	390	14,180	380
	30	2.1	2800	75.0	6600	177	11,840	317	12,500	335	14,050	377	13,770	369
	40	2.8	3200	85.8	8200	220	14,060	377	13,350	358	13,290	356	14,110	378
	50	3.4	4100	110	9750	261	14,010	375	14,530	389	12,860	345	12,050	323
	60	4.1	5000	134	11,100	297	14,040	376	13,440	360	13,020	349	10,950	293
	80	5.5	6300	169	5910	158	6140	165	9950	267	8500	228	10,200	273
	100	6.9	7600	204	5220	140	5420	145	7780	209	6500	174		
	125	8.6	9200	247	5690	152	6010	161	8220	220				
	150	10.3	10,700	287	7380	198	5970	160	4900	131				
	175	12.1	5510	148	5100	137	7250	194						
1 to 3.25 psig / 69 mbar to 0.22 bar 2 psig / 0.14 bar ±1% psia / bar T13593T0012 Light Blue	5	0.34	1020	27.3	2100	56.4	3640	97.5	7020	188	10,790	289	10,820	290
	10	0.69	1550	41.5	3340	89.5	5840	157	8990	241	12,180	326	11,180	300
	15	1.0	1920	51.4	4360	117	7580	203	11,260	302	13,580	364	11,960	321
	20	1.4	2240	60.0	5150	138	8960	240	12,950	347	13,630	365	12,750	342
	25	1.7	2570	68.9	5890	158	10,250	275	13,090	351	13,890	372	13,370	358
	30	2.1	2890	77.4	6640	178	11,540	309	14,830	397	13,740	368	14,000	375
	40	2.8	3530	94.6	8120	218	14,120	378	13,500	362	13,470	361	15,250	409
	50	3.4	4180	112	9600	257	15,010	402	13,780	369	13,970	374	12,500	335
	60	4.1	4820	129	10,890	292	15,740	422	14,050	377	14,080	377	12,300	330
	80	5.5	6110	164	9000	241	12,230	328	11,100	297	12,750	342	10,500	281
	100	6.9	7400	198	5200	139	5200	139	5200	139	6400	172		
	125	8.6	8170	219	5040	135	5200	139	5200	139				
	150	10.3	8450	226	5870	157	5200	139	5600	150				
	175	12.1	7750	208	5250	141	5730	154						
2.75 to 6 psig / 0.19 to 0.41 bar 5 psig / 0.34 bar ±1% psia / bar T13671T0012 Orange	10	0.69	1390	37.2	2910	78.0	5050	135	8470	227	12,010	322	12,190	327
	15	1.0	1870	50.1	4190	112	7280	195	11,290	303	14,300	383	12,400	332
	20	1.4	2240	60.0	5090	136	8850	237	12,590	337	13,820	370	13,260	355
	25	1.7	2570	68.9	5890	158	10,250	275	13,210	354	14,500	389	14,310	384
	30	2.1	2890	77.4	6640	178	11,540	309	13,820	370	15,290	410	15,370	412
	40	2.8	3530	94.6	8120	218	14,120	378	15,060	404	15,650	419	16,630	446
	50	3.4	4180	112	9600	257	16,700	448	15,400	413	16,010	429	14,000	375
	60	4.1	4820	129	11,090	297	16,290	437	15,750	422	16,370	439	13,250	355
	80	5.5	6110	164	14,050	377	14,000	375	13,620	365	14,000	375	14,000	375
	100	6.9	7400	198	17,020	456	9020	242	9610	258	14,000	375		
	125	8.6	9020	242	7690	206	7690	206	7890	211				
	150	10.3	10,630	285	6330	170	6360	170	5500	147				
	175	12.1	6800	182	6050	162	8200	220						
5 to 16 psig / 0.34 to 1.1 bar 10 psig / 0.69 bar ±1% psia / bar T13600T0012 Red	15	1.0	1580	42.3	3280	87.9	5690	152	9930	266	13,230	355	13,570	364
	20	1.4	2130	57.1	4720	126	8210	220	11,990	321	14,130	379	14,100	378
	25	1.7	2540	68.1	5740	154	9940	266	13,400	359	15,990	429	15,870	425
	30	2.1	2890	77.4	6580	176	11,440	307	14,810	397	17,850	478	17,640	473
	40	2.8	3530	94.6	8120	218	14,120	378	17,640	473	18,630	499	18,920	507
	50	3.4	4180	112	9600	257	16,700	448	18,110	485	19,400	520	16,400	440
	60	4.1	4820	129	11,090	297	17,200	461	18,580	498	20,170	541	16,600	445
	80	5.5	6110	164	14,050	377	16,950	454	17,810	477	15,750	422	17,600	472
	100	6.9	7400	198	17,020	456	15,350	411	15,900	426	15,950	427		
	125	8.6	9020	242	20,730	556	16,740	449	16,270	436				
	150	10.3	6790	182	6790	182	6830	183	5800	155				
	175	12.1	6200	166	5600	150	5700	153						

▭ - Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

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Table 8. Types 299H and 299HR Flow Capacities(1) for 1-1/2 NPT Internal Registration (continued)

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS													
			ORIFICE SIZE, IN. / mm													
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 16 psig / 0.34 to 1.1 bar 15 psig / 1.0 bar ±1% psia / bar T13600T0012 Red	20	1.4	1750	46.9	3620	97.0	6290	169	11,380	305	114,450	3067	14,980	401
	25	1.7	2360	63.2	5220	140	9070	243	13,590	364	17,440	467	17,430	467
	30	2.1	2820	75.6	6290	169	10,940	293	15,810	424	20,430	548	19,910	534
	40	2.8	3540	94.9	8070	216	14,020	376	20,230	542	21,610	579	21,220	569
	50	3.4	4180	112	9600	257	16,700	448	20,820	558	22,800	611	20,500	549
	60	4.1	4820	129	11,090	297	18,110	485	21,410	574	23,890	640	21,600	579
	80	5.5	6110	164	14,050	377	19,910	534	22,000	590	19,500	523	19,900	533
	100	6.9	7400	198	17,020	456	21,710	582	22,600	606	22,200	595		
	125	8.6	9020	242	20,730	556	23,960	642	23,190	621				
	150	10.3	10,630	285	24,440	655	26,210	702	21,200	568				
	175	12.1	7400	198	6750	181	7100	190						
14 to 35 psig / 0.97 to 2.4 bar 20 psig / 1.4 bar ±1% psia / bar 19B0432X012 Zinc	25	1.7	1920	51.4	3930	105	6840	183	12,840	344	15,670	420	16,320	437
	30	2.1	2580	69.1	5690	152	9870	265	15,200	407	20,740	556	20,760	556
	40	2.8	3480	93.3	7830	210	13,610	365	22,820	612	24,600	659	23,510	630
	50	3.4	4180	112	9550	256	16,610	445	20,950	561	23,620	633	22,200	595
	60	4.1	4820	129	11,090	297	18,080	485	23,330	625	26,120	700	25,000	670
	80	5.5	6110	164	14,050	377	20,980	562	25,120	673	24,500	657	24,900	667
	100	6.9	7400	198	17,020	456	23,680	635	26,930	722	26,200	702		
	125	8.6	9020	242	20,730	556	26,980	723	28,020	751				
	150	10.3	10,630	285	24,440	655	30,280	812	21,600	579				
	175	12.1	7500	201	8200	220	8600	230						
14 to 35 psig / 0.97 to 2.4 bar 25 psig / 1.7 bar ±1% psia / bar 19B0432X012 Zinc	30	2.1	2070	55.5	4230	113	7360	197	14,300	383	16,880	452	17,700	474
	40	2.8	3320	89.0	7350	197	12,780	343	16,810	451	24,040	644	24,090	646
	50	3.4	4140	111	9340	250	16,250	436	21,090	565	24,430	655	23,500	630
	60	4.1	4830	129	11,030	296	18,050	484	25,240	676	28,260	757	27,400	734
	80	5.5	6110	164	14,050	377	22,050	591	28,250	757	30,200	809	28,500	764
	100	6.9	7400	198	17,020	456	25,650	687	31,260	838	27,000	724		
	125	8.6	9020	242	20,730	556	30,000	804	32,840	880				
	150	10.3	10,630	285	24,440	655	34,360	921	27,000	724				
	175	12.1	10,200	273	25,200	675	7900	212						
14 to 35 psig / 0.97 to 2.4 bar 30 psig / 2.1 bar ±1% psia / bar 19B0432X012 Zinc	40	2.8	2980	79.9	6520	175	11,330	304	15,750	422	18,100	485	19,080	511
	50	3.4	4020	108	8950	240	15,560	417	21,220	569	25,240	676	22,500	603
	60	4.1	4800	129	10,850	291	18,020	483	27,150	728	30,390	814	28,000	750
	80	5.5	6110	164	14,050	377	23,130	620	31,370	841	30,500	817	32,300	866
	100	6.9	7400	198	17,020	456	27,630	740	35,690	956	32,500	871		
	125	8.6	9020	242	20,730	556	33,030	885	37,670	1010				
	150	10.3	10,630	285	24,440	655	38,430	1030	32,000	858				
	175	12.1	10,600	284	24,500	657	31,500	844						
14 to 35 psig / 0.97 to 2.4 bar 35 psig / 2.4 bar ±1% psia / bar 19B0432X012 Zinc	40	2.8	2350	63.0	4790	128	8330	223	13,640	366	19,570	524	20,850	559
	50	3.4	3770	101	8300	222	14,430	387	21,350	572	26,060	698	22,000	590
	60	4.1	4700	126	10,510	282	18,270	490	29,060	779	32,530	872	29,000	777
	80	5.5	6120	164	14,000	375	24,350	653	34,490	924	34,500	925	33,600	900
	100	6.9	7400	198	17,020	456	29,600	793	39,920	1070	38,200	1024		
	125	8.6	9020	242	20,730	556	36,050	966	42,500	1139				
	150	10.3	10,630	285	24,440	655	42,500	1139	32,100	860				
	175	12.1	10,900	292	24,800	665	37,000	992						
30 to 60 psig / 2.1 to 4.1 bar 40 psig / 2.8 bar ±1% psia / bar 19B0432X022 Green	50	3.4	2400	64.3	6000	161	10,000	268	14,000	375	20,000	536	20,000	536
	60	4.1	3470	93.0	8000	214	13,670	366	22,000	590	26,000	697	22,667	607
	80	5.5	5600	150	12,000	322	21,000	563	38,000	1018	30,000	804	28,000	750
	100	6.9	6400	172	14,500	389	27,000	724	38,000	1018	34,000	911		
	125	8.6	7600	204	19,500	523	33,000	884	38,000	1018				
	150	10.3	9500	255	22,750	610	37,000	992	42,000	1126				
	175	12.1	11,400	306	26,000	697	41,000	1099						
30 to 60 psig / 2.1 to 4.1 bar 50 psig / 3.4 bar ±1% psia / bar 19B0432X022 Green	60	4.1	3000	80.4	6500	174	9500	255	16,250	436	22,500	603	25,000	670
	80	5.5	5250	141	10,750	288	17,750	476	28,750	771	31,250	838	32,500	871
	100	6.9	6750	181	15,000	402	26,000	697	41,250	1106	40,000	1072		
	125	8.6	8250	221	17,500	469	32,500	871	43,750	1173				
	150	10.3	9500	255	21,750	583	37,750	1012	46,250	1240				
	175	12.1	10,750	288	26,000	697	43,000	1152						
30 to 60 psig / 2.1 to 4.1 bar 60 psig / 4.1 bar ±1% psia / bar 19B0432X022 Green	80	5.5	2750	73.7	7200	193	13,000	348	18,750	503	27,500	737	32,500	871
	100	6.9	2750	73.7	10,600	284	15,500	415	25,000	670	40,000	1072		
	125	8.6	3250	87.1	3000	80.4	22,000	590	46,250	1240				
	150	10.3	3130	83.9	2900	77.7	18,000	482	11,250	302				
	175	12.1	3000	80.4	2800	75.0	14,000	375						

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

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Table 9. Types 299H and 299HR Flow Capacities(1) for NPS 2 / DN 50 Internal Registration

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
			Orifice Size, In. / mm											
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
3.5 to 6-in. w.c. / 9 to 15 mbar 3.5-in. w.c. / 9 mbar -1 to 2-in. w.c. / -2 to 5 mbar T13707T0012 Black	2	0.14	760	20.4	1560	41.8	2700	72.4	4050	109	5740	154	6350	170
	5	0.34	1200	32.2	2600	69.7	4500	121	8600	230	11,500	308	12,000	322
	10	0.69	1700	45.6	3800	102	6500	174	9500	255	14,750	395	17,000	456
	15	1.0	2000	53.6	4600	123	8000	214	10,600	284	18,000	482	15,500	415
	20	1.4	2350	63.0	5300	142	9250	248	11,400	306	19,700	528	16,000	429
	25	1.7	2700	72.4	6000	161	10,500	281	12,200	327	20,400	547	17,300	464
	30	2.1	3030	81.2	6730	180	11,500	308	14,630	392	21,100	565	18,600	498
	40	2.8	3700	99.2	8200	220	13,500	362	19,500	523	20,400	547	21,800	584
	50	3.4	4400	118	9700	260	17,000	456	20,000	536	19,700	528	25,000	670
	60	4.1	5100	137	11,200	300	20,500	549	20,500	549	14,833	398	12,500	335
	80	5.5	4700	126	7500	201	12,750	342	19,600	525	5100	137	12,000	322
	100	6.9	4300	115	3800	102	5000	134	18,700	501	3500	93.8		
	125	8.6	4300	115	4000	107	5500	147	11,150	299				
	150	10.3	4300	115	4000	107	6000	161	3600	96.5				
	175	12.1	4300	115	4000	107	6500	174						
5 to 9-in. w.c. / 12 to 22 mbar 7-in. w.c. / 17 mbar -1 to 2-in. w.c. / -2 to 5 mbar T13589T0012 Yellow	2	0.14	750	20.1	1520	40.7	2650	71.0	5380	144	6260	168	6680	179
	5	0.34	1300	34.8	2600	69.7	4250	114	8500	228	10,500	281	10,000	268
	10	0.69	1600	42.9	3800	102	6500	174	12,500	335	14,350	385	17,000	456
	15	1.0	2000	53.6	4400	118	8000	214	10,500	281	18,200	488	16,000	429
	20	1.4	2300	61.6	5100	137	9500	255	11,500	308	20,600	552	16,000	429
	25	1.7	2600	69.7	5800	155	11,000	295	12,500	335	20,500	549	17,750	476
	30	2.1	2970	79.6	6600	177	11,170	299	16,830	451	20,400	547	19,500	523
	40	2.8	3700	99.2	8200	220	11,500	308	25,500	683	20,200	541	20,200	541
	50	3.4	4400	118	9700	260	15,750	422	22,500	603	20,000	536	20,900	560
	60	4.1	5100	137	11,200	300	20,000	536	19,500	523	14,800	397	12,500	335
	80	5.5	4850	130	7350	197	12,380	332	4500	121	4400	118	12,500	335
	100	6.9	4600	123	3500	93.8	4750	127	4500	121	2800	75.0		
	125	8.6	4600	123	4000	107	5250	141	4500	121				
	150	10.3	4600	123	4560	122	5750	154	4500	121				
	175	12.1	4600	123	5120	137	6500	174						
7 to 20-in. w.c. / 17 to 50 mbar 14-in. w.c. / 35 mbar ±2-in. w.c. / ±5 mbar 1N3112X0012 Unpainted	2	0.14	700	18.8	1430	38.3	2480	66.5	5040	135	7440	199	8460	227
	5	0.34	1100	29.5	2200	59.0	4000	107	8500	228	11,800	316	12,400	332
	10	0.69	1700	45.6	3600	96.5	6500	174	12,500	335	15,850	425	17,000	456
	15	1.0	1900	50.9	4600	123	8000	214	11,500	308	19,900	533	17,000	456
	20	1.4	2150	57.6	5300	142	8500	228	12,500	335	21,000	563	19,100	512
	25	1.7	2400	64.3	6000	161	9000	241	13,250	355	21,150	567	19,750	529
	30	2.1	2740	73.4	6740	181	10,000	268	14,000	375	21,300	571	20,400	547
	40	2.8	3400	91.1	8200	220	12,000	322	19,500	523	21,150	567	21,650	580
	50	3.4	4250	114	9700	260	13,500	362	25,000	670	21,000	563	22,900	614
	60	4.1	5100	137	11,200	300	15,000	402	22,050	591	16,330	438	14,100	378
	80	5.5	5250	141	8200	220	10,000	268	5620	151	7000	188	12,400	332
	100	6.9	5400	145	5200	139	5000	134	6000	161	8300	222		
	125	8.6	5400	145	5000	134	6000	161	6000	161				
	150	10.3	5900	158	5700	153	7000	188	6000	161				
	175	12.1	6400	172	6400	172	7000	188						
16 to 40-in. w.c. / 40 to 99 mbar 28-in. w.c. / 70 mbar ±4-in. w.c. / ±10 mbar 1B413727222 Purple	5	0.34	1200	32.2	2400	64.3	4000	107	7500	201	9500	255	11,400	306
	10	0.69	1600	42.9	3700	99.2	6500	174	11,750	315	14,850	398	16,850	452
	15	1.0	2000	53.6	4400	118	8000	214	16,000	429	20,200	541	22,300	598
	20	1.4	2300	61.6	5100	137	9250	248	19,000	509	24,500	657	21,800	584
	25	1.7	2600	69.7	5800	155	10,500	281	21,750	583	25,600	686	23,900	641
	30	2.1	2800	75.0	6600	177	11,830	317	24,500	657	25,230	676	24,130	647
	40	2.8	3200	85.8	8200	220	14,500	389	26,750	717	24,500	657	24,600	659
	50	3.4	4100	110	9750	261	16,500	442	29,000	777	24,000	643	26,000	697
	60	4.1	5000	134	11,300	303	18,500	496	24,170	648	23,500	630	27,200	729
	80	5.5	6300	169	9150	245	12,880	345	14,500	389	24,500	657	30,000	804
	100	6.9	7600	204	7000	188	7250	194	14,500	389	22,400	600		
	125	8.6	9200	247	7000	188	7380	198	14,500	389				
	150	10.3	10,700	287	9300	249	7500	201	15,500	415				
	175	12.1	12,200	327	11,600	311	15,250	409						

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

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Table 9. Types 299H and 299HR Flow Capacities(1) for NPS 2 / DN 50 Internal Registration (continued)

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
			Orifice Size, In. / mm											
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1 to 3.25 psig / 69 bar to 0.22 bar 2 psig / 0.14 bar ± 1% psia / bar T13593T0012 Light Blue	5	0.34	1020	27.3	2100	56.4	3640	97.5	7440	199	10,980	294	13,800	370
	10	0.69	1550	41.5	3340	89.5	5840	157	12,040	323	15,460	414	17,710	475
	15	1.0	1920	51.4	4360	117	7580	203	15,990	429	20,900	560	20,670	554
	20	1.4	2240	60.0	5150	138	8960	240	19,250	516	22,470	602	21,620	579
	25	1.7	2670	71.5	5890	158	10,250	275	22,030	590	24,000	643	22,410	601
	30	2.1	2890	77.4	6640	178	11,540	309	27,800	745	24,860	666	24,170	648
	40	2.8	3530	94.6	8120	218	14,120	378	27,070	725	25,640	687	26,160	701
	50	3.4	4180	112	9600	257	16,700	448	28,970	776	26,390	707	26,900	721
	60	4.1	4820	129	11,090	297	19,280	517	25,770	691	26,000	697	29,000	777
	80	5.5	6110	164	14,050	377	24,440	655	25,500	683	12,800	343	30,000	804
	100	6.9	7400	198	17,020	456	29,840	800	14,260	382	28,300	758		
	125	8.6	8170	219	12,360	331	17,520	470	13,260	355				
	150	10.3	8450	226	13,750	369	18,580	498	17,000	456				
	175	12.1	12,400	332	7100	190	20,000	536						
2.75 to 6 psig / 0.19 to 0.41 bar 5 psig / 0.34 bar ±1 % psig / bar T13671T0012 Orange	10	0.69	1390	37.2	2910	78.0	5050	135	10,350	277	13,200	354	16,070	431
	15	1.0	1870	50.1	4190	112	7280	195	15,150	406	21,850	586	21,370	573
	20	1.4	2240	60.0	5090	136	8850	237	18,640	500	21,350	572	21,390	573
	25	1.7	2570	68.9	5890	158	10,250	275	21,260	570	24,540	658	22,740	609
	30	2.1	2890	77.4	6640	178	11,540	309	24,340	652	26,500	710	25,870	693
	40	2.8	3530	94.6	8120	218	14,120	378	27,670	742	28,300	758	28,930	775
	50	3.4	4180	112	9600	257	16,700	448	30,570	819	29,870	801	30,000	804
	60	4.1	4820	129	11,090	297	19,280	517	29,390	788	30,390	814	31,000	831
	80	5.5	6110	164	14,050	377	24,440	655	31,410	842	28,000	750	34,000	911
	100	6.9	7400	198	17,020	456	29,600	793	22,150	594	32,000	858		
	125	8.6	9020	242	20,730	556	36,050	966	21,590	579				
	150	10.3	10,630	285	17,170	460	26,560	712	17,000	456				
	175	12.1	11,800	316	15,400	413	21,500	576						
5 to 16 psig / 0.34 to 1.1 bar 10 psig / 0.69 bar ± 1% psia / bar T13600T0012 Red	15	1.0	1580	42.3	3280	87.9	5690	152	11,640	312	15,420	413	18,340	492
	20	1.4	2130	57.1	4720	126	8210	220	17,000	456	19,500	523	21,000	563
	25	1.7	2540	68.1	5740	154	9940	266	20,790	557	25,440	682	23,290	624
	30	2.1	2890	77.4	6580	176	11,440	307	24,150	647	29,250	784	28,700	769
	40	2.8	3530	94.6	8120	218	14,120	378	28,660	768	32,780	879	33,540	899
	50	3.4	4180	112	9600	257	16,700	448	33,230	891	35,680	956	33,100	887
	60	4.1	4820	129	11,090	297	19,280	517	35,410	949	37,700	1010	33,100	887
	80	5.5	6110	164	14,050	377	24,440	655	41,270	1106	38,000	1018	37,000	992
	100	6.9	7400	198	17,020	456	29,600	793	35,310	946	35,000	938		
	125	8.6	9020	242	20,730	556	36,050	966	35,740	958				
	150	10.3	10,630	285	20,590	552	34,530	925	22,000	590				
	175	12.1	11,200	300	18,100	485	25,000	670						
5 to 16 psig / 0.34 to 1.1 bar 15 psig / 10 bar ± 1% psia / bar T13600T0012 Red	20	1.4	1750	46.9	3620	97.0	6290	169	12,830	344	17,640	473	20,640	553
	25	1.7	2360	63.2	5220	140	9070	243	18,700	501	26,350	706	23,850	639
	30	2.1	2820	75.6	6290	169	10,940	293	22,790	611	31,990	857	31,540	845
	40	2.8	3540	94.9	8070	216	14,020	376	29,650	795	37,270	999	38,150	1022
	50	3.4	4180	112	9600	257	16,700	448	35,890	962	41,490	1112	43,000	1152
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	45,020	1207	39,000	1045
	80	5.5	6110	164	14,050	377	24,440	655	51,120	1370	49,000	1313	43,000	1152
	100	6.9	7400	198	17,020	456	29,600	793	48,470	1299	46,000	1233		
	125	8.6	9020	242	20,730	556	36,050	966	49,780	1334				
	150	10.3	10,630	285	24,440	655	42,500	1139	60,000	1608				
	175	12.1	11,800	316	27,400	734	48,000	1286						
14 to 35 psig / 0.97 to 2.4 bar 20 psig / 14 bar ± 1% psia / bar 19B0432X012 Zinc	25	1.7	1920	51.4	3930	105	6840	183	13,930	373	20,800	557	21,940	588
	30	2.1	2580	69.1	5680	152	9870	265	20,280	544	30,630	821	32,630	874
	40	2.8	3480	93.3	7830	210	13,610	365	28,440	762	33,040	885	35,700	957
	50	3.4	4180	112	9550	256	16,610	445	35,140	942	41,800	1120	40,520	1086
	60	4.1	4820	129	11,090	297	19,280	517	41,440	1111	47,530	1274	40,520	1086
	80	5.5	6110	164	14,050	377	24,440	655	51,240	1373	41,800	1120	41,000	1099
	100	6.9	7400	198	17,020	456	29,600	793	52,260	1401	41,800	1120		
	125	8.6	9020	242	20,730	556	36,050	966	56,710	1520				
	150	10.3	10,630	285	24,440	655	42,500	1139	65,000	1742				
	175	12.1	11,600	311	26,300	705	47,000	1260						

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

- continued -

Table 9. Types 299H and 299HR Flow Capacities[1] for NPS 2 / DN 50 Internal Registration (continued)

OUTLET PRESSURE RANGE SETTING, ACCURACY, SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
			Orifice Size, In. / mm											
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
14 to 35 psig / 0.97 to 2.4 bar 25 psig / 1.7 bar ±1% psia / bar 19B0432X012 Zinc	30	2.1	2070	55.5	4230	113	7360	197	14,980	401	22,310	598	23,270	624
	40	2.8	3320	89.0	7350	197	12,780	343	23,420	628	40,220	1078	33,260	891
	50	3.4	4140	111	9340	250	16,250	436	34,040	912	42,110	1129	50,000	1340
	60	4.1	4830	129	11,030	296	19,190	514	40,630	1089	50,050	1341	54,000	1447
	80	5.5	6110	164	14,050	377	24,440	655	51,360	1376	62,000	1662	60,000	1608
	100	6.9	7400	198	17,020	456	29,600	793	56,050	1502	60,000	1608		
	125	8.6	9020	242	20,730	556	36,050	966	63,640	1706				
	150	10.3	10,630	285	24,440	655	42,500	1139	77,000	2064				
	175	12.1	11,000	295	26,500	710	46,000	1233						
14 to 35 psig / 0.97 to 2.4 bar 30 psig / 2.1 bar ±1% psia / bar 19B0432X012 Zinc	40	2.8	2980	79.9	6520	175	11,330	304	23,190	621	24,580	659	30,810	826
	50	3.4	4020	108	8950	240	15,560	417	32,300	866	42,430	1137	50,000	1340
	60	4.1	4800	129	10,850	291	18,870	506	39,600	1061	52,560	1409	54,000	1447
	80	5.5	6110	164	14,050	377	24,440	655	51,480	1380	72,000	1930	72,000	1930
	100	6.9	7400	198	17,020	456	29,600	793	59,840	1604	76,000	2037		
	125	8.6	9020	242	20,730	556	36,050	966	70,570	1891				
	150	10.3	10,630	285	24,440	655	42,500	1139	84,000	2251				
	175	12.1	10,200	273	25,000	670	48,000	1286						
14 to 35 psig / 0.97 to 2.4 bar 35 psig / 2.4 bar ±1% psia / bar 19B0432X012 Zinc	40	2.8	2350	63.0	4790	128	8330	223	16,920	453	20,350	545	28,360	760
	50	3.4	3770	101	8300	222	14,430	387	29,690	796	42,740	1145	48,000	1286
	60	4.1	4700	126	10,510	282	18,270	490	38,050	1020	55,080	1476	60,000	1608
	80	5.5	6120	164	14,000	375	24,350	653	51,600	1383	70,000	1876	74,000	1983
	100	6.9	7400	198	17,020	456	29,600	793	63,630	1705	76,000	2037		
	125	8.6	9020	242	20,730	556	36,050	966	77,500	2077				
	150	10.3	10,630	285	24,440	655	42,500	1139	87,000	2332				
	175	12.1	11,200	300	25,500	683	49,000	1313						
30 to 60 psig / 2.1 to 4.1 bar 40 psig / 2.8 bar ±1% psia / bar 19B0432X022 Green	50	3.4	1600	42.9	6500	174	9000	241	20,000	536	28,000	750	34,000	911
	60	4.1	2800	75.0	8170	219	17,000	456	33,000	884	48,000	1286	52,000	1394
	80	5.5	5200	139	11,500	308	23,000	616	48,000	1286	66,000	1769	68,000	1822
	100	6.9	7600	204	13,500	362	29,000	777	31,000	831	76,000	2037		
	125	8.6	8200	220	19,000	509	35,000	938	76,000	2037				
	150	10.3	9800	263	22,750	610	42,000	1126	91,000	2439				
	175	12.1	11,400	306	26,500	710	47,000	1260						
30 to 60 psig / 2.1 to 4.1 bar 50 psig / 3.4 bar ±1% psia / bar 19B0432X022 Green	60	4.1	3400	91.1	7000	188	10,000	268	21,000	563	32,000	858	45,000	1206
	80	5.5	5800	155	11,000	295	21,000	563	45,000	1206	69,000	1849	74,000	1983
	100	6.9	6200	166	15,000	402	26,000	697	59,000	1581	88,000	2358		
	125	8.6	8400	225	19,500	523	35,000	938	77,000	2064				
	150	10.3	9600	257	23,000	616	42,000	1126	89,000	2385				
	175	12.1	10,800	289	26,500	710	49,000	1313						
30 to 60 psig / 2.1 to 4.1 bar 60 psig / 4.1 bar ±1% psia / bar 19B0432X022 Green	80	5.5	2800	75.0	3500	93.8	17,000	456	36,000	965	52,000	1394	53,000	1420
	100	6.9	3600	96.5	9500	255	23,000	616	50,000	1340	64,000	1715		
	125	8.6	2800	75.0	15,000	402	22,000	590	69,000	1849	90,000	2412		
	150	10.3	4600	123	11,000	295	18,000	482	89,000	2385				
	175	12.1	6400	172	7000	188	18,000	482						

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Downstream piping may affect actual capacity. It may be necessary to use enlarged downstream piping to obtain published capacities.

Table 10. Types 299HS, 299HV, 299HSR and 299HVR Flow Capacities[(1)(2)] for 1-1/2 NPT and NPS 2 / DN 50 External/Dual Registration

OUTLET PRESSURE RANGE SETTING, CONTROL SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH/ Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS							
			Orifice Size, In. / mm							
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
	2	0.14	750	20.1	1540	41.3	1960	52.5	4750	127
	5	0.34	1150	30.8	2440	65.4	3230	86.6	7760	208
	10	0.69	1580	42.3	3570	95.7	4970	133	11,660	312
3.5 to 6 in. w.c. /	15	1.0	1910	51.2	4400	118	6890	185	15,890	426
9 to 15 mbar	20	1.4	2230	59.8	5140	138	8050	216	18,570	498
	25	1.7	2560	68.6	5880	158	9210	247	21,250	570
3.5 in. w.c. / 9 mbar	30	2.1	2880	77.2	6630	178	10,370	278	23,930	641
-1 to 2 in. w.c. /	40	2.8	3520	94.3	8110	217	12,700	340	29,280	785
-2 to 5 mbar	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	465	39,990	1072
T13707T0012	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
Black	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1025	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		
	2	0.14	730	19.6	1490	39.9	1900	50.9	4610	124
	5	0.34	1150	30.8	2420	64.9	3190	85.5	7690	206
	10	0.69	1580	42.3	3570	95.7	4950	133	11,620	311
5 to 9 in. w.c. /	15	1.0	1910	51.2	4400	118	6890	185	15,890	426
12 to 22 mbar	20	1.4	2230	59.8	5140	138	8050	216	18,570	498
	25	1.7	2560	68.6	5880	158	9210	247	21,250	570
7 in. w.c. / 17 mbar	30	2.1	2880	77.2	6630	178	10,370	278	23,930	641
-1 to 2 in. w.c. /	40	2.8	3520	94.3	8110	217	12,700	340	29,280	785
-2 to 5 mbar	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	465	39,990	1072
T13589T0012	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
Yellow	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1025	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		
	2	0.14	690	18.5	1410	37.8	1790	48.0	4340	116
	5	0.34	1130	30.3	2390	64.1	3130	83.9	7550	202
	10	0.69	1570	42.1	3550	95.1	4920	132	11,540	309
7 to 20 in. w.c. /	15	1.0	1910	51.2	4400	118	6890	185	15,890	426
17 to 50 mbar	20	1.4	2230	59.8	5140	138	8050	216	18,570	498
	25	1.7	2560	68.6	5880	158	9210	244	21,250	570
14 in. w.c. /	30	2.1	2880	77.2	6630	178	10,370	278	23,930	641
35 mbar	40	2.8	3520	94.3	8110	217	12,700	340	29,280	785
±2 in. w.c. / ±5 mbar	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	465	39,990	1072
1N3112X0012	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
Unpainted	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1025	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		
	5	0.34	1100	29.5	2310	61.9	3010	80.7	7260	195
	10	0.69	1560	41.8	3420	91.7	4680	125	11,180	300
	15	1.0	1910	51.2	4400	118	6890	185	14,680	393
16 to 40 in. w.c. /	20	1.4	2230	59.8	5140	138	8050	216	18,570	498
40 to 99 mbar	25	1.7	2560	68.6	5880	158	9210	247	21,250	570
28 in. w.c. /	30	2.1	2880	77.2	6630	178	10,370	278	23,930	641
70 mbar	40	2.8	3520	94.3	8110	217	12,700	340	29,280	785
±4 in. w.c. / ±10 mbar	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	465	39,990	1072
1B413727222	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
Purple	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1025	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Capacities are limited to 15,000 SCFH / 402 Nm³/h when the Types VSX2 and VSX8 are used without a control line.
2. Due to slam-shut properties, capacities cannot be calculated with critical flow equation.

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Table 10. Types 299HS, 299HV, 299HSR and 299HVR Flow Capacities[1][2] for 1-1/2 NPT and NPS 2 / DN 50 External/Dual Registration (continued)

OUTLET PRESSURE RANGE SETTING, CONTROL SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH/ Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS							
			Orifice Size, In. / mm							
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19	
	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1 to 3.25 psig / 69 mbar to 0.22 bar 2 psig / 0.14 bar ±1% psia / bar T13593T0012 Light blue	5	0.34	1010	27.1	2090	56.0	2690	72.1	6500	174
	10	0.69	1540	41.3	3330	89.2	4500	121	10,780	289
	15	1.0	1910	51.2	4350	117	6160	165	14,420	386
	20	1.4	2230	59.8	5140	138	8050	216	18,570	498
	25	1.7	2560	68.6	5880	158	9210	247	21,250	570
	30	2.1	2880	77.2	6630	178	10,370	278	23,930	641
	40	2.8	3520	94.3	8110	217	12,700	340	29,280	785
	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	465	39,990	1072
	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1024	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		
2.75 to 6 psig / 0.19 to 0.41 bar 5 psig / 0.34 bar ±1% psia / bar T13671T0012 Orange	10	0.69	1380	37.0	2890	77.5	3780	101	9110	244
	15	1.0	1860	49.8	4180	112	5690	152	13,370	358
	20	1.4	2230	59.8	5080	136	7170	192	16,790	450
	25	1.7	2560	68.6	5880	158	9210	247	21,250	570
	30	2.1	2880	77.2	6630	178	10,370	278	23,930	641
	40	2.8	3520	94.3	8110	217	12,700	340	29,280	785
	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	465	39,990	1072
	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1024	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		
5 to 16 psig / 0.34 to 1.1 bar 10 psig / 0.69 bar ±1% psia / bar T13600T0012 Red	15	1.0	1570	42.1	3270	87.6	4220	113	10,200	273
	20	1.4	2120	56.8	4710	126	6310	169	14,850	398
	25	1.7	2530	67.8	5700	153	7890	211	18,510	496
	30	2.1	2880	77.2	6630	178	10,370	278	21,820	585
	40	2.8	3520	94.3	8110	217	12,700	340	29,280	785
	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	465	39,990	1072
	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1025	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		
5 to 16 psig / 0.34 to 1.1 bar 15 psig / 1.0 bar ±1% psia / bar T13600T0012 Red	20	1.4	1740	46.6	3610	96.7	4640	124	11,210	300
	25	1.7	2350	63.0	5210	139	6890	185	16,220	435
	30	2.1	2810	75.3	6280	168	8560	229	20,110	539
	40	2.8	3520	94.3	8110	217	12,700	340	26,850	720
	50	3.4	4170	112	9590	257	15,020	403	34,630	928
	60	4.1	4810	129	11,080	297	17,340	464	39,990	1072
	80	5.5	6100	163	14,040	376	21,980	589	50,690	1358
	100	6.9	7390	198	17,010	456	26,630	714	61,400	1646
	125	8.6	9010	241	20,720	555	32,430	869	74,780	2004
	150	10.3	10,620	285	24,430	655	38,240	1025	88,170	2363
	175	12.1	12,230	328	28,140	754	44,040	1180		

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Capacities are limited to 15,000 SCFH / 402 Nm^3/h when the Types VSX2 and VSX8 are used without a control line.
2. Due to slam-shut properties, capacities cannot be calculated with critical flow equation.

Table 11. Types 299HS, 299HV, 299HSR and 299HVR Flow Capacities(1)(2) for 1-1/2 NPT and NPS 2 / DN 50 Internal Registration

OUTLET PRESSURE RANGE SETTING, CONTROL SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS							
			Orifice Size, In. / mm							
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19	
	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
3.5 to 6 in. w.c. / 9 to 15 mbar 3.5 in. w.c. / 9 mbar -1 to 2 in. w.c. / -2 to 5 mbar T13707T0012 Black	2	0.14	760	20.4	1780	47.7	2800	75.0	6460	173
	5	0.34	1160	31.1	2450	65.7	4000	107	7140	191
	10	0.69	1590	42.6	3560	95.4	6000	161	7140	191
	15	1.0	1920	51.5	4400	118	7500	201	8320	223
	20	1.4	2240	60.0	5100	137	9000	241	10,830	290
	25	1.7	2570	68.9	5450	146	7620	204	9870	265
	30	2.1	2890	77.5	5800	155	9880	265	9870	265
	40	2.8	3530	94.6	7550	202	12,070	323	6400	172
	50	3.4	3880	104	9300	249	11,300	303	6840	183
	60	4.1	4090	110	7700	206	6660	178	7010	188
	80	5.5	3110	83.3	2800	75.0	1230	33.0	9000	241
	100	6.9	4790	128	3600	96.5	2990	80.1	4650	125
	125	8.6	5210	140	3600	96.5	4090	110	3230	86.6
	150	10.3	5640	151	3600	96.5	5210	140	3230	86.6
	175	12.1	7310	196	5680	152	7300	196		
5 to 9 in. w.c. / 12 to 22 mbar 7 in. w.c. / 17 mbar -1 to 2 in. w.c. / -2 to 5 mbar T13589T0012 Yellow	2	0.14	750	20.1	1890	50.7	2800	75.0	5520	148
	5	0.34	1120	30.0	2460	65.9	4000	107	6020	161
	10	0.69	1590	42.6	3400	91.1	6000	161	6520	175
	15	1.0	1920	51.5	4320	116	7000	188	8000	214
	20	1.4	2240	60.0	5060	136	9000	241	7930	213
	25	1.7	2570	68.9	5800	155	9690	260	7420	199
	30	2.1	2890	77.5	6500	174	10,480	281	7050	189
	40	2.8	3530	94.6	7900	212	11,490	308	4900	131
	50	3.4	4180	112	7800	209	10,280	276	5940	159
	60	4.1	4820	129	6560	176	7170	192	6310	169
	80	5.5	4020	108	2620	70.2	1200	32.2	8340	224
	100	6.9	4670	125	3420	91.7	2990	80.1	3900	105
	125	8.6	5070	136	3600	96.5	5180	139	3360	90.0
	150	10.3	5480	147	3870	104	5180	139	2340	62.7
	175	12.1	6430	172	5120	137	7300	196		
7 to 20 in. w.c. / 17 to 50 mbar 14 in. w.c. / 35 mbar ±2 in. w.c. / ±5 mbar 1N3112X0012 Unpainted	2	0.14	700	18.8	1420	38.1	3440	92.2	4790	128
	5	0.34	1110	29.7	2200	59.0	4000	107	6080	163
	10	0.69	1580	42.3	3500	93.8	6000	161	7440	199
	15	1.0	1920	51.5	4300	115	7600	204	9250	248
	20	1.4	2240	60.0	5000	134	9000	241	10,670	286
	25	1.7	2570	68.9	5700	153	10,000	268	8950	240
	30	2.1	2890	77.5	6500	174	11,200	300	8450	226
	40	2.8	3530	94.6	7900	212	11,620	311	6800	182
	50	3.4	4180	112	9300	249	12,400	332	7240	194
	60	4.1	4820	129	7490	201	12,090	324	7400	198
	80	5.5	4600	123	2730	73.2	2030	54.4	7420	199
	100	6.9	4970	133	3900	105	4410	118	4970	133
	125	8.6	5200	139	3900	105	5990	161	4330	116
	150	10.3	5430	146	3900	105	5990	161	3120	83.6
	175	12.1	4700	126	3900	105	6310	169		
16 to 40 in. w.c. / 40 to 99 mbar 28 in. w.c. / 70 mbar ±4 in. w.c. / ±10 mbar 1B413727222 Purple	5	0.34	1110	29.7	2600	69.7	3600	96.5	5200	139
	10	0.69	1570	42.1	3500	93.8	6000	161	6910	185
	15	1.0	1920	51.5	4400	118	7200	193	9370	251
	20	1.4	2240	60.0	5100	137	8800	236	11,030	296
	25	1.7	2570	68.9	5800	155	10,000	268	11,390	305
	30	2.1	2890	77.5	6500	174	11,600	311	11,980	321
	40	2.8	3530	94.6	7900	212	13,570	364	11,220	301
	50	3.4	4180	112	9300	249	13,920	373	10,020	269
	60	4.1	4820	129	8250	221	14,410	386	9170	246
	80	5.5	6110	164	4260	114	3090	82.8	11,320	303
	100	6.9	6360	170	5150	138	4850	130	3750	101
	125	8.6	6450	173	5930	159	5290	142	3960	106
	150	10.3	6540	175	6110	164	5570	149	2520	67.5
	175	12.1	2950	79.1	3560	95.4	3320	89.0		

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Capacities are limited to 15,000 SCFH / 402 Nm^3/h when the Types VSX2 and VSX8 are used without a control line.
2. Due to slam-shut properties, capacities cannot be calculated with critical flow equation.

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Table 11. Types 299HS, 299HV, 299HSR and 299HVR Flow Capacities(1)(2) for 1-1/2 NPT and NPS 2 / DN 50 Internal Registration (continued)

OUTLET PRESSURE RANGE SETTING, CONTROL SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS							
			Orifice Size, In. / mm							
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 3.25 psig / 69 mbar to 0.22 bar 2 psig / 0.14 bar ±1% psia / bar T13593T0012 Light blue	5	0.34	1020	27.3	2900	77.7	4000	107	5660	152
	10	0.69	1550	41.5	3600	96.5	5500	147	7840	210
	15	1.0	1920	51.5	4300	115	7500	201	10,210	273
	20	1.4	2240	60.0	5000	134	8500	228	12,100	324
	25	1.7	2570	68.9	5550	149	10,000	268	11,880	318
	30	2.1	2890	77.5	6100	163	11,000	295	12,800	343
	40	2.8	3530	94.6	7750	208	14,000	375	13,960	374
	50	3.4	4180	112	9400	252	14,380	385	10,940	293
	60	4.1	4820	129	10,530	282	15,510	416	9810	263
	80	5.5	6110	164	8580	230	12,000	322	3700	99.2
	100	6.9	6850	184	3290	88.2	1130	30.3	2910	78.0
	125	8.6	7070	189	3050	81.7	2220	59.5	2910	78.0
	150	10.3	7300	196	3200	85.8	2090	56.0	2910	78.0
	175	12.1	4560	122	5540	148	2090	56.0		
2.75 to 6 psig / 0.19 to 0.41 bar 5 psig / 0.34 bar ±1% psia / bar T13671T0012 Orange	10	0.69	1390	37.3	2800	75.0	5000	134	6540	175
	15	1.0	1870	50.1	3750	101	7000	188	9680	259
	20	1.4	2240	60.0	4700	126	8500	228	11,480	308
	25	1.7	2570	68.9	5700	153	9500	255	12,420	333
	30	2.1	2890	77.5	6430	172	11,000	295	13,050	350
	40	2.8	3530	94.6	7900	212	13,000	348	15,780	423
	50	3.4	4180	112	9300	249	16,000	429	15,110	405
	60	4.1	4790	128	10,700	287	15,200	407	10,710	287
	80	5.5	5740	154	13,350	358	13,170	353	8670	232
	100	6.9	6680	179	16,000	429	2430	65.1	8670	232
	125	8.6	7170	192	4740	127	1700	45.6	7300	196
	150	10.3	7650	205	3530	94.6	1910	51.2	6470	173
	175	12.1	4400	118	3530	94.6	3050	81.7		
5 to 16 psig / 0.34 to 1.1 bar 10 psig / 0.69 bar ±1% psia / bar T13600T0012 Red	15	1.0	1800	48.2	3200	85.8	4000	107	7250	194
	20	1.4	2200	59.0	4300	115	12,000	322	9870	265
	25	1.7	2600	69.7	5400	145	9000	241	12,240	328
	30	2.1	3000	80.4	6600	177	10,000	268	13,490	362
	40	2.8	3650	97.8	7800	209	13,000	348	17,230	462
	50	3.4	4300	115	9000	241	16,000	429	18,520	496
	60	4.1	4950	133	10,460	280	16,050	430	20,460	548
	80	5.5	6250	168	13,400	359	15,950	427	10,780	289
	100	6.9	7600	204	16,110	432	15,030	403	11,250	302
	125	8.6	9300	249	19,500	553	16,250	436	11,250	302
	150	10.3	6320	169	4960	133	1970	52.8	6590	177
	175	12.1	5810	156	3270	87.6	1970	52.8		
5 to 16 psig / 0.34 to 1.1 bar 15 psig / 1.0 bar ±1% psia / bar T13600T0012 Red	20	1.4	1900	50.9	3400	91.1	6000	161	8860	237
	25	1.7	2450	65.7	4550	122	8000	214	10,900	292
	30	2.1	3000	80.4	5700	153	10,000	268	13,870	372
	40	2.8	3700	99.2	7600	204	13,000	348	19,100	512
	50	3.4	4320	116	8900	239	15,000	402	20,300	544
	60	4.1	4950	133	10,330	277	16,900	453	20,660	554
	80	5.5	6200	166	13,200	354	18,730	502	21,940	588
	100	6.9	7350	197	16,000	429	21,260	570	16,310	437
	125	8.6	8800	236	19,500	523	23,920	641	13,970	374
	150	10.3	10,220	274	22,950	615	25,900	694	10,600	284
	175	12.1	7300	196	6500	174	5910	158		

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Capacities are limited to 15,000 SCFH / 402 Nm³/h when the Types VSX2 and VSX8 are used without a control line.
2. Due to slam-shut properties, capacities cannot be calculated with critical flow equation.

Table 12. Types 299HS, 299HV, 299HSR and 299HVR Flow Capacities[1][2] for 2 NPT Internal Registration

OUTLET PRESSURE RANGE SETTING, CONTROL SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS							
			Orifice Size, In. / mm							
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
3.5 to 6 in. w.c. / 9 to 15 mbar 3.5 in. w.c. / 9 mbar -1 to 2 in. w.c. / -2 to 5 mbar T13707T0012 Black	2	0.14	760	20.4	1780	47.7	2800	75.0	6460	173
	5	0.34	1160	31.1	2450	65.7	4000	107	7600	204
	10	0.69	1590	42.6	3560	95.4	6000	161	9500	255
	15	1.0	1920	51.5	4400	118	7500	201	12,400	332
	20	1.4	2240	60.0	5100	137	9000	241	17,500	469
	25	1.7	2570	68.9	5450	146	8000	214	17,000	456
	30	2.1	2890	77.5	5800	155	11,000	295	17,000	456
	40	2.8	3530	94.6	7550	202	14,000	375	13,000	348
	50	3.4	3880	104	9300	249	16,500	442	13,000	348
	60	4.1	4090	110	7700	206	12,000	322	12,400	332
	80	5.5	3110	83.3	4500	121	3500	93.8	11,600	311
	100	6.9	4790	128	4500	121	3750	101	6000	161
	125	8.6	5210	140	4500	121	5120	137	4400	118
	150	10.3	5620	151	4500	121	6500	174	4400	118
	175	12.1	5620	151	4500	121	6500	174		
5 to 9 in. w.c. / 12 to 22 mbar 7 in. w.c. / 17 mbar -1 to 2 in. w.c. / -2 to 5 mbar T13589T0012 Yellow	2	0.14	750	20.1	1890	50.7	2800	75.0	5520	148
	5	0.34	1120	30.0	2460	65.9	4000	107	7200	193
	10	0.69	1590	42.6	3400	91.1	6000	161	10,000	268
	15	1.0	1920	51.5	4320	116	7000	188	13,600	364
	20	1.4	2240	60.0	5060	136	9000	241	14,000	375
	25	1.7	2570	68.9	5800	155	10,000	268	15,000	402
	30	2.1	2890	77.5	6500	174	11,250	302	16,000	429
	40	2.8	3530	94.6	7900	212	13,000	348	10,400	279
	50	3.4	4180	112	7800	209	14,500	389	10,400	279
	60	4.1	4180	112	6560	176	12,250	328	10,400	279
	80	5.5	4020	108	4100	110	3250	87.1	10,400	279
	100	6.9	4670	125	4270	114	3750	101	5200	139
	125	8.6	5070	136	4500	121	6500	174	4400	118
	150	10.3	5480	147	4850	130	6500	174	4400	118
	175	12.1	5480	147	5200	139	6500	174		
7 to 20 in. w.c. / 17 to 50 mbar 14 in. w.c. / 35 mbar ±2 in. w.c. / ±5 mbar 1N3112X0012 Unpainted	2	0.14	700	18.8	1420	38.1	3440	92.2	4800	129
	5	0.34	1110	29.7	2200	59.0	4000	107	7200	193
	10	0.69	1580	42.3	3500	93.8	6000	161	11,200	300
	15	1.0	1920	51.5	4300	115	7600	204	15,200	407
	20	1.4	2240	60.0	5000	134	9000	241	18,000	482
	25	1.7	2570	68.9	5700	153	10,000	268	17,200	461
	30	2.1	2890	77.5	6500	174	11,200	300	18,200	488
	40	2.8	3530	94.6	7900	212	12,800	343	14,400	386
	50	3.4	4180	112	9300	249	16,400	440	14,400	386
	60	4.1	4820	129	7630	204	18,800	504	14,000	375
	80	5.5	4600	123	4300	115	5000	134	8400	225
	100	6.9	4970	133	4430	119	5000	134	6000	161
	125	8.6	5200	139	4600	123	6800	182	6000	161
	150	10.3	5430	146	4850	130	6800	182	6000	161
	175	12.1	5430	146	5100	137	6800	182		
16 to 4 in. w.c. / 40 to 99 mbar 28 in. w.c. / 70 mbar ±4 in. w.c. / ±10 mbar 1B413727222 Purple	5	0.34	1110	29.7	2600	69.7	3600	96.5	6500	174
	10	0.69	1570	42.1	3500	93.8	6000	161	10,000	268
	15	1.0	1920	51.5	4400	118	7200	193	14,500	389
	20	1.4	2240	60.0	5100	137	8800	236	17,500	469
	25	1.7	2570	68.9	5800	155	10,000	268	20,000	536
	30	2.1	2890	77.5	6500	174	11,600	311	23,500	630
	40	2.8	3530	94.6	7900	212	14,000	375	22,500	603
	50	3.4	4180	112	9300	249	16,400	440	20,000	536
	60	4.1	4820	129	8400	225	19,000	509	16,500	442
	80	5.5	6110	164	6600	177	6500	174	16,500	442
	100	6.9	6360	170	6910	185	6500	174	7000	188
	125	8.6	6450	173	7300	196	6500	174	7000	188
	150	10.3	6540	175	7700	206	7000	188	7000	188
	175	12.1	6540	175	8100	217	7000	188		

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Capacities are limited to 15,000 SCFH / 402 Nm³/h when the Types VSX2 and VSX8 are used without a control line.
2. Due to slam-shut properties, capacities cannot be calculated with critical flow equation.

- continued -

Table 12. Types 299HS, 299HV, 299HSR and 299HVR Flow Capacities(1)(2) for 2 NPT Internal Registration (continued)

OUTLET PRESSURE RANGE SETTING, CONTROL SPRING PART NUMBER AND COLOR	INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS							
			Orifice Size, In. / mm							
			1/4 x 3/8 / 6.4 x 9.5		3/8 / 9.5		1/2 / 13		3/4 / 19	
	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1 to 3.25 psig / 69 mbar to 0.22 bar 2 psig / 0.14 bar ±1% psia / bar T13593T0012 Light blue	5	0.34	1020	27.3	2900	77.7	4000	107	6000	161
	10	0.69	1550	41.5	3600	96.5	5500	147	10,500	281
	15	1.0	1920	51.5	4300	115	7500	201	14,500	389
	20	1.4	2240	60.0	5000	134	8500	228	18,000	482
	25	1.7	2670	71.6	5550	149	10,000	268	20,000	536
	30	2.1	2890	77.5	6100	163	11,000	295	24,000	643
	40	2.8	3530	94.6	7750	208	14,000	375	28,000	750
	50	3.4	4180	112	9400	252	16,000	429	23,000	616
	60	4.1	4820	129	10,730	288	19,000	509	18,000	482
	80	5.5	6110	164	13,400	359	24,000	643	8000	214
	100	6.9	6850	184	10,770	289	6500	174	8000	214
	125	8.6	7070	189	7500	201	7500	201	8000	214
	150	10.3	7300	196	7500	201	7500	201	9500	255
	175	12.1	7300	196	7500	201	7500	201		
2.75 to 6 psig / 0.19 to 0.41 bar 5 psig / 0.34 bar ±1% psia / bar T13671T0012 Orange	10	0.69	1390	37.3	2800	75.0	5000	134	8000	214
	15	1.0	1870	50.1	3750	101	7000	188	13,000	348
	20	1.4	2240	60.0	4700	126	8500	228	17,000	456
	25	1.7	2570	68.9	5700	153	9500	255	20,000	536
	30	2.1	2890	77.5	6430	172	11,000	295	23,000	616
	40	2.8	3530	94.6	7900	212	13,000	348	29,000	777
	50	3.4	4180	112	9300	249	16,000	429	30,000	804
	60	4.1	4790	128	10,700	287	18,000	482	20,000	536
	80	5.5	5740	154	13,350	358	23,000	616	20,000	536
	100	6.9	6680	179	16,000	429	8000	214	20,000	536
	125	8.6	7170	192	12,800	343	8000	214	20,000	536
	150	10.3	7650	205	9600	257	8000	214	20,000	536
	175	12.1	7650	205	9600	257	8000	214		
5 to 16 psig / 0.34 to 1.1 bar 10 psig / 0.69 bar ±1% psia / bar T13600T0012 Red	15	1.0	1800	48.2	3200	85.8	4000	107	8500	228
	20	1.4	2200	59.0	4300	115	12,000	322	14,000	375
	25	1.7	2600	69.7	5400	145	9000	241	19,000	509
	30	2.1	3000	80.4	6600	177	10,000	268	22,000	590
	40	2.8	3650	97.8	7800	209	13,000	348	28,000	750
	50	3.4	4300	115	9000	241	16,000	429	34,000	911
	60	4.1	4950	133	10,460	280	18,000	482	39,000	1045
	80	5.5	6250	168	13,400	359	23,000	616	25,000	670
	100	6.9	7600	204	16,110	432	29,000	777	25,000	670
	125	8.6	9300	249	19,500	523	35,000	938	25,000	670
	150	10.3	9900	265	15,050	403	10,000	268	25,000	670
	175	12.1	10,500	281	10,600	284	10,000	268		
5 to 16 psig / 0.34 to 1.1 bar 15 psig / 1.0 bar ±1% psia / bar T13600T0012 Red	20	1.4	1900	50.9	3400	91.1	6000	161	10,000	268
	25	1.7	2450	65.7	4550	122	8000	214	15,000	402
	30	2.1	3000	80.4	5700	153	10,000	268	20,000	536
	40	2.8	3700	99.2	7600	204	13,000	348	28,000	750
	50	3.4	4320	116	8900	239	15,000	402	35,000	938
	60	4.1	4950	133	10,330	277	18,000	482	40,000	1072
	80	5.5	6200	166	13,200	354	23,000	616	51,000	1367
	100	6.9	7350	197	16,000	429	29,000	777	35,000	938
	125	8.6	8800	236	19,500	523	36,000	965	30,000	804
	150	10.3	10,220	274	22,950	615	40,000	1072	30,000	804
	175	12.1	11,650	312	26,400	708	40,000	1072		

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Capacities are limited to 15,000 SCFH / 402 Nm^3/h when the Types VSX2 and VSX8 are used without a control line.
2. Due to slam-shut properties, capacities cannot be calculated with critical flow equation.

Introduction

The 627 Series direct-operated pressure reducing regulators are for low-pressure and high-pressure systems. The 627 Series can be used as farm tap or small city gate regulators, monitoring regulators or high-pressure industrial gases. Performance characteristics vary according to construction.

Available Constructions
See Table 1

Body Sizes and End Connection Styles
See Table 3

Flow Coefficients
See Table 4

IEC Sizing Coefficients
See Table 5

Maximum Inlet Pressure
NPT Stainless steel: 2000 psig / 138 bar
Flanged Stainless steel: 1440 psig / 99.2 bar
NPT Steel: 2000 psig / 138 bar
Flanged Steel: 1500 psig / 103 bar
Ductile Iron: 1000 psig / 69 bar

Maximum Spring and Diaphragm Casing Pressures
See Table 7

Shipping Weights
See Table 8

Outlet Pressure Range
5 to 500 psig / 0.34 to 34.5 bar in 6 ranges, See Table 9

Internal Relief Performance
Type 627R: See Table 10
Type 627LR: See Table 11
Type 627MR: Limited by field-installed control line piping

Pressure Registration
See Table 1

Temperature Capabilities
-40 to 180°F / -40 to 82°C

Ordering Guide
To order this product, contact your local Sales Office.

Applications

- Air
- Fuel Gas
- Process Gas

Features

- Extended Body Option
- Internal Relief Valve Constructions
- Relief Operation Indicator
- Easy to Maintain
- Installation Adaptability
- Application Versatility
- Tamper-Resistant
- Wide Range of Flow Capabilities
- Tight Shutoff Capability
- NACE Configuration Available
- DVGW Approved

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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W4793

Figure 1. *Type 627 Direct-Operated Pressure Reducing Regulator*

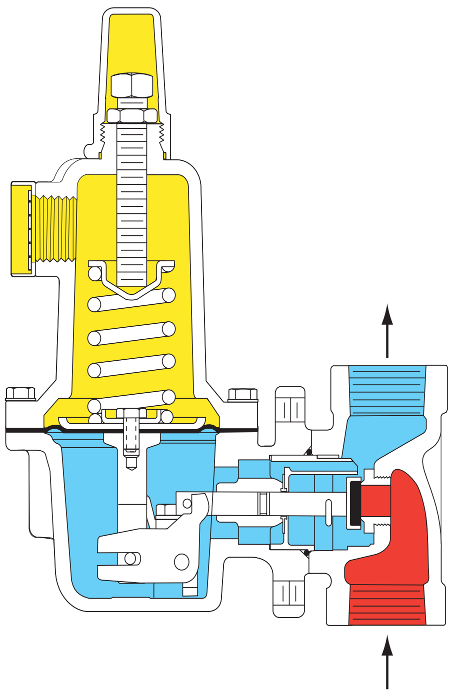

Figure 2. *Type 627 Operational Schematic*

Table 1. Available Construction

TYPE	CONFIGURATION
627	Direct-operated pressure reducing regulator equipped with a pitot tube for greater regulated capacities.
627R	Type 627 with internal relief and open throat.
627LR	Type 627R with light rate relief spring.
627M	Type 627 with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4 NPT downstream control line connection.
627MR	Type 627M with internal relief.
627H	Type 627 with a diaphragm limiter to deliver a higher outlet pressure.
627HM	Type 627H with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4 NPT downstream control line connection.

Table 2. Construction Material

BODY	SPRING AND DIAPHRAGM CASING	ORIFICE	DIAPHRAGM		DISK HOLDER	DISK
			Types 627H and 627HM	All Other		
Ductile iron, WCC steel or Stainless steel	Ductile iron, Aluminum, WCC steel or Stainless steel	Aluminum **(standard)** or Stainless steel	Neoprene (CR)	Nitrile (NBR) or Fluorocarbon (FKM)	Aluminum or Stainless steel	Nylon (PA), Nitrile (NBR) or Fluorocarbon (FKM)

Table 3. Body Size and End Connection Style

BODY SIZE		END CONNECTION STYLE	CONSTRUCTION AVAILABLE
NPS	DN		
3/4	- - - -	NPT(1)	All
1	25	NPT(1), CL150 RF, CL300 RF, CL600 RF and Long Body	
2	50	NPT(1), CL150 RF, CL300 RF, CL600 RF and Long Body	

1. Ductile iron bodies are only available with NPT end connection.

Table 4. Wide-Open Flow Coefficient for Relief Sizing

ORIFICE SIZE		3/4 NPT BODY			NPS 1 / DN 25 BODY			NPS 2 / DN 50 BODY		
In.	mm	Wide-Open		C_1	Wide-Open		C_1	Wide-Open		C_1
		C_g	C_v		C_g	C_v		C_g	C_v	
3/32	2.4	6.9	0.24	29.2	6.9	0.24	28.5	6.9	0.23	29.7
1/8	3.2	12.5	0.43	29.1	12.5	0.43	29.4	12.5	0.42	29.5
3/16	4.8	29	1.01	28.6	29	0.93	31.2	29	1.02	28.5
1/4	6.4	50	1.63	30.6	50	1.71	29.3	52	1.66	31.3
3/8	9.5	108	2.99	36.1	108	3.42	31.6	115	3.39	33.9
1/2	13	190	4.87	39.0	190	5.29	35.9	200	5.01	39.9

Table 5. IEC Sizing Coefficient

ORIFICE SIZE		X_T			F_D	F_L
In.	mm	3/4 NPT Body	NPS 1 / DN 25 Body	NPS 2 / DN 50 Body		
3/32	2.4	0.539	0.514	0.558	0.50	0.85
1/8	3.2	0.536	0.547	0.539		0.79
3/16	4.8	0.517	0.616	0.514		0.85
1/4	6.4	0.592	0.543	0.620		0.87
3/8	9.5	0.824	0.632	0.727		0.89
1/2	13	0.962	0.815	1.01		0.86

Table 6. Maximum Cold Working Pressure of Body Inlet (Body Rating)(1)(2)

BODY SIZE		BODY MATERIAL	END CONNECTION	MAXIMUM INLET PRESSURE	
NPS	DN			psig	bar
3/4	20	Ductile iron	NPT	1000	69.0
		Steel	NPT	2000	138
		Stainless steel	NPT	2000	138
1 and 2	25 and 50	Ductile iron	NPT	1000	69.0
		Steel	NPT	2000	138
			CL150 RF	290	20.0
			CL300 RF	750	51.7
			CL600 RF	1500	103
			PN 16/25/40	580	40.0
1 and 2	25 and 50	Stainless steel	CL150 RF	275	19.0
			CL300 RF	720	49.6
			CL600 RF	1440	99.3
			PN 16/25/40	580	40.0

1. The pressure/temperature limits in this Application Guide, and any applicable standard or code should not be exceeded.
2. Temperature may decrease these maximum pressures.

Table 7. Maximum Spring and Diaphragm Casing Pressure(1)

MAXIMUM PRESSURE DESCRIPTION	DIAPHRAGM CASING MATERIAL	TYPE 627		TYPES 627R AND 627LR		TYPE 627M		TYPE 627MR		TYPES 627H AND 627HM	
		psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
Maximum pressure to spring and diaphragm casings to prevent leak to atmosphere other than relief action (internal parts damage may occur).	Die cast aluminum	250	17.2	250	17.2	Not Available		Not Available		Not Available	
	Ductile iron	250	17.2	250	17.2	250	17.2	Not Available		Not Available	
	Steel or Stainless steel	250	17.2	250	17.2	250	17.2	250	17.2	800	55.2
Maximum pressure to spring and diaphragm casings to prevent burst of casings during abnormal operation (leak to atmosphere and internal parts damage may occur).	Die cast aluminum	375	25.9	375	25.9	Not Available		Not Available		Not Available	
	Ductile iron	465	32.1	465	32.1	465	32.1	465	32.1	Not Available	
	Steel or Stainless steel	1500	103	1500	103	1500	103	1500	103	1500	103
Maximum diaphragm casing overpressure (above setpoint) to prevent damage to internal parts.	All materials	60	4.1	120	8.3	60	4.1	120	8.3	120	8.3

1. If the spring case is pressurized, a metal adjusting screw cap is required. Contact your local Sales Office for details.

Table 8. Shipping Weight

CASING MATERIAL	APPROXIMATE SHIPPING WEIGHT	
	lbs	kg
Ductile iron, Steel or Stainless steel	10	5
Aluminum	6.3	3

Air
Process Gas

Natural gas regulating capacities at selected inlet pressures and outlet pressure settings are given in Tables 12 to 15 for the Type 627 or 627M, in Tables 16 to 18 for the Type 627H, and in Tables 19 to 20 for the Type 627R regulators. Flows are in SCFH (60°F and 14.7 psia) and Nm³/h (0°C and 1.01325 bar) of 0.6 specific gravity natural gas. To determine the equivalent capacities for other gases, multiply the table capacity by the following appropriate conversion factor: 0.775 for air, 0.789 for nitrogen, 0.628 for propane, or 0.548 for butane. 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 Nm³/h at 0°C and 1.01325 bar, multiply the values in SCFH by 0.0268.

Table 9. Maximum Inlet and Outlet Pressure Range

TYPE	OUTLET PRESSURE RANGE AND COLOR	ORIFICE SIZE		MAXIMUM INLET PRESSURE[1]					
				Nylon (PA) Disk		Nitrile (NBR) Disk		Fluorocarbon (FKM) Disk	
		In.	mm	psig	bar	psig	bar	psig	bar
627 and 627M[3]	5[2] to 20 psig / 0.34[2] to 1.4 bar, Yellow	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	750	51.7	750	51.7	300	20.7
		1/4	6.4	500	34.5	500	34.5	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	250	17.2	250	17.2	250	17.2
	15 to 40 psig / 1.0 to 2.8 bar, Green	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1500	103	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	500	34.5	500	34.5	300	20.7
		1/2	13	300	20.7	300	20.7	300	20.7
	35 to 80 psig / 2.4 to 5.5 bar, Blue	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	2000	138	1000	69.0	300	20.7
		3/16	4.8	1750	121	1000	69.0	300	20.7
		1/4	6.4	1500	103	1000	69.0	300	20.7
		3/8	9.5	1000	69.0	1000	69.0	300	20.7
		1/2	13	750	51.7	750	51.7	300	20.7
	70 to 150 psig / 4.8 to 10.3 bar, Red	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	2000	138	1000	69.0	300	20.7
		3/16	4.8	2000	138	1000	69.0	300	20.7
		1/4	6.4	1750	121	1000	69.0	300	20.7
		3/8	9.5	1250	86.2	1000	69.0	300	20.7
		1/2	13	750	51.7	750	51.7	300	20.7
627R and 627MR	5[2] to 20 psig / 0.34[2] to 1.4 bar, Yellow	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	750	51.7	750	51.7	300	20.7
		1/4	6.4	500	34.5	500	34.5	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	15 to 40 psig / 1.0 to 2.8 bar, Green	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1500	103	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	35 to 80 psig / 2.4 to 5.5 bar, Blue	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1750	121	1000	69.0	300	20.7
		3/16	4.8	1000	69.0	1000	69.0	300	20.7
		1/4	6.4	750	51.7	750	51.7	300	20.7
		3/8	9.5	300	20.7	300	20.7	300	20.7
		1/2	13	200	13.8	200	13.8	200	13.8
	70 to 150 psig / 4.8 to 10.3 bar, Red	3/32	2.4	2000	138	1000	69.0	300	20.7
		1/8	3.2	1000	69.0	1000	69.0	300	20.7
		3/16	4.8	500	34.5	500	34.5	300	20.7
		1/4	6.4	300	20.7	300	20.7	300	20.7
		3/8	9.5	200	13.8	200	13.8	200	13.8
		1/2	13	200	13.8	200	13.8	200	13.8
627LR	15 to 40 psig / 1.0 to 2.8 bar, Green	3/32	2.4			1000	69.0	300	20.7
		1/8	3.2			1000	69.0	300	20.7
		3/16	4.8			750	51.7	300	20.7
		1/4	6.4			500	34.5	300	20.7
627H and 627HM[3]	140 to 250 psig / 9.6 to 17.2 bar, Blue	3/32	2.4	2000	138	1000	69.0		
		1/8	3.2	2000	138	1000	69.0		
		3/16	4.8	1750	121	1000	69.0		
		1/4	6.4	1500	103	1000	69.0		
		3/8	9.5	1000	69.0	750	51.7		
		1/2	13	750	51.7	500	34.5		
	240 to 500 psig / 16.5 to 34.5 bar, Red	3/32	2.4	2000	138	1000	69.0		
		1/8	3.2	2000	138	1000	69.0		
		3/16	4.8	1750	121	1000	69.0		
		1/4	6.4	1500	103	1000	69.0		
		3/8	9.5	1000	69.0	1000	69.0		
		1/2	13	750	51.7	750	51.7		

1. For inlet pressure in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specification section.
2. For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.
3. The unbalance forces change from the wide-open monitor mode to an active regulator mode such that the Type 627M or 627HM should have a 3/8 in. / 9.5 mm or larger orifice.
- Shaded areas indicate that Fluorocarbon (FKM) / Nylon (PA) disk material is not available.

Table 10. Type 627R Internal Relief Performance(1)

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE		MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED(2) — Orifice Size, In. / mm: 3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
5(3) to 20 psig / 0.34 to 1.4 bar Yellow	10	0.69	60	4.1	1250	86.2	740	51.0	320	22.1	190	13.1	95	6.6	75	5.2
			100	6.9	2000	138	1500	103	620	42.7	390	26.9	180	12.4	130	9.0
			125	8.6	2000	138	1900	131	830	57.2	480	33.1	220	15.2	160	11.0
			175	12.1	2000	138	2000	138	1100	75.8	670	46.2	320	22.1	220	15.2
			200	13.8	2000	138	2000	138	1300	89.6	770	53.1	360	24.8	260	17.9
			250	17.2	2000	138	2000	138	1600	110	960	66.2	450	31.0	320	22.1
	20	1.4	60	4.1	850	58.6	490	33.8	210	14.5	130	9.0	80	5.5	65	4.5
			100	6.9	2000	138	1300	89.6	600	41.4	360	24.8	170	11.7	120	8.3
			125	8.6	2000	138	1800	124	800	55.2	480	33.1	220	15.2	160	11.0
			175	12.1	2000	138	2000	138	1100	75.8	670	46.2	320	22.1	220	15.2
			200	13.8	2000	138	2000	138	1300	89.6	770	53.1	360	24.8	260	17.9
			250	17.2	2000	138	2000	138	1600	110	960	66.2	450	31.0	320	22.1
15 to 40 psig / 1.0 to 2.8 bar Green	20	1.4	60	4.1	630	43.4	200	13.8	150	10.3	100	6.9	70	4.8	65	4.5
			100	6.9	2000	138	1200	82.7	550	37.9	330	22.8	160	11.0	120	8.3
			125	8.6	2000	138	1700	117	760	52.4	450	31.0	210	14.5	160	11.0
			175	12.1	2000	138	2000	138	1100	75.8	630	43.4	320	22.1	220	15.2
			200	13.8	2000	138	2000	138	1300	89.6	770	53.1	360	24.8	260	17.9
			250	17.2	2000	138	2000	138	1600	66.2	960	66.2	460	31.7	320	22.1
	30	2.1	100	6.9	2000	138	950	65.5	450	31.0	260	17.9	140	9.7	110	7.6
			125	8.6	2000	138	1500	103	670	46.2	400	27.6	190	13.1	150	10.3
			175	12.1	2000	138	2000	138	1000	69.0	610	42.1	300	20.7	220	15.2
			200	13.8	2000	138	2000	138	1200	82.7	760	52.4	360	24.8	260	17.9
			250	17.2	2000	138	2000	138	1600	110	970	66.9	460	31.7	320	22.1
	40	2.8	100	6.9	1500	103	700	48.3	330	22.8	200	13.8	120	8.3	108	7.5
			125	8.6	2000	138	1300	89.6	560	38.6	340	23.4	180	12.4	140	9.7
			175	12.1	2000	138	1800	124	1000	69.0	550	37.9	290	20.0	220	15.2
			200	13.8	2000	138	2000	138	1200	82.7	730	50.3	350	24.1	250	17.2
			250	17.2	2000	138	2000	138	1600	110	970	66.9	460	31.7	320	22.1
35 to 80 psig / 2.4 to 5.5 bar Blue	40	2.8	125	8.6	2000	138	1100	75.8	500	34.5	300	20.7	170	11.7	140	9.7
			150	10.3	2000	138	1600	110	750	51.7	440	30.3	230	15.9	180	12.4
			175	12.1	2000	138	2000	138	980	67.6	580	40.0	290	20.0	220	15.2
			200	13.8	2000	138	2000	138	1200	82.7	720	49.6	340	23.4	250	17.2
			250	17.2	2000	138	2000	138	1600	110	940	64.8	450	31.0	320	22.1
	60	4.1	125	8.6	900	62.1	450	31.0	270	18.6	190	13.1	140	9.7	130	9.0
			150	10.3	1700	117	1100	75.8	540	37.2	300	20.7	190	13.1	160	11.0
			175	12.1	2000	138	1700	117	780	53.8	470	32.4	250	17.2	200	13.8
			200	13.8	2000	138	2000	138	1000	69.0	610	42.1	310	21.4	230	15.9
			250	17.2	2000	138	2000	138	1400	96.5	880	60.7	420	29.0	310	21.4
	80	5.5	150	10.3	800	55.2	500	34.5	300	20.7	200	13.8	160	11.0	150	10.3
			175	12.1	1500	103	1200	82.7	550	37.9	330	22.8	210	14.5	190	13.1
			200	13.8	2000	138	1700	117	800	55.2	480	33.1	270	18.6	220	15.2
			250	17.2	2000	138	2000	138	1200	82.7	770	53.1	390	26.9	300	20.7
70 to 150 psig / 4.8 to 10.3 bar Red	80	5.5	175	12.1	1400	96.5	250	17.2	240	16.5	200	13.8	190	13.1	175	12.1
			200	13.8	2000	138	960	66.2	520	35.9	330	22.8	240	16.5	210	14.5
			250	17.2	2000	138	2000	138	1000	69.0	620	42.7	350	24.1	280	19.3
	100	6.9	200	13.8	1500	103	250	17.2	240	16.5	230	15.9	210	14.5	210	14.5
			250	17.2	2000	138	1600	110	770	53.1	520	35.9	320	22.1	270	18.6
	150	10.3	250	17.2	1200	82.7	260	17.9	260	17.9	260	17.9	260	17.9	260	17.9

1. The internal relief performance values are obtained by removing the disk assembly.
2. For inlet pressures in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications.
3. For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.
- Shaded areas indicate maximum inlet pressures allowed during system malfunction only. Table 8 gives the maximum inlet pressure for normal regulator operation.

Table 11. Type 627LR Internal Relief Performance(1)

OUTLET PRESSURE RANGE AND CONTROL SPRING INFORMATION	OUTLET PRESSURE SETTING		MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE		MAXIMUM INLET PRESSURE TO KEEP MAXIMUM ALLOWABLE DOWNSTREAM SYSTEM PRESSURE FROM BEING EXCEEDED(2) — Orifice Diameter, In. / mm: 3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4	
	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
15 to 40 psig / 1.0 to 2.8 bar Green	30	2.1	55	3.8	500	34.5	270	18.6	110	7.6	80	5.5
			60	4.1	850	58.6	480	33.1	200	13.8	120	8.3
			66	4.5	1000	69.0	660	45.5	290	20.0	175	12.1
	40	2.8	66	4.5	380	26.2	190	13.1	85	5.9	80	5.5
			70	4.8	700	48.3	370	25.5	150	10.3	115	7.9
			75	5.2	1000	69.0	560	38.6	240	16.5	160	11.0

1. The internal relief performance values are obtained by removing the disk assembly.
2. For inlet pressures in excess of 1000 psig / 69.0 bar, refer to the maximum body and disk pressure ratings in the Specifications section.

Fuel Gas

Table 12. Types 627, 627M and 627MR Capacities for 3/4 NPT Body Size[(1)]

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — Orifice Size, In. / mm											
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 20 psig[(2)] / 0.34 to 1.4 bar[(2)] Yellow	10	0.69	20	1.4	280	7.5	455	12.2	1130	30.3	1790	48.0	3000	80.4	4300	115
			60	4.1	640	17.2	1170	31.4	2550	68.3	4240	114	6270	168	7370	198
			100	6.9	990	26.5	1800	48.2	3800	102	5980	160	7440	199	7900	212
			200	13.8	1850	49.6	3370	90.3	6970	187	7250	194	8200	220	8300	222
			500	34.5	4010	107	8090	217	8060	216	8100	217				
			750	51.7	4400	118	8930	239	8950	240						
			1000	69.0	4450	119	10,300	276								
			1250	86.2	4540	122										
			1500	103	4880	131										
			1750	121	5230	140										
			2000	138	5900	158										
	20	1.4	30	2.1	350	9.4	620	16.6	1400	37.5	2490	66.7	4360	117	6290	169
			60	4.1	640	17.2	1170	31.4	2640	70.8	4680	125	8340	224	8940	240
			100	6.9	990	26.5	1800	48.2	3980	107	7220	193	11,500	308	12,600	338
			200	13.8	1850	49.6	3370	90.3	7340	197	12,000	322	13,200	354	13,700	367
			500	34.5	4400	118	8090	217	18,300	490	15,100	405				
			750	51.7	6600	117	12,000	322	14,200	381						
			1000	69.0	7300	196	14,600	391								
			1250	86.2	7500	201										
			1500	103	7800	209										
			1750	121	8400	225										
			2000	138	8600	230										
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	60	4.1	610	16.3	1090	29.2	2530	67.8	4350	117	8140	218	9420	252
			100	6.9	990	26.5	1790	48.0	4070	109	7220	193	13,200	354	15,300	410
			200	13.8	1850	49.6	3370	90.3	7630	204	13,500	362	18,000	482	18,500	496
			500	34.5	4400	118	8090	217	18,300	490	24,000	643	27,000	724		
			750	51.7	6600	177	12,000	322	23,000	616	24,200	649				
			1000	69.0	8700	233	16,000	429	24,400	654						
			1250	86.2	11,000	295	18,000	482								
			1500	103	12,000	322	21,000	563								
			1750	121	13,000	348										
			2000	138	14,000	375										
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	75	5.2	700	18.8	1230	33.0	2760	74.0	4750	127	8620	231	15,200	407
			100	6.9	970	26.0	1740	46.6	4010	107	6990	187	12,800	343	17,300	464
			200	13.8	1850	49.6	3370	90.3	7630	204	13,500	362	21,600	579	27,400	734
			500	34.5	4400	118	8090	217	18,300	490	28,100	753	28,900	775	33,400	895
			750	51.8	6600	177	12,000	322	26,300	705	30,000	804	37,000	992	45,000	1206
			1000	69.0	8700	233	16,000	429	30,000	804	31,200	836	37,400	1002		
			1250	86.2	11,000	295	19,000	509	31,600	847	34,000	911				
			1500	103	13,000	348	22,000	590	30,400	815	36,000	965				
			1750	121	15,000	402	25,000	670	34,000	911						
			2000	138	17,000	456	28,000	750								
	80	5.5	100	6.9	900	24.1	1600	42.9	3750	101	6490	174	12,200	327	17,300	464
			200	13.8	1850	49.6	3370	90.3	7,630	204	13,500	362	25,400	681	29,300	785
			500	34.5	4400	118	8090	217	18,300	490	31,900	855	36,000	965	36,700	984
			750	51.8	6600	177	12,000	322	27,200	729	35,000	938	44,000	1179	46,000	1233
			1000	69.0	8700	233	16,000	429	36,100	967	38,000	1018	56,200	1506		
			1250	86.2	11,000	295	19,000	509	37,000	992	40,000	1072				
			1500	103	13,000	348	22,000	590	38,000	1018	44,000	1179				
			1750	121	15,000	402	25,000	670	42,000	1126						
			2000	138	17,000	456	28,000	750								
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	200	13.8	1850	49.6	3370	90.3	7630	204	12,000	322	21,300	571	25,700	689
			500	34.5	4400	118	8090	217	18,300	490	31,800	852	39,000	1045	39,200	1051
			750	51.8	6600	177	12,000	322	27,200	729	39,000	1045	39,200	1051	45,900	1230
			1000	69.0	8700	233	16,000	429	36,100	967	40,000	1072	40,500	1085		
			1250	86.2	11,000	295	19,000	509	39,000	1045	40,500	1085	41,000	1099		
			1500	103	13,000	348	22,000	590	43,000	1152	44,000	1179				
			1750	121	15,000	402	25,000	670	45,000	1206	47,000	1260				
			2000	138	17,000	456	28,000	750	46,000	1233						
	150	10.3	200	13.8	1760	47.2	3200	85.8	7290	195	12,500	335	21,400	574	30,600	820
			500	34.5	4400	118	8090	217	18,300	490	32,500	871	48,900	1311	59,700	1600
			750	51.8	6600	177	12,000	322	27,200	729	48,300	1294	59,000	1581	72,000	1930
			1000	69.0	8700	233	16,000	429	36,100	967	64,100	1718	81,100	2173	85,000	2278
			1250	86.2	11,000	295	19,000	509	45,000	1206	68,000	1822	90,000	2412		
			1500	103	13,000	348	22,000	590	54,000	1447	72,000	1930				
			1750	121	15,000	402	25,000	670	63,000	1688	77,000	2064				
			2000	138	17,000	456	28,000	750	71,000	1903						

1. Capacity is based on 20% droop unless otherwise noted below.
2. For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.

- Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.
- Shaded areas indicate where a Type 627MR regulator should not be used because unbalanced forces can cause the internal relief valve to start-to-discharge during normal operation. Refer to Table 10.

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Table 13. Types 627, 627M and 627MR Capacities for NPS 1 / DN 25 Body Size[1]

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
					Orifice Size, In. / mm											
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 20 psig[2] / 0.34 to 1.4 bar[2] Yellow	10	0.69	20	1.4	280	7.5	490	13.1	1150	30.8	2050	54.9	3380	90.6	4410	118
			60	4.1	640	17.2	1170	31.4	2600	69.7	4710	126	8140	218	13,700	367
			100	6.9	990	26.5	1800	48.2	4070	109	7310	196	12,500	335	16,000	429
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	18,000	482	18,500	496
			500	34.5	4400	118	8090	217	15,700	421	20,000	536				
			750	51.7	5400	145	12,000	322	18,000	482						
			1000	69.0	5800	155	14,000	375								
			1250	86.2	6300	169										
			1500	103	6600	177										
			1750	121	6800	182										
			2000	138	7600	204										
	20	1.4	30	2.1	350	9.4	620	16.6	1450	38.9	2580	69.1	4360	117	6290	169
			60	4.1	640	17.2	1170	31.4	2640	70.8	4750	127	9690	260	14,500	389
			100	6.9	990	26.5	1800	48.2	4070	109	7310	196	13,900	373	23,300	624
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	26,600	713	39,100	1048
			500	34.5	4400	118	8090	217	18,300	490	32,900	882				
			750	51.7	6600	177	12,000	322	23,600	632						
			1000	69.0	8900	239	16,000	429								
			1250	86.2	10,000	268										
			1500	103	10,400	279										
			1750	121	12,000	322										
			2000	138	14,000	375										
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	60	4.1	610	16.3	1090	29.2	2530	67.8	4510	121	9290	249	9420	252
			100	6.9	990	26.5	1790	48.0	4070	109	7310	196	14,700	394	21,900	587
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	27,100	726	46,400	1244
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	63,900	1713		
			750	51.7	6600	177	12,000	322	27,200	729	39,400	1056				
			1000	69.0	8700	233	16,000	429	36,100	967						
			1250	86.2	11,000	295	19,000	509								
			1500	103	13,000	348	22,000	590								
			1750	121	15,000	402										
			2000	138	17,000	456										
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	100	6.9	970	26.0	1740	46.6	4010	107	7000	188	13,000	348	19,300	517
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	24,000	643	42,200	1131
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	64,000	1715	94,300	2527
			750	51.8	6600	177	12,000	322	27,200	729	43,380	1163	66,000	1769	130,000	3484
			1000	69.0	8700	233	16,000	429	36,100	967	50,300	1348	67,700	1814		
			1250	86.2	11,000	295	19,000	509	45,000	1206	57,000	1528				
			1500	103	13,000	348	22,000	590	54,000	1447	63,000	1688				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
	80	5.5	100	6.9	900	24.1	1600	42.9	3750	101	6650	178	12,200	327	18,600	498
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	28,400	761	44,100	1182
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	71,600	1919	110,000	2948
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	105,500	2827	135,000	3618
			1000	69.0	8700	233	16,000	429	36,100	967	64,900	1739	118,000	3162		
			1250	86.2	11,000	295	19,000	509	45,000	1206	80,000	2144				
			1500	103	13,000	348	22,000	590	54,000	1447	96,000	2573				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	200	13.8	1850	49.6	3370	90.3	7630	204	12,000	322	21,300	571	34,100	914
			500	34.5	4400	118	8090	217	18,300	490	31,800	852	66,500	1782	83,900	2249
			750	51.8	6600	177	12,000	322	27,200	729	47,300	1268	95,300	2554	117,000	3136
			1000	69.0	8700	233	16,000	429	36,100	967	59,700	1600	100,000	2680		
			1250	86.2	11,000	295	19,000	509	45,000	1206	72,000	1930	114,000	3055		
			1500	103	13,000	348	22,000	590	54,000	1447	86,000	2305				
			1750	121	15,000	402	25,000	670	63,000	1688	95,000	2546				
			2000	138	17,000	456	28,000	750	71,000	1903						
	150	10.3	200	13.8	1760	47.2	3200	85.8	7290	195	12,900	346	21,400	574	33,600	900
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	70,300	1884	111,000	2975
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	104,000	2787	160,000	4288
			1000	69.0	8700	233	16,000	429	36,100	967	64,800	1737	138,000	3698	162,000	4342
			1250	86.2	11,000	295	19,000	509	45,000	1206	80,000	2144	150,000	4020		
			1500	103	13,000	348	22,000	590	54,000	1447	96,000	2573				
			1750	121	15,000	402	25,000	670	63,000	1688	112,000	3002				
			2000	138	17,000	456	28,000	750	71,000	1903						

1. Capacity is based on 20% droop unless otherwise noted below.
2. For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.
- Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.
- Shaded areas indicate where a Type 627MR regulator should not be used because unbalanced forces can cause the internal relief valve to start-to-discharge during normal operation. Refer to Table 10.

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Table 14. Type 627 Capacities for NPS 2 / DN 50 Body Size[1]

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS: Orifice Size, In. / mm											
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 20 psig[2] / 0.34 to 1.4 bar[2] Yellow	10	0.69	20	1.4	280	7.5	490	13.1	1150	30.8	1880	50.4	2610	69.9	3830	103
			60	4.1	640	17.2	1170	31.4	2600	69.7	4750	127	7250	194	17,800	477
			100	6.9	990	26.5	1790	48.0	4070	109	7310	196	16,200	434	28,700	769
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	22,700	608	24,000	643
			500	34.5	4400	118	8090	217	18,300	490	21,000	563				
			750	51.7	6600	177	12,000	322	27,200	729						
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	6300	169										
	20	1.4	30	2.1	350	9.4	620	16.6	1450	38.9	2350	63.0	4300	115	6110	164
			60	4.1	640	17.2	1170	31.4	2640	70.8	4750	127	8400	225	15,700	421
			100	6.9	990	26.5	1800	48.2	4070	109	7310	196	16,200	434	28,700	769
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	24,000	643	33,000	884
			500	34.5	4400	118	8090	217	18,300	490	32,900	882				
			750	51.7	6600	177	12,000	322	27,200	729						
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	6300	169										
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	60	4.1	610	16.3	1090	29.2	2530	67.8	4370	117	8680	233	13,300	356
			100	6.9	990	26.5	1800	48.2	4070	109	7310	196	16,200	434	25,400	681
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	30,400	815	53,900	1445
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	22,000	590		
			750	51.7	6600	177	12,000	322	27,200	729	28,000	750				
			1000	69.0	8700	233	16,000	429	36,100	967						
			1250	86.2	11,000	295	19,000	509								
			1500	103	13,000	348	22,000	590								
			1750	121	15,000	402										
			2000	138	17,000	456										
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	75	5.2	700	18.8	1260	33.8	2760	74.0	4900	131	9000	241	12,300	330
			100	6.9	970	26.0	1740	46.6	4010	107	7000	188	15,000	402	20,400	547
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	30,400	815	53,900	1445
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	38,800	1040
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	53,000	1420	32,000	858
			1000	69.0	8700	233	16,000	429	36,100	967	43,000	1152	52,000	1394		
			1250	86.2	11,000	295	19,000	509	45,000	1206	70,000	1876				
			1500	103	13,000	348	22,000	590	54,000	1447	43,000	1152				
			1750	121	15,000	402	25,000	670	26,000	697						
			2000	138	17,000	456	28,000	750								
	80	5.5	100	6.9	900	24.1	1630	43.7	3750	101	6400	172	12,800	343	20,400	547
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	30,400	815	53,900	1445
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	48,000	1286
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	87,000	2332	44,000	1179
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742	63,000	1688		
			1250	86.2	11,000	295	19,000	509	45,000	1206	63,000	1688				
			1500	103	13,000	348	22,000	590	54,000	1447	86,000	2305				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	22,000	590	33,000	884
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	129,000	3457
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	108,000	2894	54,000	1447
			1000	69.0	8700	233	16,000	429	36,100	967	64,800	1737	82,000	2198		
			1250	86.2	11,000	295	19,000	509	45,000	1206	80,000	2144	110,000	2948		
			1500	103	13,000	348	22,000	590	54,000	1447	96,000	2573				
			1750	121	15,000	402	25,000	670	63,000	1688	112,000	3002				
			2000	138	17,000	456	28,000	750	71,000	1903						
	150	10.3	200	13.8	1760	47.2	3200	85.8	7290	195	13,000	348	24,000	643	38,000	1018
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	129,000	3457
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	108,000	2894	62,000	1662
			1000	69.0	8700	233	16,000	429	36,100	967	64,800	1737	144,000	3859		
			1250	86.2	11,000	295	19,000	509	45,000	1206	80,000	2144	81,000	2171		
			1500	103	13,000	348	22,000	590	54,000	1447	96,000	2573				
			1750	121	15,000	402	25,000	670	63,000	1688	112,000	3002				
			2000	138	17,000	456	28,000	750	71,000	1903						

1. Capacity is based on 20% droop unless otherwise noted below.
2. For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.
▭ - Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

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Table 15. Types 627M and 627MR Capacities for NPS 2 / DN 50 Body Size(1)

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS, Orifice Size, In. / mm											
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
5 to 20 psig(2) / 0.34 to 1.4 bar(2) Yellow	10	0.69	20	1.4	280	7.5	490	13.1	1150	30.8	1880	50.4	2610	69.9	3830	103
			60	4.1	640	17.2	1170	31.4	2600	69.7	4750	127	7250	194	15,000	402
			100	6.9	990	26.5	1790	48.0	4070	109	7310	196	14,600	391	23,000	616
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	27,300	732	43,000	1152
			500	34.5	4400	118	8090	217	18,300	490	32,900	882				
			750	51.7	6600	177	12,000	322	27,200	729						
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	17,000	456										
	20	1.4	30	2.1	350	9.4	620	16.6	1450	38.9	2480	66.5	4300	115	6110	164
			60	4.1	640	17.2	1170	31.4	2640	70.8	4750	127	8400	225	15,000	402
			100	6.9	990	26.5	1800	48.2	4070	109	7310	196	14,600	391	23,000	616
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	27,300	732	43,000	1152
			500	34.5	4400	118	8090	217	18,300	490	32,900	882				
			750	51.7	6600	177	12,000	322	27,200	729						
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	17,000	456										
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	60	4.1	610	16.3	1090	29.2	2530	67.8	4370	117	8680	233	13,300	356
			100	6.9	990	26.5	1800	48.2	4070	109	7310	196	14,600	391	25,400	681
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	27,300	732	48,000	1286
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	65,000	1742		
			750	51.7	6600	177	12,000	322	27,200	729	48,900	1311				
			1000	69.0	8700	233	16,000	429	36,100	967						
			1250	86.2	11,000	295	19,000	509								
			1500	103	13,000	348	22,000	590								
			1750	121	15,000	402										
			2000	138	17,000	456										
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	100	6.9	970	26.0	1740	46.6	4010	107	7000	188	15,000	402	20,400	547
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	30,400	815	48,500	1300
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	116,000	3109
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	108,000	2894	172,000	4610
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742	144,000	3859		
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447	97,000	2600				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
	80	5.5	100	6.9	900	24.1	1630	43.7	3750	101	6400	172	12,800	343	20,400	547
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	30,400	815	48,500	1300
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	116,000	3109
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	108,000	2894	172,000	4610
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742	144,000	3859		
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447	97,000	2600				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	22,000	590	33,000	884
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	116,000	3109
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	108,000	2894	172,000	4610
			1000	69.0	8700	233	16,000	429	36,100	967	64,800	1737	144,000	3859		
			1250	86.2	11,000	295	19,000	509	45,000	1206	80,000	2144	179,000	4797		
			1500	103	13,000	348	22,000	590	54,000	1447	96,000	2573				
			1750	121	15,000	402	25,000	670	63,000	1688	112,000	3002				
			2000	138	17,000	456	28,000	750	71,000	1903						
	150	10.3	200	13.8	1760	47.2	3200	85.8	7290	195	13,000	348	24,000	643	38,000	1018
			500	34.5	4400	118	8090	217	18,300	490	32,900	882	73,000	1956	116,000	3109
			750	51.8	6600	177	12,000	322	27,200	729	48,900	1311	108,000	2894	172,000	4610
			1000	69.0	8700	233	16,000	429	36,100	967	64,800	1737	144,000	3859		
			1250	86.2	11,000	295	19,000	509	45,000	1206	80,000	2144	179,000	4797		
			1500	103	13,000	348	22,000	590	54,000	1447	96,000	2573				
			1750	121	15,000	402	25,000	670	63,000	1688	112,000	3002				
			2000	138	17,000	456	28,000	750	71,000	1903						

1. Capacity is based on 20% droop unless otherwise noted below.
2. For pressure settings under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 psig / 6.9 bar so the setpoint adjustment can be obtained.
- Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.
- Shaded areas indicate where a Type 627MR regulator should not be used because unbalanced forces can cause the internal relief valve to start-to-discharge during normal operation. Refer to Table 10.

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Table 16. Types 627H and 627HM Capacities for 3/4 NPT Body Size[1]

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — Orifice Size, In. / mm: 3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
140 to 250 psig / 9.7 to 17.2 bar, Blue	150	10.3	200	13.8	1760[2]	47.2[2]	3200[2]	85.8[2]	7290	195	11,500	308	21,600	579	31,000	831
			250	17.2	2260[2]	60.6[2]	4100[2]	110[2]	9200	247	15,400	413	28,600	766	40,000	1072
			300	20.7	2700	72.4	4910	132	11,200	300	19,300	517	31,000	831	46,000	1233
			400	27.6	3600	96.5	6500	174	14,800	397	24,700	662	40,000	1072	50,000	1340
			500	34.5	4400	118	8090	217	18,300	490	29,700	796	51,000	1367		
			750	51.7	6600	177	12,000	322	27,200	729	43,000	1152				
			1000	69.0	8700	233	16,000	429	36,100	967	57,000	1528				
			1250	86.2	11,000	295	19,000	509	45,000	1206						
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
	200	13.8	250	17.2	2160[2]	57.9[2]	3850[2]	103[2]	8400	225	15,000	402	31,000	831	41,000	1099
			300	20.7	2700[2]	72.4[2]	4910[2]	132[2]	11,200	300	19,500	523	36,000	965	52,000	1394
			400	27.6	3600	96.5	6500	174	14,800	397	25,500	683	52,000	1394	68,000	1822
			500	34.5	4400	118	8090	217	18,300	490	31,000	831	61,000	1635		
			750	51.7	6600	177	12,000	322	27,200	729	45,500	1219				
			1000	69.0	8700	233	16,000	429	36,100	967	60,000	1608				
			1250	86.2	11,000	295	19,000	509	45,000	1206						
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
	250	17.2	300	20.7	2500[2]	67.0[2]	4500[2]	121[2]	9900	265	18,500	496	37,000	992	52,000	1394
			400	27.6	3600[2]	96.5[2]	6400[2]	172[2]	14,300	383	26,000	697	55,000	1474	74,000	1983
			500	34.5	4400	118	8090	217	18,300	490	33,000	884	64,000	1715	87,000	2332
			750	51.7	6600	177	12,000	322	27,200	729	49,000	1313	93,000	2492		
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742				
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
240 to 500 psig / 16.5 to 34.5 bar, Red	250	17.2	300	20.7	2500[2]	67.0[2]	4500[2]	121[2]	9300	249	14,000	375	25,000	670	37,000	992
			400	27.6	3600[2]	96.5[2]	6400[2]	172[2]	14,300	383	21,400	574	36,000	965	49,000	1313
			500	34.5	4400	118	8090	217	18,300	490	26,300	705	42,000	1126	62,000	1662
			750	51.7	6600	177	12,000	322	27,200	729	37,100	994	57,000	1528		
			1000	69.0	8700	233	16,000	429	36,100	967	47,400	1270				
			1250	86.2	11,000	295	19,000	509	45,000	1206	57,000	1528				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
	500	34.5	550	37.9	4300[2]	115[2]	7700[2]	206[2]	16,800	450	33,000	884	62,000	1662	90,000	2412
			600	41.4	4900[2]	131[2]	8800[2]	236[2]	19,400	520	37,000	992	70,000	1876	104,000	2787
			750	51.7	6600	177	12,000	322	27,200	729	49,000	1313	88,000	2358	137,000	3672
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742	130,000	3484		
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447	97,000	2600				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						

1. Capacity is based on 20% droop unless otherwise noted.
2. Small orifices and low-pressure drops may cause the setpoint to shift ±15 psig / 1.0 bar.
- Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

Fuel Gas

Table 17. Types 627H and 627HM Capacities for NPS 1 / DN 25 Body Size(1)

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
					Orifice Size, In. / mm											
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
140 to 250 psig / 9.7 to 17.2 bar Blue	150	10.3	200	13.8	1760(2)	47.2(2)	3200(2)	85.8(2)	7290	195	11,500	308	21,600	579	31,000	831
			250	17.2	2260(2)	60.6(2)	4100(2)	110(2)	9200	247	15,400	413	28,600	766	40,000	1072
			300	20.7	2700	72.4	4910	132	11,200	300	19,300	517	31,000	831	46,000	1233
			400	27.6	3600	96.5	6500	174	14,800	397	25,000	670	40,000	1072	50,000	1340
			500	34.5	4400	118	8090	217	18,300	490	32,000	858	51,000	1367		
			750	51.7	6600	177	12,000	322	27,200	729	46,000	1233				
			1000	69.0	8700	233	16,000	429	36,100	967	57,000	1528				
			1250	86.2	11,000	295	19,000	509	45,000	1206						
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
	250	17.2	300	20.7	2500(2)	67.0(2)	4500(2)	121(2)	9900	265	18,500	496	37,000	992	52,000	1394
			400	27.6	3600(2)	96.5(2)	6400(2)	172(2)	14,300	383	26,000	697	55,000	1474	74,000	1983
			500	34.5	4400	118	8090	217	18,300	490	33,000	884	64,000	1715	87,000	2332
			750	51.7	6600	177	12,000	322	27,200	729	49,000	1313	102,000	2734		
			1000	6.9	8700	233	16,000	429	36,100	967	65,000	1742				
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
240 to 500 psig / 16.5 to 34.5 bar Red	250	17.2	300	20.7	2500(2)	67.0(2)	4500(2)	121(2)	9300	249	14,000	375	25,000	670	37,000	992
			500	34.5	4400	118	8090	217	18,300	490	26,300	705	42,000	1126	62,000	1662
			750	51.7	6600	177	12,000	322	27,200	729	37,100	994	57,000	1528		
			1000	69.0	8700	233	16,000	429	36,100	967	47,400	1270				
			1250	86.2	11,000	295	19,000	509	45,000	1206	57,000	1528				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
	500	34.5	550	37.9	4300(2)	115(2)	7700(2)	206(2)	16,800	450	33,000	884	62,000	1662	90,000	2412
			750	51.7	6600	177	12,000	322	27,200	729	49,000	1313	88,000	2358	140,000	3752
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742	130,000	3484		
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447	97,000	2600				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						

1. Capacity is based on 20% droop unless otherwise noted.
2. Small orifices and low-pressure drops may cause the setpoint to shift ±15 psig / 1.0 bar.
- Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

Fuel Gas

Table 18. Types 627H and 627HM Capacities for NPS 2 / DN 50 Body Size[1]

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
					Orifice Size, In. / mm											
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
140 to 250 psig / 9.7 to 17.2 bar Blue	150	10.3	200	13.8	1760[2]	47.2[2]	3200[2]	85.8[2]	7290	195	13,700	367	24,100	646	31,000	831
			400	27.6	3600	96.5	6500	174	14,800	397	25,000	670	40,000	1072	50,000	1340
			500	34.5	4400	118	8090	217	18,300	490	32,000	858				
			750	51.7	6600	177	12,000	322	27,200	729	48,000	1286				
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742				
			1250	86.2	11,000	295	19,000	509	45,000	1206						
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750								
	250	17.2	300	20.7	2500[2]	67.0[2]	4500[2]	121[2]	9900	265	18,500	496	37,000	992	75,000	2010
			500	34.5	4400	118	8090	217	18,300	490	33,000	884	64,000	1715	95,000	2546
			750	51.7	6600	177	12,000	322	27,200	729	49,000	1313	102,000	2734		
			1000	69.0	8,700	233	16,000	429	36,100	967	65,000	1742				
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
240 to 500 psig / 16.5 to 34.5 bar Red	250	17.2	300	20.7	2500[2]	67.0[2]	4500[2]	121[2]	9300	249	14,000	375	25,000	670	37,000	992
			500	34.5	4400	118	8090	217	18,300	490	26,300	705	42,000	1126	62,000	1662
			750	51.7	6600	177	12,000	322	27,200	729	37,100	994	57,000	1528		
			1000	69.0	8700	233	16,000	429	36,100	967	47,400	1270				
			1250	86.2	11,000	295	19,000	509	45,000	1206	57,000	1528				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
	300	20.7	350	24.2	2900[2]	77.7[2]	5150[2]	138[2]	11,300	303	18,400	493	31,000	831	45,000	1206
			500	34.5	4400	118	8090	217	18,300	490	32,000	858	53,000	1420	67,000	1796
			750	51.7	6600	177	12,000	322	27,200	729	48,000	1286	80,000	2144		
			1000	69.0	8700	233	16,000	429	36,100	967	62,000	1662				
			1250	86.2	11,000	295	19,000	509	45,000	1206	79,000	2117				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
	400	27.6	450	31.1	3600[2]	96.5[2]	6400[2]	172[2]	14,000	375	25,000	670	47,000	1260	67,000	1796
			500	34.5	4400[2]	118[2]	8090[2]	217[2]	18,300	490	32,000	858	54,000	1447	77,000	2064
			750	51.7	6600	177	12,000	322	27,200	729	49,000	1313	91,000	2439		
			1000	69.0	8700	233	16,000	429	36,100	967	65 000	1742				
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447						
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						
	500	34.5	550	37.9	4300[2]	115[2]	7700[2]	206[2]	16,800	450	33,000	884	62,000	1662	90,000	2412
			600	41.4	4900[2]	131[2]	8800[2]	236[2]	19,400	520	37,000	992	70,000	1876	104,000	2787
			750	51.7	6600	177	12,000	322	27,200	729	49,000	1313	88,000	2358	140,000	3752
			1000	69.0	8700	233	16,000	429	36,100	967	65,000	1742	130,000	3484		
			1250	86.2	11,000	295	19,000	509	45,000	1206	81,000	2171				
			1500	103	13,000	348	22,000	590	54,000	1447	97,000	2600				
			1750	121	15,000	402	25,000	670	63,000	1688						
			2000	138	17,000	456	28,000	750	71,000	1903						

1. Capacity is based on 20% droop unless otherwise noted.
2. Small orifices and low-pressure drops may cause the setpoint to shift ±15 psig / 1.0 bar.
- Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

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Table 19. Type 627R Capacities for 3/4 NPT Body Size[1]

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — Orifice Size, In. / mm: 3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 20 psig[2] / 0.34 to 1.4 bar[2] Yellow	10	0.69	20	1.4	280	7.5	450	12.1	1070	28.7	1740	46.6	2700	72.4	3800	102
			60	4.1	640	17.2	1170	31.4	2460	65.9	3690	98.9	5270	141	6120	164
			100	6.9	990	26.5	1690	45.3	3540	94.9	4790	128	6200	166	7600	204
			200	13.8	1850	49.6	3070	82.3	4200	113	6200	166	6380	171	7680	206
			500	34.5	4010	107	4240	114	5640	151	6520	175				
			750	51.7	4400	118	5120	137	6400	172						
			1000	69.0	4450	119	6220	167								
			1250	86.2	4540	122										
			1500	103	4880	131										
			1750	121	5230	140										
			2000	138	5900	158										
	20	1.4	30	2.1	350	9.4	590	15.8	1390	37.3	2480	66.5	4350	117	4970	133
			60	4.1	640	17.2	1170	31.4	2610	69.9	4680	125	7800	209	8900	239
			100	6.9	990	26.5	1800	48.2	3980	107	6700	180	9750	261	10,400	279
			200	13.8	1850	49.6	3370	90.3	7050	189	9000	241	10,200	273	10,800	289
			500	34.5	4400	118	5200	139	7400	198	9760	262				
			750	51.7	6600	177	5360	144	8870	238						
			1000	69.0	7300	196	6500	174								
			1250	86.2	7500	201										
			1500	103	7800	209										
			1750	121	8400	225										
			2000	138	8600	230										
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	60	4.1	610	16.3	1090	29.2	2270	60.8	4230	113	8100	217	9100	244
			100	6.9	990	26.5	1790	48.0	4070	109	6840	183	11,900	319	13,400	359
			200	13.8	1850	49.6	3370	90.3	7630	204	11,000	295	16,300	437	17,100	458
			500	34.5	4400	118	8090	217	14,500	389	14,800	397				
			750	51.8	6600	177	10,800	289	14,800	397	14,900	399				
			1000	69.0	8700	233	13,100	351	16,300	437						
			1250	86.2	11,000	295	13,800	370								
			1500	103	12,000	322	14,000	375								
			1750	121	13,000	348										
			2000	138	14,000	375										
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	75	5.2	700	18.8	1230	33.0	2760	74.0	4700	126	8170	219	12,600	338
			100	6.9	970	26.0	1740	46.6	3910	105	6690	179	11,900	319	14,400	386
			200	13.8	1850	49.6	3370	90.3	7630	204	12,400	332	18,400	493	21,200	568
			500	34.5	4400	118	8090	217	18,300	490	20,000	536				
			750	51.8	6600	177	12,000	322	18,900	507	21,400	574				
			1000	69.0	8700	233	16,000	429	19,000	509						
			1250	86.2	11,000	295	18,700	501								
			1500	103	13,000	348	19,000	509								
			1750	121	15,000	402	20,000	536								
			2000	138	17,000	456										
	80	5.5	100	6.9	900	24.1	1630	43.7	3570	95.7	6490	174	12,000	322	17,200	461
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	23,000	616	29,000	777
			500	34.5	4400	118	8090	217	18,300	490	29,000	777				
			750	51.8	6600	177	12,000	322	23,100	619	30,900	828				
			1000	69.0	8700	233	16,000	429	27,400	734						
			1250	86.2	11,000	295	19,000	509								
			1500	103	13,000	348	22,000	590								
			1750	121	15,000	402	25,000	670								
			2000	138	17,000	456										
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	150	10.3	1170	31.4	2510	67.3	5540	148	8310	223	15,500	415	20,300	544
			200	13.8	1850	49.6	3370	90.3	7630	204	12,000	322	20,100	539	25,700	689
			500	34.5	4400	118	8090	217	18,300	490						
			750	51.8	6600	177	12,000	322								
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	17,000	456										
	150	10.3	200	13.8	1760	47.2	3200	85.8	7020	188	12,500	335	21,400	574	30,600	820
			500	34.5	4400	118	8090	217	18,300	490						
			750	51.8	6600	177	12,000	322								
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	17,000	456										

1. Capacity is based on 20% droop unless otherwise noted below.
2. For pressure setting under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 / 6.9 bar so that setpoint adjustment can be obtained.
☐ - Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

Fuel Gas

Table 20. Type 627R Capacities for NPS 1 and 2 / DN 25 and 50 Body Size(1)

OUTLET PRESSURE RANGE AND COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
					Orifice Size, In. / mm											
					3/32 / 2.4		1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
5 to 20 psig(2) / 0.34 to 1.4 bar Yellow	10	0.69	15	1.0	210	5.6	390	10.5	840	22.5	1480	39.7	2300	61.6	2930	78.5
			20	1.4	280	7.5	500	13.4	1100	29.5	1880	50.4	2700	72.4	3830	103
			60	4.1	640	17.2	1170	31.4	2460	65.9	3690	98.9	5650	151	6900	185
			100	6.9	990	26.5	1800	48.2	3540	94.9	4790	128	7520	202	8150	218
			200	13.8	1850	49.6	3370	90.3	5620	151	6360	170	11,000	295	12,900	346
			500	34.5	4400	118	6720	180	8570	230	11,600	311				
			750	51.7	5400	145	8850	237	9000	241						
			1000	69.0	5800	155	9500	255								
			1250	86.2	6300	169										
			1500	103	6600	177										
			1750	121	6800	182										
			2000	138	7600	204										
	20	1.4	30	2.1	350	9.4	600	16.1	1390	37.3	2580	69.1	4350	117	6290	169
			60	4.1	640	17.2	1170	31.4	2630	70.5	4750	127	7800	209	10,600	284
			100	6.9	990	26.5	1800	48.2	4070	109	7310	196	10,800	289	13,400	359
			200	13.8	1850	49.6	3370	90.3	7050	189	10,500	281	14,000	375	14,400	386
			500	34.5	4400	118	7830	210	11,800	316	13,300	356				
			750	51.7	6600	177	9000	241	12,000	322						
			1000	69.0	8700	233	9660	259								
			1250	86.2	10,000	268										
			1500	103	10,400	279										
			1750	121	12,000	322										
			2000	138	14,000	375										
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	60	4.1	610	16.3	1090	29.2	2430	65.1	4510	121	9200	247	9400	252
			100	6.9	990	26.5	1790	48.0	4070	109	7310	196	13,500	362	17,600	472
			200	13.8	1850	49.6	3370	90.3	7630	204	11,000	295	21,400	574	24,600	659
			500	34.5	4400	118	8090	217	16,300	437	21,800	584				
			750	51.7	6600	177	12,000	322	20,200	541	23,600	632				
			1000	69.0	8700	233	16,000	429	23,200	622						
			1250	86.2	11,000	295	19,000	509								
			1500	103	13,000	348	21,000	563								
			1750	121	15,000	402										
			2000	138	17,000	456										
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	75	5.2	700	18.8	1230	33.0	2760	74.0	4860	130	8600	230	12,800	343
			100	6.9	970	26.0	1740	46.6	3910	105	7000	188	12,500	335	16,700	448
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	20,900	560	27,700	742
			500	34.5	4400	118	8090	217	18,300	490	28,500	764				
			750	51.8	6600	177	12,000	322	22,800	611	29,500	791				
			1000	69.0	8700	233	16,000	429	26,800	718						
			1250	86.2	11,000	295	19,000	509								
			1500	103	13,000	348	22,000	590								
			1750	121	15,000	402	25,000	670								
			2000	138	17,000	456										
	80	5.5	100	6.9	900	24.1	1630	43.7	3570	95.7	6650	178	12,000	322	17,400	466
			200	13.8	1850	49.6	3370	90.3	7630	204	13,700	367	25,100	673	31,800	852
			500	34.5	4400	118	8090	217	18,300	490	30,300	812				
			750	51.8	6600	177	12,000	322	27,200	729	37,400	1002				
			1000	69.0	8700	233	16,000	429	33,300	892						
			1250	86.2	11,000	295	19,000	509								
			1500	103	13,000	348	22,000	590								
			1750	121	15,000	402	25,000	670								
			2000	138	17,000	456										
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	150	10.3	1170	31.4	2510	67.3	5540	148	8310	223	15,500	415	20,300	544
			200	13.8	1850	49.6	3370	90.3	7630	204	12,000	322	20,100	539	26,700	716
			500	34.5	4400	118	8090	217	18,300	490						
			750	51.8	6600	177	12,000	322								
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	17,000	456										
	150	10.3	200	13.8	1760	47.2	3200	85.8	7020	188	12,900	346	21,400	574	33,300	892
			500	34.5	4400	118	8090	217	18,300	490						
			750	51.8	6600	177	12,000	322								
			1000	69.0	8700	233	16,000	429								
			1250	86.2	11,000	295										
			1500	103	13,000	348										
			1750	121	15,000	402										
			2000	138	17,000	456										

1. Capacity is based on 20% droop unless otherwise noted below.
2. For pressure setting under 10 psig / 0.69 bar, inlet pressure should be limited to approximately 100 / 6.9 bar so that setpoint adjustment can be obtained.
- Blank areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

Introduction

The Types 627W and 627WH are direct-operated pressure reducing regulators for liquid service. Both types are available with either internal or external downstream pressure registration. The regulators can be used in nearly all liquid applications where constant downstream pressure is required.

Available Configurations

See Table 1

Body Sizes and End Connection Styles

NPT: 3/4, 1 or 2
CL150, CL300 or CL600 RF Flanged: NPS 1 or 2 / DN 25 or 50
PN 16, 25 or 40: NPS 1 or 2 / DN 25 or 50

Construction Materials

See Table 2

Maximum Operating Inlet And Outlet Pressure Ranges

See Table 3 for pressures by orifice and spring range

Body Pressure Shell Rating

NPT (Steel): 2000 psig / 138 bar
NPT (Ductile Iron): 1000 psig / 69.0 bar
CL600 RF Flanged (Steel): 1500 psig / 103 bar

Maximum Spring And Diaphragm Casing Pressure

See Table 4

Orifice Sizes

1/4 or 1/2 in. / 6.4 or 12.7 mm

Temperature Capabilities

See Table 5

Flow and Sizing Coefficients

See Table 6

C_v Coefficients

Type 627W: See Table 7
Type 627WH: See Table 8

Flow Capacities

Type 627W: See Table 9
Type 627WH: See Table 10

Pressure Registration

Type 627W or 627WH: Internal
Optional: External through 1/4 NPT control line connection in the diaphragm case

Spring Case Vent Connection

3/4 NPT with removable screened vent assembly

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Liquid

Features

- **Application Versatility**
- **Easy to Maintain**
- **Tamper-Resistant**
- **Tight Shutoff Capability**
- **Installation Adaptability**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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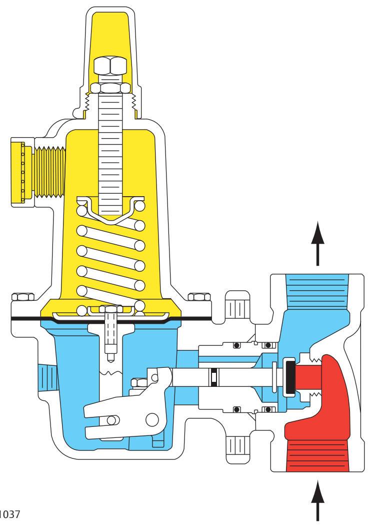
www.Emerson.com


W6309

Figure 1. Type 627W Pressure Reducing Regulator


M1037

INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE

Figure 2. Type 627W Operational Schematic

Table 1. Available Configurations

TYPE	CONFIGURATION
627W	Direct-operated pressure reducing liquid regulator
627WH	Type 627W with a diaphragm limiter to deliver a higher outlet pressure
Control Line Option	Type 627W or 627WH with a stem seal between the body outlet pressure and diaphragm case. Pressure is measured under the diaphragm through the 1/4 NPT downstream control line connection

Table 2. Construction Materials

BODY, SPRING CASE AND DIAPHRAGM CASE	O-RINGS	DIAPHRAGM	TRIM	VALVE DISK
Ductile iron (Type 627W only), Steel or Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Polytetrafluoroethylene (PTFE)	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Polytetrafluoroethylene (PTFE) Protector	Stainless steel	Nylon (PA), Nitrile (NBR), Fluorocarbon (FKM) or Ethylenepropylene (EPDM)

Table 3. Maximum Inlet Pressure, Differential Pressure and Outlet Pressure Ranges

TYPE	OUTLET PRESSURE RANGE AND SPRING COLOR	ORIFICE SIZE		MAXIMUM INLET PRESSURE				MAXIMUM DIFFERENTIAL PRESSURE			
				Elastomer Disk		Nylon (PA) Disk		Elastomer Disk		Nylon (PA) Disk	
		In.	mm	psig	bar	psig	bar	psig	bar	psid	bar d
627W	10 to 20 psig / 0.69 to 1.4 bar Yellow	1/4	6.3	220	15.2	420	29.0	200	13.8	400	27.6
		1/2	13	220	15.2	250	17.2	200	13.8	250	17.2
	15 to 40 psig / 1.0 to 2.8 bar Green	1/4	6.3	240	16.5	440	30.3	200	13.8	400	27.6
		1/2	13	240	16.5	300	20.7	200	13.8	300	20.7
	35 to 80 psig / 2.4 to 5.5 bar Blue	1/4	6.3	280	19.3	480	33.1	200	13.8	400	27.6
		1/2	13	280	19.3	480	33.1	200	13.8	400	27.6
	70 to 150 psig / 4.8 to 10.3 bar Red	1/4	6.3	350	24.1	550	37.9	200	13.8	400	27.6
		1/2	13	350	24.1	550	37.9	200	13.8	400	27.6
627WH	140 to 250 psig / 9.6 to 17.2 bar Blue	1/4	6.3	450	31.0	650	44.8	200	13.8	400	27.6
		1/2	13	450	31.0	500	34.5	200	13.8	250	17.2
	240 to 500 psig / 16.5 to 34.5 bar Red	1/4	6.3	700	48.3	900	62.1	200	13.8	400	27.6
		1/2	13	700	48.3	750	51.7	200	13.8	250	17.2

Table 4. Maximum Spring and Diaphragm Casing Pressure[1]

MAXIMUM PRESSURE CONDITION	DIAPHRAGM CASING MATERIAL	TYPE 627W		TYPE 627WH	
		psig	bar	psig	bar
Maximum pressure to spring and diaphragm casings to prevent leak to atmosphere (internal parts damage may occur)	Ductile Iron	250	17.2	----	----
	Steel or Stainless Steel	250	17.2	800	55.2
Maximum pressure to spring and diaphragm casings to prevent burst of casings during abnormal operation (leak to atmosphere and internal parts damage may occur)	Ductile Iron	465	32.1	----	----
	Steel or Stainless Steel	1500	103	1500	103
Maximum diaphragm casing overpressure (above setpoint) to prevent damage to internal parts	All Materials	60	4.1	120	8.3

1. If the spring case is pressurized, a metal adjusting screw cap is required. Contact your local Sales Office for details.

Table 5. Elastomer Temperature Ranges

MATERIAL	DISK/DIAPHRAGM	TEMPERATURES[1]		USAGE
		°F	°C	
Nitrile (NBR)	Disk	-40 to 180	-40 to 82	General
	Diaphragm			
Fluorocarbon (FKM)	Disk	0 to 300	-18 to 149	Not Recommended for Hot Water Service
	Diaphragm			
Ethylenepropylene (EPDM)	Disk	-40 to 275	-40 to 135	Not Recommended for Hydrocarbon Service
	Diaphragm			
Perfluoroelastomer (FFKM)	Disk	0 to 400	-18 to 204	Corrosive
Nylon (PA)	Disk	-40 to 200	-40 to 93	General
PTFE	Diaphragm Protector	-40 to 400	-40 to 204	Corrosive

1. Stainless steel body is rated to -40°F / -40°C. Steel and ductile iron bodies are rated to -20°F / -29°C.

Table 6. Flow and Sizing Coefficients

BODY SIZE	ORIFICE SIZE, IN. / mm									
	Wide-Open C_V For Relief Sizing		K_m		IEC Sizing Coefficients					
					X_T		F_D		F_L	
	1/4 / 6.4	1/2 / 12.7	1/4 / 6.4	1/2 / 12.7	1/4 / 6.4	1/2 / 12.7	1/4 / 6.4	1/2 / 12.7	1/4 / 6.4	1/2 / 12.7
3/4 NPT	1.63	4.87	0.76	0.74	0.592	0.962	0.50	0.50	0.87	0.86
NPS 1 / DN 25	1.70	5.29			0.543	0.815				
NPS 2 / DN 50	1.66	5.01			0.620	1.01				

Table 7. Type 627W C_v Coefficients

OUTLET PRESSURE RANGE AND SPRING COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE SETTING		COEFFICIENTS BASED ON A 20% DROOP					
					3/4 In. / DN 20 Body		1 In. / DN 25 Body		2 In. / DN 50 Body	
	psig	bar	psig	bar	1/4 In. / 6.4 mm Orifice	1/2 In. / 12.7 mm Orifice	1/4 In. / 6.4 mm Orifice	1/2 In. / 12.7 mm Orifice	1/4 In. / 6.4 mm Orifice	1/2 In. / 12.7 mm Orifice
10 to 20 psig / 0.69 to 1.4 bar Yellow	10	0.7	15	1.0	1.09	2.60	1.10	2.65	1.15	2.65
			30	2.1	1.14	2.76	1.27	2.87	1.27	2.87
			100	6.9	1.06	1.12	1.27	2.41	1.27	3.20
			200	13.8	0.68	0.70	1.27	1.49	1.27	3.15
			300	20.7	0.52	----	1.27	----	1.27	----
			400	27.6	0.50	----	1.27	----	1.27	----
	20	1.4	30	2.1	1.27	2.96	1.27	3.03	1.27	3.03
			50	3.4	1.27	2.33	1.27	3.48	1.27	3.48
			100	6.9	1.27	1.81	1.27	3.54	1.27	3.54
			200	13.8	1.13	1.02	1.27	3.14	1.27	3.16
			300	20.7	0.84	----	1.27	----	1.27	----
			400	27.6	0.59	----	1.27	----	1.27	----
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	100	6.9	1.27	2.30	1.27	3.44	1.27	3.77
			200	13.8	1.27	1.40	1.27	3.75	1.27	3.75
			300	20.7	1.19	1.18	1.27	3.68	1.27	3.68
			400	27.6	0.94	----	1.27	----	1.27	----
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	75	5.2	1.22	3.61	1.25	3.61	1.25	3.61
			100	6.9	1.27	2.80	1.27	3.23	1.27	3.27
			200	13.8	1.27	2.11	1.27	3.44	1.27	3.68
			300	20.7	1.27	1.55	1.27	3.60	1.27	3.60
			400	27.6	1.10	1.10	1.27	3.16	1.27	3.55
	80	5.5	100	6.9	1.27	3.17	1.27	3.48	1.27	3.72
			200	13.8	1.27	2.31	1.27	3.66	1.27	3.78
			300	20.7	1.27	1.74	1.27	3.64	1.27	3.64
			400	27.6	1.27	1.15	1.27	3.56	1.27	3.56
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	200	13.8	1.14	2.10	1.18	2.90	1.18	2.90
			300	20.7	1.27	1.67	1.27	2.97	1.27	3.07
			500	34.5	1.27	1.23	1.27	2.82	1.27	3.58
	125	8.6	200	13.8	1.27	2.45	1.27	2.91	1.27	3.05
			300	20.7	1.27	2.04	1.27	2.98	1.27	3.14
			500	34.5	1.27	1.64	1.27	3.68	1.27	3.68
	150	10.3	200	13.8	1.27	2.81	1.27	3.18	1.27	3.47
			300	20.7	1.27	2.54	1.27	3.22	1.27	3.22
			500	34.5	1.27	1.90	1.27	3.76	1.27	3.76

Table 8. Type 627WH C_v Coefficients

OUTLET PRESSURE RANGE AND SPRING COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE SETTING		COEFFICIENTS BASED ON A 20% DROOP					
					3/4 In. / DN 20 Body		1 In. / DN 25 Body		2 In. / DN 50 Body	
	psig	bar	psig	bar	1/4 In. / 6.4 mm Orifice	1/2 In. / 12.7 mm Orifice	1/4 In. / 6.4 mm Orifice	1/2 In. / 12.7 mm Orifice	1/4 In. / 6.4 mm Orifice	1/2 In. / 12.7 mm Orifice
140 to 250 psig / 9.7 to 17.2 bar Blue	150	10.3	200	13.8	1.17	2.83	1.20	2.83	1.26	2.83
			250	17.2	1.20	2.71	1.24	2.71	1.24	2.71
			300	20.7	1.25	2.51	1.30	2.51	1.30	2.51
			400	27.6	1.20	2.01	1.27	2.01	1.27	2.01
			500	34.5	1.17	----	1.23	----	1.23	----
			550	37.9	1.17	----	1.23	----	1.23	----
	200	13.8	250	17.2	1.26	3.14	1.30	3.14	1.34	3.14
			300	20.7	1.30	3.05	1.34	3.05	1.34	3.05
			400	27.6	1.25	2.80	1.27	2.80	1.27	2.80
			500	34.5	1.22	----	1.27	----	1.27	----
			600	41.4	1.22	----	1.27	----	1.27	----
	250	17.2	300	20.7	1.27	3.46	1.27	5.10	1.32	5.10
			400	27.6	1.27	3.25	1.27	3.68	1.28	3.68
			500	34.5	1.27	2.92	1.27	3.33	1.28	3.33
			650	44.8	1.27	----	1.27	----	1.28	----
240 to 500 psig / 16.5 to 34.5 bar Red	250	17.2	300	20.7	1.00	2.46	1.03	2.52	1.03	2.52
			400	27.6	1.07	2.15	1.10	2.23	1.10	2.23
			500	34.5	1.02	2.08	1.02	2.17	1.02	2.17
			650	44.8	1.02	----	1.02	----	1.02	----
	300	20.7	350	24.1	1.17	2.63	1.18	2.69	1.18	2.69
			400	27.6	1.22	2.45	1.25	2.52	1.25	2.52
			500	34.5	1.27	2.33	1.27	2.45	1.27	2.45
			700	48.3	1.27	----	1.27	----	1.27	----
	400	27.6	450	31.0	1.27	3.16	1.29	3.23	1.29	3.23
			500	34.5	1.38	3.02	1.40	3.10	1.40	3.10
			750	51.7	1.28	----	1.28	----	1.28	----
			800	55.2	1.28	----	1.28	----	1.28	----
	500	34.5	550	37.9	1.40	3.57	1.42	3.64	1.42	3.64
			600	41.4	1.36	3.51	1.38	3.60	1.38	3.60
			750	51.7	1.34	3.50	1.38	3.50	1.38	3.50
			900	62.1	1.34	----	1.38	----	1.38	----

Table 9. Type 627W Capacities

OUTLET PRESSURE RANGE AND SPRING COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE SETTING		CAPACITIES IN GPM (l/min) OF WATER BASED ON A 20% DROOP											
					3/4 In. / DN 20 Body				1 In. / DN 25 Body				2 In. / DN 50 Body			
					1/4 In. / 6.4 mm Orifice		1/2 In. / 12.7 mm Orifice		1/4 In. / 6.4 mm Orifice		1/2 in. / 12.7 mm Orifice		1/4 In. / 6.4 mm Orifice		1/2 In. / 12.7 mm Orifice	
	psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
10 to 20 psig / 0.69 to 1.4 bar Yellow	10	0.7	15	1.0	2.9	11.0	6.9	26.1	2.9	11.0	7.0	26.5	3.0	11.4	7.0	26.5
			30	2.1	5.4	20.4	13	49.2	6.0	22.7	13	49.2	6.0	22.7	13	49.2
			100	6.9	10	37.9	11	41.6	12	45.4	23	87.1	12	45.4	38	144
			200	13.8	10	37.9	10	37.9	18	68.1	20	75.7	18	68.1	24	90.8
			300	20.7	10	37.9	----	----	22	83.3	----	----	22	83.3	----	----
	20	1.4	30	2.1	4.8	18.2	11	41.6	4.8	18.2	11	41.6	4.8	18.2	11	41.6
			50	3.4	7.4	28.0	14	53.0	7.4	28.0	20	75.7	7.4	28.0	20	75.7
			100	6.9	12	45.4	17	64.3	12	45.4	32	121	12	45.4	32	121
			200	13.8	15	56.8	16	60.6	17	64.3	43	163	17	64.3	43	163
			300	20.7	14	53.0	----	----	21	79.5	----	----	21	79.5	----	----
			400	27.6	12	45.4	----	----	25	94.6	----	----	25	94.6	----	----
15 to 40 psig / 1.0 to 2.8 bar Green	40	2.8	100	6.9	11	41.6	19	71.9	11	41.6	28	106	11	41.6	31	117
			200	13.8	16	60.6	19	71.9	16	60.6	49	185	16	60.6	49	185
			300	20.7	18	68.1	19	71.9	21	79.5	45	170	21	79.5	45	170
			400	27.6	20	75.7	----	----	24	90.8	60	227	24	90.8	----	----
35 to 80 psig / 2.4 to 5.5 bar Blue	60	4.1	100	6.9	9.2	34.8	20	75.7	9.2	34.8	23	87.1	9.2	34.8	24	90.8
			200	13.8	16	60.6	26	98.4	16	60.6	42	159	16	60.6	51	193
			300	20.7	20	75.7	25	94.6	20	75.7	60	227	20	75.7	60	227
			400	27.6	22	83.3	23	87.1	22	83.3	60	227	22	83.3	66	250
	80	5.5	100	6.9	7.7	29.1	19	71.9	7.7	29.1	21	79.5	7.7	29.1	22	83.3
			200	13.8	15	56.8	24	90.8	15	56.8	43	163	15	56.8	49	185
			300	20.7	20	75.7	26	98.4	20	75.7	60	227	20	75.7	60	227
			400	27.6	23	87.1	25	94.6	23	87.1	70	265	23	87.1	70	265
70 to 150 psig / 4.8 to 10.3 bar Red	100	6.9	200	13.8	12	45.4	23	87.1	13	49.2	32	121	14	53.0	32	121
			300	20.7	19	71.9	25	94.6	19	71.9	44	167	19	71.9	50	189
			500	34.5	26	98.4	25	94.6	26	98.4	58	220	26	98.4	82	310
	125	8.6	200	13.8	13	49.2	24	90.8	13	49.2	29	110	13	49.2	31	117
			300	20.7	18	68.1	29	110	18	68.1	42	159	18	68.1	49	185
			500	34.5	25	94.6	33	125	25	94.6	74	280	25	94.6	74	280
	150	10.3	200	13.8	11	41.6	25	94.6	11	41.6	28	106	11	41.6	31	117
			300	20.7	17	64.3	34	129	17	64.3	43	163	17	64.3	43	163
			500	34.5	25	94.6	37	140	25	94.6	73	276	25	94.6	73	276

Table 10. Type 627WH Capacities

OUTLET PRESSURE RANGE AND SPRING COLOR	OUTLET PRESSURE SETTING		INLET PRESSURE SETTING		CAPACITIES IN GPM (l/min) OF WATER BASED ON A 20% DROOP											
					3/4 In. / DN 20 Body				1 In. / DN 25 Body				2 In. / DN 50 Body			
					1/4 In. / 6.4 mm Orifice		1/2 In. / 12.7 mm Orifice		1/4 In. / 6.4 mm Orifice		1/2 in. / 12.7 mm Orifice		1/4 In. / 6.4 mm Orifice		1/2 In. / 12.7 mm Orifice	
	psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
140 to 250 psig / 9.7 to 17.2 bar Blue	150	10.3	200	13.8	10	37.9	25	94.6	11	41.6	25	94.6	12	45.4	25	94.6
			300	20.7	17	64.3	33	125	17	64.3	33	125	17	64.3	33	125
			400	27.6	20	75.7	34	129	21	79.5	34	129	21	79.5	34	129
			500	34.5	23	87.1	----	----	24	90.8	----	----	24	90.8	----	----
	200	13.8	300	20.7	15	56.8	36	136	16	60.6	36	136	16	60.6	36	136
			400	27.6	19	71.9	44	167	20	75.7	44	167	20	75.7	44	167
			500	34.5	22	83.3	----	----	22	83.3	----	----	23	87.1	----	----
			600	41.4	25	94.6	----	----	27	102	----	----	27	102	----	----
	250	17.2	300	20.7	13	49.2	35	132	13	49.2	51	193	13	49.2	51	193
			400	27.6	18	68.1	46	174	18	68.1	52	197	18	68.1	52	197
			500	34.5	22	83.3	51	193	23	87.1	58	220	22	83.3	58	220
			650	44.8	27	102	----	----	27	102	----	----	27	102	----	----
240 to 500 psig / 16.5 to 34.5 bar Red	250	17.2	300	20.7	10	37.9	25	94.6	10	37.9	25	94.6	10	37.9	25	94.6
			400	27.6	15	56.8	30	114	16	60.6	32	121	16	60.6	32	121
			500	34.5	18	68.1	36	136	18	68.1	38	144	18	68.1	38	144
			650	44.8	20	75.7	----	----	20	75.7	----	----	20	75.7	----	----
	300	20.7	350	24.1	12	45.4	28	106	12	45.4	28	106	12	45.4	28	106
			400	27.6	15	56.8	31	117	16	60.6	32	121	16	60.6	32	121
			500	34.5	20	75.7	38	144	20	75.7	39	148	20	75.7	39	148
			700	48.3	27	102	----	----	27	102	----	----	27	102	----	----
	400	27.6	450	31.0	14	53.0	36	136	15	56.8	33	125	15	56.8	33	125
			500	34.5	18	68.1	41	155	19	71.9	42	159	19	71.9	42	159
			750	51.7	27	102	----	----	27	102	----	----	27	102	----	----
			800	55.2	28	106	----	----	28	106	----	----	28	106	----	----
	500	34.5	550	37.9	17	64.3	44	167	17	64.3	45	170	17	64.3	45	170
			600	41.4	19	71.9	50	189	20	75.7	51	193	20	75.7	51	193
			750	51.7	25	94.6	62	235	28	106	66	250	28	106	66	250
			900	62.1	27	102	----	----	28	106	----	----	28	106	----	----

Introduction

The 670 Series panel-mounted regulators are compact, rugged units used primarily for manually loading gas regulators. Applications include any control device that needs to be manipulated from a remote location. The 670 Series includes an atmospheric bleed which allows the loading pressure to be reduced.

Three basic panels are available within the product line, each having one pressure regulator connected to one or two gauges or two gauges and a changeover valve. A single gauge typically shows loading pressure to the control valve. With two gauges, one gauge shows the loading pressure and the other gauge can be connected to show downstream control pressure or any other pressure. The 670 Series is available with a three-way changeover valve. This allows the operator to manually set the regulator in the off, manual, or automatic position.

Available Configurations

See Table 1

End Connections

Inlet: 1/4 NPT internal
Outlet:
Types 670 and 675—1/4 NPT internal;
Type 671—3/8 NPT internal;
Type 674—1/4 NPT internal

Maximum Allowable Inlet Pressure

Without Changeover Valve:
250 psig / 17.2 bar
With Changeover Valve:
50 psig / 3.4 bar

Maximum Outlet Pressure

See Table 1

Maximum Emergency Outlet Pressure

See Table 1

Outlet Pressure Ranges

See Table 2

Pressure Registration

Internal

Temperature Capabilities

-20 to 180°F / -29 to 82°C

Construction Materials

See Table 4

Pressure Gauges

Connection: 1/8 NPT external fitting on back of case
Ranges: Standard ranges shown in Table 3 with other ranges available upon request
Face Colors: White with black numerals
Case Color: Black
Gauge Identification: White engraving on black laminated plastic plate below gauge indicates units and function.
Up to 16 characters per line, 3 lines, are available.

Regulator Port Diameters

Types 670 and 675: 0.125 in. / 3.2 mm
Type 671: 0.073 in. / 1.9 mm **(standard)**; 0.094 in. / 2.4 mm (optional)
Type 674: 0.078 in. / 2.0 mm

Regulator Flow Capacity

See appropriate pressure regulator Bulletin

Internal Relief for Pressure Regulators

Adequate for relieving only minor build-up situations. Refer to the appropriate pressure regulator Bulletin to determine if external relief is required.

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Air

Features

- **Control Flexibility**
- **Convenient Fingertip Control**
- **Easy Connections**
- **Compact Size**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Figure 1. *Type 670 Panel Loader with One Gauge*

P1128

Figure 2. *Type 670G Panel Loader with Two Gauges*

P1130

Figure 3. *Type 670GV Panel Loader with Two Gauges and Changeover Valve*

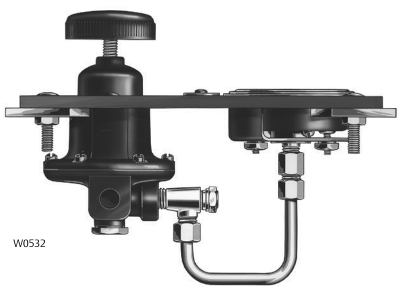

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Figure 4. *Type 670 Panel Loader*

Table 1. Available Configurations

TYPE	NUMBER OF GAUGE	DESCRIPTION	REGULATOR TYPE	MAXIMUM INLET PRESSURE		MAXIMUM OUTLET PRESSURE		MAXIMUM EMERGENCY OUTLET PRESSURE	
				psig	bar	psig	bar	psig	bar
670	1	Basic 1-gauge panel	67CR	250	17.2	100	6.9	110	7.6
670F	1	1-gauge panel; regulator has filter	67CFR						
670FG	2	2-gauge panel; regulator has filter	67CFR						
670FGV	2	2-gauge panel with 3-way changeover valve; regulator has filter	67CFR	50	3.4	50	3.4	55	3.8
670G	2	Basic 2-gauge panel	67CR	250	17.2	100	6.9	110	7.6
670GV	2	2-gauge panel with 3-way or 4-way changeover valve	67CR	50	3.4	50	3.4	55	3.8
671	1	Basic 1-gauge panel	912N	250	17.2	5	0.34	10	0.69
674G	2	Basic 2-gauge panel	1301F	6000	414	225	15.5	250	17.2
675G	2	Basic 2-gauge panel	67CR	250	17.2	100	6.9	110	7.6

Table 2. Outlet Pressure Range

TYPE	OUTLET PRESSURE RANGE	
	psig	bar
670 and 675(1)	3 to 18	0.21 to 1.2
	5 to 30	0.34 to 2.1
	30 to 50	2.1 to 3.4
	35 to 80 psig except 35 to 50 psig with change over valve	2.4 to 5.5 bar except 2.4 to 3.4 bar with change over valve
671	0 to 1	0 to 0.07
	0 to 5	0 to 0.34
674	10 to 75	0.69 to 5.2
	50 to 150	3.4 to 10.3
	100 to 225	6.9 to 15.5

1. These pressure ranges are recommended, but all springs used in the Type 67CR or 67CFR regulators can be adjusted down to 0 psig / 0 bar.

Table 3. Pressure Gauge Ranges - Triple Scale

psig	Pa	bar
0 to 10 0 to 30 0 to 60 0 to 160 0 to 300	0 to 0.6 K 0 to 0.2 M 0 to 0.4 M 0 to 1.1 M 0 to 2 M	0 to 0.69 0 to 2.1 0 to 4.1 0 to 11.0 0 to 20.7

Table 4. Construction Material

PANEL TUBING	REGULATOR BODY	REGULATOR SPRING CASE	PANEL	OTHER REGULATOR PARTS
Copper, PVC-coated copper, aluminum or 316 (316 Stainless steel)	**Types 670 and 675**: Die-cast aluminum **Type 671:** Die-cast zinc **Type 674:** Brass	**Types 670 and 675:** Die-cast zinc/Stainless steel **Type 671:** Die-cast zinc **Type 674:** Forged brass or steel	**Types 670, 670F and 671:** Zinc **Types 670FG, 670G, 670FGV and 670GV:** Steel **Handwheel:** Die-cast aluminum	**Diaphragm:** Nitrile (NBR) **Valve Disk:** Nitrile (NBR) **Diaphragm Plate:** Plated steel **Spring:** Plated steel **Filter Cartridge (Type 67CFR Regulator Only):** Cellulose **(standard)** or Stainless steel or Brass

Introduction

The 912N Series direct-operated, spring-loaded regulators are used in a variety of service and industrial applications. These regulators have limited-capacity internal relief across the diaphragm to help minimize overpressure.

Available Constructions

See Table 1

Body Sizes and End Connection Styles

Inlet: 1/4 NPT
Outlet: 1/4 or 3/8 NPT

Maximum Allowable Inlet Pressure

250 psig / 17.2 bar

Outlet Pressure Ranges

See Table 1

Maximum Allowable Outlet Pressure

Emergency Outlet Pressure:
20 psig /1.4 bar
Recommended Outlet Pressure to Avoid Internal Part Damage: 3 psid / 0.21 bar differential above outlet pressure setting; provide external relief if start-to-discharge point exceeds 3 psid / 0.21 bar differential
See Table 1

Body Port Diameter

0.073 or 0.094-inch / 1.9 or 2.4 mm

Flow Coefficients

Wide-Open C_g: 4
Wide-Open C_v: 0.114
C_1: 35
K_m: 0.79

IEC Sizing Coefficient

X_T: 0.78, **F_D:** 1.00, **F_L:** 0.89

Typical Regulating Capacities

See Tables 2 and 3

Internal Relief Performance

Approximate Internal Relief Valve Start-to-Discharge Point: See Table 1
Capacity: Adequate only for relieving minor buildup situations such as those caused by chips or dirt blocking the seat partly open; for major malfunctions, external relief is required

Temperature Capabilities

-20 to 160°F / -29 to 71°C

Pressure Registration

Internal

Spring Case Vent

Standard Construction: 1/8 NPT tapped with removable screen
Standard Location
Constructions Without Handwheel: Over body outlet
Handwheel Constructions: Over body inlet

Approximate Weight

1.3 pounds / 0.6 kg

Construction Materials

Body/Lower Casing: Zinc
Spring Case: Zinc
Disk/Lever Assembly: Fluorocarbon (FKM) disk with zinc lever, stainless steel lever pin and rod, and plated carbon steel lever screws
Diaphragm: Nitrile (NBR)/Nylon (PA)
Diaphragm Plate: Plated steel
Spring Seat: Plated steel
Control and Relief Valve Spring: Plated-steel spring wire, except stainless steel spring wire for control spring
Relief Valve Assembly: Brass and zinc

Ordering Guide

wTo order this product, contact your local Sales Office.

Figure 1. *Type 912N Pressure Reducing Regulator*

Application

- Fuel Gas

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
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Features

- **Accurate and Sensitive Control**
- **Versatility**
- **Weather and Insect Protection**
- **Easy Maintenance**

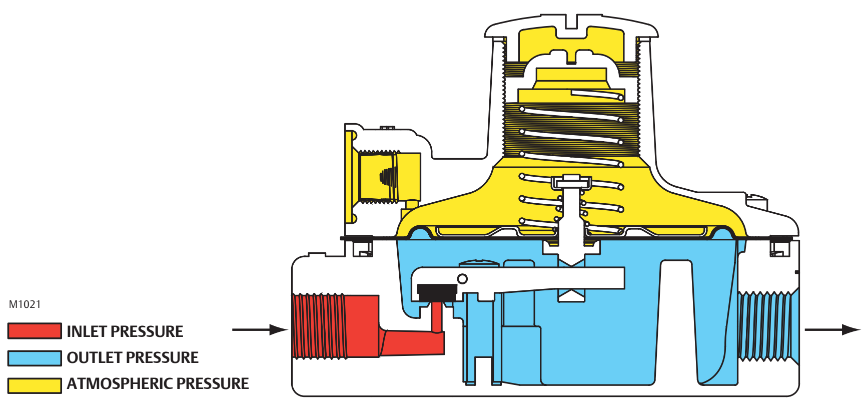

Figure 2. *Type 912N Operational Schematic*

Table 1. Outlet Pressure Range Data

AVAILABLE CONSTRUCTION	OUTLET PRESSURE RANGE		APPROXIMATE POINT ABOVE OUTLET PRESSURE SETTING AT WHICH INTERNAL RELIEF STARTS TO DISCHARGE		CONTROL SPRING SELECTION				
					Color Code	Spring Free Length		Spring Wire Diameter	
	In. w.c.	mbar	In. w.c.	mbar		In	mm	In	mm
912N Series without handwheel	3 to 7 5 to 10 9.25 to 13 12 to 24	7 to 17 12 to 25 23 to 32 30 to 60	5 to 21 8 to 30 16 to 39 17 to 3 psig	12 to 52 20 to 75 40 to 97 42 to 0.21 bar	Red Orange Unpainted Blue	1.09 1.37 1.78 1.34	27.7 34.8 45.2 34.0	0.035 0.037 0.038 0.047	0.89 0.94 0.97 1.19
	0.5 to 2.7 psig 2.7 to 5 psig	0.03 to 0.18 bar 0.18 to 0.34 bar	0.70 to 6.80 psig 3.80 to 12.5 psig	0.05 to 0.47 bar 0.26 to 0.86 bar	Yellow Green	1.19 1.31	30.2 33.3	0.075 0.080	1.91 2.03
912N Series with handwheel	8 to 24	20 to 60	30.3 to 35.4	75 to 88	Blue	1.34	34.0	0.047	1.19
	2.7 to 5 psig	0.18 to 0.34 bar	5.4 to 6.7 psig	0.37 to 0.46 bar	Green	1.31	33.3	0.080	2.03

1. Internal Relief Performance is only adequate for relieving minor buildup situations. External relief is required if start-to-discharge point exceeds 3 psid / 0.21 bar differential.

Table 2. Capacities for Type 912N Regulators without Handwheel (Body Size 1/4 x 3/8 NPT)

OUTLET PRESSURE SETTING		OUTLET PRESSURE RANGE		OFFSET		ORIFICE SIZE		CAPACITY IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — Inlet Pressure, psig / bar								
In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In	mm	5 / 0.34	10 / 0.69	25 / 1.7	50 / 3.4	75 / 5.2	100 / 6.9	150/ 10.3	200 / 13.8	250 / 17.2
5	12	3 to 7	7 to 17	1	2	0.073	1.9	53 / 1.42	73 / 1.96	136 / 3.65	199 / 5.33					
7	17	5 to 10	12 to 25	1	2				72 / 1.93	122 / 3.27	171 / 4.58	187 / 5.01	222 / 5.95	222 / 5.95	232 / 6.22	
11	27	9.25 to 13	23 to 32	1	2				61 / 1.64	100 / 2.68	144 / 3.86	163 / 4.37	180 / 4.82	210 / 5.63	234 / 6.27	259 / 6.94
20	50	12 to 24	30 to 60	2	5				58 / 1.55	95 / 2.55	137 / 3.67	163 / 4.37	189 / 5.07	243 / 6.51	303 / 8.12	315 / 8.44
1 psig	69	0.5 to 2.7 psig	0.03 to 0.18 bar	10%		0.094	2.4		51 / 1.37	63 / 1.69	83 / 2.22	99 / 2.65	105 / 2.81	148 / 3.97	204 / 5.47	236 / 6.33
				20%					70 / 1.88	100 / 2.68	140 / 3.75	177 / 4.74	201 / 5.39	302 / 8.09	377 / 10.1	440 / 11.8
2 psig	138	0.5 to 2.7 psig	0.03 to 0.18 bar	10%					62 / 1.66	91 / 2.44	120 / 3.22	155 / 4.15	178 / 4.77	249 / 6.67	304 / 8.15	358 / 9.59
				20%					85 / 2.28	146 / 3.91	220 / 5.90	300 / 8.04	348 / 9.33	480 / 12.9	576 / 15.4	683 / 18.3
5 psig	0.34 bar	2.7 to 5 psig	0.18 to 0.34 bar	10%					68 / 1.82	107 / 2.87	149 / 3.99	207 / 5.55	329 / 8.82	329 / 8.82	425 / 11.4	618 / 16.6
				20%					94 / 2.52	169 / 4.53	283 / 7.58	386 / 10.3	486 / 13.0	711 / 19.1	860 / 23.0	1030 / 27.6

- Not recommended for the given pressure range.

Table 3. Capacities for Type 912N Regulators with Handwheel (Body Size 1/4 x 3/8 NPT)

OUTLET PRESSURE SETTING		OUTLET PRESSURE RANGE		OFFSET		ORIFICE SIZE		CAPACITY IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — Inlet Pressure, psig / bar								
In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In	mm	5 / 0.34	10 / 0.69	25 / 1.7	50 / 3.4	75 / 5.2	100 / 6.9	150 / 10.3	200 / 13.8	250 / 17.2
14	35	8 to 24	20 to 60	2	5	0.094	2.4	70 / 1.88	96 / 2.57	121 / 3.24	129 / 3.46	143 / 3.83	156 / 4.18	156 / 4.18	190 / 5.09	212 / 5.68
3 psig	207	2.7 to 5 psig	0.18 to 0.34 bar	10%					92 / 2.47	153 / 4.10	261 / 7.00	354 / 9.49	459 / 12.3	587 / 15.7	716 / 19.2	731 / 19.6

- Not recommended for the given pressure range.

Types 1098-EGR and 1098H-EGR

Pressure Reducing Regulator

Introduction

Types 1098-EGR and 1098H-EGR regulators provide economical and accurate pressure control in a variety of applications: natural gas distribution systems; fuel gas supply to industrial boilers, furnaces, ovens and mixers; and commercial or industrial businesses such as steel mills, asphalt plants and shopping centers. This regulator is used with a Type 6351, 6352, 6353, 6354, Y600AM or 61 Series pilot.

The superior performance of this regulator is due to the amplifying effect of the pilot and the two-path control system. Changes in outlet pressure act quickly on the actuator diaphragm to provide fast response to system changes. The pilot amplifies small system changes to position the main valve for precise pressure control.

Body Sizes and End Connection Styles

See Table 1

Actuator Sizes and Maximum Pressures

See Table 2

Outlet Pressure (Control) Ranges

4 in. w.c. to 300 psig /
10 mbar to 20.7 bar
See Table 3

Differential Pressures

See Table 4

Main Valve Flow Characteristics

Linear (standard), Whisper Trim™ or Quick opening

Flow and IEC Sizing Coefficients

See Table 5

Flow Capacities

See Tables 8 and 9

Maximum Inlet Pressure

400 psig / 27.6 bar or body rating limit, whichever is lower

Temperature Capabilities

Nitrile (NBR):
-20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
0 to 300°F / -18 to 149°C except water which is limited to 0 to 200°F / -18 to 93°C
Ethylenepropylene (EPR):
-20 to 275°F / -29 to 135°C

Pressure Registration

External

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Liquid
- Process Gas
- Fuel Gas

Features

- **Differential as Low as 1 psid / 69 mbar d**
- **Quick Change Trim Package**
- **Optional Noise Abatement Trim (Up to 30 dBA reduction)**
- **No Atmospheric Bleed**
- **Easy Top Entry In-Line Maintenance**
- **Stainless Steel Construction for Corrosive Environments and Oxygen Service**
- **Aqueous Trim Packages (Application Specific)**
- **In-Service Travel Inspection**
- **Optional NACE construction**

Figure 1. *Type 1098-EGR Pressure Reducing Regulator*

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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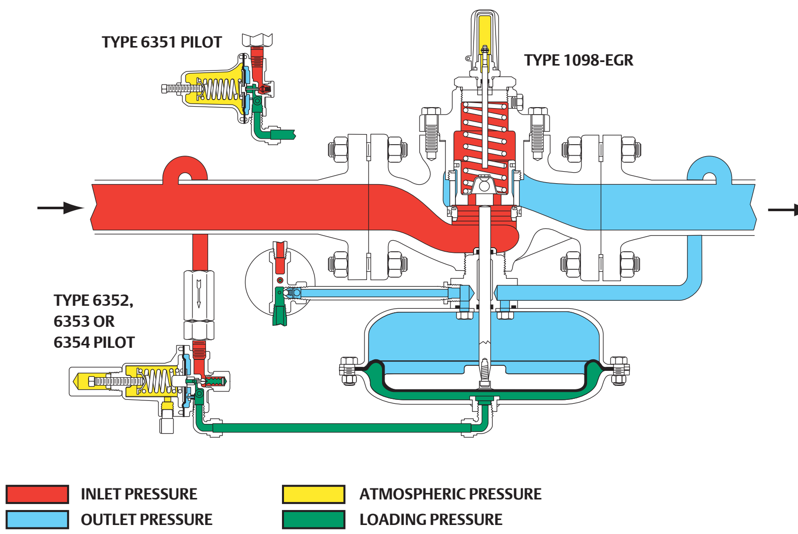

Figure 2. *Type 1098-EGR with 6350 Series Pilot Operational Schematic*

Table 1. Body Sizes and End Connection Styles

BODY SIZE		CAST IRON	STEEL OR STAINLESS STEEL
NPS	DN		
1 or 2	25 or 50	NPT, CL125 FF or CL250 RF	NPT, CL150 RF, CL300 RF, CL600 RF, BWE, SWE or PN 16/25/40
3, 4 or 6	80, 100 or 150	CL125 FF or CL250 RF	CL150 RF, CL300 RF, CL600 RF, BWE or PN 16/25/40
8 x 6 or 12 x 6	200 x 150 or 300 x 150	- - - -	CL150 RF, CL300 RF, CL600 RF or BWE

Table 2. Actuator Sizes and Maximum Pressures

ACTUATOR TYPE	ACTUATOR SIZE	OUTLET CONTROL PRESSURE		EMERGENCY CASING PRESSURE	
		psig	bar	psig	bar
1098	30 40 (standard) 70	100 75 50	6.9 5.2 3.4	115 82 65	7.9 5.6 4.5
1098H	30	350	24.1	400	27.6

Table 3. Outlet Pressure Ranges

PILOT TYPE	OUTLET (CONTROL) PRESSURE RANGE		SPRING COLOR
	psig	bar	
6351	3 to 20 5 to 35 35 to 100	0.2 to 1.4 0.3 to 2.4 2.4 to 6.9	Green Unpainted Red
6352	14 in. w.c. to 2 psig 2 to 10	35 mbar to 0.1 bar 0.1 to 0.7	Yellow Black
6353	3 to 40 35 to 125	0.2 to 2.8 2.4 to 8.6	Yellow Red
6354L(1)	85 to 200	5.9 to 13.8	Blue
6354M(2)	175 to 220	12.1 to 15.2	Blue
6354H(2)	200 to 300	13.8 to 20.7	Green
61L 61LD 61LE	7 in. w.c. to 2 psig 1 to 5 2 to 10 5 to 15 10 to 20	17 mbar to 0.1 bar 0.07 to 0.3 0.1 to 0.7 0.3 to 1.0 0.7 to 1.4	Red Yellow Blue Brown Green
61H	10 to 65	0.7 to 4.5	Green Stripe
61HP	15 to 45 35 to 10 100 to 300	1.0 to 3.1 2.4 to 6.9 6.9 to 20.7	Yellow Blue Red
Y600AM	4 to 8 in. w.c. 7 to 16 in. w.c. 15 in. w.c. to 1.2 psig 1.2 to 2.5 2.5 to 4.5 4.5 to 7	10 to 20 mbar 17 to 4 mbar 37 mbar to 0.08 bar 0.08 to 0.17 0.17 to 0.31 0.31 to 0.48	Red Unpainted Yellow Green Light Blue Black

1. Without diaphragm limiter.
2. With diaphragm limiter.

Table 4. Maximum and Minimum Differential Pressures for Main Valve Selection

BODY SIZE		SPRING COLOR	MAXIMUM ALLOWABLE DIFFERENTIAL PRESSURE(1)		MINIMUM DIFFERENTIAL PRESSURE REQUIRED FOR FULL STROKE					
					Size 30 Actuator		Size 40 Actuator		Size 70 Actuator	
NPS	DN		psig	bar	psig	bar	psig	bar	psig	bar
1	25	Green	60	4.1	3.5	0.24	2.5	0.17	1	0.07
		Blue	125	8.6	5	0.34	3	0.21	1.5	0.10
		Red	400(3)	27.6(3)	7	0.48	5	0.34	2.5	0.17
2	50	Yellow	20	1.4	- - - -	- - - -	2	0.14	1	0.07
		Green	60	4.1	4	0.28	3	0.21	1.5	0.10
		Blue	125	8.6	6	0.41	5	0.34	2	0.14
		Red	400(3)	27.6(3)	11	0.76	10	0.69	3	0.21
3	80	Yellow	20	1.4	- - - -	- - - -	2.5	0.17	1	0.07
		Green	60	4.1	5	0.34	4	0.28	2	0.14
		Blue	125	8.6	8	0.55	6	0.41	2.5	0.17
		Red	400(3)	27.6(3)	14	0.97	11	0.76	4	0.28
4	100	Yellow	20	1.4	- - - -	- - - -	3.5	0.25	1.3	0.09
		Green	60	4.1	10	0.69	5	0.34	2.5	0.17
		Blue	125	8.6	13	0.90	8	0.55	3	0.21
		Red	400(3)	27.6(3)	22	1.5	13	0.90	5	0.34
6, 8 x 6 and 12 x 6	150, 200 x 150 and 300 x 150	Yellow	20	1.4	- - - -	- - - -	6	0.42	2.2	0.15
		Green	60	4.1	13	0.90	9.5	0.66	4	0.28
		Blue	125	8.6	19	1.3	14	0.97	6	0.41
		Red	400(3)	27.6(3)	28(2)	1.9(2)	19	1.3	8	0.55

1. Maximum inlet pressure is equal to set pressure plus maximum differential.
2. Requires special 6300 Series pilot construction without integral check valve and with external Type 1806 40 psid / 2.8 bar d check valve.
3. Should not exceed the body rating limit. Use this pressure value or the body rating limit, whichever is lower.

Table 5. Flow Coefficients for Type 1098-EGR with Cage Option

BODY SIZE		1:1 LINE SIZE TO BODY SIZE					2:1 LINE SIZE TO BODY SIZE					K_m	IEC SIZING COEFFICIENT		
		C_g		C_v		C_1	C_g		C_v		C_1		X_T	F_D	F_L
NPS	DN	Regulating	Wide-Open	Regulating	Wide-Open		Regulating	Wide-Open	Regulating	Wide-Open					
LINEAR CAGE															
1	25	600	632	16.8	17.7	35.7	568	598	17.2	18.1	33.0	0.70	0.806	0.43	0.84
2	50	2280	2400	63.3	66.7	36.0	2050	2160	59.6	62.8	34.4		0.820	0.35	
3	80	4630	4880	132	139	35.1	4410	4650	128	135			0.779	0.30	
4	100	7320	7710	202	213	36.2	6940	7310	198	209	35.0		0.829	0.28	
6	150	12,900	13,600	397	418	32.5	12,100	12,800	381	404	31.7		0.668		
8 x 6	200 x 150	18,480	19,450	578	608	32.0	17,370	18,280	543	571	32.0		0.648		
12 x 6	300 x 150	21,180	22,290	662	697		19,900	20,950	622	655					
QUICK OPENING TRIM															
1	25	769	810	23.9	25.2	32.2	728	766	24.5	25.7	29.8	0.70	0.656	0.36	0.84
2	50	2460	2590	68.3	71.9	36.0	2214	2331	64.4	67.8	34.4		0.820		
3	80	4790	5050	141	149	33.9	4571	4812	137	145	33.3		0.727		
4	100	8120	8550	229	242	35.4	7701	8106	225	237	34.2		0.793	0.30	
6	150	14,915	15,700	445	469	33.5	14,571	15,350	435	458	33.5		0.710	0.28	
8 x 6	200 x 150	15,770	22,470	478	681	33.0	15,410	20,100	467	609	33.0		0.689		
12 x 6	300 x 150		25,750		780			25,760		781					
WHISPER TRIM™ CAGE															
1	25	576	607	16.7	17.6	34.5	529	557	15.6	16.4	34.0	0.80	0.753	0.10	0.89
2	50	1970	2080	54.7	57.8	36.0	1830	1930	52.3	55.1	35.0		0.820	0.07	
3	80	3760	3960	107	113	35.0	3630	3830	106	110	34.2		0.775	0.05	
4	100	6280	6610	180	190	34.8	6020	6340	171	180	35.2		0.766	0.04	
6	150	9450	9950	295	310	32.0	9240	9730	291	306	31.7		0.648	0.03	
8 x 6	200 x 150	10,660	11,220	305	321	35.0	10,020	10,550	286	301	35.0		0.775		
12 x 6	300 x 150	11,050	11,630	316	332		10,380	10,930	297	312					

Table 6. Proportional Band (Standard Pilot Restriction and Size 40 Type 1098 Actuator(1))

BODY SIZE		PILOT		PROPORTIONAL BAND					
		Type	Control Spring Color	Yellow or Green Main Valve Spring		Blue Main Valve Spring		Red Main Valve Spring	
NPS	DN			psi	mbar	psi	mbar	psi	mbar
1	25	6351	Green	0.10	7	0.20	14	0.40	28
			Unpainted	0.20	14	0.40	28	0.80	55
			Red	0.40	28	0.80	55	1	69
		6352	Yellow	0.04	3	0.10	7	0.20	14
			Black	0.08	6	0.20	14	0.40	28
		6353	Yellow	0.20	14	0.40	28	0.80	55
			Red	0.40	28	0.80	55	1	69
		61L	All	0.09	6	0.16	11	0.30	21
		61LD		0.04	3	0.08	6	0.20	14
		61LE, 61H and 61HP		0.40	28	0.80	55	1	69
		Y600AM(2)	Red	0.01	0.6	0.02	1	0.04	3
			Unpainted	0.01	0.6	0.02	1	0.04	3
			Yellow	0.05	3	0.10	7	0.15	10
			Green	0.10	7	0.15	10	0.20	14
			Light Blue	0.15	10	0.20	14	0.25	17
			Black	0.20	14	0.25	17	0.30	21

1. For other combinations, multiply table values by 1.6 for a size 30 actuator, 0.4 for a size 70 actuator, 2.0 for a low-gain Type 6352 or 6353 pilot restriction and 0.5 for a high-gain Type 6352 or 6353 pilot restriction. For instance, a standard NPS 2 / DN 50 Type 1098-EGR-6352 regulator with black pilot control spring and blue main valve spring has a proportional band of 0.3 psi / 0.021 bar as given in the table, but this same regulator with low-gain restriction and size 70 actuator has a proportional band of 0.3 psi / 0.021 bar x 2.0 x 0.4 = 0.24 psi / 0.017 bar.
2. The configuration utilized in determining the proportional band of the Type Y600AM included the 95 Series pilot supplying the Type Y600AM for improved stability and a fixed restrictor, part number 1K9484X0022 or an optional Type 112 variable restrictor with a setting of 3.

- continued -

Table 6. Proportional Band (Standard Pilot Restriction and Size 40 Type 1098 Actuator[(1)]) (continued)

BODY SIZE		PILOT		PROPORTIONAL BAND					
		Type	Control Spring Color	Yellow or Green Main Valve Spring		Blue Main Valve Spring		Red Main Valve Spring	
NPS	DN			psi	mbar	psi	mbar	psi	mbar
2	50	6351	Green	0.20	14	0.30	21	0.50	34
			Unpainted	0.30	21	0.50	34	1	69
			Red	0.50	34	1	69	1.40	97
		6352	Yellow	0.05	3	0.15	10	0.30	21
			Black	0.10	7	0.30	21	0.60	41
		6353	Yellow	0.30	21	0.50	34	1	69
			Red	0.50	34	1	69	1.40	97
		61L	All	0.10	7	0.20	14	0.60	41
		61LD		0.05	3	0.10	7	0.30	21
		61LE, 61H and 61HP		0.50	34	1	69	1.40	97
		Y600AM[(2)]	Red	0.01	0.6	0.02	1	0.04	3
			Unpainted	0.01	0.6	0.02	1	0.04	3
			Yellow	0.05	4	0.10	7	0.15	10
			Green	0.10	7	0.15	10	0.20	14
			Light Blue	0.15	10	0.20	14	0.25	17
			Black	0.20	14	0.25	17	0.30	21
3	80	6351	Green	0.30	21	0.40	28	0.60	41
			Unpainted	0.40	28	0.60	41	1.20	83
			Red	0.90	62	1.20	83	1.50	103
		6352	Yellow	0.10	7	0.20	14	0.40	27.6
			Black	0.20	14	0.40	28	0.80	55.2
		6353	Yellow	0.40	28	0.60	41	1.20	82.8
			Red	0.90	62	1.20	83	1.50	103
		61L	All	0.20	14	0.40	28	1	69.0
		61LD		0.10	7	0.20	14	0.50	34.5
		61LE, 61H and 61HP		0.90	62	1.20	83	1.50	103
		Y600AM[(2)]	Red	0.01	0.6	0.02	1	0.04	3
			Unpainted	0.01	0.6	0.02	1	0.04	3
			Yellow	0.05	4	0.10	7	0.15	10
			Light Green	0.10	7	0.15	10	0.20	14
			Light Blue	0.15	10	0.20	14	0.25	17
			Black	0.20	14	0.25	17	0.30	21
4	100	6351	Green	0.40	28	0.50	34	0.80	55
			Unpainted	0.70	48	0.80	55	1.40	97
			Red	1.20	83	2.00	138	3.00	207
		6352	Yellow	0.15	10	0.30	21	0.60	41
			Black	0.30	21	0.60	41	1.20	83
		6353	Yellow	0.70	48	0.80	55	1.40	97
			Red	1.20	83	2.00	138	3.00	207
		61L	All	0.30	21	0.60	41	1.40	97
		61LD		0.15	10	0.30	21	0.70	48
		61LE, 61H and 61HP		1.20	83	2.00	138	3.00	207
		Y600AM[(2)]	Red	0.01	0.6	0.02	1	0.04	3
			Unpainted	0.01	0.6	0.02	1	0.04	3
			Yellow	0.05	3	0.10	7	0.15	10
			Green	0.10	7	0.15	10	0.20	14
			Light Blue	0.15	10	0.20	14	0.25	17
			Black	0.20	14	0.25	17	0.30	21
6, 8 x 6 and 12 x 6	150, 200 x 150 and 300 x 150	6351	Green	0.50	34	0.60	41	1.00	69
			Unpainted	0.90	62	1.50	103	2.00	138
			Red	1.50	103	2.50	172	3.50	241
		6352	Yellow	0.20	14	0.40	28	0.80	55
			Black	0.40	28	0.80	55	1.60	110
		6353	Yellow	0.90	62	1.50	103	2.00	138
			Red	1.50	103	2.50	172	3.50	241
		61L	All	0.60	41	1.20	83	2.00	138
		61LD		0.30	21	0.60	41	2.00	69
		61LE, 61H and 61HP		1.50	103	2.50	172	3.50	241
		Y600AM[(2)]	Red	0.01	0.6	0.02	1	0.04	3
			Unpainted	0.01	0.6	0.02	1	0.04	3
			Yellow	0.05	3	0.10	7	0.15	10
			Green	0.05	3	0.15	10	0.20	14
			Light Blue	0.15	10	0.20	14	0.25	17
			Black	0.20	14	0.25	17	0.30	21

1. For other combinations, multiply table values by 1.6 for a size 30 actuator, 0.4 for a size 70 actuator, 2.0 for a low-gain Type 6352 or 6353 pilot restriction and 0.5 for a high-gain Type 6352 or 6353 pilot restriction. For instance, a standard NPS 2 / DN 50 Type 1098-EGR-6352 regulator with black pilot control spring and blue main valve spring has a proportional band of 0.3 psi / 0.021 bar as given in the table, but this same regulator with low-gain restriction and size 70 actuator has a proportional band of 0.3 psi / 0.021 bar x 2.0 x 0.4 = 0.24 psi / 0.017 bar.
2. The configuration utilized in determining the proportional band of the Type Y600AM included the 95 Series pilot supplying the Type Y600AM for improved stability and a fixed restrictor, part number 1K9484X0022 or an optional Type 112 variable restrictor with a setting of 3.

Table 7. Approximate Proportional Band Range (Standard Pilot Restriction, Size 30 Type 1098H Actuator[1])

BODY SIZE		PILOT		APPROXIMATE PROPORTIONAL BAND RANGE					
		Type	Control Spring Color	Green Main Valve Spring		Blue Main Valve Spring		Red Main Valve Spring	
NPS	DN			psi	bar	psi	bar	psi	bar
1	25	6354L, 6354M or 6354H	Blue or Green	1	0.07	1.5	0.10	2.5	0.17
2	50			1.5	0.10	2.0	0.14	3.0	0.21
3	80			2.5	0.17	3.0	0.21	4.0	0.28
4	100			3.5	0.24	4.0	0.28	5.0	0.34
6, 8 x 6 or 12 x 6	150, 200 x 150 or 300 x 150			4	0.28	5.0	0.34	Not Available	

1. For other restrictions, multiply table values by 2.0 for a low-gain restriction or by 0.5 for a high gain restriction. For instance, a standard NPS 2 / DN 50 Type 1098H-EGR-6354L regulator with blue control spring and blue main valve spring has a proportional band of 2.0 psi / 0.14 bar as given in the table. But this same regulator with low-gain restriction has a proportional band of 2.0 psi / 0.14 bar x 2.0 = 4.0 psi / 0.28 bar.

Liquid

Table 8. Liquid Capacities

INLET PRESSURE		OUTLET PRESSURE SETTING		CAPACITIES IN GPM / L/MIN OF WATER FOR REGULATORS WITH STAINLESS STEEL LINEAR HOLE CAGE													
				NPS 1 / DN 25		NPS 2 / DN 50		NPS 3 / DN 80		NPS 4 / DN 100		NPS 6 / DN 150		NPS 8 x 6 / DN 200 x 150		NPS 12 x 6 / DN 300 x 150	
psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
3	0.21	0.25	0.02	28	106	105	397	219	829	335	1268	658	2491	959	3630	1098	4156
5	0.34	0.25	0.02	37	140	138	522	288	1090	440	1665	865	3274	1260	4769	1443	5462
		1	0.07	34	129	127	481	264	999	404	1529	794	3005	1156	4375	1324	5011
		2	0.1	29	110	110	416	229	867	350	1325	688	2604	1001	3789	1147	4342
10	0.69	0.25	0.02	52	197	198	749	412	1559	631	2388	1240	4693	1805	8632	2067	7824
		3	0.2	44	167	167	632	349	1321	534	2021	1050	3974	1529	5787	1751	6628
		5	0.3	38	144	142	537	295	1117	452	1711	888	3361	1292	4890	1480	5602
		7	0.5	29	110	110	416	229	867	350	1325	688	2604	1001	3789	1147	4341
15	1.0	1	0.07	63	238	237	897	494	1870	756	2861	1485	5621	2163	8187	2477	9375
		4	0.3	56	212	210	795	438	1658	670	2536	1317	4985	1917	7256	2196	8312
		8	0.5	44	167	167	632	349	1321	534	2021	1050	3974	1529	5787	1751	6628
		12	0.8	29	110	110	416	229	867	350	1325	688	2604	1001	3789	1147	4341
20	1.4	1	0.07	73	276	276	1045	575	2176	880	3331	1730	6548	2519	9534	2886	10,924
		10	0.7	53	201	200	757	417	1578	639	2419	1255	4750	1828	6919	2093	7922
		15	1.0	38	144	142	537	295	1117	452	1711	888	3361	1292	4890	1480	5602
		17	1.2	29	110	110	416	229	867	350	1325	688	2604	1001	3789	1147	4341
30	2.1	4	0.3 or less	86	326	323	1223	673	2547	1030	3899	2024	7661	2947	11,154	3376	12,778
		15	1.0	65	246	245	927	511	1934	782	2960	1538	5821	2239	8475	2564	9705
		20	1.4	53	201	200	757	417	1578	639	2419	1255	4750	1828	6919	2093	7922
		25	1.7	38	144	142	537	295	1117	452	1711	888	3361	1292	4890	1480	5602
40	2.8	9	0.6 or less	94	356	352	1332	735	2782	1125	4258	2210	8365	3218	12,180	3686	13,952
		20	1.4	75	284	283	1071	590	2233	903	3418	1775	6718	2585	9784	2961	11,207
		30	2.1	53	201	200	757	417	1578	639	2419	1255	4750	1828	6919	2093	7922
		35	2.4	38	144	142	537	295	1117	452	1711	888	3361	1292	4890	1480	5602
50	3.4	13	0.9 or less	102	386	385	1457	803	3039	1229	4652	2415	9141	3516	13,308	4027	15,242
		20	1.4	92	348	347	1313	723	2737	1106	4186	2174	8229	3166	11,983	3626	13,724
		30	2.1	75	284	283	1071	590	2233	903	3418	1775	6718	2585	9784	2961	11,207
		40	2.8	53	201	200	757	417	1578	639	2419	1255	4750	1828	6919	2093	7922
		45	3.1	38	144	142	537	295	1117	452	1711	888	3361	1292	4890	1480	5602
75	5.2	24	1.6 or less	120	454	452	1711	943	3569	1443	5462	2835	10,730	4128	15,624	4728	17,895
		50	3.4	84	318	317	1200	660	2498	1010	3823	1985	7513	2890	10,939	3310	12,528
		60	4.1	65	246	245	927	511	1934	782	2960	1538	5821	2239	8475	2564	9705
		70	4.8	38	144	142	537	295	1117	452	1711	888	3361	1292	4890	1480	5602
100	6.9	35	2.4 or less	135	511	510	1930	1064	4027	1629	6166	3201	12,116	4660	17,638	5337	20,201
		60	4.1	106	401	400	1514	835	3160	1278	4837	2511	9504	3656	13,837	4187	15,848
		75	5.2	84	318	317	1200	660	2498	1010	3823	1985	7513	2890	10,939	3310	12,528
125	8.6	46	3.2 or less	149	564	563	2131	1173	4440	1795	6794	3529	13,357	5137	19,444	5884	22,271
		75	5.2	119	450	448	1696	933	3531	1428	5405	2807	10,624	4087	15,469	4681	17,718
150	10.3	57	3.9 or less	162	613	610	2309	1273	4818	1948	7373	3829	14,493	5574	21,098	6384	24,163
		75	5.2	145	549	548	2074	1143	4326	1749	6620	3438	13,013	5006	18,948	5733	21,699
175	12.1	68	4.7 or less	174	659	655	2479	1365	5167	2090	7911	4107	15,545	5979	22,630	6848	25,920
200	13.8	75	5.2 or less	188	712	708	2680	1476	5587	2258	8547	4439	16,802	6462	24,459	7401	28,013
250	17.2			222	840	837	3168	1746	6609	2672	10,114	5252	19,879	7646	28,940	8757	33,145
300	20.7			252	954	950	3596	1980	7494	3030	11,469	5955	22,540	8670	32,816	9930	37,585
350	24.1			279	1056	1050	3974	2189	8285	3350	12,680	6584	24,920	9585	36,279	10,978	41,552
400	27.6			303	1147	1141	4319	2380	9008	3642	13,785	7157	27,089	10,420	39,440	11,934	45,170

Air

Table 9. Air Capacities

INLET PRESSURE		OUTLET PRESSURE SETTING		CAPACITIES IN THOUSANDS OF SCFH / Nm³/h OF AIR FOR REGULATORS WITH STANDARD LINEAR CAGE, STANDARD TRAVEL AND LINE SIZE EQUALS MAIN VALVE BODY SIZE													
				NPS 1 / DN 25		NPS 2 / DN 50		NPS 3 / DN 80		NPS 4 / DN 100		NPS 6 / DN 150		NPS 8 x 6 / DN 200 x 150		NPS 12 x 6 / DN 300 x 150	
psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
3	0.21	7 in. w.c.	17 mbar	6	0.2	25	0.7	51	1.4	78	2.1	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
5	0.34	7 in. w.c.	17 mbar	9	0.2	33	0.9	67	1.8	105	2.8	199	5.3	288	7.8	331	8.8
		1	0.07	8	0.2	30	0.8	64	1.7	98	2.6	187	5.0	271	7.3	311	8.3
		2	0.1	7	0.2	27	0.7	57	1.6	87	2.3	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
10	0.69	7 in. w.c.	17 mbar	13	0.4	49	1.3	100	2.7	156	4.2	291	7.8	420	11.2	482	12.9
		3	0.2	12	0.3	43	1.2	90	2.4	140	3.7	264	7.1	382	10.2	438	11.7
		5	0.3	10	0.3	38	1.0	79	2.1	122	3.3	234	6.3	339	9.1	389	10.5
		7	0.5	9	0.2	31	0.9	64	1.7	98	2.6	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
15	1.0	1	0.07	16	0.5	61	1.6	126	3.4	197	5.3	365	9.8	525	14.1	602	16.1
		4	0.3	16	0.4	57	1.6	119	3.2	184	5.0	345	9.2	498	13.3	570	15.3
		8	0.5	13	0.4	49	1.3	101	2.7	156	4.2	298	8.0	432	11.5	494	13.3
		12	0.8	9	0.2	34	0.9	71	1.9	109	2.9	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
20	1.4	1	0.07	21	0.5	79	2.1	160	4.3	254	6.8	447	12.0	641	17.1	735	19.7
		10	0.7	16	0.5	61	1.6	127	3.4	197	5.3	374	10.0	539	14.5	618	16.6
		15	1.0	12	0.3	47	1.2	97	2.6	149	4.0	288	7.7	417	11.2	477	12.8
		17	1.2	10	0.3	37	1.0	77	2.1	119	3.2	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -
30	2.1	4	0.3 or less	27	0.7	102	2.7	207	5.6	327	8.8	577	15.4	826	22.2	946	25.3
		15	1.0	22	0.6	84	2.2	173	4.7	267	7.2	505	13.6	729	19.5	835	22.4
		20	1.4	19	0.5	72	1.9	149	4.0	230	6.2	440	11.8	637	17.1	730	19.5
		25	1.7	14	0.4	53	1.2	112	3.0	171	4.6	332	8.9	482	12.9	553	14.8
40	2.8	9	0.6 or less	33	0.9	125	3.3	253	6.8	401	10.8	705	18.9	1011	27.0	1159	31.1
		20	1.4	28	0.8	105	2.8	217	5.8	336	9.0	632	17.0	913	24.5	1046	28.1
		30	2.1	22	0.6	81	2.2	168	4.5	260	7.0	499	13.4	723	19.4	828	22.2
		35	2.4	16	0.5	60	1.6	125	3.3	191	5.1	372	10.0	540	14.5	618	16.6
50	3.4	13	0.9 or less	39	1.0	147	4.0	299	8.0	474	12.7	835	22.4	1195	32.0	1370	36.7
		20	1.4	35	0.9	133	3.6	274	7.4	427	11.5	793	21.2	1142	30.6	1308	35.0
		30	2.1	31	0.9	118	3.2	243	6.5	376	10.1	712	19.1	1028	27.6	1179	31.6
		40	2.8	24	0.6	89	2.4	186	5.0	286	7.7	552	14.8	800	21.5	916	24.6
		45	3.1	17	0.5	66	1.8	136	3.6	209	5.6	408	10.9	592	15.9	678	18.2
75	5.2	24	1.6 or less	53	1.5	205	5.5	415	11.2	656	17.6	1157	31.0	1657	44.4	1900	50.9
		50	3.4	42	1.2	157	4.2	325	8.7	502	13.5	955	25.6	1380	37.0	1582	42.4
		60	4.1	34	0.9	129	3.5	266	7.1	410	11.0	790	21.2	1144	30.7	1311	35.1
		70	4.8	21	0.5	78	2.1	162	4.3	250	6.7	486	13.0	706	18.9	809	21.7
100	6.9	35	2.4 or less	69	1.9	261	7.0	531	14.3	839	22.5	1479	39.7	2119	56.7	2429	65.1
		60	4.1	57	1.6	217	5.8	448	12.0	694	18.6	1309	35.1	1889	50.6	2165	58.0
		75	5.2	48	1.3	183	4.9	379	10.2	584	15.7	1119	30.0	1620	43.4	1857	49.8
125	8.6	46	3.2 or less	84	2.2	319	8.5	646	17.4	1022	27.4	1802	48.3	2581	69.1	2958	79.1
		75	5.2	71	1.9	267	7.1	550	14.7	853	22.9	1606	43.0	2317	62.1	2656	71.1
150	10.3	57	3.9 or less	98	2.6	375	10.1	763	20.5	1205	32.3	2124	57.0	3043	81.4	3488	93.8
		75	5.2	89	2.4	338	9.1	695	18.6	1082	29.0	2010	53.9	2895	77.5	3318	89.1
175	12.1	68	4.7 or less	114	3.0	432	11.6	878	23.6	1388	37.2	2447	65.6	3505	93.8	4017	108
200	13.8	75	5.2 or less	129	3.5	489	13.1	994	26.7	1571	42.1	2769	74.2	3966	106	4546	122
250	17.2			159	4.3	604	16.2	1225	32.9	1938	51.9	3414	91.5	4890	131	5605	150
300	20.7			189	5.0	718	19.2	1457	39.1	2303	61.7	4059	109	5814	156	6663	178
350	24.1			219	5.9	832	22.3	1688	45.3	2669	71.5	4703	126	6738	181	7722	207
400	27.6			249	6.7	946	25.3	1920	51.5	3035	81.4	5348	143	7662	205	8782	236

Fuel Gas

Process Gas

Regulating capacities at selected pressures and outlet pressure flows in Table 9 is given in SCFH (60°F and 14.7 psia) of air. To determine the equivalent capacities for other gases, multiply the table capacities in Table 9 by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm³/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

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Type 1190
Tank Blanketing Regulator

Introduction

The Type 1190 low pressure tank blanketing valve is used for extremely accurate pressure control on very low pressure blanketing systems. The regulator helps to control vapor space pressure and provides protection against any contamination from atmosphere. The Type 1190 gas blanketing regulator maintains a positive vessel pressure during pumpout operations.

A Type 1190 low pressure tank blanketing valve reduces a high pressure gas, such as nitrogen, to maintain a protective environment above any liquid stored in a tank or vessel while the liquid is being pumped out. Also, when the vessel cools suddenly, causing the vapor pressure inside the vessel to decrease, the gas blanketing regulator replaces the vapor pressure with a blanketing gas to prevent the internal vessel pressure from decreasing. In both cases, a slight positive vessel pressure prevents outside air, moisture, and other contaminants from entering the vessel.

Body Sizes and End Connection Styles
NPS 1 to 12 x 6 / DN 25 to 300 x 150 in various end connections; See Table 1

Construction Materials
See Table 2

Control Pressure Ranges (Type T205P)
0.25 in. w.c. to 7 psig / 0.6 mbar to 0.48 bar in seven ranges; See Table 3

Maximum Main Valve Inlet Pressures
400 psig / 27.6 bar

Maximum Operating Inlet Pressures
Cast iron: 200 psig / 13.8 bar
Steel or Stainless steel: 300 psig / 20.7 bar

Maximum Outlet (Casing) Pressure
Steel or Stainless steel: 75 psig / 5.2 bar

Maximum Operating Outlet Pressure to Avoid Internal Part Damage
Nitrile (NBR) or Fluorocarbon (FKM) Diaphragm: 75 psig / 5.2 bar

Max/Min Differential Pressures (Type EGR Main Valve)
See Table 5

Flow Coefficients
See Table 6

Flow Coefficients for Fixed Restriction
C_g: 3; C_v: 11.7; C_1: 35

Flow Capacities
See Table 7

Main Valve Temperature Capabilities[1]
Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
40 to 300°F / 4 to 149°C
Ethylenepropylene (EPDM):
-20 to 275°F / -29 to 135°C
Perfluoroelastomer (FFKM):
-20 to 300°F / -29 to 149°C

Pilot Temperature Capabilities[1]
Nitrile (NBR):
-20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
40 to 180°F / 4 to 82°C

Pressure Registration
External (3/4 NPT Control Line Connection)

Main Valve Flow Characteristic
Linear

Approximate Weights
See Table 4

Ordering Guide
To order this product, contact your local Sales Office.

Features

- **Quick-Change Trim Package for Ease of Maintenance**
- **In-Service Travel Inspection**
- **Factory-Piped Pilot Supply**
- **0.25 in. w.c. / 0.6 mbar Setpoint Capability for Better Cost Savings**
- **Whisper Trim™ Cage Construction for Application Versatility**
- **In-Service Travel Inspection**
- **Valve Positioner Add-on Capability and Bracketing**

Figure 1. Type 1190 Tank Blanketing Regulator

Figure 2. Type T205P Pilot

Application

Tank Blanketing

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
www.Emerson.com

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

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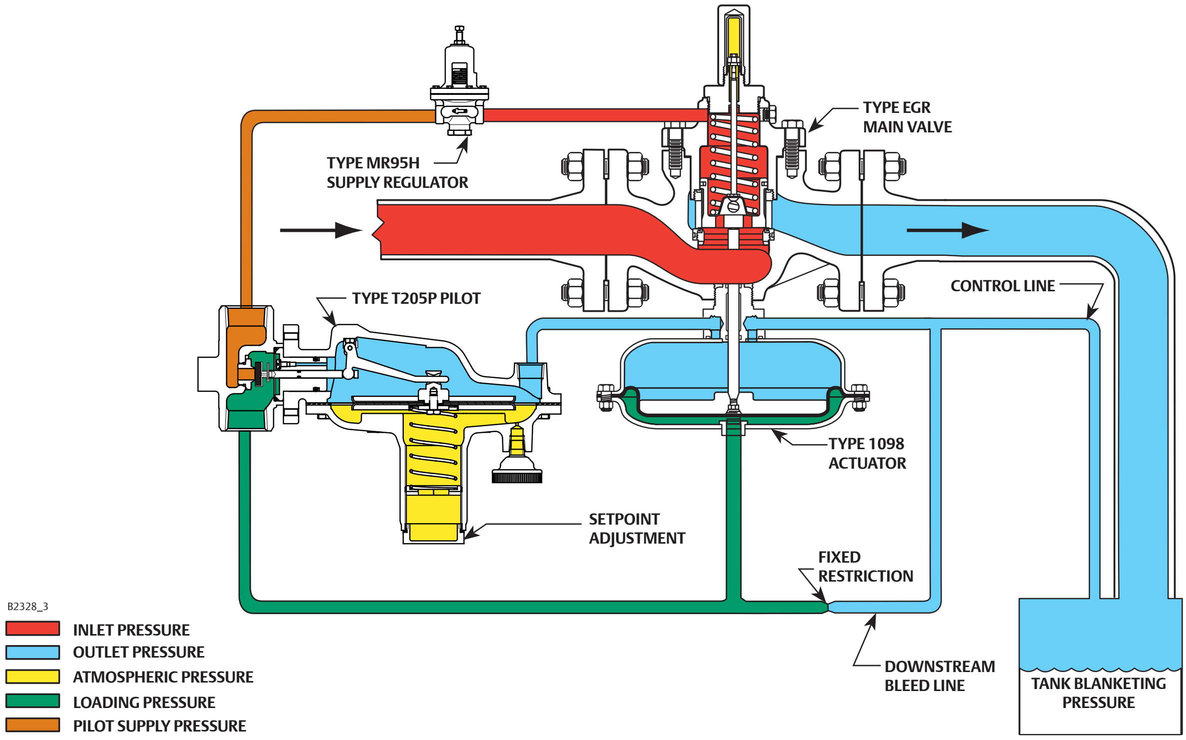

Figure 3. *Type 1190 Operational Schematic*

Table 1. Type EGR Main Valve Body Sizes and End Connection Styles

MAIN VALVE BODY SIZE		MAIN VALVE END CONNECTION STYLE	
NPS	DN	Cast Iron	WCC Steel or CF8M Stainless Steel
1, 2	25, 50	NPT, CL125 FF or CL250 RF flanged	NPT, SWE, BWE, CL150 RF, CL300 RF, CL600 RF or PN 16/25/40 flanged
3, 4, 6	80, 100, 150	CL125 FF or CL250 RF flanged	BWE, CL150 RF, CL300 RF, CL600 RF or PN 16 flanged
8 x 6, 12 x 6	200 x 150, 300 x 150	- - - -	BWE, CL150 RF, CL300 RF, CL600 RF flanged or PN 25

Table 2. Construction Materials(1)

BODY AND BODY FLANGE	SEAT RING AND VALVE PLUG	SPRING	SIZE 40 ACTUATOR	CAGE	PILOT	SUPPLY REGULATOR	DIAPHRAGMS	O-RINGS AND SEALS
Cast iron, WCC Steel or CF8M Stainless steel	416 or 316 Stainless steel	Steel or Inconel® X750	Steel or Stainless steel	CF8M, 416 or 316 Stainless steel	Carbon Steel or Stainless Steel Body	Cast iron, Steel or Stainless steel	Nitrile (NBR), Fluorocarbon (FKM) or Ethylenepropylene (EPDM)	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM)

1. Special construction materials are offered for your system compatibility. Contact your local Sales Office for additional information.

Table 3. Outlet Pressure Ranges (Type T205P Pilot)

OUTLET PRESSURE RANGE(1)		SPRING COLOR	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
In. w.c.	mbar		In.	mm	In.	mm
0.25 to 2.5(2)	0.6 to 6(2)	Orange	0.072	1.83	3.25	82.6
2 to 7(2)	5.0 to 17(2)	Red	0.085	2.16	3.63	92.1
5 to 16	12 to 40	Unpainted	0.105	2.67	3.75	95.3
0.5 to 1.2 psig	34 to 83	Yellow	0.114	2.90	4.31	109
1.1 to 2.5 psig	76 to 172	Green	0.156	3.96	4.06	103
2.5 to 4.5 psig	172 mbar to 0.31 bar	Light blue	0.187	4.75	3.94	100
4.5 to 7.0 psig	0.31 to 0.48 bar	Black	0.218	5.54	3.98	101

1. Outlet pressure ranges based on pilot being installed with the spring case pointed down.
2. Do not use Fluorocarbon (FKM) diaphragm with this spring at diaphragm temperatures lower than 60°F / 16°C.

Table 4. Approximate Weights

BODY SIZE	APPROXIMATE WEIGHT	BODY SIZE	APPROXIMATE WEIGHT
NPS 1 / DN 25	85 lbs / 39 kg	NPS 6 / DN 150	380 lbs / 172 kg
NPS 2 / DN 50	100 lbs / 45 kg	NPS 8 x 6 / DN 200 x 150	740 lbs / 336 kg
NPS 3 / DN 80	145 lbs / 66 kg	NPS 12 x 6 / DN 300 x 150	1265 lbs / 574 kg
NPS 4 / DN 100	195 lbs / 88 kg		

Table 5. Maximum and Minimum Differential Pressures for Type EGR Main Valve Spring Selection

BODY SIZE		SPRING COLOR	MAXIMUM ALLOWABLE DIFFERENTIAL PRESSURE		MINIMUM DIFFERENTIAL PRESSURE REQUIRED FOR FULL STROKE	
NPS	DN		psig	bar	psig	bar
1	25	Green	60	4.1	2.5	0.17
		Blue	125	8.6	4	0.28
		Red	300 or body rating limit, whichever is lower	20.7 or body rating limit, whichever is lower	5	0.34
2	50	Green	60	4.1	3	0.21
		Blue	125	8.6	5	0.34
		Red	300 or body rating limit, whichever is lower	20.7 or body rating limit, whichever is lower	10	0.69
3	80	Green	60	4.1	4	0.28
		Blue	125	8.6	6	0.41
		Red	300 or body rating limit, whichever is lower	20.7 or body rating limit, whichever is lower	11	0.76
4	100	Green	60	4.1	5	0.34
		Blue	125	8.6	8	0.55
		Red	300 or body rating limit, whichever is lower	20.7 or body rating limit, whichever is lower	13	0.90
6, 8 x 6, 12 x 6	150, 200 x 150, 300 x 150	Green	60	4.1	9.5	0.66
		Blue	125	8.6	14	1.0
		Red	300 or body rating limit, whichever is lower	20.7 or body rating limit, whichever is lower	19	1.3

Table 6. Flow Coefficients

BODY SIZE		PIPING STYLE									
		Line Size Equals Body Size Piping									
		Linear Cage					Drilled Hole Whisper Trim™ Cage				
		C_g		C_v		C_1	C_g		C_v		C_1
NPS	DN	Regulating	Wide-Open	Regulating	Wide-Open		Regulating	Wide-Open	Regulating	Wide-Open	
1	25	600	632	16.8	17.7	35.7	576	607	16.7	17.6	34.5
2	50	2280	2400	63.3	66.7	36.0	1970	2080	54.7	57.8	36.0
3	80	4630	4880	132	139	35.1	3760	3960	107	113	35.0
4	100	7320	7710	202	213	36.2	6280	6610	180	190	34.8
6	150	12,900	13,600	397	418	32.5	9450	9950	295	310	32.0
8 x 6	200 x 150	18,480	19,450	578	608	32.0	10,660	11,220	305	321	35.0
12 x 6	300 x 150	21,180	22,290	662	697	32.0	11,050	11,630	316	332	35.0
BODY SIZE		2:1 LINE SIZE TO BODY SIZE PIPING									
		Standard Linear Cage					Drilled Hole Whisper Trim Cage				
		C_g		C_v		C_1	C_g		C_v		C_1
NPS	DN	Regulating	Wide-Open	Regulating	Wide-Open		Regulating	Wide-Open	Regulating	Wide-Open	
1	25	568	598	17.2	18.1	33.0	529	557	15.6	16.4	34.0
2	50	2050	2160	59.6	62.8	34.4	1830	1930	52.3	55.1	35.0
3	80	4410	4650	128	135	34.4	3630	3830	106	110	34.2
4	100	6940	7310	198	209	35.0	6020	6340	171	180	35.2
6	150	12,100	12,800	381	404	31.7	9240	9730	291	306	31.7
8 x 6	200 x 150	17,370	18,280	543	571	32.0	10,020	10,550	286	301	35.0
12 x 6	300 x 150	19,900	20,950	622	655	32.0	10,380	10,930	297	312	35.0

Table 7. Flow Capacities in SCFH / Nm³/h of 0.97 Specific Gravity Nitrogen

INLET PRESSURE		OUTLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.97 SPECIFIC GRAVITY NITROGEN									
				NPS 1 / DN 25 Body		NPS 2 / DN 50 Body		NPS 3 / DN 80 Body		NPS 4 / DN 100 Body		NPS 6 / DN 150 Body	
psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
30	2.1	4 or less	0.28 or less	27,300	732	103,900	2785	204,000	5467	322,000	8630	580,000	15,544
40	2.8	7 or less	0.48 or less	33,300	892	126,600	3393	257,000	6888	406,300	10,889	716,100	19,191
50	3.5			39,400	1056	149,800	4015	304,000	8147	480,600	12,880	847,100	22,702
60	4.1			45,500	1219	173,000	4636	351,000	9407	554,900	14,871	978,000	26,210
70	4.8			51,600	1383	196,000	5253	398,000	10,666	629,200	16,863	1,108,900	29,719
80	5.5			57,700	1546	220,000	5896	444,900	11,923	703,500	18,854	1,239,900	33,229
90	6.2			64,000	1715	243,000	6512	491,900	13,183	777,800	20,845	1,370,800	36,737
100	6.9	7 or less	0.48 or less	70,100	1879	266,000	7129	538,900	14,443	852,100	22,836	1,501,700	40,246
120	8.3			82,300	2206	312,000	8362	632,900	16,962	1,000,600	26,816	1,763,600	47,264
140	9.7			94,500	2533	359,000	9621	726,900	19,481	1,149,200	30,799	2,025,400	54,281
160	11.0			107,000	2868	406,000	10,881	820,900	22,000	1,297,800	34,781	2,287,347	61,301
180	12.4			119,000	3189	452,000	12,114	914,800	24,517	1,446,400	38,764	2,549,200	68,319
200	13.8			131,000	3511	490,000	13,132	1,008,800	27,036	1,595,000	42,746	2,811,000	75,335

Table 7 gives typical Nitrogen regulating capacities at selected inlet pressures and outlet pressure settings. Flows are in SCFH (at 60°F and 14.7 psia) and Nm³/h (at 0°C and 1.01325 bar) of 0.97 specific gravity Nitrogen. For gases of other specific gravities, multiply the given capacity of Nitrogen by 0.985, and divide by the square root of the appropriate specific gravity of the gas required.

Type 1290

Vapor Recovery Regulator

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Introduction

The Type 1290 vapor recovery regulator controls vessel blanketing gas pressure when the vessel is being filled with fluid or when ambient temperature causes the vapor gas to expand. The system monitors the increasing blanket pressure and throttles open to pass excess blanketing gas into a vapor disposal or reclamation system thus controlling the desired set pressure of the vessel.

The Type 1290 vapor recovery regulator is not intended to be used as an ASME certified relief device for overpressure protection. It is to be used as part of the gas blanketing system to control the outflow of blanketing gas under normal conditions and to collect vessel vapors for the vapor recovery system. You should provide alternate methods of emergency overpressure protection.

Body Sizes and End Connection Styles

NPS 1 to 12 x 6 / DN 25 to 300 x 150 in various end connections; See Table 1

Control Pressure Ranges (Type T208P or T208PL Pilot)

0.5 in. w.c. to 7 psig / 1 mbar to 0.48 bar in eight ranges; See Table 4

Construction Materials

See Table 2

Type MR95H Supply Pressure Settings

See Table 3

Maximum Inlet Pressures (Type EGR Main Valve)

See Table 5

Flow Coefficients

See Table 6

Flow Capacities

See Table 7

Maximum Differential Pressure

35 psi / 2.4 bar

Pressure Registration

External (1/2 NPT Control Line Connection)

Exhaust Line Connection

3/4 NPT

Supply Pressure and Spring Case Connections

1/4 NPT

Main Valve Material Temperature Capabilities[1]

Nitrile (NBR):
-20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
For In. w.c. Setpoints: 40 to 300°F / 4 to 149°C
For psig Setpoints: 0 to 300°F / -18 to 149°C
Ethylenepropylene (EPDM):
-20 to 275°F / -29 to 135°C
Perfluoroelastomer (FFKM):
-20 to 300°F / -29 to 149°C

Pilot Material Temperature Capabilities[1]

See Table 9

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Vapor Recovery

Features

- Quick-Change Trim Package
- Easy In-Line Maintenance
- In-Service Travel Inspection
- High Accuracy
- Proven Technology
- Setpoints as Low as 0.5 in. w.c. / 1 mbar
- Whisper Trim™ Cage Construction for Application Versatility
- Optional NACE Construction

P2103_1

Figure 1. *Type 1290 Vapor Recovery Regulator*

P1739

Figure 2. *Type T208P Pilot*

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Body Sizes and End Connection Styles[2]

BODY SIZE	TYPE EGR MAIN VALVE END CONNECTION STYLE	
	Cast Iron	WCC Steel or CF8M Stainless Steel
NPS 1 or 2 / DN 25 or 50	NPT, CL125 FF or CL250 RF flanged	NPT, SWE, BWE, CL150 RF, CL300 RF, CL600 RF or PN 16/25/40 flanged
NPS 3, 4 or 6 / DN 80, 100 or 150	CL125 FF or CL250 RF flanged	BWE, CL150 RF, CL300 RF, CL600 RF or PN 16 flanged
NPS 8 x 6 or 12 x 6 / DN 200 x 150 or 300 x 150	- - - -	BWE, CL150 RF, CL300 RF, CL600 RF or PN 25 flanged

1. The pressure/temperature limits in this document and any applicable standard or code limitation should not be exceeded.
2. End connections for other than U.S. standards can usually be provided. Consult your local Sales Office.

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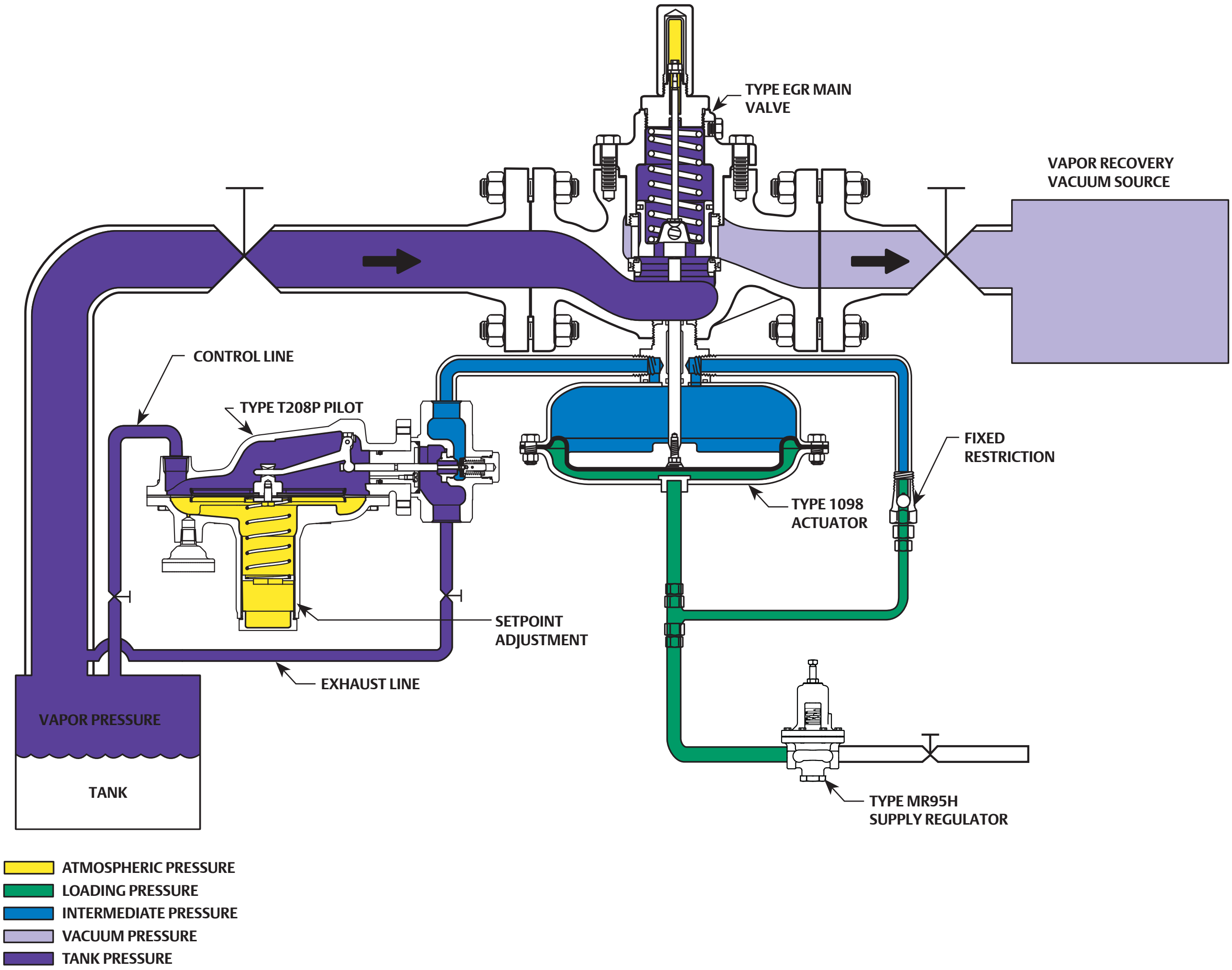

Figure 3. *Type 1290 Operational Schematic*

Table 2. Construction Materials[1]

MAIN VALVE				SIZE 40 ACTUATOR	PILOT	SUPPLY REGULATOR	DIAPHRAGM	O-RING AND SEAL
Body and Body Flange	**Plug and Seat Ring**	**Spring**	**Cage**					
Cast iron	416 Stainless steel	Steel	Cast iron	Steel	Cast iron	Cast iron	Nitrile (NBR), Fluorocarbon (FKM), Fluorinated Ethylene Propylene (FEP) or Ethylenepropylene (EPDM)	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM)
WCC Steel	416 Stainless steel	Steel	Steel	Steel	WCC Steel	WCC Steel		
CF8M Stainless steel	316 Stainless steel	Inconel® X-750	316 Stainless steel Whisper Trim™ Cage	Stainless steel	CF3M Stainless steel	CF8M Stainless steel		

1. Special construction materials are offered for your system compatibility. Contact your local Sales Office for additional information.

Table 3. Type MR95H Supply Pressure Settings

PILOT TYPE	TYPE EGR MAIN VALVE WITH GREEN SPRING, NPS / DN		SPRING COLOR
	1, 2, 3 or 4 / 25, 50, 80 or 100	**6 or 8 x 6 / 150 or 200 x 150**	
T208PL	8 psig / 0.55 bar	13 psig / 0.90 bar	Black
T208P	8 psig / 0.55 bar 8 psig / 0.55 bar 9 psig / 0.62 bar 10 psig / 0.69 bar	13 psig / 0.90 bar 13 psig / 0.90 bar 14 psig / 0.97 bar 14 psig / 0.97 bar	Orange Red Unpainted Yellow
	11 psig / 0.76 bar 14 psig / 0.97 bar 15 psig / 1.0 bar	15 psig / 1.0 bar 18 psig / 1.2 bar 20 psig / 1.4 bar	Green Light blue Black

Table 4. Control Pressure Ranges

PILOT TYPE	CONTROL PRESSURE RANGES[1]	SPRING COLOR	BUILDUP TO WIDE-OPEN (TYPE EGR MAIN VALVE)	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
				In.	mm	In.	mm
T208PL	0.5 to 1.5 in. w.c. / 1 to 4 mbar[2]	Black	0.25 in. w.c. / 0.60 mbar	0.075	1.90	2.19	56.0
T208P	1 to 2.5 in. w.c. / 2 to 6 mbar[2][3]	Orange	0.25 in. w.c. / 0.60 mbar	0.072	1.83	3.25	83
	2 to 7 in. w.c. / 5 to 17 mbar[2][4]	Red	0.25 in. w.c. / 0.60 mbar	0.085	2.20	3.63	92.0
	4 to 14 in. w.c. / 10 to 35 mbar	Unpainted	0.25 in. w.c. / 0.60 mbar	0.100	2.70	3.75	95.0
	0.5 to 1.2 psig / 35 to 83 mbar	Yellow	1.4 in. w.c. / 3 mbar	0.114	2.90	4.31	109
	1.0 to 2.5 psig / 0.07 to 0.17 bar	Green	2.8 in. w.c. / 7 mbar	0.156	4.00	4.06	103
	2.5 to 4.5 psig / 0.17 to 0.31 bar	Light blue	4.2 in. w.c. / 10 mbar	0.187	4.80	3.94	100
	4.5 to 7 psig / 0.31 to 0.48 bar	Black	5.5 in. w.c. / 14 mbar	0.218	5.40	3.98	101

1. Spring ranges based on pilot being installed with the spring case pointed down.
2. Do not use Fluorocarbon (FKM) diaphragm with this spring at diaphragm temperatures lower than 60°F / 16°C.
3. When using a Fluorocarbon (FKM) diaphragm, the minimum outlet pressure is 2 in. w.c. / 5 mbar.
4. When using a Fluorocarbon (FKM) diaphragm, the minimum outlet pressure is 2.5 in. w.c. / 6 mbar.

Table 5. Maximum Main Valve Inlet Pressures[1]

PILOT TYPE	MAXIMUM INLET PRESSURE, psig / bar					SPRING COLOR
	Type EGR Main Valve with Green Spring					
	NPS 1 / DN 25	NPS 2 / DN 50	NPS 3 / DN 80	NPS 4 / DN 100	NPS 6, 8 x 6 or 12 x 6 / DN 150, 200 x 150 or 300 x 150	
T208PL	5.5 / 0.38	5 / 0.35	4 / 0.28	3 / 0.21	3.5 / 0.24	Black
T208P	5.5 / 0.38	5 / 0.35	4 / 0.28	3 / 0.21	3.5 / 0.24	Orange
	5.5 / 0.38	5 / 0.35	4 / 0.28	3 / 0.21	3.5 / 0.24	Red
	6.5 / 0.45	6 / 0.41	5 / 0.35	4 / 0.28	4.5 / 0.31	Unpainted
	7.5 / 0.52	7 / 0.48	6 / 0.41	5 / 0.35	4.5 / 0.31	Yellow
	8.5 / 0.59	8 / 0.55	7 / 0.48	6 / 0.41	5.5 / 0.38	Green
	11.5 / 0.79[2]	11 / 0.76[2]	10 / 0.69	9 / 0.62	8.5 / 0.59	Light Blue
	12.5 / 0.86[2]	12 / 0.83[2]	11 / 0.76[2]	10 / 0.69	10.5 / 0.72[2]	Black

1. The pressure/temperature limits in this Application Guide and any applicable standard or code limitation should not be exceeded.
2. For Fluorinated Ethylene Propylene (FEP) Pilot Diaphragm, the maximum inlet pressure is 10 psig / 0.69 bar.

Table 6. Flow Coefficients

BODY SIZE, NPS / DN	PIPING STYLE											
	Line Size Equals Body Size Piping											
	Linear Cage						Drilled Hole Whisper Trim™ Cage					
	C_g		C_v		C_1	K_m	C_g		C_v		C_1	K_m
	Regulating	Wide-Open	Regulating	Wide-Open			Regulating	Wide-Open	Regulating	Wide-Open		
1 / 25	600	632	16.8	17.7	35.7		576	607	16.7	17.6	34.5	
2 / 50	2280	2400	63.3	66.7	36.0		1970	2080	54.7	57.8	36.0	
3 / 80	4630	4880	132	139	35.1		3760	3960	107	113	35.0	
4 / 100	7320	7710	202	213	36.2		6280	6610	180	190	34.8	
6 / 150	12,900	13,600	397	418	32.5	0.70	9450	9950	295	310	32.0	0.80
8 x 6 / 200 x 150	18,480	19,450	578	608	32.0		10,660	11,220	305	321	35.0	
12 x 6 / 300 x 150	21,180	22,290	662	697	32.0		11,050	11,630	316	332	35.0	

BODY SIZE, NPS / DN	PIPING STYLE											
	2:1 Line Size to Body Size Piping											
	Standard Linear Cage						Drilled Hole Whisper Trim Cage					
	C_g		C_v		C_1	K_m	C_g		C_v		C_1	K_m
	Regulating	Wide-Open	Regulating	Wide-Open			Regulating	Wide-Open	Regulating	Wide-Open		
1 / 25	568	598	17.2	18.1	33.0		529	557	15.6	16.4	34.0	
2 / 50	2050	2160	59.6	62.8	34.4		1830	1930	52.3	55.1	35.1	
3 / 80	4410	4650	128	135	34.4		3630	3830	106	110	34.2	
4 / 100	6940	7310	198	209	35.0		6020	6340	171	180	35.2	
6 / 150	12,100	12,800	381	404	31.7	0.70	9240	9730	291	306	31.7	0.80
8 x 6 / 200 x 150	17,370	18,280	543	571	32.0		10,020	10,550	286	301	35.0	
12 x 6 / 300 x 150	19,900	20,950	622	655	32.0		10,380	10,930	297	312	35.0	

Table 7. Flow Capacities for Type 1290 Vapor Recovery Regulators

PILOT TYPE	PILOT SPRING COLOR	CONTROL PRESSURE	BUILDUP OVER CONTROL PRESSURE TO WIDE-OPEN[1]	DOWNSTREAM VACUUM PRESSURE	CAPACITIES IN SCFH / NM^3/H OF 0.97 SPECIFIC GRAVITY NITROGEN									
					NPS 1 / DN 25 Body		NPS 2 / DN 50 Body		NPS 3 / DN 80 Body		NPS 4 / DN 100 Body		NPS 6 / DN 150 Body	
T208PL	Black	0.5 in. w.c. / 1 mbar	0.25 in. w.c. / 0.60 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	600 5600 7300	16.1 150 196	2300 19,900 25,800	61.6 533 691	4900 43,100 55,700	131 1155 1493	7600 66,900 86,700	204 1793 2324	14,600 124,500 160,600	391 3337 4304
T208P	Orange	1 in. w.c. / 2 mbar	0.25 in. w.c. / 0.60 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	700 5700 7400	18.8 153 198	2700 10,000 25,900	72.4 268 694	5900 43,200 55,800	158 1158 1495	9200 67,000 86,800	247 1796 2326	17,700 126,700 160,800	474 3396 4309
		2 in. w.c. / 5 mbar	0.25 in. w.c. / 0.60 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	1100 5800 7400	29.5 155 198	3900 20,200 26,000	105 541 697	8400 43,500 56,000	225 1166 1501	13,000 67,600 87,200	348 1812 2337	25,000 127,700 161,500	670 3422 4328
	Unpainted	4 in. w.c. / 10 mbar	0.25 in. w.c. / 0.60 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	1500 5800 7500	40.2 155 201	5300 20,500 26,300	142 549 705	11,500 44,100 56,600	308 1182 1517	17,800 68,500 88,100	477 1836 2361	34,200 129,400 162,200	917 3468 4347
		8 in. w.c. / 20 mbar	0.25 in. w.c. / 0.60 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	2100 6000 7600	56.3 161 204	7400 21,000 26,800	198 563 718	16,000 45,300 57,700	429 1214 1546	24,800 70,400 89,800	665 1887 2407	47,600 132,800 166,200	1276 3559 4454
		14 in. w.c. / 35 mbar	0.25 in. w.c. / 0.60 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	2900 6300 7900	77.7 169 212	10,100 22,000 27,800	271 590 745	21,800 47,400 59,800	584 1270 1603	33,800 73,600 93,100	906 1972 2495	64,900 138,700 172,400	1739 3717 4620
	Yellow	1 psig / 0.07 bar	0.05 psig / 3 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	4000 6800 8100	107 182 217	14,100 23,900 28,700	378 641 769	30,500 51,400 61,800	817 1378 1656	47,200 79,900 96,200	1265 2141 2578	90,300 150,100 177,200	2420 4023 4749
	Light blue	3 psig / 0.21 bar	0.15 psig / 10 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	7000 8700 9600	188 233 257	24,700 30,600 34,100	662 820 914	53,200 66,000 73,400	1426 1769 1967	82,500 102,700 114,600	2211 2752 3071	155,800 190,700 209,100	4175 5111 5604
		5 psig / 0.34 bar	0.15 psig / 10 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	9100 10,200 11,000	244 273 295	31,900 36,300 39,000	855 973 1045	68,600 78,100 83,900	1838 2093 2249	106,700 121,600 131,000	2860 3259 3511	199,500 224,000 327,400	5347 6003 8774
	Black	7 psig / 0.48 bar	0.20 psig / 14 mbar	0 psig / 0 bar 2.5 psig / 0.17 bar 5 psig / 0.34 bar	10,800 11,700 12,300	289 314 330	38,200 41,600 43,800	1024 1115 1174	82,200 89,500 94,200	2203 2399 2525	127,900 139,700 147,300	3428 3744 3948	237,100 255,300 265,100	6354 6842 7105

1. Increased capacity is available at higher buildups.

Table 8. Flow Rate Conversions (Gas Flow Required to Displace Blanketing Gas with Pump-in of Liquid)

MULTIPLY MAXIMUM PUMP RATE IN	BY	TO OBTAIN
U.S. GPM U.S. GPH Barrels/hour Barrels/day	8.021 0.1337 5.615 0.2340	SCFH air required[2]

1. For liquids with a flash point below 100°F / 38°C or normal boiling point below 300°F / 149°C, multiply the above calculated outbreathing requirement by 2.0.
2. To convert to Nm^3/h, multiply SCFH by 0.0268.

Table 9. Diaphragm Material Selection Information

TRIM OPTION CODE	DIAPHRAGM MATERIAL	DISK AND O-RING MATERIAL	OPERATING TEMPERATURE RANGE
Standard	Nitrile (NBR)	Nitrile (NBR)	-40 to 180°F / -40 to 82°C
VV	Fluorocarbon (FKM)	Fluorocarbon (FKM)	40 to 300°F / 4 to 149°C
TN	Fluorinated Ethylene Propylene (FEP)	Nitrile (NBR)	-20 to 180°F / -29 to 82°C
TV	Fluorinated Ethylene Propylene (FEP)	Fluorocarbon (FKM)	40 to 180°F / 4 to 82°C
TK	Fluorinated Ethylene Propylene (FEP)	Perfluoroelastomer (FFKM)	0 to 180°F / -18 to 82°C
TE	Fluorinated Ethylene Propylene (FEP)	Ethylene Propylene Diene (EPDM)	-20 to 180°F / -29 to 82°C

Table 8 gives typical nitrogen regulating capacities at selected inlet pressures and outlet pressure settings. Flows are in SCFH (at 60°F and 14.7 psia) and Nm^3/h (at 0°C and 1.01325 bar) of 0.97 specific gravity nitrogen. For gases of other specific gravities, multiply the given capacity of nitrogen by 0.985 and divide by the square root of the appropriate specific gravity of the gas required.

1301 Series

High Pressure Regulator

FISHER

Introduction

The proven reliability and accurate regulation of the 1301 Series regulators make them ideal for numerous high-pressure drop applications. These multi-purpose regulators can be used as pilot supply or pressure-loading regulators where high-pressure operating medium must be reduced for use by gas regulator pilots or pressure-loaded regulators. Their rugged design offers versatility for a wide variety of applications including air, gas, water and other liquids.

Available Configurations

Type 1301F: Direct-operated, high-pressure reducing regulator for inlet pressures to 6000 psig / 414 bar and outlet pressure ranges from 10 to 225 psig / 0.69 to 15.5 bar in three ranges.

Type 1301G: Direct-operated, high-pressure reducing regulator for inlet pressures to 6000 psig / 414 bar and an outlet pressure range of 200 to 500 psig / 13.8 to 34.5 bar.

Outlet Pressure Ranges

10 to 500 psig / 0.69 to 34.5 bar in four ranges; See Table 2

Body Size and End Connection Style

1/4 NPT

Body Construction Material

Brass or Stainless Steel; See Table 1

Spring Case Vents

Type 1301F Brass Spring Case:
Four 5/32 in. / 4.0 mm holes
Type 1301F Stainless Steel Spring Case:
One 1/4 NPT connection
Type 1301G:
One 1/8 NPT connection with screen

Orifice Size

5/64 in. / 2.0 mm

Pressure Registration

Internal

Maximum Emergency Outlet Pressures

Type 1301F: 250 psig / 17.2 bar
Type 1301G: 550 psig / 37.9 bar

Recovery Coefficient

K_m: 0.72

Maximum Inlet Pressure

Air and Gas:
6000 psig / 414 bar (at or below 200°F / 93°C)
1000 psig / 69.0 bar (above 200°F / 93°C)
Liquid:
Polytetrafluoroethylene (PTFE) Disk:
1000 psig / 69.0 bar
Nylon (PA) Disk:
1000 psig / 69.0 bar (Water)
2000 psig / 138 bar (Other Liquids)

Material Temperature Capabilities

Nylon (PA) Valve Disk and Neoprene (CR) Gaskets: -20 to 180°F / -29 to 82°C
PTFE Valve Disk and Fluorocarbon (FKM) Gaskets: -20 to 400°F / -29 to 204°C (not recommended for hot water use)
PTFE Valve Disk and Ethylenepropylene (EPDM) Gaskets: -40 to 300°F / -40 to 149°C

Special Construction for Low Temperature Service to -80°F / -62°C is available

Flow Coefficients

Wide-Open C_g: 5.0
Wide-Open C_v: 0.13
C_1: 38.5
C_v Coefficients at 20% Droop:
Type 1301F: See Table 8
Type 1301G: See Table 9

IEC Sizing Coefficients

X_T: 0.938
F_D: 0.50
F_L: 0.85

Options

- Pipe plug in second outlet
- Handwheel adjusting screw (Type 1301F only)
- Panel mounting spring case with T-handle adjusting screw (Type 1301G only)
- Bracket for mounting regulator on yoke of control valve actuator
- NACE construction
- Stainless steel construction

Approximate Weight

8 lbs / 3.6 kg

Ordering Guide

To order this product, contact your local Sales Office.

P1519

Figure 1. *Type 1301F High Pressure Regulator*

Applications

- Air
- Liquid
- Process Gas

Features

- Durable Stainless Steel Diaphragm
- Spare Valve Disk Provided
- Versatility
- ANSI Class VI Shutoff
- Sour Gas Service Capability

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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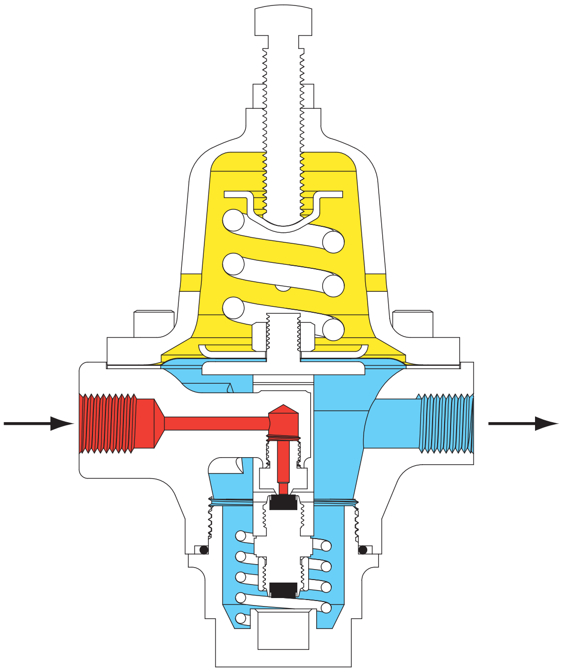


INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE

Figure 2. *Type 1301F Operational Schematic*

Table 1. Construction Materials

BODY	BOTTOM CAP AND SPRING CASE	ORIFICE	ORIFICE YOKE	GASKET	VALVE SPRING	VALVE DISKS AND HOLDER	DIAPHRAGM
Brass	Brass	303 Stainless steel	Brass	Neoprene, Fluorocarbon (FKM) or Ethylenepropylene (EPDM)	302 Stainless steel	Nylon (PA) and Zinc-plated brass or PTFE and Zinc-plated brass	302 Stainless steel
CF8M Stainless steel	304 Stainless steel 316 Stainless steel	303 Stainless steel	316 Stainless steel	Neoprene, Fluorocarbon (FKM) or Ethylenepropylene (EPDM)	302 Stainless steel or Inconel®	Nylon (PA) and 316 Stainless steel or PTFE and 316 Stainless steel	302 Stainless steel or Monel®

Table 2. Outlet Pressure Ranges

TYPE	OUTLET PRESSURE RANGES[1]		SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	psig	bar		In.	mm	In.	mm
1301F	10 to 75	0.69 to 5.2	Blue	0.200	5.08	1.69	42.9
	50 to 150	3.4 to 10.3	Silver	0.225	5.72		
	100 to 225	6.9 to 15.5	Red	0.243	6.17		
1301G	200 to 500	13.8 to 34.5	Silver	0.331	8.41	1.88	47.8

1. All springs can be backed off to 0 psig / 0 bar.

Air

Table 3. Type 1301F Regulating Capacities — Air with 100 to 750 psig / 6.9 to 51.7 bar Inlet Pressure

OUTLET PRESSURE RANGE, SPRING COLOR	OUTLET PRESSURE SETTING		CAPACITIES IN SCFH / Nm³/h OF AIR — Inlet Pressure, psig / bar															
			100 / 6.9				250 / 17.2				500 / 34.5				750 / 51.7			
			10% Droop		20% Droop		10% Droop		20% Droop		10% Droop		20% Droop		10% Droop		20% Droop	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
10 to 75 psig / 0.69 to 5.2 bar Blue	25	1.7	190	5.1	290	7.8	300	8.0	480	12.9	400	10.7	650	17.4	500	13.4	750	20.1
	50	3.4	280	7.5	400	10.7	480	12.9	800	21.4	720	19.3	1000	26.8	840	22.5	1200	32.2
	75	5.2	250	6.7	400	10.7	600	16.1	900	24.1	900	24.1	1400	37.5	1000	26.8	1600	42.9
50 to 150 psig / 3.4 to 10.3 bar Silver	75	5.2	200	5.4	350	9.4	500	13.4	800	21.4	800	21.4	1300	34.8	950	25.5	1500	40.2
	150	10.3	----	----	----	----	750	20.1	1000	26.8	1100	29.5	1800	48.2	1450	38.9	2300	61.6
100 to 225 psig / 6.9 to 15.5 bar Red	150	10.3	----		----		650	17.4	900	24.1	1000	26.8	1700	45.6	1350	36.2	2200	59.0
	225	15.5	----		----		500	13.4	800	21.4	1400	37.5	2100	56.3	1900	50.9	2900	77.7

Table 4. Type 1301F Regulating Capacities — Air with 1000 to 2000 psig / 69.0 to 138 bar Inlet Pressure

OUTLET PRESSURE RANGE, SPRING COLOR	OUTLET PRESSURE SETTING		CAPACITIES IN SCFH / Nm³/h OF AIR — Inlet Pressure, psig / bar											
			1000 / 69.0				1500 / 103				2000 / 138			
			10% Droop		20% Droop		10% Droop		20% Droop		10% Droop		20% Droop	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
10 to 75 psig / 0.69 to 5.2 bar Blue	25	1.7	520	13.9	770	20.6	540	14.5	800	21.4	560	15.0	820	22.0
	50	3.4	900	24.1	1300	34.8	950	25.5	1400	37.5	1000	26.8	1500	40.2
	75	5.2	1100	29.5	1700	45.6	1200	32.2	1800	48.2	1300	34.8	1900	50.9
50 to 150 psig / 3.4 to 10.3 bar Silver	75	5.2	1000	26.8	1600	42.9	1100	29.5	1700	45.6	1200	32.2	1800	48.2
	150	10.3	1600	42.9	2600	69.7	1700	45.6	2800	75.0	1800	48.2	3000	80.4
100 to 225 psig / 6.9 to 15.5 bar Red	150	10.3	1500	40.2	2250	60.3	1650	44.2	2750	73.7	1800	48.2	3000	80.4
	225	15.5	2400	64.3	3500	93.8	2700	72.4	4000	107	3000	80.4	4500	121

Table 5. Type 1301G Regulating Capacities — Air

OUTLET PRESSURE RANGE, SPRING COLOR	OUTLET PRESSURE SETTING		OFFSET		CAPACITIES IN SCFH / Nm³/h OF AIR — Inlet Pressure, psig / bar													
					300 / 20.7		500 / 34.5		750 / 51.7		1000 / 69.0		1500 / 103		2000 / 138		2250 / 155	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
200 to 500 psig / 13.8 to 34.5 bar Silver	200	13.8	10	0.69	350	9.4	550	14.7	750	20.1	950	25.5	1100	29.5	1250	33.5	1400	37.5
			20	1.4	650	17.4	900	24.1	1200	32.2	1500	40.2	1800	48.2	2000	53.6	2100	56.3
			30	2.1	900	24.1	1350	36.2	1700	45.6	2000	53.6	2300	61.6	2700	72.4	3000	80.4
			40	2.8	1100	29.5	1650	44.2	2100	56.3	2500	67.0	3000	80.4	3500	93.8	3700	99.2
	500	34.5	15	1.0	----		----		800	21.4	1000	26.8	1300	34.8	1500	40.2	1600	42.9
			25	1.7	----		----		1400	37.5	1600	42.9	2000	53.6	2600	69.7	2800	75.0
			50	3.4	----		----		2200	59.0	2800	75.0	3300	88.4	4000	107	4500	121

Process Gas

Tables 3 and 4 give regulating capacities at selected pressures and outlet pressure flows in SCFH (at 60°F and 14.7 psia) and Nm³/h (at 0°C and 1.01325 bar) of air. To determine the equivalent capacities for other gases, multiply the table capacities by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane, or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm³/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

Liquid

Table 6. Type 1301F Regulating Capacities — Water[1]

OUTLET PRESSURE RANGE, SPRING COLOR	OUTLET PRESSURE SETTING		CAPACITIES IN GALLONS / LITERS PER MINUTE OF WATER BASED ON 20% DROOP									
			Inlet Pressure, psig / bar									
			100 / 6.9		250 / 17.2		500 / 34.5		750 / 51.7		1000 / 69.0[1]	
	psig	bar	Gal.	L.	Gal.	L.	Gal.	L.	Gal.	L.	Gal.	L.
10 to 75 psig / 0.69 to 5.2 bar Blue	25 50 75	1.7 3.4 5.2	0.50 0.50 0.46	2.0 2.0 1.7	0.73 0.83 0.91	2.8 3.1 3.4	0.94 1.12 1.28	3.6 4.2 4.8	1.09 1.32 1.52	4.1 5.0 5.7	1.16 1.43 1.69	4.4 5.4 6.4
50 to 150 psig / 3.4 to 10.3 bar Silver	75 150	5.2 10.3	0.43 ----	1.6 ----	0.88 1.01	3.3 3.8	1.24 1.64	4.7 6.2	1.49 2.02	5.6 7.6	1.65 2.31	6.2 8.7
100 to 225 psig / 6.9 to 15.5 bar Red	150 225	10.3 15.5	---- ----		0.95 0.84	3.6 3.2	1.56 1.73	5.9 6.5	1.96 2.27	7.4 8.6	2.24 2.68	8.5 10.1

1. Inlet pressure greater than 1000 psig / 69.0 bar is not recommended for water service.

Table 7. Type 1301G Regulating Capacities — Water[1]

OUTLET PRESSURE RANGE, SPRING COLOR	OUTLET PRESSURE SETTING		CAPACITIES IN GALLONS / LITERS PER MINUTE OF WATER BASED ON 20% DROOP							
			Inlet Pressure, psig / bar							
			300 / 20.7		500 / 34.5		750 / 51.7		1000 / 69.0[1]	
	psig	bar	Gal.	L.	Gal.	L.	Gal.	L.	Gal.	L.
200 to 500 psig / 13.8 to 34.5 bar Silver	200 500	13.8 34.5	1.12 ----	4.2 ----	1.73 ----	6.5 ----	2.24 1.99	8.5 7.5	2.64 2.58	10.0 9.8

1. Inlet pressure greater than 1000 psig / 69.0 bar is not recommended for water service.

Table 8. Type 1301F C_V Coefficients[1] — Incompressible Fluid

OUTLET PRESSURE RANGE, SPRING COLOR	OUTLET PRESSURE SETTING		TYPE 1301F C_V COEFFICIENTS BASED ON 20% DROOP						
			Inlet Pressure, psig / bar						
	psig	bar	100 / 6.9	250 / 17.2	500 / 34.5	750 / 51.7	1000 / 69.0	1500 / 103[1]	2000 / 138[1]
10 to 75 psig / 0.69 to 5.2 bar Blue	25 50 75	1.7 3.4 5.2	0.056 0.065 0.073	0.048 0.057 0.066	0.043 0.052 0.061	0.040 0.050 0.058	0.037 0.046 0.055	0.032 0.041 0.051	0.029 0.038 0.049
50 to 150 psig / 3.4 to 10.3 bar Silver	75 150	5.2 10.3	0.068 ----	0.064 0.089	0.059 0.084	0.057 0.080	0.054 0.078	0.050 0.075	0.047 0.074
100 to 225 psig / 6.9 to 15.5 bar Red	150 225	10.3 15.5	---- ----	0.083 0.100	0.080 0.097	0.078 0.095	0.076 0.094	0.074 0.092	0.074 0.091

1. Inlet pressure greater than 1000 psig / 69.0 bar is not recommended for water service.

Table 9. Type 1301G C_V Coefficients[1] — Incompressible Fluid

OUTLET PRESSURE RANGE, SPRING COLOR	OUTLET PRESSURE SETTING		TYPE 1301G C_V COEFFICIENTS BASED ON 20% DROOP						
			Inlet Pressure, psig / bar						
	psig	bar	300 / 20.7	500 / 34.5	750 / 51.7	1000 / 69.0	1500 / 103[1]	2000 / 138[1]	2250 / 155[1]
200 to 500 psig / 13.8 to 34.5 bar Silver	200 500	13.8 34.5	0.095 ----	0.094 ----	0.092 0.106	0.091 0.105	0.089 0.104	0.088 0.103	0.088 0.103

1. Inlet pressure greater than 1000 psig / 69.0 bar is not recommended for water service.

1305 Series

Pressure Reducing Regulator

FISHER

Introduction

The 1305 Series regulators are direct-operated, pressure reducing regulators that resist hydrate formation and regulator freeze-up. The regulators are suitable for service with natural gas, air, propane and other gases compatible with the internal parts. 1305 Series regulators are typically used on high-pressure lines from wellheads and separators.

Regulator freeze-up resistance occurs as the pipeline gas warms the finned inlet adaptor and the orifice area. As the gas cools within the inlet adaptor due to pressure drop and volume expansion, the warm inlet adaptor helps keep the gas temperature above the freezing point of water and the hydrate formation temperature.

Body Size and End Connection Styles

1/4 NPT outlet with 1 NPT inlet adaptor connection

Outlet Pressure Ranges

Type 1305C:
Blue Spring:
0 to 75 psig / 0 to 5.2 bar
Silver Spring:
0 to 150 psig / 0 to 10.3 bar
Red Spring:
0 to 225 psig / 0 to 15.5 bar
Type 1305D:
200 to 500 psig / 13.8 to 34.5 bar

Coefficients for Relief Sizing

Wide-Open C_g: 5.5
Wide-Open C_1: 38.5

Typical Regulating Capacities

See Figure 3

Maximum Allowable Inlet Pressure

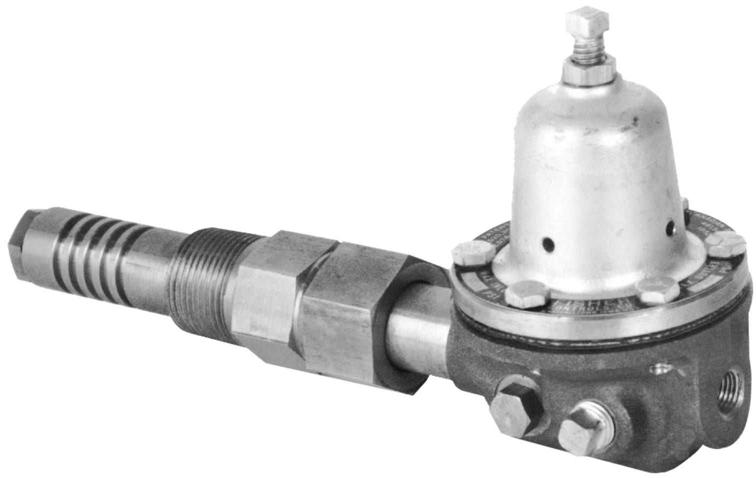
4000 psig / 276 bar

Maximum Emergency Outlet (Casing) Pressure

Type 1305C:
250 psig / 17.2 bar
Type 1305D:
550 psig / 37.9 bar

Temperature Capabilities

-20 to 200°F / -29 to 93°C



W3101

Figure 1. *1305 Series Regulator with Tapped Lower Casing Connection*

Pressure Registration

Internal

Construction Materials

Inlet Adaptor: 416 Stainless steel or 316 Stainless steel for NACE construction
Union Nut: 416 Stainless steel
Lower Casing: Brass or CF8M Stainless Steel for NACE construction
Spring Case: Brass
Orifice: 416 Stainless steel or 316 Stainless steel for NACE construction
Valve Stem: 416 Stainless steel or 316 Stainless steel for NACE construction
Valve Disk: Nylon (PA)
O-rings: Nitrile (NBR)

Orifice Size

5/64 in. / 2.0 mm

Options

1/4 in. NPT connection for optional pressure gauge or relief valve

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Process Gas

Features

- **Resists Hydrate Formation and Regulator Freeze-up**
- **Durable**
- **Easy Maintenance**
- **High Pressure Capabilities**
- **NACE Construction Available**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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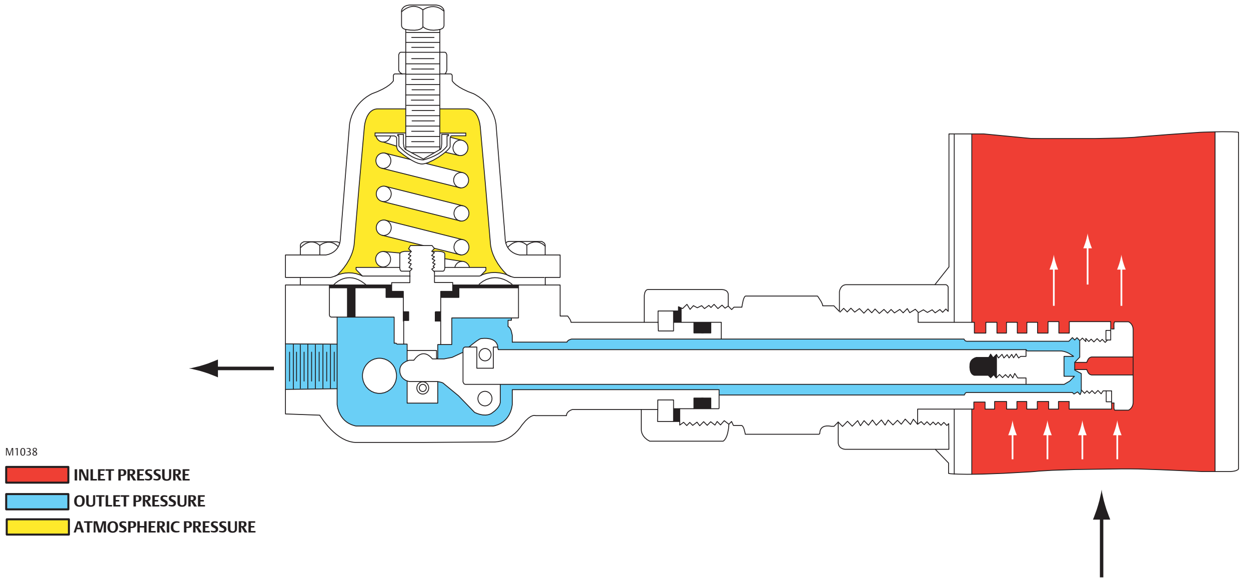

Figure 2. Typical 1305 Operational Schematic

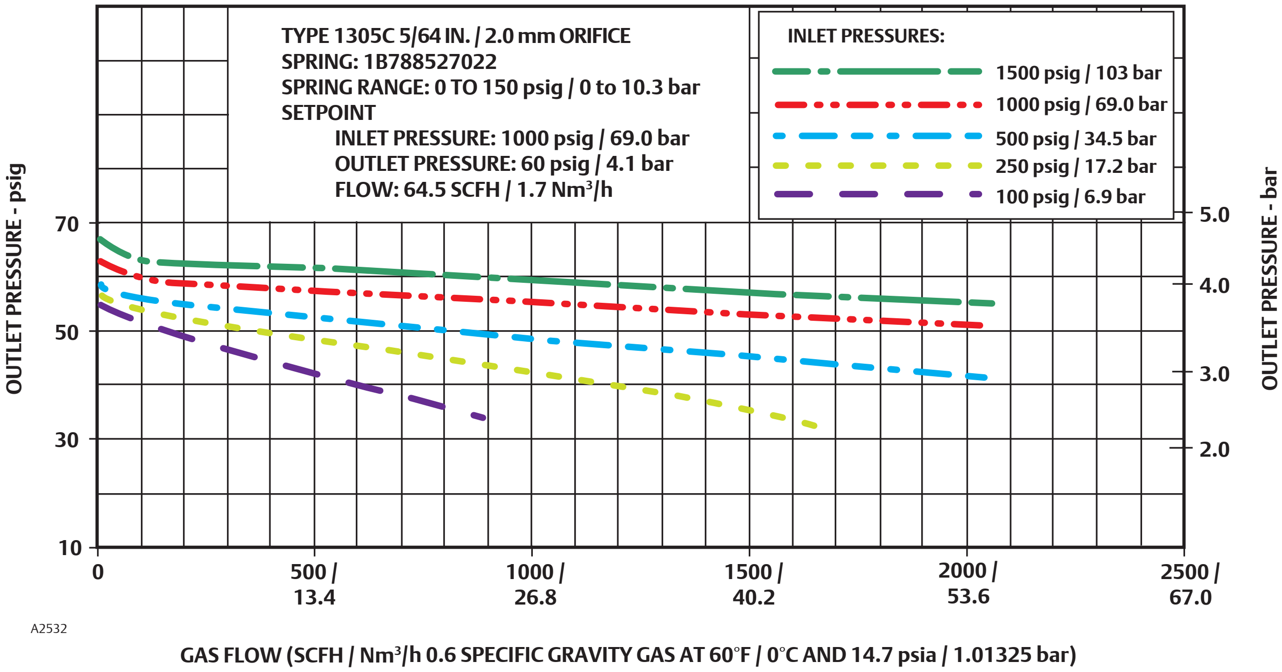

Figure 3. Typical 1305 Regulator Capacity Curves

Figure 3 provides 1305 Series regulator capacities. The initial setting was made with an initial inlet pressure of 1000 psig / 69.0 bar and then the inlet pressure was varied to obtain the different capacity curves. To determine capacities 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 (Nm^3/h) at 0°C and 1.01325 bar, multiply SCFH obtained in Figure 3 by 0.0268.

Type 1367

High-Pressure Instrument Supply System

FISHER

Introduction

Type 1367 high-pressure instrument supply system takes a pressure of up to 2000 psig / 138 bar and reduces it to a controlled pressure to be used for supplying a pneumatic instrument. This system consists of the following filters, regulators and relief valves:

- A Type 252 extended body filter with drain valve
- A first-stage Type 1301F regulator with mounting bracket for an actuator yoke or casing
- A Type H120 relief valve mounted in the side outlet of the Type 1301F regulator
- A second-stage Type 67CF filter-style regulator, mounted on the Type 1301F regulator
- A Type H800 or H120 relief valve nipple-mounted in the outlet of the Type 67CF regulator

Body Size and End Connection Style

Inlet and Outlet: 1/4 NPT
Type H800 Vent: 1/2 NPT with removable screen

Fixed Relief Setting of the First Stage Type H120 Relief Valve

150 psig / 10.3 bar

Maximum Inlet Pressure

2000 psig / 138 bar

Outlet (Supply) Pressure Range

5 to 90 psig / 0.34 to 6.2 bar

Maximum Outlet (Supply) Pressure with Type 67CF Regulator Failed Wide-Open with:

Type H800 Relief Valve Relieving: 50 psig / 3.4 bar
Type H120 (Second Stage) Relief Valve Relieving: 5 psig / 0.34 bar over Type H120 set point

Temperature Capabilities

-20 to 150°F / -29 to 66°C

Approximate Shipping Weight

12 lbs / 5.4 kg

Pressure Registration

Internal

Ordering Guide

To order this product, contact your local Sales Office.

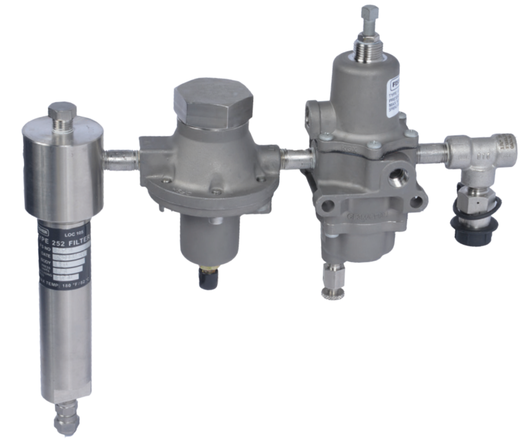

Figure 1. *Type 1367 High-Pressure Instrument Supply System*

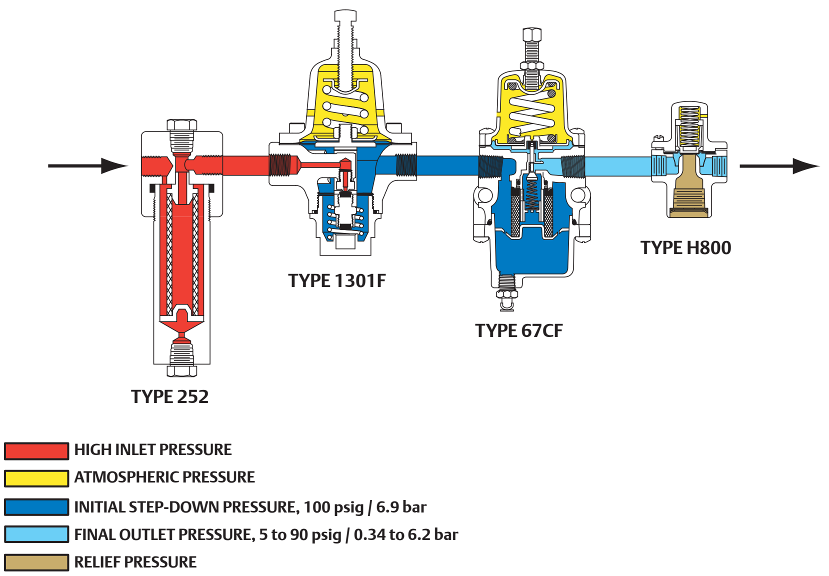

Figure 2. *Type 1367 Operational Schematic*

Features

- **Regulation and Overpressure Protection in One Complete Package**
- **Installation Flexibility**
- **Capability for Continuous Moisture Removal**
- **NACE Configuration Available**
- **Dual Gauge Port Type 1301 Configuration Available**
- **All Stainless steel Construction Available**

Applications

Air

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Type ACE95

Tank Blanketing Regulator

Introduction

The Type ACE95 is a pilot-operated tank blanketing valve used for accurate pressure control on low pressure blanketing systems. The unit is stainless steel, and actuated by a very large, 76 in.^{2} / 490 cm^2, diaphragm actuator. Blanketing setpoint is controlled by a single adjusting screw.

The oversized actuator offers high sensitivity to changes in tank pressure, increasing accuracy. A rolling diaphragm is utilized to maintain a fully balanced main valve, ensuring extremely accurate operation under all conditions. Lockup is typically less than 0.3 in. w.c. / 0.7 mbar. The main valve stroke is minimal to further insure accuracy and fast response.

Body Size and End Connection Style

See Table 1

Maximum Operating Inlet Pressure

200 psig / 13.8 bar

Maximum Emergency Outlet (Casing) Pressure

20 psig / 1.4 bar

Maximum Operating Outlet Pressure

1.5 psig / 0.10 bar

Outlet Pressure Ranges

-5 in. w.c. to 1.5 psig / -12 to 0.10 bar

Minimum and Maximum Differential Pressures

See Table 4

Main Valve Flow Characteristic

Linear

IEC Sizing Coefficients

For NPS 1 / DN 25 body size, all trims
X_T: 0.72; **F_D:** 0.40; **F_L:** 0.89; **K_m:** 0.79

Flow Coefficients for Relief Valve Sizing

C_v 1 use C_v 1.1
C_v 2 use C_v 2.2
C_v 4 use C_v 4.4
C_v 7.5 use C_v 9.25
C_v 10 use C_v 11

Pressure Registration

External

Accuracy

Typically within 0.5 in. w.c. / 1 mbar when flowing 5 to 70 percent of advertised capacities

Temperature Capabilities

Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
0 to 212°F / -18 to 100°C
Ethylenepropylene (EPDM - FDA):
-20 to 212°F / -29 to 100°C
Perfluoroelastomer (FFKM):
-20 to 212°F / -29 to 100°C

Construction Material

See Table 2

Approximate Weight

40 lbs / 18 kg

Ordering Guide

To order this product, contact your local Sales Office.

Figure 1. *Type ACE95 Tank Blanketing Valve*

Features

- **Fully Balanced Pilot Design Reduces Inlet Pressure Sensitivity**
- **Frictionless Pilot Valve**
- **Bubble Tight Shutoff**
- **Highly Sensitive**
- **Operation Diagnostics Available**
- **Vacuum Settings Available**
- **Stainless Steel and NACE Compliant Constructions Available**

Application

- **Tank Blanketing**

Additional Technical Data

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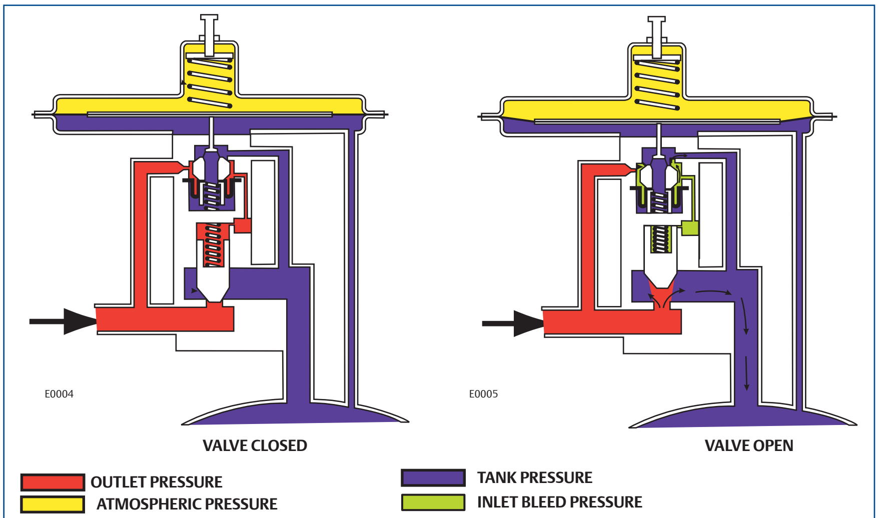

Figure 2. *Type ACE95 Operational Schematic*

Table 1. Body Size and End Connection Style

BODY TYPE	BODY SIZE	END CONNECTION STYLE
Angled (Various Single Array Manifold (SAM) tank connections are also available)	3/4 in.	NPT
	1 in.	NPT
	NPS 1 / DN 25	CL150 RF, CL300 RF, PN 16/25/40 RF or Sanitary Flange
In-Line	3/4 in.	NPT
	1 in.	NPT
	NPS 1 / DN 25	CL150 RF, CL300 RF, PN 16/25/40 RF or Sanitary Flange
	NPS 1 x 2 / DN 25 x 50	CL150 RF or PN 16/25/40 RF

Table 2. Construction Materials

BODY AND BONNET	TRIM	ELASTOMERS	DIAPHRAGM	ACTUATOR
CF3M/CF8M Stainless steel	304/316 Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (FDA-EPDM) or Perfluoroelastomer (FFKM)	Fluorinated Ethylene Propylene (FEP)	Carbon steel or 316 Stainless steel

Table 3. Type ACE95 Capacities

INLET PRESSURE				CAPACITIES IN SCFH / Nm^3/h OF NITROGEN									
				C_v = 1		C_v = 2		C_v = 4		C_v = 7.5		C_v = 10	
psig	bar	kg/cm²	kPa	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
25	1.7	1.76	172	1130	30.3	2300	61.6	4440	119	9900	265	11,200	300
30	2.1	2.11	207	1280	34.3	2670	71.6	5020	135	11,200	300	13,000	348
40	2.8	2.81	276	1680	45.0	3440	92.2	6780	182	13,500	362	16,400	440
50	3.5	3.52	345	2050	54.9	4090	110	8140	218	17,800	477	20,200	541
60	4.1	4.22	414	2330	62.4	4800	129	9370	251	18,200	488	22,700	608
70	4.8	4.92	483	2670	71.6	5450	146	10,600	284	23,600	632	26,600	713
80	5.5	5.62	552	3010	80.7	6160	165	12,000	322	27,400	734	30,800	825
90	6.2	6.33	621	3410	91.4	6840	183	13,200	354	30,800	825	34,100	914
100	6.9	7.03	690	3690	98.9	7430	199	14,600	391	34,100	914	38,000	1018
110	7.6	7.73	758	4000	107	8110	217	16,000	429	36,800	986	41,300	1107
120	8.3	8.44	827	4370	117	8750	235	17,200	461	38,800	1040	44,600	1195
130	8.9	9.14	896	4590	123	9340	250	18,300	490	43,400	1163	46,300	1241
140	9.6	9.84	965	4930	132	10,100	271	19,500	523	46,500	1246	50,500	1353
150	10.3	10.55	1034	5300	142	10,800	289	21,000	563	49,900	1337	54,500	1461
160	11.0	11.25	1103	5640	151	11,400	306	21,500	576	53,200	1426	58,200	1560
170	11.7	11.95	1172	5950	159	12,000	322	23,000	616	55,800	1495	62,300	1670
180	12.4	12.65	1241	6320	169	12,600	338	24,700	662	59,600	1597	65,900	1766
190	13.1	13.36	1310	6630	178	13,400	359	25,600	686	62,600	1678	69,600	1865
200	13.8	14.06	1379	6970	187	14,000	375	27,200	729	65,100	1745	71,900	1927

Table 4. Minimum and Maximum Differential Pressures

BODY SIZE		VALVE C_v	INLET PRESSURE RANGE		SPRING FREE LENGTH		SPRING WIRE DIAMETER	
NPS	DN		psig	bar	In.	mm	In.	mm
3/4 and 1	20 and 25	1 to 4	25 to 50	1.7 to 3.4	1.50	38.1	0.038	0.96
			51 to 120	3.5 to 8.3	1.50	38.1	0.051	1.30
			121 to 200	8.3 to 13.8	1.50	38.1	0.059	1.50
1	25	7.5 to 10	25 to 50	1.7 to 3.4	1.50	38.1	0.051	1.30
			51 to 120	3.5 to 8.3	1.50	38.1	0.059	1.50
			121 to 200	8.3 to 13.8	1.50	38.1	0.072	1.83
2	50	20 to 60	25 to 50	1.7 to 3.4	4.58	116	0.148	3.76
			51 to 120	3.5 to 8.3	4.00	102	0.177	4.50
			121 to 200	8.3 to 13.8	4.00	102	0.218	5.54

Introduction

The Type ACE95Jr is a direct-operated valve used for accurate pressure control on low pressure blanketing systems. The unit is stainless steel, and actuated by a very large, 76 in.^{2} / 490 cm^2, diaphragm actuator. Blanketing setpoint is controlled by a single adjusting screw.

The oversized actuator offers high sensitivity to changes in tank pressure, increasing accuracy. A rolling diaphragm is utilized to maintain a fully balanced main valve, insuring extremely accurate operation under all conditions. Lockup is typically less than 0.3 in. w.c. / 0.7 mbar. The main valve stroke is minimal to further insure accuracy and fast response.

Sizes and End Connection Styles

1/2 NPT; 1 x 1/2 NPT; 1 NPT; NPS 1/2 / DN 15; CL150 RF; NPS 1 / DN 25; CL150 RF; NPS 1 x 1/2 / DN 25 x 15; CL150 RF; NPS 1 / DN 25; Sanitary Flange

Contsruction Material

See Table 1

Maximum Operating Inlet Pressure

200 psig / 13.8 bar

Maximum Emergency Outlet (Casing) Pressure

20 psig / 1.4 bar

Maximum Operating Control Pressure

1.5 psig / 0.10 bar

Temperature Capabilities

Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
0 to 212°F / -18 to 100°C
Ethylenepropylene (EPDM - FDA):
-20 to 212°F / -29 to 100°C
Perfluoroelastomer (FFKM):
-20 to 212°F / -29 to 100°C

Control Pressure Ranges

See Table 2

Maximum Differential Pressures

Up to 200 psig / 13.8 bar

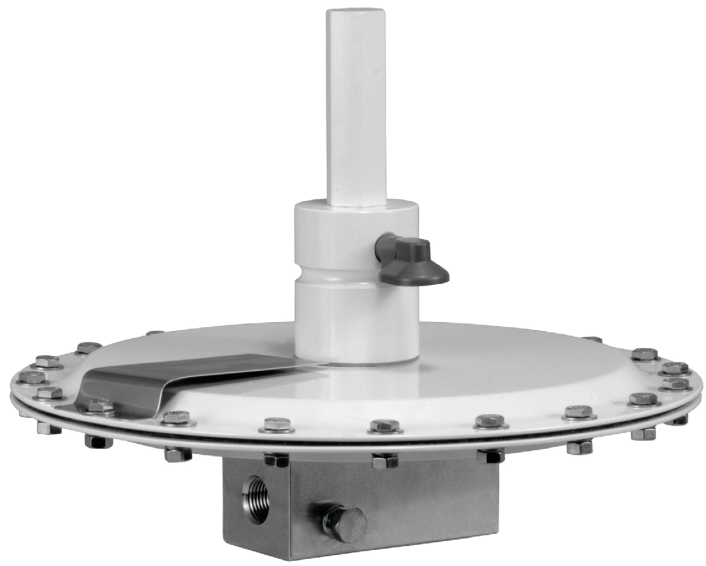

Figure 1. Type ACE95Jr Tank Blanketing Valve

Application

- Tank Blanketing

Main Valve Flow Characteristic

Linear

Pressure Registration

External

Flow Coefficients for Relief Valve Sizing (110% of rated C_v)

C_v 0.2 use C_v 0.22
C_v 0.4 use C_v 0.44

IEC Sizing Coefficients

X_T: 0.655; **F_D:** 0.86; **F_L:** 0.89

Approximate Weight

30 lbs / 14 kg

Ordering Guide

To order this product, contact your local Sales Office.

Features

- Fully Balanced Plug Design Reduces Inlet Pressure Sensitivity
- High Sensitivity
- Bubble Tight Shutoff
- Stainless Steel Construction Available
- Self-Contained
- Vacuum Settings Available
- Extremely Accurate Control
- Designed for Small Flow Service

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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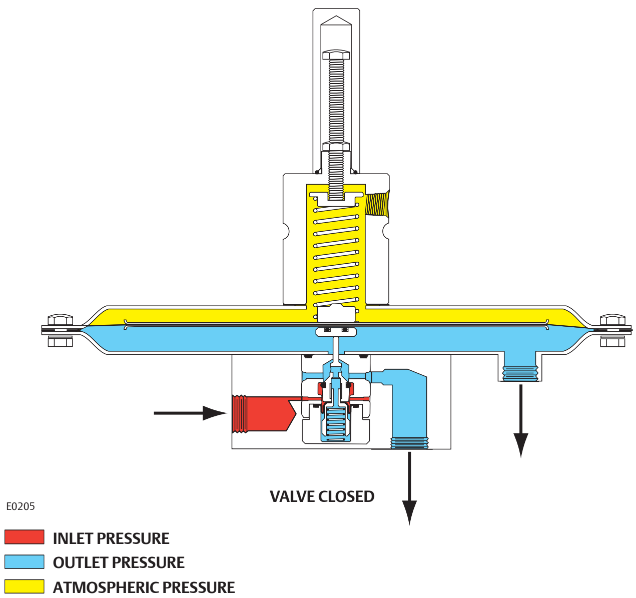

Figure 2. Type ACE95Jr Operational Schematic

Table 1. Construction Materials

BODY AND BONNET	ELASTOMERS	DIAPHRAGM	ACTUATOR	SPRING
316 Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), FDA-Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM)	Polytetrafluoroethylene (PTFE)	316 Stainless Steel or Carbon Steel	Stainless steel

Table 2. Control Pressure Ranges

CONTROL PRESSURE RANGES		SPRING FREE LENGTH		SPRING WIRE DIAMETER	
In. w.c.	mbar	In.	mm	In.	mm
-5 to -0.5	-12 to -1	2.75 0.88(1)	69.8 22.4(1)	0.080 0.085(1)	2.03 2.16(1)
-1 to 1	-2 to 2	2.75 1.60(1)	69.8 40.6(1)	0.080 0.065(1)	2.03 1.65(1)
0.5 to 5 4 to 10 8 to 15 0.5 to 1.5 psig	1 to 12 10 to 25 20 to 37 34 to 103	2.75 2.00 2.00 2.75	69.8 50.8 50.8 69.8	0.080 0.112 0.125 0.225	2.03 2.84 3.17 5.71

1. The second spring is located under the diaphragm assembly.

Table 3. Type ACE95Jr Capacities

INLET PRESSURE				CAPACITIES IN SCFH / Nm³/h OF 0.97 SPECIFIC GRAVITY NITROGEN			
				C_v = 0.2		C_v = 0.4	
psig	bar	kg/cm²	kPa	SCFH	Nm³/h	SCFH	Nm³/h
1(1)	0.07(1)	0.07(1)	6.90(1)	42	1.1	84	2.2
2(1)	0.14(1)	0.14(1)	13.8(1)	61	1.6	120	3.2
5(1)	0.34(1)	0.35(1)	34.5(1)	98	2.6	210	5.6
10	0.69	0.70	69.0	130	4.6	310	8.3
15	1.0	1.06	103	160	4.3	400	10.7
20	1.4	1.41	138	210	5.6	480	12.9
25	1.7	1.76	172	250	6.7	550	14.7
30	2.1	2.11	207	290	7.7	630	16.9
40	2.8	2.81	276	370	9.9	780	20.9
50	3.4	3.52	345	450	12.1	930	24.9
60	4.1	4.22	414	530	14.2	1070	28.7
70	4.8	4.92	483	610	16.3	1230	33.0
80	5.5	5.63	552	690	18.5	1390	37.3
90	6.2	6.33	621	780	20.9	1560	41.8
100	6.9	7.03	690	860	23.0	1720	46.1
120	8.3	8.44	827	1020	27.3	2040	54.7
140	9.6	9.85	965	1180	31.6	2360	63.2
160	11.0	11.3	1103	1340	35.9	2680	71.8
180	12.4	12.7	1241	1500	40.2	3000	80.4
200	13.8	14.1	1379	1660	44.5	3330	89.2

1. Assumes an outlet (control) pressure of 5 in. w.c. / 12 mbar or less.

Introduction

The Type ACE95Sr is a pilot-operated tank blanketing valve used for accurate pressure control on low pressure blanketing systems. The unit is stainless steel, and actuated by a very large, 76 in.^{2} / 490 cm^2, diaphragm actuator. Blanketing setpoint is controlled by a single adjusting screw.

The oversized actuator offers high sensitivity to changes in tank pressure, increasing accuracy. A rolling diaphragm is utilized to maintain a fully balanced main valve, ensuring extremely accurate operation under all conditions. Lockup is typically less than 0.3 in. w.c. / 0.7 mbar. The main valve stroke is minimal to further insure accuracy and fast response.

Body Size and End Connection Style
See Table 1

Maximum Operating Inlet Pressure
200 psig / 13.8 bar

Maximum Emergency Outlet (Casing) Pressure
20 psig / 1.4 bar

Maximum Operating Outlet Pressure
1.5 psig / 0.10 bar

Outlet Pressure Ranges
-5 in. w.c. to 1.5 psig / -12 to 0.10 bar

Minimum and Maximum Differential Pressures
See Table 4

Main Valve Flow Characteristic
Linear

IEC Sizing Coefficients
For NPS 1 / DN 25 body size, all trims
X_T: 0.72; **F_D**: 0.46; **F_L**: 0.89; **K_m**: 0.79

Flow Coefficients for Relief Valve Sizing
C_v 20 use C_v 22
C_v 45 use C_v 50
C_v 60 use C_v 66

Pressure Registration
External

Accuracy
Typically within 0.5 in. w.c. / 1 mbar when flowing 5 to 70 percent of advertised capacities

Temperature Capabilities
Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
0 to 212°F / -18 to 100°C
Ethylenepropylene (EPDM - FDA):
-20 to 212°F / -29 to 100°C
Perfluoroelastomer (FFKM):
-20 to 212°F / -29 to 100°C

Construction Material
See Table 2

Approximate Weight
60 lbs / 27 kg

Ordering Guide
To order this product, contact your local Sales Office.

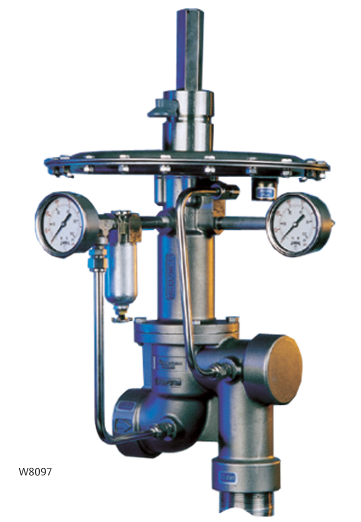

Figure 1. *Type ACE95Sr Tank Blanketing Valve*

Features

- **Fully Balanced Pilot Design Reduces Inlet Pressure Sensitivity**
- **Frictionless Pilot Valve**
- **Bubble Tight Shutoff**
- **Highly Sensitive**
- **Operation Diagnostics Available**
- **Vacuum Settings Available**
- **Stainless Steel Construction Available**

Application

- **Tank Blanketing**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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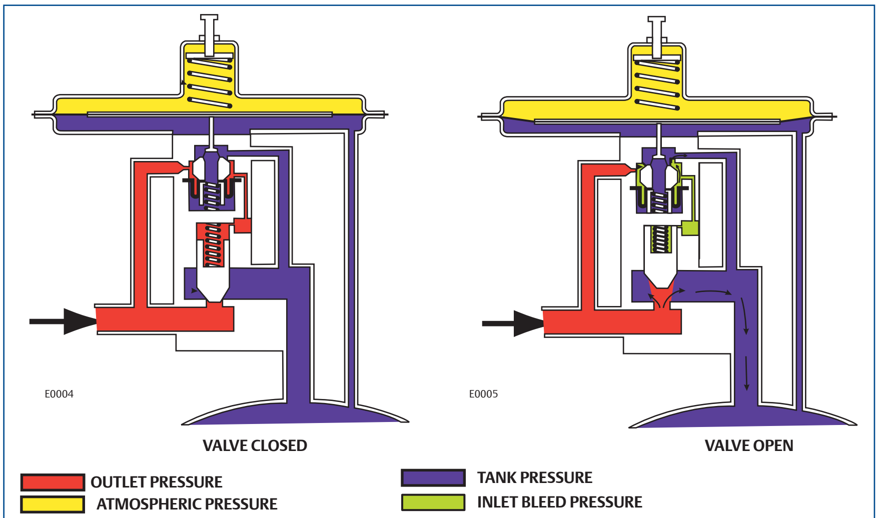

Figure 2. *Type ACE95Sr Operational Schematic*

Table 1. Body Size and End Connection Style

BODY TYPE	BODY SIZE	END CONNECTION STYLE
Angled (Various Single Array Manifold (SAM) tank connections are also available)	2 in.	NPT
	NPS 2 / DN 50	CL150 RF or CL300 RF

Table 2. Construction Materials

BODY AND BONNET	TRIM	ELASTOMERS	DIAPHRAGM	ACTUATOR
CF3M/CF8M Stainless steel	304/316 Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (FDA-EPDM) or Perfluoroelastomer (FFKM)	Fluorinated Ethylene Propylene (FEP)	Carbon steel or 316 Stainless steel

Table 3. Type ACE95Sr Capacities

INLET PRESSURE				CAPACITIES IN SCFH / Nm^3/h OF NITROGEN					
				C_v = 20		C_v = 45		C_v = 60	
psig	bar	kg/cm²	kPa	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
25	1.7	1.76	172	26,700	716	60,200	1613	80,000	2144
30	2.1	2.11	207	30,200	809	68,100	1825	90,800	2433
40	2.8	2.81	276	37,500	1005	84,500	2265	112,700	3020
50	3.5	3.52	345	45,700	1225	102,800	2755	137,100	3674
60	4.1	4.22	414	53,800	1442	121,000	3243	161,400	4325
70	4.8	4.92	483	61,800	1656	139,200	3731	185,600	4974
80	5.5	5.62	552	69,900	1873	154,400	4138	209,800	5623
90	6.2	6.33	621	78,000	2090	175,500	4703	234,000	6271
100	6.9	7.03	690	86,000	2305	193,600	5188	258,200	6920
125	8.6	8.79	862	102,100	2736	238,900	6402	306,500	8214
150	10.3	10.55	1034	126,300	3385	284,200	7616	378,900	10,154
175	12.1	12.31	1207	142,400	3816	329,400	8828	427,200	11,449
200	13.8	14.06	1379	166,500	4462	347,700	9318	499,600	13,390

Table 4. Minimum and Maximum Differential Pressures

BODY SIZE		VALVE C_v	INLET PRESSURE RANGE		SPRING FREE LENGTH		SPRING WIRE DIAMETER	
NPS	DN		psig	bar	In.	mm	In.	mm
3/4 and 1	20 and 25	1 to 4	25 to 50	1.7 to 3.4	1.50	38.1	0.038	0.96
			51 to 120	3.5 to 8.3	1.50	38.1	0.051	1.30
			121 to 200	8.3 to 13.8	1.50	38.1	0.059	1.50
1	25	7.5 to 10	25 to 50	1.7 to 3.4	1.50	38.1	0.051	1.30
			51 to 120	3.5 to 8.3	1.50	38.1	0.059	1.50
			121 to 200	8.3 to 13.8	1.50	38.1	0.072	1.83
2	50	20 to 60	25 to 50	1.7 to 3.4	4.58	116	0.148	3.76
			51 to 120	3.5 to 8.3	4.00	102	0.177	4.50
			121 to 200	8.3 to 13.8	4.00	102	0.218	5.54

Type ACE97

Tank Blanketing and Vapor Recovery Regulator

Introduction

The Type ACE97 Dual Tank Blanketing and Vapor Recovery regulator is a self-contained, pilot-operated valve that maintains a blanket of inert gas on top of a stored product to protect it from atmospheric contamination. It reduces combustibility, decreases vaporization, controls vapor space pressure during pump-in and pump-out operations, and helps prevent the tank from entering a vacuum condition and collapsing upon itself. The Type ACE97 valve provides excellent and accurate pressure control of the vapor space in the tank. Blanketing pressure is kept to a minimum in order to conserve the use of blanketing gas.

Tank Blanketing – ensures a minimum pressure is maintained in the tank vapor space during normal operation.

Vapor Recovery – limits tank pressure to a maximum value during normal operation.

Tank and vapor recovery connections are available to meet most customer requirements. A Single Array Manifold (SAM) provides a single tank and sensing connection and is required for tanks having a single nozzle. Accessories include gauges, purge meters, pressure switches and check valves.

Tank Blanketing Specifications

Tank Blanketing Body Sizes

NPS 1/2, 1 and 2 / DN 15, 25 and 50

Maximum Operating Inlet Pressure

200 psig / 13.8 bar

Maximum Main Valve Inlet Pressure

200 psig / 13.8 bar

Control Pressure Ranges

See Table 1

Maximum and Minimum Differential Pressures

Minimum: 25 psig / 1.7 bar
Maximum: 200 psig / 13.8 bar

Maximum Backpressure

20 psig / 1.4 bar

Flow Coefficients for Relief Valve Sizing (110% of rated C_v)

C_v = 0.2 use C_v = 0.22
C_v = 7.5 use C_v = 8.25
C_v = 0.4 use C_v = 0.44
C_v = 10 use C_v = 11
C_v = 1 use C_v = 1.1
C_v = 20 use C_v = 22
C_v = 2 use C_v = 2.2
C_v = 45 use C_v = 50
C_v = 4 use C_v = 4.4
C_v = 60 use C_v = 66

Vapor Recovery Specifications

Vapor Recovery Body Sizes

NPS 1, 2, 3 and 4 /
DN 25, 50, 80 and 100

Vapor Recovery Pressure Ranges

See Table 1

Valve Coefficients

NPS 1 / DN 25 body: C_v = 3, C_v = 12 or C_v = 17
NPS 2 / DN 50 body: C_v = 20, C_v = 35 or C_v = 70
NPS 3 / DN 80 body: C_v = 6, C_v = 90, C_v = 115 or C_v = 140
NPS 4 / DN 100 body: C_v = 150, C_v = 200 or C_v = 280

General Type ACE97 Specifications

Pressure Registration

External

Temperature Capabilities

Nitrile (NBR):
-20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
0 to 212°F / -18 to 100°C
Ethylenepropylene (EPDM - FDA):
-20 to 212°F / -29 to 100°C
Perfluoroelastomer (FFKM):
-20 to 212°F / -29 to 100°C

Approximate Weights

NPS 1/2 x 1 x 1 / DN 15 x 25 x 25:
70 lbs / 32 kg
NPS 1 x 2 x 2 / DN 25 x 50 x 50:
105 lbs / 48 kg
NPS 2 x 3 x 3 / DN 50 x 80 x 80:
175 lbs / 79 kg

Ordering Guide

To order this product, contact your local Sales Office.

W8161

***Figure 1.** Type ACE97 Tank Blanketing and Vapor Recovery Regulator*

Application

- **Tank Blanketing/ Vapor Recovery**

Features

- **Bubble Tight Shutoff**
- **Frictionless Pilot Valve**
- **Maximum Vapor Space Control**
- **Stainless Steel Construction**
- **Pilot Controlled**
- **Fully Balanced**
- **Diagnostic Port for Servicing**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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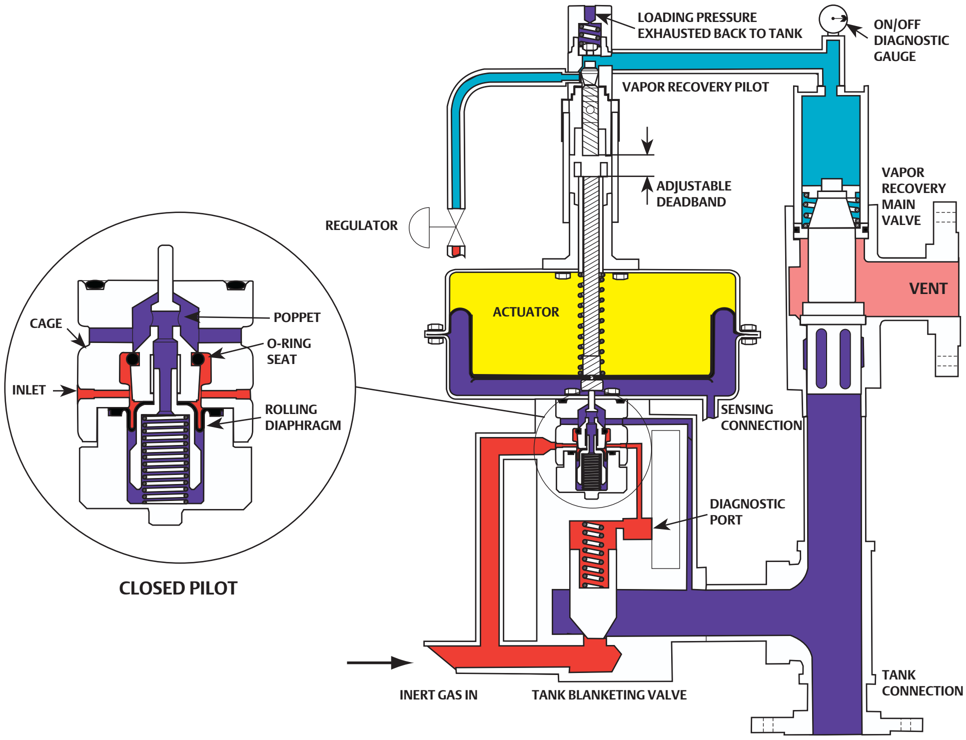


Figure 2. *Type ACE97 Tank Blanketing Off/Vapor Recovery Off Operational Schematic*

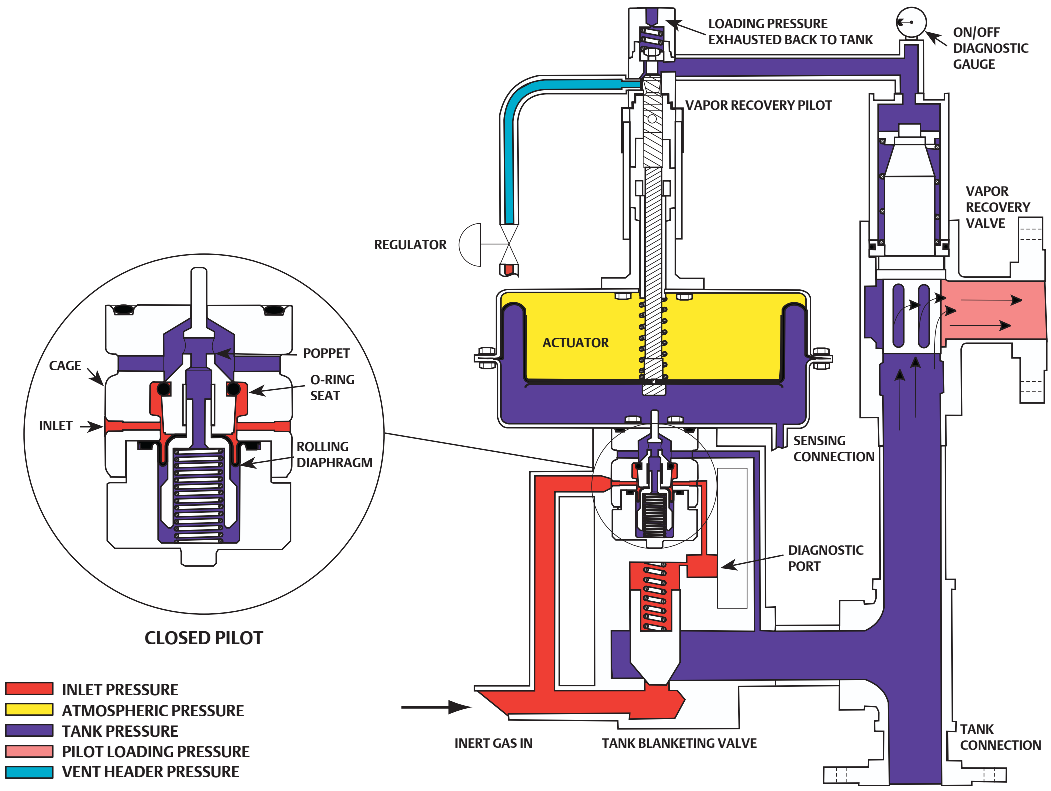


Figure 3. *Type ACE97 Tank Blanketing Off/Vapor Recovery On Operational Schematic*

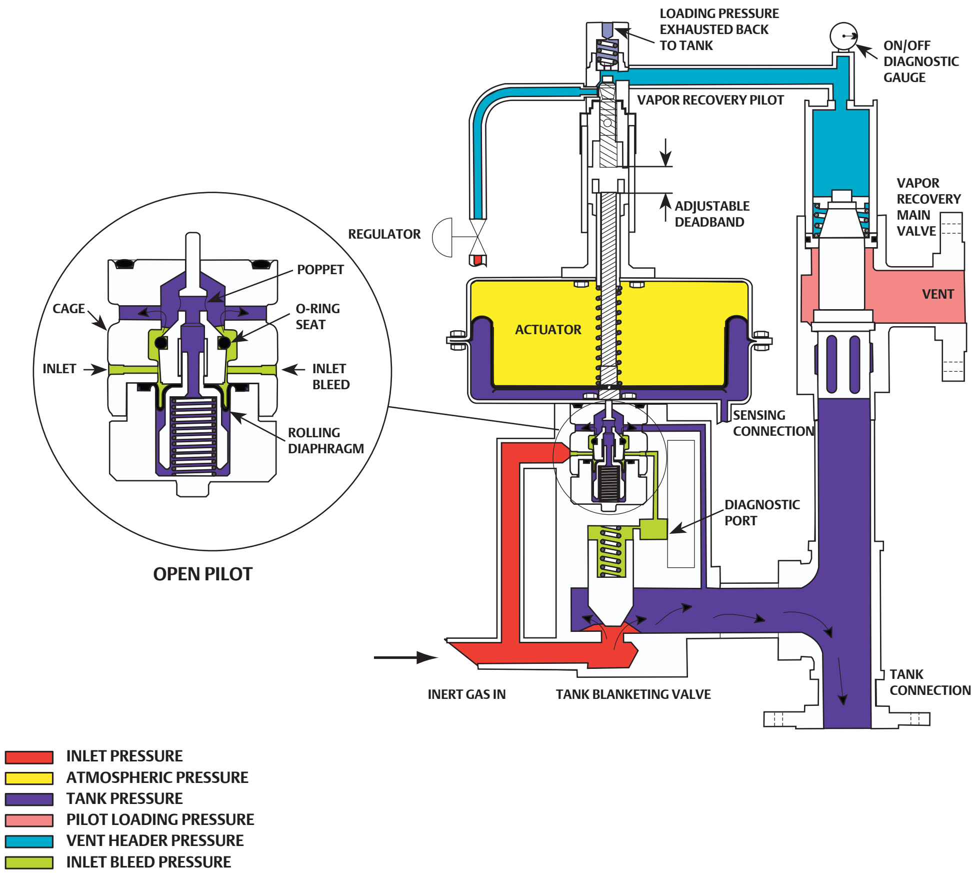


Figure 4. *Type ACE97 Tank Blanketing On/Vapor Recovery Off Operational Schematic*

Table 1. Control Pressure Ranges

CONTROLLED PRESSURE RANGES				SPRING FREE LENGTH		SPRING WIRE DIAMETER	
Tank Blanketing Setpoint		Vapor Recovery Setpoint (Above Tank Blanketing Setpoint)					
In. w.c.	mbar	In. w.c.	mbar	In.	mm	In.	mm
0.5 to 3	1 to 7	4 to 10	10 to 25	3.08	78.2	0.105	2.67
0.5 to 7	1 to 17	4 to 6	10 to 15	4.00	102	0.092	2.34
3 to 13	7 to 32	4 to 16	10 to 40	3.73	94.7	0.156	3.96
4 to 10	10 to 25[1]	16 to 78	40 to 194[1]	3.73	94.7	0.156	3.96
4 to 10	10 to 25[1]	16 to 78	40 to 194[1]	2.90	73.7	0.250	6.35
0.5 in. w.c. to 1.4 psig	0.03 mbar to 0.10 bar	0.25 in. w.c. to 1 psig	0.02 mbar to 0.07 bar	3.80	96.5	0.250	6.35
1.0 in. w.c. to 2.2 psig	0.07 mbar to 0.15 bar	0.25 in. w.c. to 2.0 psig	0.02 mbar to 0.14 bar			0.313	7.95

1. Two nested springs are used.

Table 2. Flow Rate Conversion

MULTIPLY MAXIMUM PUMP RATE	BY	TO OBTAIN:
U.S. GPM	8.021	SCFH
U.S. GPH	0.1337	SCFH
m^3/hr	1.01	Nm^3/h
Barrels/hr	5.615	SCFH
Barrels/day	0.2340	SCFH

Table 3. Correction Factors (For Converting Nitrogen Flow Rates to Other Gas Flow Rates)

BLANKET GAS	SPECIFIC GRAVITY	CORRECTION FACTOR
Natural Gas	0.60	1.27
Air	1.00	0.99
Dry CO_2	1.52	0.80

$$\text{Correction Factor} = \frac{0.985}{\sqrt{SG}}$$

Table 4. Correction Factors (For Converting Air Flow Rates to Other Gas Flow Rates)

VENT GAS SPECIFIC GRAVITY	CORRECTION FACTOR
0.60	1.29
0.80	1.19
1.20	0.91
1.40	0.85
1.60	0.79
1.80	0.75
2.00	0.71
3.00	0.58

Correction Factor = $\frac{1.00}{\sqrt{SG}}$

Table 5. Flow Rate Requirements for Liquid Pump-In Pump-Out per API 2000

	PUMP-OUT (INBREATHING)	PUMP-IN (OUTBREATHING)
Flashpoint > 100°F / 38°C or Normal Boiling Point > 300°F / 149°C	5.6 SCFH / 0.15 Nm³/h of air per barrel/hour of liquid 8.0 SCFH / 0.21 Nm³/h of air per GPM of liquid 35.1 SCFH / 0.94 Nm³/h of air per m³/hr of liquid	6 barrels/hour of SCFH air per barrel/hour of liquid 8.6 SCFH / 0.23 Nm³/h of air per GPM of liquid 37.7 SCFH / 1.01 Nm³/h of air per m³/hr of liquid
Flashpoint < 100°F / 38°C or Normal Boiling Point < 300°F / 149°C	5.6 SCFH / 0.15 Nm³/h of air per barrel/hour of liquid 8.0 SCFH / 0.21 Nm³/h of air per GPM of liquid 35.1 SCFH / 0.94 Nm³/h of air per m³/hr of liquid	12 SCFH / 0.32 Nm³/h of air per barrel/hour of liquid 17 SCFH / 0.46 Nm³/h of air per GPM of liquid 75.3 SCFH / 2.02 Nm³/h of air per m³/hr of liquid

Table 6. Gas Flow Required for Thermal Cooling (Inbreathing) or Heating (Outbreathing) per API 2000 (Interpolate for Intermediate Sizes)

VESSEL CAPACITY			AIR FLOW RATE REQUIRED					
			Inbreathing		Outbreathing			
					Flashpoint < 100°F / 38°C or Normal Boiling Point < 300°F / 149°C		Flashpoint > 100°F / 38°C or Normal Boiling Point > 300°F / 149°C	
Barrels	Gallons	Liters	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
60	2520	9500	60	1.61	40	1.07	60	1.61
100	4200	16,000	100	2.68	60	1.61	100	2.68
500	21,000	79,500	500	13.4	300	8.04	500	13.4
1000	42,000	159,000	1000	26.8	600	16.1	1000	26.8
2000	84,000	318,000	2000	53.6	1200	32.2	2000	53.6
3000	126,000	477,000	3000	80.4	1800	48.2	3000	80.4
4000	168,000	636,000	4000	107	2400	64.3	4000	107
5000	210,000	795,000	5000	134	3000	80.4	5000	134
10,000	420,000	1,590,000	10,000	268	6000	161	10,000	268
15,000	630,000	2,385,000	15,000	402	9000	241	15,000	402
20,000	840,000	3,180,000	20,000	536	12,000	322	20,000	536
25,000	1,050,000	3,975,000	24,000	643	15,000	402	24,000	643
30,000	1,260,000	4,769,000	28,000	750	17,000	456	28,000	750
35,000	1,470,000	5,564,000	31,000	831	19,000	509	31,000	831
40,000	1,680,000	6,359,000	34,000	911	21,000	563	34,000	911
45,000	1,890,000	7,154,000	37,000	992	23,000	616	37,000	992
50,000	2,100,000	7,949,000	40,000	1072	24,000	643	40,000	1072
60,000	2,520,000	9,539,000	44,000	1179	27,000	724	44,000	1179
70,000	2,940,000	11,129,000	48,000	1286	29,000	777	48,000	1286
80,000	3,360,000	12,719,000	52,000	1394	31,000	831	52,000	1394
90,000	3,780,000	14,309,000	56,000	1501	34,000	911	56,000	1501
100,000	4,200,000	15,899,000	60,000	1608	36,000	965	60,000	1608
120,000	5,040,000	19,079,000	68,000	1822	41,000	1099	68,000	1822
140,000	5,880,000	22,258,000	75,000	2010	45,000	1206	75,000	2010
160,000	6,720,000	25,438,000	82,000	2198	50,000	1340	82,000	2198
180,000	7,560,000	28,618,000	90,000	2412	54,000	1447	90,000	2412

Table 7. NPS 1/2 / DN 15 Blanketing Valve Capacities of 0.97 Specific Gravity Nitrogen

INLET PRESSURE				CAPACITIES IN SCFH / Nm³/h OF NITROGEN			
				C_v = 0.2		C_v = 0.4	
psig	bar	kg/cm²	kPa	SCFH	Nm³/h	SCFH	Nm³/h
25	1.7	1.8	172	250	6.7	550	14.7
30	2.1	2.1	207	290	7.8	630	16.9
40	2.8	2.8	276	370	9.9	780	20.9
50	3.4	3.5	345	450	12.1	930	24.9
60	4.1	4.2	414	530	14.2	1070	28.7
70	4.8	4.9	483	610	16.3	1230	33.0
80	5.5	5.6	552	690	18.5	1390	37.3
90	6.2	6.3	621	780	20.9	1560	41.8
100	6.9	7.0	690	860	23.0	1720	46.1
120	8.3	8.4	828	1020	27.3	2040	54.7
140	9.7	9.8	966	1180	31.6	2360	63.2
160	11.0	11.2	1103	1340	35.9	2680	71.8
180	12.4	12.7	1241	1500	40.2	3000	80.4
200	13.8	14.1	1379	1660	44.5	3330	89.2

Table 8. NPS 1 / DN 25 Blanketing Valve Capacities of 0.97 Specific Gravity Nitrogen

INLET PRESSURE				CAPACITIES IN SCFH / Nm³/h OF NITROGEN									
				C_v = 1		C_v = 2		C_v = 4		C_v = 7.5		C_v = 10	
psig	bar	kg/cm²	kPa	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
25	1.7	1.76	172	1330	35.6	2670	71.6	5350	143	10,000	268	13,000	348
30	2.1	2.11	207	1510	40.5	3020	80.9	6050	162	11,300	303	15,100	405
40	2.8	2.81	276	1870	50.1	3750	101	7510	201	14,000	375	18,700	501
50	3.4	3.52	345	2280	61.1	4570	122	9140	245	17,100	458	22,800	611
60	4.1	4.22	414	2690	72.1	5380	144	10,700	287	20,100	539	26,900	721
70	4.8	4.92	483	3090	82.8	6180	166	12,300	330	23,200	622	30,000	804
80	5.5	5.62	552	3490	93.5	6990	187	13,900	373	26,200	702	34,900	935
90	6.2	6.33	621	3900	105	7800	209	15,600	418	29,200	783	39,000	1045
100	6.9	7.03	690	4300	115	8600	230	17,200	461	32,200	863	43,000	1152
110	7.6	7.73	759	4700	126	9410	252	18,800	504	35,300	946	47,000	1260
120	8.3	8.44	827	5100	137	10,200	273	20,400	547	38,300	1026	51,000	1367
130	9.0	9.14	897	5510	148	11,000	295	22,000	590	41,300	1107	55,100	1477
140	9.7	9.84	965	5910	158	11,800	316	23,600	632	44,300	1187	59,100	1584
150	10.3	10.55	1034	6310	169	12,600	338	25,200	675	47,300	1268	63,100	1691
160	11.0	11.25	1103	6710	180	13,400	359	26,800	718	50,300	1348	67,100	1798
170	11.7	11.95	1172	7120	191	14,200	381	28,400	761	53,400	1431	71,200	1908
180	12.4	12.65	1241	7520	202	15,000	402	30,000	804	56,400	1512	75,200	2015
190	13.1	13.36	1310	7920	212	15,800	423	31,700	850	59,400	1592	79,200	2123
200	13.8	14.06	1379	8320	223	16,600	445	33,300	892	62,400	1672	83,200	2230

Typical accuracy when flowing 5 to 70% of table value is ± 0.5 in. w.c. / 1 mbar.

Table 9. NPS 2 / DN 50 Blanketing Valve Capacities of 0.97 Specific Gravity Nitrogen

INLET PRESSURE				CAPACITIES IN SCFH / Nm³/h OF NITROGEN					
				C_v = 20		C_v = 45		C_v = 60	
psig	bar	kg/cm²	kPa	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
25	1.7	1.76	172	26,700	716	60,200	1613	80,000	2144
30	2.1	2.11	207	30,200	809	68,100	1825	90,800	2433
40	2.8	2.81	276	37,500	1005	84,500	2265	112,700	3020
50	3.4	3.52	345	45,700	1225	102,800	2755	137,100	3674
60	4.1	4.22	414	53,800	1442	121,000	3243	161,400	4326
70	4.8	4.92	483	61,800	1656	139,200	3731	185,600	4974
80	5.5	5.62	552	69,900	1873	154,400	4138	209,800	5623
90	6.2	6.33	621	78,000	2090	175,500	4703	234,000	6271
100	6.9	7.03	690	86,000	2305	193,600	5188	258,200	6920
125	8.6	8.79	862	102,100	2736	238,900	6403	306,500	8214
150	10.3	10.55	1034	126,300	3385	284,200	7617	378,900	10,155
175	12.1	12.31	1207	142,400	3816	329,400	8828	427,200	11,449
200	13.8	14.06	1379	166,500	4462	347,700	9318	499,600	13,389

Typical accuracy when flowing 5 to 70% of table value is ± 0.5 in. w.c. / 1 mbar.

Table 10. NPS 1 / DN 25 Vapor Recovery Valve Capacities of 1.0 Specific Gravity Air

DIFFERENTIAL PRESSURE[1]		FLOW CAPACITY IN SCFH / Nm³/h OF 1.0 SPECIFIC GRAVITY AIR							
		C_v = 3		C_v = 6		C_v = 12		C_v = 17	
In. w.c.	mbar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
2	5	180	4.8	360	9.6	730	19.6	1030	27.6
3	7	220	5.9	440	11.8	890	23.9	1260	33.8
4	10	250	6.7	510	13.7	1030	27.6	1460	39.1
5	12	280	7.5	570	15.3	1150	30.8	1630	43.7
6	15	310	8.3	630	16.9	1260	33.8	1790	48.0
7	17	340	9.1	680	18.2	1360	36.4	1930	51.7
8	20	360	9.6	730	19.6	1460	39.1	2060	55.2
9	22	380	10.2	770	20.6	1540	41.3	2190	58.7
10	25	400	10.7	810	21.7	1630	43.7	2310	61.9
12	30	440	11.8	890	23.9	1780	47.7	2530	67.8
14	35	480	12.9	960	25.7	1930	51.7	2730	73.2
16	40	510	13.7	1030	27.6	2060	55.2	2920	78.3
18	45	540	14.5	1090	29.2	2190	58.7	3100	83.1
20	50	570	15.3	1150	30.8	2300	61.6	3270	87.6
22	55	600	16.1	1210	32.4	2420	64.9	3430	91.9
24	60	630	16.9	1260	33.8	2520	67.5	3580	95.9
26	65	650	17.4	1310	35.1	2630	70.5	3720	99.7
28	70	680	18.2	1360	36.5	2730	73.2	3870	104
30	75	700	18.8	1410	37.8	2820	75.6	4000	107

1. Always use the differential pressure between tank pressure (vapor recovery setpoint) and vent header (vapor recovery) pressure to calculate flow through the vapor recovery valve.

- continued -

Table 10. NPS 1 / DN 25 Vapor Recovery Valve Capacities of 1.0 Specific Gravity Air (continued)									
DIFFERENTIAL PRESSURE[1]		FLOW CAPACITY IN SCFH / Nm³/h OF 1.0 SPECIFIC GRAVITY AIR							
		C_v = 3		C_v = 6		C_v = 12		C_v = 17	
In. w.c.	mbar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1.0 psig	69	670	18.0	1350	36.2	2710	72.6	3840	103
1.1 psig	76	710	19.0	1420	38.1	2840	76.1	4030	108
1.2 psig	83	740	19.8	1480	39.7	2970	79.6	4210	113
1.3 psig	90	770	20.6	1540	41.3	3090	82.8	4380	117
1.4 psig	97	800	21.4	1600	42.9	3210	86.0	4550	122
1.5 psig	103	830	22.2	1660	44.5	3320	89.0	4710	126
1.6 psig	110	850	22.8	1710	45.8	3430	91.9	4870	130
1.7 psig	117	880	23.6	1770	47.4	3540	94.9	5020	134
1.8 psig	124	910	24.4	1820	48.8	3640	97.6	5160	138
1.9 psig	131	930	24.9	1870	50.1	3740	100	5300	142
2.0 psig	138	960	25.7	1920	51.5	3840	103	5440	146
2.1 psig	145	980	26.3	1970	52.8	3940	106	5580	149
2.2 psig	152	1000	26.8	2010	53.9	4030	108	5710	153
2.3 psig	159	1030	27.6	2060	55.2	4120	110	5840	156
2.4 psig	165	1050	28.1	2100	56.3	4210	113	5970	160
2.5 psig	172	1070	28.7	2150	57.6	4300	115	6090	163
2.6 psig	179	1090	29.2	2190	58.7	4380	117	6210	166
2.7 psig	186	1110	29.7	2230	59.8	4470	120	6330	170
2.8 psig	193	1130	30.3	2270	60.8	4550	122	6450	173

1. Always use the differential pressure between tank pressure (vapor recovery setpoint) and vent header (vapor recovery) pressure to calculate flow through the vapor recovery valve.

Table 11. NPS 2 / DN 50 Vapor Recovery Valve Capacities of 1.0 Specific Gravity Air							
DIFFERENTIAL PRESSURE[1]		FLOW CAPACITY IN SCFH / Nm³/h OF 1.0 SPECIFIC GRAVITY AIR					
		C_v = 20		C_v = 35		C_v = 70	
In. w.c.	mbar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
2	5	1210	32.4	2130	57.1	4260	114
3	7	1490	39.9	2600	69.7	5210	140
4	10	1720	46.1	3010	80.7	6020	161
5	12	1920	51.5	3360	90.0	6730	180
6	15	2100	56.3	3680	98.6	7370	198
7	17	2270	60.8	3980	107	7970	214
8	20	2430	65.1	4260	114	8520	228
9	22	2580	69.1	4510	121	9030	242
10	25	2720	72.9	4760	128	9520	255
12	30	2980	79.9	5210	140	10,430	280
14	35	3220	86.3	5630	151	11,270	302
16	40	3440	92.2	6020	161	12,040	323
18	45	3650	97.8	6380	171	12,770	342
20	50	3840	103	6730	180	13,470	361
22	55	4030	108	7060	189	14,120	378
24	60	4210	113	7370	198	14,750	395
26	65	4380	117	7670	206	15,350	411
28	70	4550	122	7960	213	15,930	427
30	75	4710	126	8240	221	16,490	442
1.0 psig	69	4520	121	7920	212	15,800	423
1.1 psig	76	4740	127	8310	223	16,600	445
1.2 psig	83	4960	133	8680	233	17,300	464
1.3 psig	90	5160	138	9030	242	18,000	482
1.4 psig	97	5350	143	9370	251	18,700	501
1.5 psig	103	5540	148	9700	260	19,400	520
1.6 psig	110	5720	153	10,000	268	20,000	536
1.7 psig	117	5900	158	10,300	276	20,600	552
1.8 psig	124	6070	163	10,600	284	21,200	568
1.9 psig	131	6240	167	10,900	292	21,800	584
2.0 psig	138	6400	172	11,200	300	22,400	600
2.1 psig	145	6560	176	11,400	306	22,900	614
2.2 psig	152	6720	180	11,700	314	23,500	630
2.3 psig	159	6870	184	12,000	322	24,000	643
2.4 psig	165	7020	188	12,200	327	24,500	657
2.5 psig	172	7170	192	12,500	335	25,000	670
2.6 psig	179	7310	196	12,700	340	25,500	683
2.7 psig	186	7450	200	13,000	348	26,000	697
2.8 psig	193	7590	203	13,200	354	26,500	710

1. Always use the differential pressure between tank pressure (vapor recovery setpoint) and vent header (vapor recovery) pressure to calculate flow through the vapor recovery valve.

Table 12. NPS 3 / DN 80 Vapor Recovery Valve Capacities of 1.0 Specific Gravity Air

DIFFERENTIAL PRESSURE[1]		FLOW CAPACITY IN SCFH / Nm3/h OF 1.0 SPECIFIC GRAVITY AIR					
		C_v = 90		C_v = 115		C_v = 140	
In. w.c.	mbar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
2	5	5400	145	7000	188	8500	228
3	7	6700	180	8500	228	10,400	279
4	10	7700	206	9800	263	12,000	322
5	12	8600	230	11,000	295	13,400	359
6	15	9400	252	12,100	324	14,700	394
7	17	10,200	273	13,000	348	15,900	426
8	20	10,900	292	13,900	373	17,000	456
9	22	11,600	311	14,800	397	18,000	482
10	25	12,200	327	15,600	418	19,000	509
12	30	13,400	359	17,100	458	20,800	557
14	35	14,400	386	18,500	496	22,500	603
16	40	15,400	413	19,700	528	24,000	643
18	45	16,400	440	20,900	560	25,500	683
20	50	17,300	464	22,100	592	26,900	721
22	55	18,100	485	23,200	622	28,200	756
24	60	18,900	507	24,200	649	29,500	791
26	65	19,700	528	25,200	675	30,700	823
28	70	20,400	547	26,100	699	31,800	852
30	75	21,200	568	27,100	726	32,900	882
1.0 psig	69	20,300	544	26,000	697	31,600	847
1.1 psig	76	21,300	571	27,300	732	33,200	890
1.2 psig	83	22,300	598	28,500	764	34,700	930
1.3 psig	90	23,200	622	29,600	793	36,100	967
1.4 psig	97	24,100	646	30,800	825	37,500	1005
1.5 psig	103	24,900	667	31,800	852	38,800	1040
1.6 psig	110	25,700	689	32,900	882	40,100	1074
1.7 psig	117	26,500	710	33,900	909	41,300	1107
1.8 psig	124	27,300	732	34,900	935	42,500	1139
1.9 psig	131	28,100	753	35,900	962	43,700	1171
2.0 psig	138	28,800	772	36,800	986	44,800	1201
2.1 psig	145	29,500	791	37,700	1010	45,900	1230
2.2 psig	152	30,200	809	38,600	1034	47,000	1260
2.3 psig	159	30,900	828	39,500	1059	48,100	1289
2.4 psig	165	21,600	579	40,300	1080	49,100	1316
2.5 psig	172	32,200	863	41,200	1104	50,100	1343
2.6 psig	179	32,900	882	42,000	1126	51,100	1369
2.7 psig	186	33,500	898	42,800	1147	52,100	1396
2.8 psig	193	34,100	914	43,600	1168	53,100	1423

1. Always use the differential pressure between tank pressure (vapor recovery setpoint) and vent header (vapor recovery) pressure to calculate flow through the vapor recovery valve.

Table 13. NPS 4 / DN 100 Vapor Recovery Valve Capacities of 1.0 Specific Gravity Air

DIFFERENTIAL PRESSURE[1]		FLOW CAPACITY IN SCFH / Nm³/h OF 1.0 SPECIFIC GRAVITY AIR					
		C_v = 150		C_v = 200		C_v = 280	
In. w.c.	mbar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
2	5	9100	244	12,100	324	17,000	456
3	7	11,100	297	14,900	399	20,800	557
4	10	12,900	346	17,200	461	24,100	646
5	12	14,400	386	19,200	515	26,900	721
6	15	15,800	423	21,000	563	29,500	791
7	17	17,000	456	22,700	608	31,800	852
8	20	18,200	488	24,300	651	34,000	911
9	22	19,300	517	25,800	691	36,100	967
10	25	20,400	547	27,200	729	38,100	1021
12	30	22,300	598	29,800	799	41,700	1118
14	35	24,100	646	32,200	863	45,000	1206
16	40	25,800	691	34,400	922	48,100	1289
18	45	27,300	732	36,500	978	51,100	1369
20	50	28,800	772	38,400	1029	53,800	1442
22	55	30,200	809	40,300	1080	56,500	1514
24	60	31,600	847	42,100	1128	59,000	1581
26	65	32,900	882	43,800	1174	61,400	1646
28	70	34,100	914	45,500	1219	63,700	1707
30	75	35,300	946	47,100	1262	65,900	1766
1.0 psig	69	33,900	909	45,200	1211	63,300	1696
1.1 psig	76	35,600	954	47,400	1270	66,400	1780
1.2 psig	83	37,200	997	49,600	1329	69,400	1860
1.3 psig	90	38,700	1037	51,600	1383	72,200	1935
1.4 psig	97	40,100	1075	53,500	1434	75,000	2010
1.5 psig	103	41,600	1115	55,400	1485	77,600	2080
1.6 psig	110	42,900	1150	57,200	1533	80,200	2149
1.7 psig	117	44,300	1187	59,000	1581	82,600	2214
1.8 psig	124	45,500	1219	60,700	1627	85,100	2281
1.9 psig	131	46,800	1254	62,400	1672	87,400	2342
2.0 psig	138	48,000	1286	64,000	1715	89,700	2404
2.1 psig	145	49,200	1319	65,600	1758	91,900	2463
2.2 psig	152	50,400	1351	67,200	1801	94,100	2522
2.3 psig	159	51,500	1380	68,700	1841	96,200	2578
2.4 psig	165	52,600	1410	70,200	1881	98,300	2634
2.5 psig	172	53,700	1439	71,700	1922	100,300	2688
2.6 psig	179	54,800	1469	73,100	1959	102,300	2742
2.7 psig	186	55,900	1498	74,500	1997	104,300	2795
2.8 psig	193	56,900	1525	75,900	2034	106,200	2846

1. Always use the differential pressure between tank pressure (vapor recovery setpoint) and vent header (vapor recovery) pressure to calculate flow through the vapor recovery valve.

Table 14. Construction Materials

TANK BLANKETING BODY AND BONNET	ACTUATOR, CAGE, VAPOR RECOVERY BODY AND BONNET	TRIM	ELASTOMERS	DIAPHRAGM
NPS 1/2 and 1 / DN 15 and 25; C_v = 0.2 and C_v = 0.4: 316L Stainless steel **NPS 1 and 2 / DN 25 and 50; C_v = 1 to 4 and C_v = 5 to 10:** 316 Stainless steel **NPS 2 / DN 50; C_v = 20 to 60:** CF3M/CF8M Stainless steel	316 Stainless steel	Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), Perfluoroelastomer (FFKM) or Ethylenepropylene (EPDM - FDA)	Nitrile (NBR), Fluorocarbon (FKM) or Ethylenepropylene (EPDM - FDA)

Introduction

The CS400 Series direct-operated, spring-loaded regulators have been engineered to fit a multitude of pressure-reducing applications including commercial and industrial installations. This flexibility is provided by the numerous body sizes and end connections, outlet pressure settings, orifice sizes, as well as the option for internal or external pressure registration.

In addition to application flexibility, the CS400 Series offers multiple overpressure protection options to meet demands on application requirements.

Body Sizes, Materials, End Connections and Pressure Rating

See Table 2

Flow Capacities

See Tables 10 through 23

Flow and Sizing Coefficients

See Table 9

Maximum Inlet Pressure

Emergency: 175 psig / 12.1 bar
Operating: See Table 9

Maximum Outlet Pressure

Casing: 25 psig / 1.7 bar
To Avoid Internal Parts Damage:
5 psig / 0.34 bar over set pressure
Operating: 5.5 psig / 0.38 bar

Outlet Pressure Ranges

3.5 in. w.c. to 5.5 psig / 9 mbar to 0.38 bar
See Table 4

Spring Case Vent Connection

1 NPT

Pressure Registration

Internal or External

Operating Temperature (TS)[1]

According to PED Standards
All Types: -4 to 150°F / -20 to 66°C
Non-PED
All Types: -20 to 150°F / -29 to 66°C

Approximate Shipping Weight

With Threaded Body
Type CS400: 9 lb / 4.1 kg
Type CS403: 18.5 lb / 8.4 kg
Type CS404: 11.2 lb / 5.1 kg
With Flanged Body
Add 8.6 lbs / 4.0 kg to weights listed in the previous section.

Ordering Guide

To order this product, contact your local Sales Office.

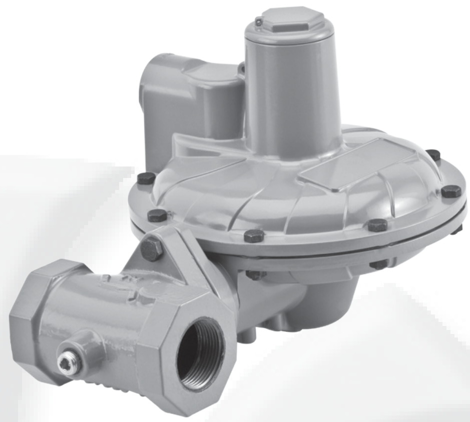


Figure 1. *Typical Type CS400 Pressure Reducing Regulator*

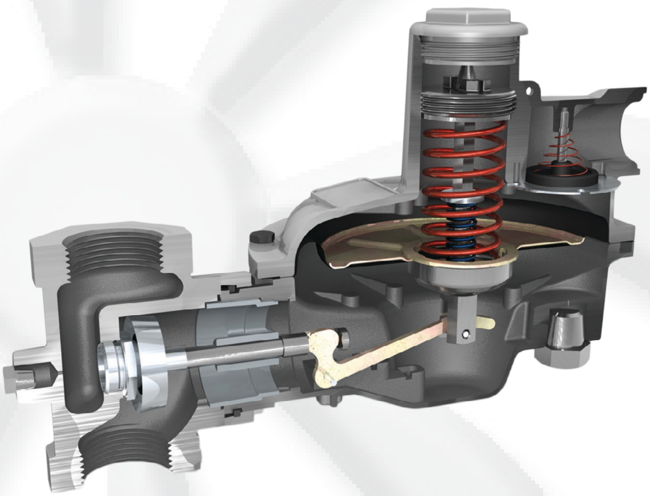


Figure 2. *Typical Type CS400 Pressure Reducing Regulator Internal View*

Features

- **Wide Variety of Body Sizes and End Connections**
- **Fixed Factor/ PFM Accuracy Capabilities**
- **Only Standard Tools Required for Pressure Adjustment and Orifice Removal**
- **Easy to Maintain**

Application

Fuel Gas

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

www.Emerson.com

10/14

1. Product has passed Fisher™ testing for lockup, relief start-to-discharge and reseal down to -40°.

Table 1. Available Configurations

TYPE NUMBER							OPTION
C	S	4	0				
							OVERPRESSURE PROTECTION MODULE
				0			Without Overpressure Protection Module
				3			With Integral Monitor Module[1][3]
				4			With Slam-Shut Module[2]
							PRESSURE REGISTRATION
					E		External Registration[3]
					I		Internal Registration
							RELIEF
						N	Non-Relief
						T	Token Internal Relief
						R	Internal Relief

Example: Type number **CS404IT**: A Type CS400 regulator constructed with Type VSX4 Slam-Shut module, with Internal pressure registration and with Token relief.

1. Reference Instruction Manual D103126X012 for information regarding the Integral Monitor module.
2. Reference Instruction Manual D103127X012 for information regarding the Type VSX4 safety shut-off module.
3. Available only with Non-Relieving or Token Relief options, not Internal Relief.

Table 2. Body Size, Material, End Connection and Pressure Rating

BODY MATERIAL	BODY SIZE, In.		END CONNECTION	FACE-TO-FACE DIMENSION		BODY PRESSURE RATING	
	INLET	OUTLET		In.	mm	psig	bar
Gray Cast iron	1-1/4	1-1/4	NPT	4.5	114	175	12.1
	1-1/4	1-1/2					
	1-1/2	1-1/2					
	2	2	NPT	5	127		
	NPS 2 / DN 50	NPS 2 / DN 50	CL125 FF	10	254		
Ductile Cast iron	1-1/4	1-1/4	NPT	4.5	114	290	20.0
	1-1/2	1-1/2		4.5	114		
	2	2		5	127		
	1-1/4	1-1/4	Rp	4.5	114		
	1-1/2	1-1/2		4.5	114		
	2	2		5	127		
	NPS 2 / DN 50	NPS 2 / DN 50	CL125 FF / CL150 FF	10	254	290	20.0
			PN 10/16	10	254	232	16.0
Steel	1-1/4	1-1/4	NPT	4.5	114	290	20.0
	1-1/2	1-1/2		4.5	114		
	1-1/4	1-1/4	Rp	4.5	114		
	1-1/2	1-1/2		4.5	114		

Table 3. CS400 Series Main Valve and Actuator Construction Material

BODY	CONTROL SPRING	RELIEF VALVE SPRING	LEVER PIN	DIAPHRAGM PLATE	O-RING, DIAPHRAGM AND DISK	CLOSING CAP, ADJUSTING SCREW, VALVE STEM, ORIFICE AND RELIEF VALVE SPRING RETAINER
Gray Cast iron, Ductile iron and Steel	Stainless steel or Music Wire	Stainless steel	Stainless steel	Zinc-plated steel	Nitrile (NBR)	Aluminum

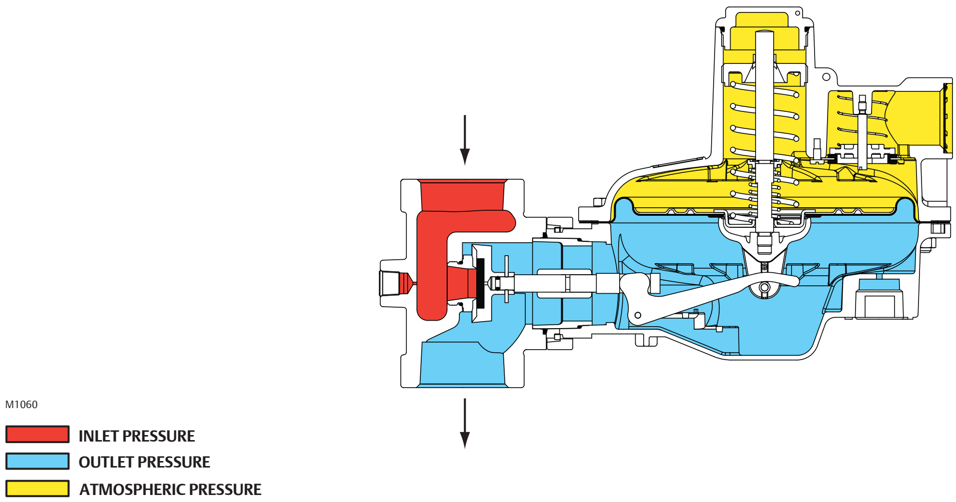


Figure 3. *Type CS400IR Internally Registered Regulator with Internal Relief Operational Schematic*

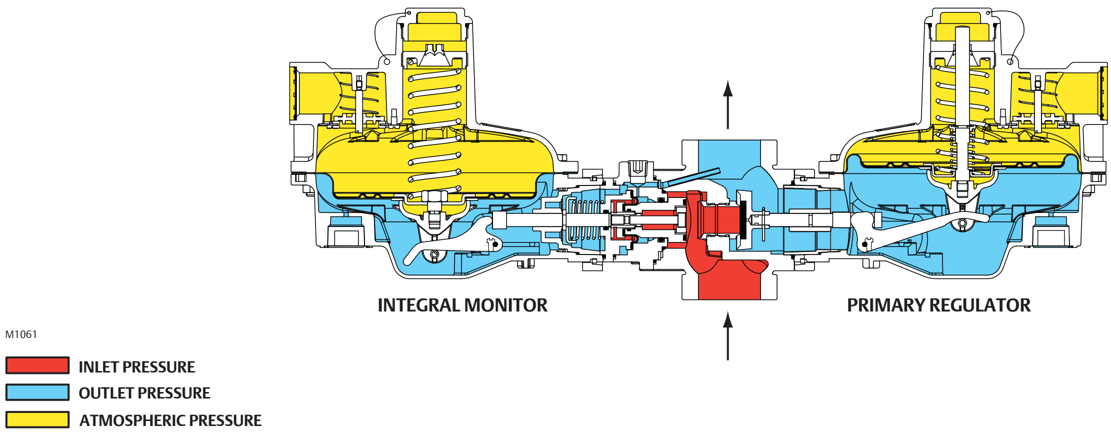


Figure 4. *Type CS403, Internally Registered Primary Regulator with Internally Registered Integral Monitor Operational Schematic*

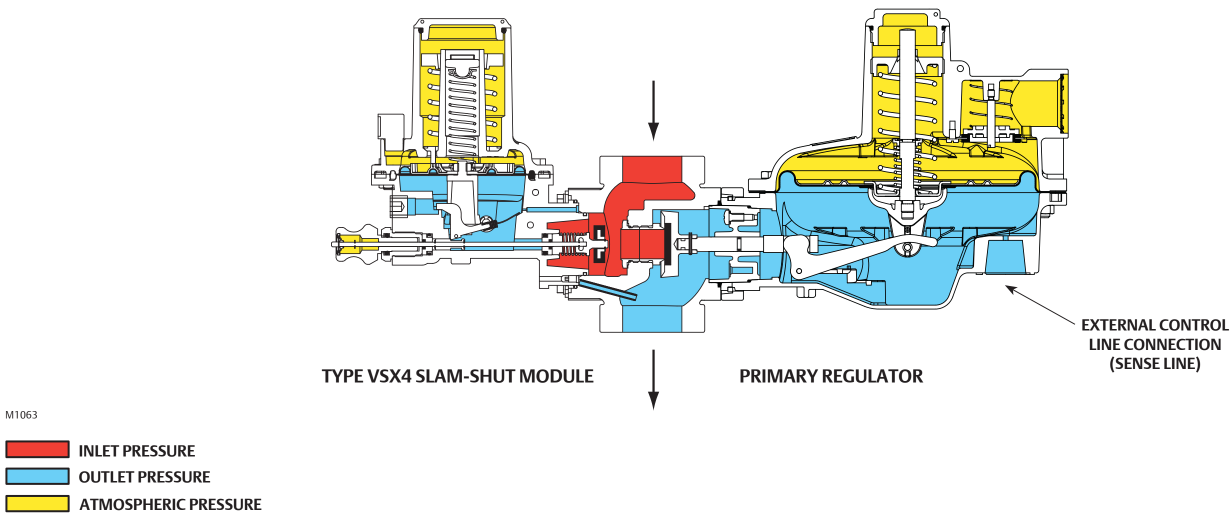


Figure 5. *Type CS404ET with Slam-Shut Module, External Pressure Registration and Token Relief Operational Schematic*

Table 4. Outlet Pressure Range

TYPE	OUTLET PRESSURE RANGE		COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	In. w.c.	mbar		In.	mm	In.	mm
CS400, CS403 and CS404	3.5 to 5	9 to 12	Red	0.098	2.49	4.18	106
	4.5 to 6.5	11 to 16	Purple	0.080	2.03	4.32	110
	6 to 8	15 to 20	Gold	0.108	2.74	4.18	106
	7.5 to 11	19 to 27	Blue	0.110	2.80	4.40	112
	10 to 14	25 to 35	Unpainted	0.110	2.80	4.40	112
	12 to 19	30 to 47	Green	0.112	2.85	4.70	119
	18 in. w.c. to 1 psig	45 mbar to 0.07 bar	Orange	0.120	3.05	4.94	125
	1 to 2 psig	0.07 to 0.14 bar	Black	0.140	3.56	4.66	118
	2 to 5.5 psig	0.14 to 0.38 bar	Yellow	0.172	4.37	4.42	112

Table 5. Approximate Internal Relief Valve Start-to-Discharge Pressure Above Setpoint

SETPOINT	SPRING COLOR	START-TO-DISCHARGE PRESSURE RANGE ABOVE SETPOINT	
		Internal Relief	Token Relief
7 in. w.c. / 17 mbar	Gold	6 to 12 in. w.c. / 15 to 30 mbar	6 to 12 in. w.c. / 15 to 30 mbar
11 in. w.c. / 27 mbar	Blue	6 to 12 in. w.c. / 15 to 30 mbar	6 to 12 in. w.c. / 15 to 30 mbar
14 in. w.c. / 35 mbar	Unpainted	6 to 12 in. w.c. / 15 to 30 mbar	6 to 12 in. w.c. / 15 to 30 mbar
1 psig / 0.07 bar	Orange	0.5 to 1.5 psi / 35 to 103 mbar	0.5 to 1 psi / 35 mbar to 0.07 bar
2 psig / 0.14 bar	Black	0.5 to 1.5 psi / 35 to 103 mbar	0.5 to 1 psi / 35 mbar to 0.07 bar
5 psig / 0.34 bar	Yellow	0.5 to 3.3 psi / 35 to 228 mbar	0.5 to 2 psi / 35 mbar to 0.14 bar

Table 6. Type CS403 Regulator and Integral Monitor Outlet Pressure Range

PRIMARY REGULATOR				INTEGRAL MONITOR				
Type	Setpoint		Spring Color	Setpoint(1)		Spring Range		Spring Color
	In. w.c.	mbar		In. w.c.	mbar	In. w.c.	mbar	
CS403	4	10	Red	14	35	12 to 21	30 to 52	Blue
	5	12	Purple					
	7	17	Gold					
	11	27	Blue	21	52	18 to 30	45 to 75	Green
	14	35	Unpainted					
	18	45	Green	1 psig	0.07 bar	26 to 40	65 to 99	Orange
	1 psig	0.07 bar	Orange	1.5 psig	0.10 bar	1.4 to 2.9 psig	97 to 200	Black
	2 psig	0.14 bar	Black	2.5 psig	0.17 bar	1.4 to 2.9 psig	97 to 200	Black
	3 psig	0.21 bar	Yellow	3.5 psig	0.24 bar	2.6 to 3.7 psig	179 to 255	Purple
	4 psig	0.28 bar		5 psig	0.34 bar	3.6 to 6 psig	248 to 414	Dark Blue
	5 psig	0.34 bar		6 psig	0.41 bar	5.1 to 7.5 psig	352 to 517	Red

1. Integral Monitor setpoints shown represent the minimum setpoint difference between the Integral Monitor and the Primary regulator. Higher monitor setpoints can be chosen, e.g., for a Primary regulator setpoint of 7 in. w.c. / 17 mbar, the Integral Monitor can also be set at 14 and 21 in. w.c. / 35 and 52 mbar; 1 psig / 0.07 bar or higher.

Table 7. Type CS404 Regulator and Slam-Shut OPSO Pressure Range

REGULATOR					SLAM-SHUT DEVICE Overpressure Shutoff (OPSO)			
Type	Setpoint		Spring Range		Factory Setpoint(1)		Spring Range	
	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar
CS404	4	10	3.5 to 5	9 to 12	18	45	12 to 25	30 to 60
	5	12	4.5 to 6.5	11 to 16	19	47		
	7	17	6 to 8	15 to 20	21	52		
	11	27	7.5 to 11	19 to 27	0.9 psig	62	0.58 to 1.6 psig	40 to 110
	14	35	10 to 14	25 to 35	1.1 psig	75		
	0.65 psig	45	0.45 to 0.7 psig	30 to 47	1.4 psig	96	0.87 to 2.8 psig	60 to 190
	0.72 psig	50	0.65 to 1 psig	45 to 69	1.6 psig	112		
	1 psig	69			2.5 psig	172	1.4 to 4.1 psig	95 to 280
	1.5 psig	103	1 to 2 psig	69 to 138	3.0 psig	207		
	2 psig	138			3.5 psig	241		
	3 psig	207	2 to 5.5 psig	138 to 380	6.3 psig	434	3.2 to 11 psig	220 to 760
	4 psig	276			7.3 psig	503		
	5 psig	345			8.3 psig	572		
	5.5 psig	380			8.8 psig	606		

1. For Types CS404IT and CS404ET equipped with Token Relief, if Non-Factory slam-shut OPSO setpoints are specified, they must not encroach on the Token Relief Start-to-Discharge values provided in Table 5.

Table 8. Type CS404 Regulator and Slam-shut OPSO and UPSO Pressure Range

REGULATOR					SLAM-SHUT DEVICE							
					Overpressure Shutoff (OPSO)				Underpressure Shutoff (UPSO)			
Type	Setpoint		Spring Range		Typical Setpoint(1)		Range		Typical Setpoint(1)		Range	
	psig	mbar	psig	mbar	psig	mbar	psig	mbar	psig	mbar	psig	mbar
CS404	0.51	35	0.36 to 0.51	25 to 35	1.1	75	0.73 to 1.9	50 to 130	0.32	22	0.14 to 1.1	10 to 75
	0.65	45	0.45 to 0.7	30 to 48	1.4	95			0.4	30		
	0.72	50	0.65 to 1	45 to 69	1.6	110	1.4 to 3.9	95 to 270	0.4	30		
	1	69			2.5	172	2.2 to 5.5	150 to 380	0.58	40	0.36 to 2.3	25 to 160
	1.5	103	1 to 2 psig	69 to 138	3.0	207			0.73	50		
	2	138			3.5	241			1	69		
	3	207	2 to 5.5 psig	138 to 380	6.3	434	3.8 to 8.7	260 to 600	1.75	121	1.5 to 7.3	100 to 500
	4	276			7.3	503			2	140		
	5	345			8.3	572	5.8 to 16	400 to 1100	2.9	200		
	5.5	380			8.8	606			3.6	250		

1. For Types CS404IT and CS404ET equipped with Token Relief, if Non-Factory slam-shut OPSO setpoints are specified, they must not encroach on the Token Relief Start-to-Discharge values provided in Table 5.

Table 9. Inlet Pressure Rating and Flow and Sizing Coefficient

TYPE	ORIFICE SIZE		MAXIMUM OPERATING INLET PRESSURE TO OBTAIN OPTIMUM PERFORMANCE		FLOW COEFFICIENT (WIDE-OPEN)		C_1	IEC SIZING COEFFICIENT		
	In.	mm	psig	bar	C_g	C_v		X_T	F_L	F_D
CS400, CS403 and CS404	3/16	4.8	125	8.6	27	0.97	27.7	0.50	0.89	0.91
	1/4	6.4	125	8.6	50	1.77	28.2	0.50		0.92
	5/16	7.9	100	6.9	82	2.90	28.3	0.50		0.94
	3/8(1)	9.5(1)	60	4.1	113	3.72	30.4	0.58		0.89
	1/2	12	40	2.8	182	5.61	32.4	0.66		0.82
	5/8	16	30	2.1	284	7.26	39.1	0.97		0.74
	3/4	19	20	1.4	356	9.83	36.2	0.83		0.72

1. 80 psig / 5.5 bar maximum operating inlet pressure available at special request for setpoints 1 psig / 0.07 bar or greater.

	ACCURACY			
SETPOINT	Droop	Boost	SET RANGE	SPRING COLOR
7 in. w.c.	-1 in. w.c.	2 in. w.c.	6 to 8 in. w.c.	Gold
17 mbar	-2 mbar	5 mbar	15 to 20 mbar	

Table 10. Type CS400 Internal Registration Flow Capacities for 7 in. w.c. / 17 mbar Setpoint

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS															
Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4													
0.5	0.03	100	2.6	160	4.2	200	5.3	290	7.7	370	9.9	630	16.9	560	15.0
2	0.14	260	6.9	510	13.6	770	20.6	660	17.7	880	23.6	1100	29.5	1200	32.2
5	0.34	500	13.4	800	21.4	970	26.0	1300	34.8	1600	42.9	2700	72.4	3200	85.9
15	1.0	1000	26.8	1700	45.6	2800	75.1	3200	85.9	3300	88.5	3300	88.5	3900	105
30	2.1	1500	40.2	2700	72.4	3300	88.5	2400	64.4	2700	72.4	3300	88.5		
50	3.4	2200	59.0	2800	75.1	2000	53.6	1600	42.9						
80	5.5	3100	83.2	1900	51.0	1500	40.2								
125	8.6	1700	45.6	1900	51.0										
psig	bar	Body Size: NPS 1-1/2													
0.5	0.03	120	3.2	210	5.6	220	5.9	280	7.5	340	9.1	470	12.6	720	19.3
2	0.14	260	6.9	500	13.4	770	20.6	730	19.5	850	22.8	1100	29.5	1300	34.8
5	0.34	540	14.4	940	25.2	950	25.5	1300	34.8	2300	61.7	3300	88.5	4400	118
15	1.0	990	26.5	1800	48.3	2900	77.8	3300	88.5	3300	88.5	4300	115	4400	118
30	2.1	1500	40.2	2300	61.7	3300	88.5	3300	88.5	2500	67.1	2800	75.1		
50	3.4	2200	59.0	1900	51.0	2900	77.8	2200	59.0						
80	5.5	2200	59.0	1800	48.3	2200	59.0								
125	8.6	1600	42.9	1800	48.3										
psig	bar	Body Size: NPS 2													
0.5	0.03	130	3.4	200	5.3	260	6.9	260	6.9	420	11.2	380	10.2	750	20.1
2	0.14	240	6.4	400	10.7	700	18.7	700	18.7	840	22.5	1100	29.5	1100	29.5
5	0.34	540	14.4	730	19.5	790	21.2	1100	29.5	1900	51.0	2400	64.4	2700	72.4
15	1.0	980	26.3	1700	45.6	2500	67.1	3500	93.9	4200	113	4400	118	4400	118
30	2.1	1500	40.2	2600	69.7	3300	88.5	3500	93.9	4400	118	3200	85.9		
50	3.4	2200	59.0	3200	85.9	3200	85.9	2800	75.1						
80	5.5	3100	83.2	3000	80.5	2900	77.8								
125	8.6	3100	83.2	2800	75.1										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
Gray areas indicate limited capacities due to boost effects.

SETPOINT	ACCURACY		SET RANGE	SPRING COLOR
	Droop	Boost		
11 in. w.c.	-2 in. w.c.	2 in. w.c.	7.5 to 11 in. w.c.	Blue
27 mbar	-5 mbar	5 mbar	19 to 27 mbar	

Table 11. Type CS400 Internal Registration Flow Capacities for 11 in. w.c. / 27 mbar Setpoint

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4													
0.5	0.03	150	4.0	220	5.9	300	8.0	320	8.5	530	14.2	710	19.0	550	14.7
2	0.14	320	8.5	600	16.1	940	25.2	920	24.6	1100	29.5	1500	40.2	1600	42.9
5	0.34	540	14.4	920	24.6	1200	32.2	1500	40.2	2100	56.3	2900	77.8	3200	85.9
15	1.0	980	26.3	1700	45.6	2800	75.1	3400	91.2	3500	93.9	3900	105	4300	115
30	2.1	1500	40.2	2800	75.1	3400	91.2	3400	91.2	3500	93.9	2200	59.0		
50	3.4	2200	59.0	2800	75.1	2500	67.1	1700	45.6						
80	5.5	2500	67.1	2000	53.6	2400	64.4								
125	8.6	1700	45.6	1900	51.0										
psig	bar	Body Size: NPS 1-1/2													
0.5	0.03	100	2.6	160	4.2	240	6.4	340	9.1	410	11.0	530	14.2	690	18.5
2	0.14	280	7.5	550	14.7	840	22.5	970	26.0	1200	32.2	1500	40.2	2000	53.6
5	0.34	560	15.0	970	26.0	1200	32.2	1700	45.6	2700	72.4	3500	93.9	3500	93.9
15	1.0	990	26.5	1800	48.3	2900	77.8	3300	88.5	3500	93.9	3500	93.9	4800	129
30	2.1	1500	40.2	2800	75.1	3300	88.5	3300	88.5	2500	67.1	1900	51.0		
50	3.4	2200	59.0	3200	85.9	3300	88.5	1800	48.3						
80	5.5	2800	75.1	2000	53.6	1900	51.0								
125	8.6	2800	75.1	2000	53.6										
psig	bar	Body Size: NPS 2													
0.5	0.03	110	2.9	200	5.3	270	7.2	340	9.1	420	11.2	620	16.6	870	23.3
2	0.14	290	7.7	530	14.2	800	21.4	940	25.2	1100	29.5	1400	37.5	1700	45.6
5	0.34	550	14.7	920	24.6	1100	29.5	1500	40.2	2200	59.0	3100	83.2	3500	93.9
15	1.0	1000	26.8	1800	48.3	2800	75.1	3700	99.3	4000	107	4200	113	4800	129
30	2.1	1500	40.2	2700	72.4	3400	91.2	3700	99.3	4100	110	2600	69.7		
50	3.4	2200	59.0	3200	85.9	3400	91.2	3200	85.9						
80	5.5	3200	85.9	3200	85.9	3400	91.2								
125	8.6	3300	88.5	3200	85.9										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
Gray areas indicate limited capacities due to boost effects.

SETPOINT	ACCURACY		SET RANGE	SPRING COLOR
	Droop	Boost		
14 in. w.c.	-2 in. w.c.	2 in. w.c.	10 to 14 in. w.c.	Unpainted
35 mbar	-5 mbar	5 mbar	25 to 35 mbar	

Table 12. Type CS400 Internal Registration Flow Capacities for 14 in. w.c. / 35 mbar Setpoint

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4													
1	0.07	190	5.1	280	7.5	380	10.2	680	18.2	860	23.0	890	23.8	1000	26.8
3	0.21	390	10.4	700	18.7	840	22.5	1100	29.5	1500	40.2	2000	53.6	2200	59.0
10	0.69	770	20.6	1300	34.8	2000	53.6	2600	69.7	3300	88.5	3600	96.6	4100	110
20	1.4	1100	29.5	2000	53.6	3200	85.9	3400	91.2	3600	96.6	3600	96.6	4300	115
40	2.8	1800	48.3	2300	61.7	1900	51.0	2300	61.7	2000	53.6				
60	4.1	2500	67.1	2300	61.7	1900	51.0	2300	61.7						
100	6.9	2500	67.1	1900	51.0	1900	51.0								
125	8.6	1600	42.9	1900	51.0										
psig	bar	Body Size: NPS 1-1/2													
1	0.07	180	4.8	260	6.9	420	11.2	680	18.2	870	23.3	840	22.5	840	22.5
3	0.21	370	9.9	740	19.8	870	23.3	980	26.3	1500	40.2	2100	56.3	2200	59.0
10	0.69	760	20.4	1300	34.8	1900	51.0	2700	72.4	3500	93.9	3800	102	4500	121
20	1.4	1100	29.5	2100	56.3	3200	85.9	3400	91.2	3500	93.9	3800	102	4500	121
40	2.8	1900	51.0	2900	77.8	3400	91.2	3100	83.2	2800	75.1				
60	4.1	2600	69.7	2900	77.8	3400	91.2	2800	75.1						
100	6.9	3500	93.9	2900	77.8	3400	91.2								
125	8.6	3600	96.6	2900	77.8										
psig	bar	Body Size: NPS 2													
1	0.07	170	4.5	230	6.1	350	9.3	530	14.2	890	23.8	790	21.2	960	25.7
3	0.21	360	9.6	700	18.7	860	23.0	1100	29.5	1400	37.5	1700	45.6	2200	59.0
10	0.69	760	20.4	1300	34.8	1900	51.0	2600	69.7	3300	88.5	3400	91.2	4500	121
20	1.4	1100	29.5	2100	56.3	3200	85.9	3500	93.9	3600	96.6	3600	96.6	4800	129
40	2.8	1900	51.0	3200	85.9	3500	93.9	3600	96.6	2700	72.4				
60	4.1	2600	69.7	3200	85.9	3700	99.3	2800	75.1						
100	6.9	3100	83.2	2600	69.7	3700	99.3								
125	8.6	3100	83.2	2600	69.7										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
Gray areas indicate limited capacities due to boost effects.

SETPOINT	ACCURACY + / - 20%		SET RANGE	SPRING COLOR
1 psig	-0.2 psi	0.2 psi	18 in. w.c. to 1 psig	Orange
69 mbar	-14 mbar	14 mbar	45 to 69 mbar	

Table 13. Type CS400 Internal Registration Flow Capacities for 1 psig / 69 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4													
2	0.14	270	7.2	510	13.6	840	22.5	1000	26.8	1200	32.2	1700	45.6	2000	53.6
5	0.34	530	14.2	940	25.2	1300	34.8	1700	45.6	2400	64.4	3400	91.2	4100	110
15	1.0	1000	26.8	1700	45.6	2900	77.8	3800	102	5300	142	7000	188	7800	209
30	2.1	1500	40.2	2700	72.4	4700	126	6200	166	7600	204	7600	204		
50	3.4	2200	59.0	4000	107	6200	166	7600	204						
80	5.5	3200	85.9	5800	156	7600	204								
125	8.6	4700	126	6500	174										
psig	bar	Body Size: NPS 1-1/2													
2	0.14	290	7.7	530	14.2	810	21.7	1000	26.8	1300	34.8	1500	40.2	1900	51.0
5	0.34	550	14.7	960	25.7	1300	34.8	1800	48.3	2700	72.4	3800	102	4900	132
15	1.0	1000	26.8	1800	48.3	2700	72.4	3900	105	5600	150	5600	150	6000	161
30	2.1	1500	40.2	2800	75.1	4700	126	6300	169	5600	150	5600	150		
50	3.4	2300	61.7	3900	105	5500	148	5600	150						
80	5.5	3300	88.5	5400	145	5500	148								
125	8.6	4000	107	5500	148										
psig	bar	Body Size: NPS 2													
2	0.14	290	7.7	450	12.0	750	20.1	1000	26.8	1300	34.8	1700	45.6	1800	48.3
5	0.34	540	14.4	950	25.5	1200	32.2	1700	45.6	2400	64.4	3100	83.2	4300	115
15	1.0	1000	26.8	1800	48.3	2700	72.4	3900	105	5700	153	6600	177	8200	220
30	2.1	1500	40.2	2600	69.7	4200	113	6300	169	6000	161	6600	177		
50	3.4	2200	59.0	4000	107	5700	153	6300	169						
80	5.5	3300	88.5	5500	148	5700	153								
125	8.6	4000	107	5500	148										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY + / - 20%		SET RANGE	SPRING COLOR
2 psig	-0.4 psi	0.4 psi	1 to 2 psig	Black
138 mbar	-28 mbar	28 mbar	69 to 138 mbar	

Table 14. Type CS400 Internal Registration Flow Capacities for 2 psig / 138 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4													
3	0.21	350	9.3	460	12.3	820	22.0	1100	29.5	1300	34.8	1600	42.9	1900	51.0
10	0.69	850	22.8	1300	34.8	1900	51.0	2600	69.7	3400	91.2	4700	126	6200	166
20	1.4	1200	32.2	2100	56.3	3100	83.2	4100	110	6200	166	6200	166	6200	166
40	2.8	1800	48.3	3400	91.2	5400	145	6000	161	6200	166				
60	4.1	2600	69.7	4600	123	6000	161	6000	161						
100	6.9	3900	105	5800	156	6000	161								
125	8.6	3900	105	5800	156										
psig	bar	Body Size: NPS 1-1/2													
3	0.21	310	8.3	570	15.3	900	24.1	1100	29.5	1300	34.8	1700	45.6	1900	51.0
10	0.69	800	21.4	1300	34.8	1900	51.0	2500	67.1	3400	91.2	5300	142	6700	180
20	1.4	1100	29.5	2100	56.3	3100	83.2	4500	121	6200	166	6400	172	6700	180
40	2.8	1900	51.0	3300	88.5	5700	153	6200	166	6200	166				
60	4.1	2500	67.1	4500	121	6000	161	6200	166						
100	6.9	3900	105	5800	156	6000	161								
125	8.6	3900	105	5800	156										
psig	bar	Body Size: NPS 2													
3	0.21	300	8.0	560	15.0	850	22.8	1100	29.5	1300	34.8	1700	45.6	1900	51.0
10	0.69	780	20.9	1300	34.8	1800	48.3	2600	69.7	3600	96.6	4900	131	5600	150
20	1.4	1100	29.5	2000	53.6	3000	80.5	4200	113	6000	161	6000	161	6000	161
40	2.8	1900	51.0	3300	88.5	5400	145	6000	161	6000	161				
60	4.1	2600	69.7	4600	123	5800	156	6000	161						
100	6.9	4100	110	5800	156	5800	156								
125	8.6	4100	110	5800	156										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY + / - 20%		SET RANGE	SPRING COLOR
5 psig	-1 psig	1 psig	2 to 5.5 psig	Yellow
345 mbar	-69 mbar	69 mbar	138 to 380 mbar	

Table 15. Type CS400 Internal Registration Flow Capacities for 5 psig / 345 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
psig	bar	Body Size: NPS 1-1/4													
10	0.69	720	19.3	1200	32.2	1700	45.6	2200	59.0	3000	80.5	3900	105	4700	126
20	1.4	1100	29.5	2000	53.6	3000	80.5	4000	107	6000	161	6500	174	7000	188
40	2.8	1900	51.0	3400	91.2	5500	148	6500	174	6500	174				
60	4.1	2600	69.7	4600	123	6500	174	6500	174						
100	6.9	4000	107	5700	153	6500	174								
125	8.6	4200	113	5700	153										
psig	bar	Body Size: NPS 1-1/2													
10	0.69	750	20.1	1200	32.2	1600	42.9	2300	61.7	2900	77.8	3900	105	4400	118
20	1.4	1100	29.5	2000	53.6	2800	75.1	4000	107	5900	158	6600	177	7200	193
40	2.8	1900	51.0	3300	88.5	5200	140	6500	174	6500	174				
60	4.1	2600	69.7	4500	121	6200	166	6500	174						
100	6.9	4100	110	5700	153	6200	166								
125	8.6	4500	121	5700	153										
psig	bar	Body Size: NPS 2													
10	0.69	720	19.3	1200	32.2	1500	40.2	2200	59.0	3000	80.5	3800	102	4700	126
20	1.4	1100	29.5	2000	53.6	2900	77.8	3900	105	5200	140	6800	183	7200	193
40	2.8	1900	51.0	3200	85.9	5000	134	6500	174	6500	174				
60	4.1	2600	69.7	4300	115	6200	166	6500	174						
100	6.9	4000	107	5900	158	6200	166								
125	8.6	4900	132	5900	158										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY Droop	ACCURACY Boost	SET RANGE	SPRING COLOR
7 in. w.c.	-1 in. w.c.	2 in. w.c.	6 to 8 in. w.c.	Gold
17 mbar	-2 mbar	5 mbar	15 to 20 mbar	

Table 16. Type CS400 External Registration Flow Capacities for 7 in. w.c. / 17 mbar Setpoint

CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
psig	bar	Body Size: NPS 1-1/4, 1-1/2 and 2													
0.5	0.03	140	3.7	200	5.3	230	6.1	280	7.5	360	9.6	410	11.0	430	11.5
2	0.14	210	5.6	350	9.3	360	9.6	360	9.6	360	9.6	910	24.4	980	26.3
5	0.34	210	5.6	590	15.8	610	16.3	870	23.3	1120	30.0	1360	36.5	1920	51.5
15	1.0	210	5.6	1060	28.4	1150	30.8	1440	38.6	1720	46.1	2100	56.3	2700	72.4
30	2.1	1230	33.0	1450	38.9	1700	45.6	1800	48.3	1880	50.4	2600	69.7		
50	3.4	1450	38.9	1450	38.9	1860	49.9	2000	53.6						
80	5.5	1450	38.9	1450	38.9	2500	67.1								
125	8.6	1450	38.9	1450	38.9										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY Droop	ACCURACY Boost	SET RANGE	SPRING COLOR
11 in. w.c.	-2 in. w.c.	2 in. w.c.	7.5 to 11 in. w.c.	Blue
27 mbar	-5 mbar	5 mbar	19 to 27 mbar	

Table 17. Type CS400 External Registration Flow Capacities for 11 in. w.c. / 27 mbar Setpoint

CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
psig	bar	Body Size: NPS 1-1/4, 1-1/2 and 2													
0.5	0.03	130	3.4	170	4.5	240	6.4	290	7.7	350	9.3	350	9.3	350	9.3
2	0.14	280	7.5	470	12.6	600	16.1	840	22.5	1050	28.1	1330	35.7	1530	41.0
5	0.34	500	13.4	810	21.7	1380	37.0	1900	51.0	1950	52.3	2000	53.6	2400	64.4
15	1.0	840	22.5	1790	48.0	1960	52.6	2700	72.4	3500	93.9	4900	132	6600	177
30	2.1	1500	40.2	2400	64.4	3300	88.5	5100	137	7900	212	10,700	287		
50	3.4	2200	59.0	3900	105	5700	153	8200	220						
80	5.5	3300	88.5	6000	161	7000	188								
125	8.6	4700	126	8600	231										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY: Droop	ACCURACY: Boost	SET RANGE	SPRING COLOR
14 in. w.c.	-2 in. w.c.	2 in. w.c.	10 to 14 in. w.c.	Unpainted
35 mbar	-5 mbar	5 mbar	25 to 35 mbar	

Table 18. Type CS400 External Registration Flow Capacities for 14 in. w.c. / 35 mbar Setpoint

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4, 1-1/2 and 2													
1	0.07	170	4.5	260	6.9	370	9.9	490	13.1	610	16.3	820	22.0	840	22.5
3	0.21	350	9.3	570	15.3	750	20.1	970	26.0	1610	43.2	1650	44.2	1730	46.4
10	0.69	760	20.4	1380	37.0	1670	44.8	2100	56.3	2600	69.7	3500	93.9	3900	105
20	1.4	1170	31.4	1760	47.2	2300	61.7	3200	85.9	4200	113	6100	164	6500	174
40	2.8	1830	49.1	3200	85.9	4000	107	5900	158	10,900	293				
60	4.1	2500	67.1	4500	121	6200	166	8700	234						
100	6.9	4000	107	6700	180	11,200	301								
125	8.6	4600	123	8100	217										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY +/- 20%		SET RANGE	SPRING COLOR
1 psig	-0.2 psi	0.2 psi	18 in. w.c. to 1 psig	Orange
69 mbar	-14 mbar	14 mbar	45 to 69 mbar	

Table 19. Type CS400 External Registration Flow Capacities for 1 psig / 69 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4, 1-1/2 and 2													
2	0.14	270	7.2	360	9.6	430	11.5	430	11.5	430	11.5	430	11.5	430	11.5
5	0.34	410	11.0	410	11.0	840	22.5	1070	28.7	1330	35.7	1780	47.7	1790	48.0
15	1.0	490	13.1	1250	33.5	1670	44.8	2100	56.3	2800	75.1	3500	93.9	3700	99.3
30	2.1	1490	40.0	1940	52.0	2600	69.7	3300	88.5	4400	118	5400	145		
50	3.4	2100	56.3	2300	61.7	3900	105	4900	132						
80	5.5	3100	83.2	3300	88.5	5400	145								
125	8.6	4500	121	4500	121										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY +/- 20%		SET RANGE	SPRING COLOR
2 psig	-0.4 psi	0.4 psi	1 to 2 psig	Black
138 mbar	-28 mbar	28 mbar	69 to 138 mbar	

Table 20. Type CS400 External Registration Flow Capacities for 2 psig / 138 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4, 1-1/2 and 2													
3	0.21	330	8.8	540	14.4	720	19.3	990	26.5	1360	36.5	2200	59.0	2600	69.7
10	0.69	790	21.2	1270	34.0	1960	52.6	2500	67.1	3400	91.2	4200	113	5400	145
20	1.4	1180	31.6	2100	56.3	2800	75.1	3900	105	5800	156	7000	188	8000	215
40	2.8	1900	51.0	3300	88.5	5000	134	6900	185	9800	263				
60	4.1	2600	69.7	4500	121	6800	183	9600	258						
100	6.9	3900	105	7000	188	10,500	282								
125	8.6	4900	132	8700	234										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY + / - 20%		SET RANGE	SPRING COLOR
5 psig	-1 psig	1 psig	2 to 5.5 psig	Black
345 mbar	-69 mbar	69 mbar	138 to 380 mbar	

Table 21. Type CS400 External Registration Flow Capacities for 5 psig / 345 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4, 1-1/2 and 2													
10	0.69	670	17.9	1320	35.4	1600	42.9	1700	45.6	3000	80.5	3600	97	4200	113
20	1.4	1160	31.1	2000	53.6	2900	77.8	3700	99.3	5300	142	7000	188	8200	220
40	2.8	1860	49.9	3300	88.5	4800	129	6700	180	9000	242				
60	4.1	2500	67.1	4300	115	7000	188	9600	258						
100	6.9	3900	105	6600	177	10,200	274								
125	8.6	4900	132	8800	236										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY Droop	ACCURACY Boost	SET RANGE	SPRING COLOR
7 in. w.c.	-1 in. w.c.	2 in. w.c.	6 to 8 in. w.c.	Gold
17 mbar	-2 mbar	5 mbar	15 to 20 mbar	

Table 22. Types CS403 and CS404 Internal Registration Flow Capacities for 7 in. w.c. / 17 mbar Setpoint

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4													
0.5	0.03	80	2.1	160	4.3	210	5.6	250	67	520	13.9	420	11.3	410	11.0
2	0.14	280	7.5	350	9.4	480	12.9	590	15.8	830	22.2	1050	28.1	1210	32.4
5	0.34	420	11.3	660	17.7	960	25.7	1180	31.6	2070	55.5	2460	65.9	2730	73.2
15	1.0	970	26.0	1800	48.2	2700	72.4	3580	95.9	5130	138	3910	105	6700	180
30	2.1	1530	41.0	2780	74.5	4450	119	2410	64.6	2260	60.6	2280	61.1		
50	3.4	2260	60.6	2800	75.0	2690	72.1	2080	55.7						
80	5.5	2400	64.3	2590	69.4	2590	69.4								
125	8.6	2540	68.1	2590	69.4										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
Gray areas indicate limited capacities due to boost effects.

SETPOINT	ACCURACY + / - 20%		SET RANGE	SPRING COLOR
1 psig	-0.2 psig	0.2 psig	18 in. w.c. to 1 psig	Orange
69 mbar	-14 bar	14 mbar	45 to 69 mbar	

Table 23. Types CS403 and CS404 Internal Registration Flow Capacities for 1 psig / 69 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm													
		3/16	4.8	1/4	6.4	5/16	7.9	3/8	9.5	1/2	13	5/8	16	3/4	19
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: NPS 1-1/4													
2	0.14	220	5.9	370	9.9	700	18.8	560	15.0	760	20.4	840	22.5	960	25.7
5	0.34	450	12.1	640	17.2	1350	36.2	1080	28.9	1460	39.1	1860	49.8	2270	60.8
15	1.0	950	25.5	1460	39.1	2750	73.7	2530	67.8	3630	97.3	4980	134	5800	155
30	2.1	1530	41.0	2680	71.8	4470	120	4710	126	7650	205	9180	246		
50	3.4	2250	60.3	4000	107	6680	179	8530	229						
80	5.5	3360	90.0	5980	160	9900	265								
125	8.6	3890	104	7840	210										

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
Gray areas indicate limited capacities due to boost effects.

Introduction

The CS800 Series direct-operated, spring-loaded regulators have been engineered to fit a multitude of commercial and industrial pressure-reducing applications. This flexibility is provided by the numerous body sizes and end connections, outlet pressure settings orifice sizes, as well as the option for internal or external pressure registration.

Body Sizes, End Connection Styles and Pressure Rating

See Table 2

Flow Capacities

See Tables 10 to 31

Flow and Sizing Coefficients

See Table 8

Maximum Inlet Pressure

Emergency: 175 psig / 12.1 bar
Operating: See Table 8

Maximum Outlet Pressure

Emergency (Casing):
15 psig / 1.0 bar
To Avoid Internal Parts Damage:
3 psig / 0.21 bar differential above outlet pressure setting

Outlet Pressure Ranges

3.5 in. w.c. to 10 psig /
9 mbar to 0.69 bar
See Table 4

Spring Case Vent Connection

Internal Relief: 1 NPT
High Capacity Relief: 2-1/2 NPT

Pressure Registration

Internal or External

Temperature Capabilities

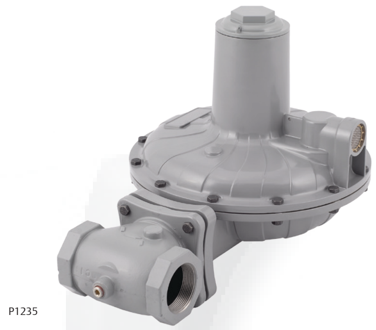
-20 to 150°F / -29 to 66°C

Approximate Weights

With Threaded Body
Type CS800/CS820: 25 lbs / 11 kg
Type CS803/CS823: 34 lbs / 16 kg
Type CS804/CS824: 31 lbs / 14 kg
Type CS805/CS825: 26 lbs / 12 kg
Type CS806/CS826: 26 lbs / 12 kg
High-Pressure Types
For CS85x add 2 lbs / 0.91 kg to types listed with threaded body
With Flanged Body
Add 11 lbs / 5.0 kg to weights listed above

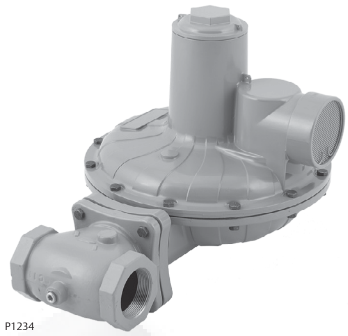
Ordering Guide

To order this product, contact your local Sales Office.



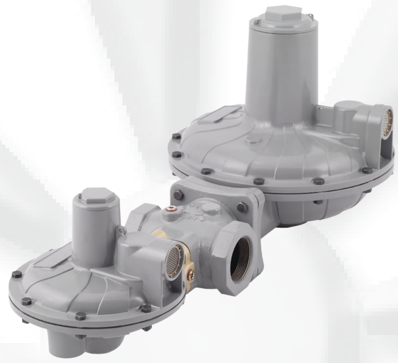
P1235

Figure 1. *Type CS800 Regulator*



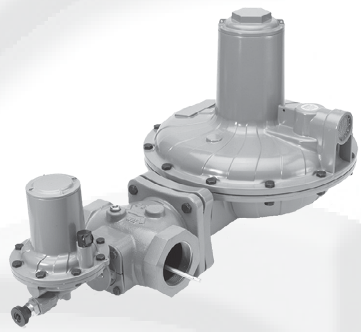
P1234

Figure 2. *Type CS800IQ with High Capacity Relief*



P1521

Figure 3. *Type CS803 Regulator with True-Monitor™ Protection*



P1692

Figure 4. *Type CS804IT Regulator with Integral Type VSX8 Slam-shut Module*

Features

- **Flow Optimized Disks Provide the Maximum Flow for Your Application**
- **Wide Variety of Body Sizes and End Connections**
- **Fixed Factor / Pressure Factor Measurement (PFM) Accuracy Capabilities**
- **Only Standard Tools Required for Pressure Adjustment and Orifice Removal**
- **Simplified Maintenance**

Application

Fuel Gas

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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11/14

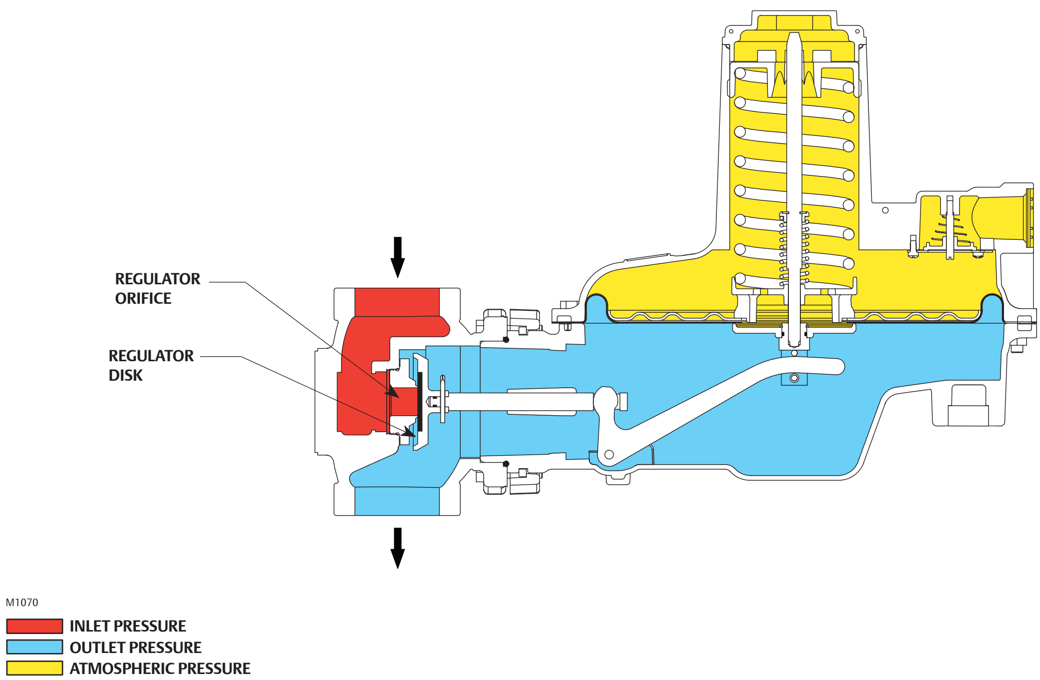

Figure 5. *Type CS800IR Internally Registered Regulator with Internal Relief Operational Schematic*

Table 1. Available Configuration

TYPE NUMBER							OPTION
C	S	8					
							OUTLET PRESSURE CONSTRUCTION
			0				Low Pressure Applications (Outlet Pressure: 3.5 to 30 in. w.c. / 9 to 75 mbar)
			2				Medium Pressure Applications (Outlet Pressure: 1 to 5.5 psig / 69 mbar to 0.38 bar)
			5				High Pressure Applications (Outlet Pressure: 5 to 10 psig / 0.34 to 0.69 bar)(1)
							OVERPRESSURE PROTECTION MODULE
				0			Without Overpressure Protection Module
				3			With Integral True-Monitor Module(4)
				4			With Slam-shut Module(4)
				5			With Secondary Seat™ Protection
				6			With Secondary Seat Protection with controlled bleed to indicate Secondary Seat is functioning(2)
							PRESSURE REGISTRATION
					I		Internal Registration
					E		External Registration(3)
							RELIEF
						N	Non-Relieving
						R	Internal Relief
						Q	High-Capacity Relief
						T	Token Relief
						L	Low Flow Token Relief

Example: Type Number CS800IR: Type CS800 regulator without Overpressure Protection Module with Internal Pressure Registration and with Internal Relief.
1. High-pressure Construction is not available with True-Monitor Protection, Secondary Seat Protection or Relief.
2. Available only with Internal Relief or High-Capacity Relief Constructions.
3. Available only with Non-Relieving or Token Relief Constructions.
4. Reference Instruction Manual D103126X012 for information regarding the Type TM600 Integral True-Monitor or Instruction Manual D103127X012 for Type VSX8 safety Slam-shut module.

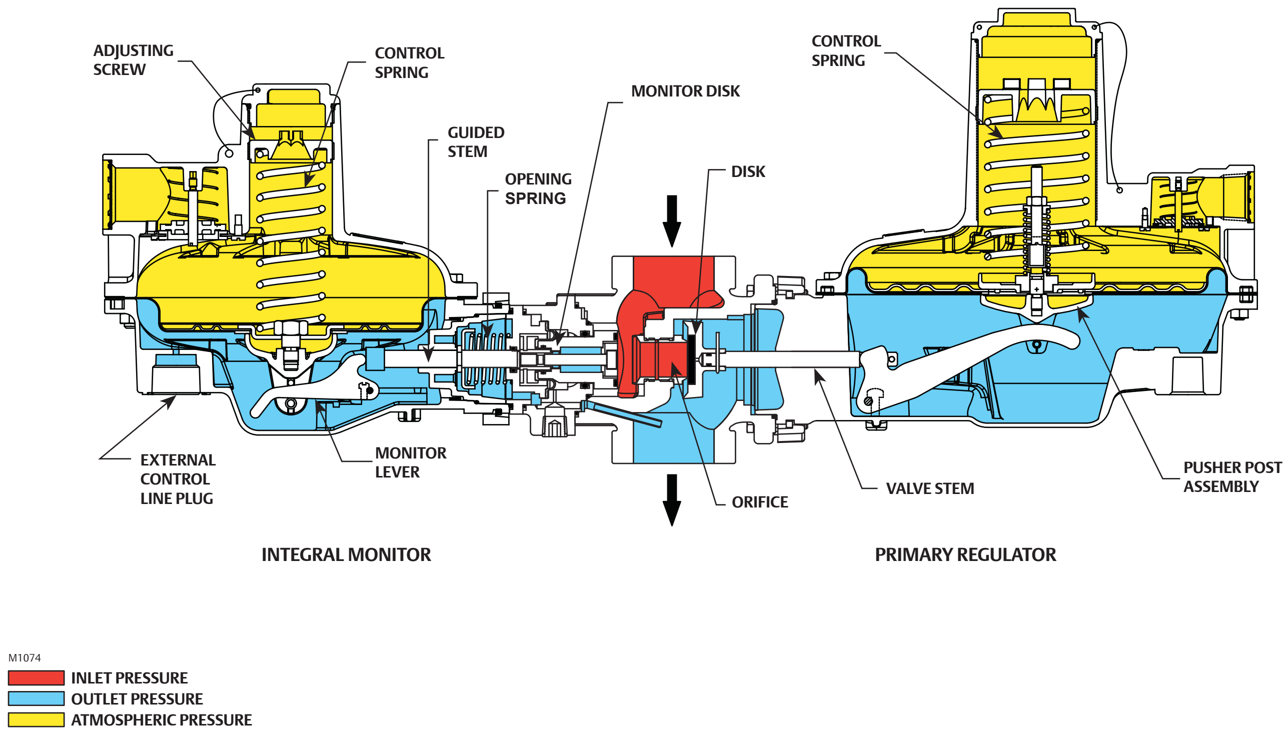

Figure 6. *Type CS803IT Internally Registered Primary Regulator with Internally Registered Integral Monitor Operational Schematic*

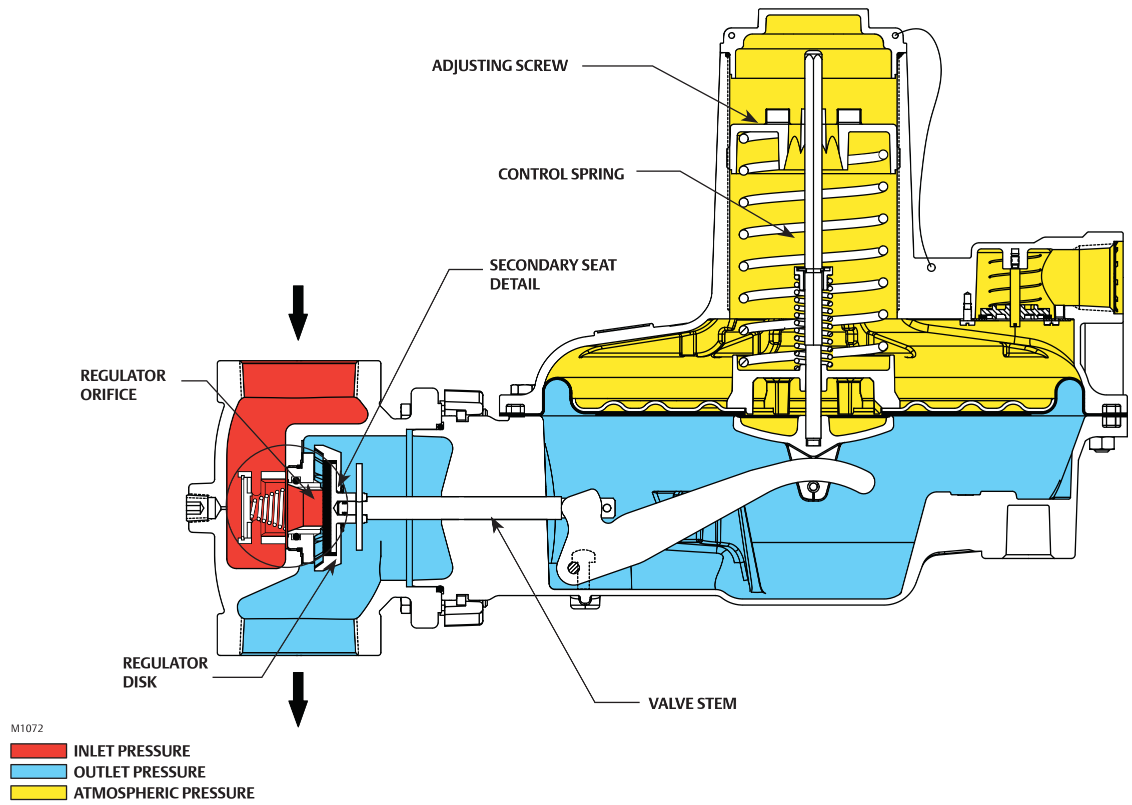

Figure 7. *CS800 Series with Secondary Seat™ Protection*

Table 2. Body Sizes, Materials, End Connections and Maximum Cold Working Pressure Ratings[5]

TYPE	BODY MATERIAL	END CONNECTION	BODY SIZE		FACE-TO-FACE DIMENSION		BODY INLET PRESSURE RATING	
			In.	DN	In.	mm	psig	bar
CS800, CS805, CS806, CS820, CS825, CS826 and CS850	Gray Cast Iron	NPT	1-1/4	----	6.12	155	175	12.1
			1-1/2	----	6.12	155		
			2[1]	----	6.12	155		
			2	----	6.12	155		
		CL125 FF	2	50	7.5	191	175	12.1
			2	50	10	254		
CS800[3], CS820[3], CS850[3], CS803, CS823, CS804, CS824 and CS854	Gray Cast Iron	NPT	2[2]	----	6.12	155	175	12.1
	Ductile Iron	NPT	1-1/4[4]	----	6.12	155	250	17.2
			1-1/2	----	6.12	155		
			2	----	6.12	155		
		Rp	2	----	6.12	155	250	17.2
		CL125 FF / CL150 FF	2	50	7.5[4]	191[4]	250	17.2
			2	50	10	254		
			2	50	10.5	267		
		PN 10/16	2	50	7.5[4]	191[4]	232	16
			2	50	10	254		
	WCC Steel	NPT	1-1/4[4]	----	6.12	155	290	20
			1-1/2	----	6.12	155		
			2	----	6.12	155		
		Rp	2	----	6.12	155	290	20
		CL150 RF	2	50	10	254	290	20
		PN 10/16	2	50	10	254	232	16

1. Standard on Types CS800, CS820 and CS850.
2. Standard on Types CS803, CS804, CS823, CS824 and CS854.
3. If a ductile iron or steel body material is selected without an Integral True-Monitor™ or Slam-shut Overpressure Protection (OPP) device, the port located at the bottom of the body will receive an aluminum plug.
4. Not available on Types CS804, CS824 and CS854.
5. The pressure/temperature limits in this Datasheet or any applicable standard or code limitation should not be exceeded.

Table 3. CS800 Series Main Valve and Actuator Construction Material

BODY	LEVER PIN AND RELIEF VALVE SPRING	DIAPHRAGM, DISK AND BODY O-RING	CLOSING CAP, ADJUSTING SCREW, PUSHER POST, UPPER AND LOWER CASE	LEVER
Gray Cast iron, Ductile iron or WCC steel	Stainless steel	Nitrile (NBR)	Aluminum	Plated steel

Table 4. Outlet Pressure Range

TYPE	OUTLET PRESSURE RANGE		SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	In. w.c.	mbar		In.	mm	In.	mm
CS800, CS803, CS804, CS805 AND CS806	3.5 to 6[1]	9 to 15[1]	Red	0.15	3.8	6.8	173
	5.5 to 8.5	13 to 21	Black	0.17	4.3	6.8	173
	5.5 to 8.5	13 to 21	Brown [Use with Low Inlet (LIN) Option]	0.16	4.1	8.3	211
	8 to 12	20 to 30	Purple	0.17	4.3	7.4	188
	10 to 16	25 to 40	White	0.18	4.6	7.4	188
	14 to 30	35 to 75	Dark Green	0.2	5.2	7.5	191
CS820, CS823, CS824, CS825 and CS826	1 to 2.5 psig	70 to 170	Dark Blue	0.25	6.4	7.5	191
	1.5 to 3.5 psig	100 to 240	Orange	0.26	6.6	7.1	180
	2.5 to 5.5 psig	170 to 380	Yellow	0.29	7.5	6.7	170
CS850	5 to 10 psig	345 to 690	Green with White Stripe	0.39	9.9	7.6	192

1. In order to achieve the complete spring range listed, in some applications it may be required to re-orient the actuator/spring case to point downward to utilize the weight of the internal components.

Table 5. Secondary Seat™ Outlet Pressure

CONTROL SPRING	SPRING RANGE		SETPOINT		TYPES CS805 AND CS825				TYPES CS806 AND CS826			
					Secondary Seat Shutoff Pressure[2]				Downstream Build-up Pressure[1][2][3]			
					Orifice Size							
					In.	mm	In.	mm	In.	mm	In.	mm
					Up to 1/2	Up to 13	Up to 7/8	Up to 22	Up to 1/2	Up to 13	Up to 7/8	Up to 22
Color	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar
Black	5.5 to 8.5	13 to 21	7	17	11	27	12	30	25	62	23	57
Brown (LIN)	5.5 to 8.5	13 to 21	7	17	11	27	12	30	25	62	23	57
White	10 to 16	25 to 40	14	35	19	47	20	50	36	89	33	81
Dark Green	14 to 30	35 to 75	1 psig	69	1.2 psig	83	1.3 psig	90	2.1 psig	145	2 psig	138
Dark Blue	1 to 2.5 psig	69 to 170	2 psig	140	2.6 psig	179	2.6 psig	179	3.8 psig	262	3.7 psig	255
Yellow	2.5 to 5.5 psig	170 to 380	5 psig	345	6.3 psig	434	6.3 psig	434	7.4 psig	510	8.2 psig	565

1. Downstream pressure buildup with Secondary Seat fixed bleed in operation and regulator relief valve relieving to atmosphere.
2. Outlet pressure values listed are at maximum operating inlet pressure rating per orifice.
3. If the outlet pressure rises above setpoint exceeding the pressure rating of the regulator, the internal parts must be inspected and replaced if damaged.

Table 6. Types CS803 and CS823 Regulator and Integral True-Monitor™ Outlet Pressure Ranges without Token Relief

type	PRIMARY REGULATOR					INTEGRAL TRUE MONITOR				
	Setpoint		Spring Range		Spring Color	Setpoint		Spring Range		Spring Color
	In. w.c.	mbar	In. w.c.	mbar		In. w.c.	mbar	In. w.c.	mbar	
CS803IN and CS803EN	4	10	3.5 to 6	9 to 15	Red	14	35	12 to 21	30 to 52	Blue
						21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
	7	17	5.5 to 8.5	13 to 21	Black	14	35	12 to 21	30 to 52	Blue
						21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
	7	17	5.5 to 8.5	13 to 21	Brown (LIN)	14	35	12 to 21	30 to 52	Blue
						21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
	11	27	8 to 12	20 to 30	Purple	21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
						1.5 psig	103	1.4 to 2.9 psig	97 to 200	Black
	14	35	10 to 16	25 to 40	White	21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
						1.5 psig	103	1.4 to 2.9 psig	97 to 200	Black
	1 psig	69	14 to 30	35 to 75	Dark Green	1.5 psig	103			
						2 psig	138	1.4 to 2.9 psig	97 to 200	Black
						3.5 psig	241	2.6 to 3.7 psig	179 to 255	Purple
CS823IN and CS823EN	2 psig	138	1 to 2.5 psig	70 to 170	Dark Blue	2.5 psig	172	1.4 to 2.9 psig	97 to 200	Black
						3 psig	207	2.6 to 3.7 psig	179 to 255	Purple
						5 psig	345	3.6 to 6 psig	248 to 414	Dark Blue
	3 psig	207	1.5 to 3.5 psig	100 to 240	Orange	3.5 psig	241	2.6 to 3.7 psig	179 to 255	Purple
						4 psig	276	3.6 to 6 psig	248 to 414	Dark Blue
						6 psig	414	5.1 to 7.5 psig	352 to 517	Red
	5 psig	345	2.5 to 5.5 psig	170 to 380	Yellow	6 psig	414			
						7 psig	483			
						7.5 psig	517			

Table 7. Types CS803 and CS823 Regulator and Integral True-Monitor Outlet Pressure Range with Token Relief

type	PRIMARY REGULATOR					INTEGRAL TRUE MONITOR				
	Setpoint		Spring Range		Spring Color	Setpoint		Spring Range		Spring Color
	In. w.c.	mbar	In. w.c.	mbar		In. w.c.	mbar	In. w.c.	mbar	
CS803IT and CS803ET	4	10	3.5 to 6	9 to 15	Red	21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
	7	17	5.5 to 8.5	13 to 21	Black	21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
	7	17	5.5 to 8.5	13 to 21	Brown (LIN)	21	52	18 to 30	45 to 75	Green
						1 psig	69	26 to 40	65 to 99	Orange
	11	27	8 to 12	20 to 30	Purple	1 psig	69	26 to 40	65 to 99	Orange
						1.5 psig	103	1.4 to 2.9 psig	97 to 200	Black
	14	35	10 to 16	25 to 40	White	1 psig	69	26 to 40	65 to 99	Orange
						1.5 psig	103	1.4 to 2.9 psig	97 to 200	Black
	1 psig	69	14 to 30	35 to 75	Dark Green	2 psig	138	1.4 to 2.9 psig	97 to 200	Black
						3 psig	207	2.6 to 3.7 psig	179 to 255	Purple
CS823IT and CS823ET	2 psig	138	1 to 2.5 psig	70 to 170	Dark Blue	3 psig	207	2.6 to 3.7 psig	179 to 255	Purple
						4 psig	276	3.6 to 6 psig	248 to 414	Dark Blue
	3 psig	207	1.5 to 3.5 psig	100 to 240	Orange	5 psig	345	3.6 to 6 psig	248 to 414	Dark Blue
						6 psig	414	5.1 to 7.5 psig	352 to 517	Red
	5 psig	345	2.5 to 5.5 psig	170 to 380	Yellow	7 psig	483	5.1 to 7.5 psig	352 to 517	Red
						7.5 psig	517	5.1 to 7.5 psig	352 to 517	Red

Table 8. Inlet Pressure Rating and Flow and Sizing Coefficient

ORIFICE SIZE		MAXIMUM OPERATING INLET PRESSURE TO OBTAIN OPTIMUM PERFORMANCE				MAXIMUM EMERGENCY INLET PRESSURE		WIDE-OPEN FLOW COEFFICIENT			IEC SIZING COEFFICIENT		
		psig Setpoint		In. w.c. Setpoint									
In.	mm	psig	bar	psig	bar	psig	bar	C_g	C_v	C_1	X_T	F_L	F_D
1/4[1]	6.4[1]	125	8.6	125	8.6	175	12.1	50	2.1	24.6	0.38	0.89	0.99
3/8	9.5	125	8.6	125	8.6	175	12.1	110	3.8	29.5	0.55	0.89	0.90
1/2	13	100	6.9	100	6.9	175	12.1	210	7.2	29.5	0.55	0.89	0.93
5/8	16	80	6.5	60	4.1	175	12.1	320	10.1	31.8	0.64	0.89	0.88
3/4	19	80	6.5	60	4.1	175	12.1	450	13.3	34	0.73	0.89	0.84
7/8	22	60	4.1	50	3.4	175	12.1	600	16.7	36	0.82	0.89	0.81
1[1]	25[1]	30	2.1	25	1.7	175	12.1	765	20.1	38.1	0.92	0.89	0.77
1-3/8[1][2]	35[1][2]	15	1.0	15	1.0	175	12.1	1125	29.8	37.7	0.90	0.89	0.76

1. Not available on the Types CS805, CS806, CS825 and CS826.
2. Not available on the Types CS803 and CS823.

Table 9. Approximate Internal Relief Valve Start-to-Discharge Pressure Above Setpoint

CONTROL SPRING COLOR	SET RANGE		SETPOINT		INTERNAL RELIEF AND HIGH CAPACITY RELIEF				TOKEN RELIEF	
					Start-to-Discharge Pressure Range above Setpoint		Low Start-to-Discharge Option(1) Start-to-Discharge Pressure Range above Setpoint		Start-to-Discharge Pressure Range above Setpoint	
	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar
Red	3.5 to 6	9 to 15	4	10	11 to 18	27 to 42	7 to 14	17 to 35	6 to 14	15 to 35
Black	5.5 to 8.5	13 to 21	7	17	11 to 18	27 to 42	7 to 14	17 to 35	6 to 14	15 to 35
Brown (LIN)	5.5 to 8.5	13 to 21	7	17	11 to 18	27 to 42	7 to 14	17 to 35	6 to 14	15 to 35
Purple	8 to 12	20 to 30	11	27	11 to 18	27 to 42	7 to 14	17 to 35	6 to 14	15 to 35
White	10 to 16	25 to 40	14	35	11 to 18	27 to 42	7 to 14	17 to 35	6 to 14	15 to 35
Dark Green	14 to 30	35 to 75	1 psig	69	7 in. w.c. to 1 psig	17 to 69	----	----	8 to 16	20 to 40
Dark Blue	1 to 2.5 psig	70 to 170	2 psig	138	7 in. w.c. to 2 psig	17 to 138	----	----	7 in. w.c. to 1 psig	17 to 69
Orange	1.5 to 3.5 psig	100 to 240	3 psig	207	7 in. w.c. to 2 psig	17 to 138	----	----	0.5 to 1.5 psig	35 to 100
Yellow	2.5 to 5.5 psig	170 to 380	5 psig	345	7 in. w.c. to 2.5 psig	17 to 170	----	----	1 to 2 psig	69 to 138

1. Low start-to-discharge option is only available on the main control spring ranges up to 10 to 16 in. w.c. / 25 to 40 mbar.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
4 in. w.c.	-1 in. w.c.	2 in. w.c.	3.5 to 6 in. w.c.	Red
10 mbar	-2.5 mbar	5 mbar	9 to 15 mbar	

Table 10. Types CS800, CS803 and CS804 Internal Registration Flow Capacities for 4 in. w.c. / 10 mbar Setpoint for 1-1/2 In. / DN 40 Body Size

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35(1)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40															
0.4	0.03			300	8.1	300	8.1	300	8.1	1000	26.8	1400	37.6	1400	37.6	1600	43.0
1	0.07	400	10.7	800	21.5	1200	32.2	1540	41.3	2100	56.4	2300	61.7	2500	67.1	2700	72.5
3	0.21	780	20.9	1600	43.0	2470	66.3	2860	76.8	3360	90.2	3620	97.2	4100	110	4190	113
10	0.69	1370	36.8	2900	77.9	4750	128	5200	140	5650	152	5650	152	5650	152	5930	159
20	1.4	2070	55.6	4300	115	6620	178	7250	195	7250	195	7400	199	7500	201		
30	2.1	2860	76.8	5010	135	7050	189	7250	195	7250	195	7500	201				
50	3.4	4120	111	5070	136	7050	189	7250	195	7250	195	7500	201				
80	5.5	5700	153	6200	166	7170	193										
125	8.6	6950	187	8300	223												

- Black areas show where indicated droop/boost would be exceeded regardless of capacity.
- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
4 in. w.c.	-1 in. w.c.	2 in. w.c.	3.5 to 6 in. w.c.	Red
10 mbar	-2.5 mbar	5 mbar	9 to 15 mbar	

Table 11. Types CS800, CS803 and CS804 Internal Registration Flow Capacities for 4 in. w.c. / 10 mbar Setpoint for 2 In. / DN 50 Body Size

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35(1)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 2 in. / DN 50															
0.4	0.03			300	8.1	300	8.1	300	8.1	1170	31.4	1400	37.6	1600	43.0	1800	48.3
1	0.07	400	10.7	900	24.2	1300	34.9	1760	47.2	1950	52.3	3000	80.5	2710	72.8	3800	102
3	0.21	730	19.6	1530	41.1	2580	69.3	3540	95.0	4980	134	6200	166	6830	183	8010	215
10	0.69	1320	35.4	3000	80.5	5100	137	7450	200	10,400	279	10,900	293	11,750	315	12,580	338
20	1.4	2020	54.2	4450	120	7850	211	10,150	273	13,000	349	13,200	354	16,000	430		
30	2.1	2720	73.0	5560	149	9460	254	10,980	295	13,400	360	13,560	364				
50	3.4	4000	107	7000	188	10,500	282	11,300	303	15,000	403	12,510	336				
80	5.5	4970	133	9250	248	12,850	345										
125	8.6	7250	195	9500	255												

- Black areas show where indicated droop/boost would be exceeded regardless of capacity.
- Gray areas indicate limited capacities due to boost effects.
- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on the Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
7 in. w.c.	-1 in. w.c.	2 in. w.c.	5.5 to 8.5 in. w.c.	Black
17 mbar	-2.5 mbar	5 mbar	13 to 21 mbar	

Table 12. Types CS800, CS803 and CS804 Internal Registration Flow Capacities for 7 in. w.c. / 17 mbar Setpoint for 1-1/2 In. / DN 40 Body Size

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35(1)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40															
0.4	0.03			430	11.5	740	19.9	550	14.8	800	21.5	800	21.5	1060	28.5	1420	38.1
1	0.07	570	15.3	770	20.7	1140	30.6	1360	36.5	1510	40.5	1830	49.1	1960	52.6	2640	70.9
3	0.21	990	26.6	1230	33.0	1960	52.6	2380	63.9	2810	75.4	3310	88.9	3680	98.8	4380	118
10	0.69	1600	43.0	3160	84.8	4900	132	5130	138	5950	160	6270	168	6650	179	7200	193
20	1.4	2330	62.6	4910	132	7300	196	7130	191	7770	209	7770	209	8010	215		
30	2.1	2990	80.3	6370	171	8310	223	8140	219	8560	230	8560	230				
50	3.4	4320	116	9010	242	9010	242	8880	238	9000	242	9210	247				
80	5.5	6290	169	9620	258	9620	258										
125	8.6	7820	210	9600	258												

- Black areas show where indicated droop/boost would be exceeded regardless of capacity.
- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

1. Not available on Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
7 in. w.c.	-1 in. w.c.	2 in. w.c.	5.5 to 8.5 in. w.c.	Black
17 mbar	-2.5 mbar	5 mbar	13 to 21 mbar	

Table 13. Types CS800(1), CS803(2) and CS804(2) Internal Registration Flow Capacities for 7 in. w.c. / 17 mbar Setpoint for 2 In. / DN 50 Body Size

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25(1)(2)		1-3/8 / 35(3)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 2 in. / DN 50															
5	0.34	1120	30.1	1120	30.1	2600	69.8	3670	98.5	4630	124	8130	218	9590	257	5510	148
15	1.0	1870	50.2	3130	84.0	7760	208	12,000	322	16,170	434	16,630	446	20,380	547	7650	205
25	1.7	2500	67.1	5530	149	10,510	282	15,920	427	20,180	542	17,370	466	22,860	614		
40	2.8	3590	96.4	7850	211	14,100	379	22,910	615	25,910	696	16,180	434				
60	4.1	4910	132	10,810	290	19,390	521	24,360	654	19,730	530						
100	6.9	7440	200	16,630	446	25,530	685										
125	8.6	8730	234	20,320	546												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
- Gray areas indicate limited capacities due to boost effects.

1. Type CS800 with Ductile iron or Steel Bodies exhibit a 20% reduction in capacity for indicated orifice size. Multiply listed values by a factor of 0.8.
2. Types CS803 and CS804 exhibit a 30% reduction in capacity for indicated orifice size. Multiply listed values by a factor of 0.7.
3. Not available on the Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
14 in. w.c.	-2 in. w.c.	2 in. w.c.	10 to 16 in. w.c.	White
35 mbar	-5 mbar	5 mbar	25 to 40 mbar	

Table 14. Types CS800, CS803 and CS804 Internal Registration Flow Capacities for 14 in. w.c. / 35 mbar Setpoint for 1-1/2 In. / DN 40 Body Size

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35(1)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40															
1	0.07	450	12.1	670	18.0	1000	26.8	1100	29.5	1250	33.6	1400	37.6	1500	40.3	1950	52.3
3	0.21	700	18.8	1160	31.1	1610	43.2	1900	51.0	2160	58.0	2500	67.1	2960	79.5	3250	87.2
10	0.69	1370	36.8	2120	56.9	3150	84.6	3800	102	4550	122	5100	137	5800	156	6300	169
20	1.4	2120	56.9	3900	105	4950	133	6000	161	7250	195	7600	204	8000	215		
30	2.1	2820	75.7	5420	146	6260	168	7500	201	8960	241	8960	241				
50	3.4	4100	110	8100	217	8720	234	9300	250	9870	265	9870	265				
80	5.5	6100	164	9920	266	10,270	276										
125	8.6	9050	243	10,400	279												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

1. Not available on Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
14 In. w.c.	-2 In. w.c.	2 In. w.c.	10 to 16 In. w.c.	White
35 mbar	-5 mbar	5 mbar	25 to 40 mbar	

Table 15. Types CS800, CS803 and CS804 Series Internal Registration Flow Capacities for 14 in. w.c. / 35 mbar Setpoint for 2 In. / DN 50 Body Size

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, in. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35[1]	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 2 in. / DN 50															
1	0.07	450	12.1	630	16.9	770	20.7	1300	34.9	1500	40.3	1600	43.0	1700	45.6	2700	72.5
3	0.21	750	20.1	1210	32.5	2200	59.1	2700	72.5	3200	85.9	3700	99.3	4300	115	6060	163
10	0.69	1400	37.6	2720	73.0	4250	114	6500	175	9200	247	10,300	277	11,650	313	14,550	391
20	1.4	2170	58.3	4700	126	7950	213	11,700	314	16,200	435	18,800	504	20,290	544		
30	2.1	2910	78.1	6440	173	10,310	277	12,400	333	18,220	489	21,400	574				
50	3.4	4170	112	9190	247	10,770	289	14,500	389	19,140	513	21,400	574				
80	5.5	6100	164	12,550	337	12,550	337										
125	8.6	9100	244	16,120	433												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on Type CS803.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
1 psig	-5.5 in. w.c.	5.5 in. w.c.	14 to 30 in. w.c.	Dark Green
0.07 bar	-14 mbar	14 mbar	35 to 75 mbar	

Table 16. Types CS800, CS803[1] and CS804[2] Internal Registration Flow Capacities for 1 psig / 0.07 bar Setpoint for 1-1/2 In. / DN 40 Body Size at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, Inch / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35[1][2]	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40															
2	0.14	500	13.4	750	20.1	1750	47.0	2000	53.7	2250	60.4	2300	61.7	2400	64.4	2850	76.5
5	0.34	1100	29.5	1800	48.3	2300	61.7	2800	75.2	3400	91.3	4100	110	4850	130	5350	144
15	1.0	1900	51.0	3970	107	5400	145	6600	177	8030	216	8700	234	9410	253	10,020	269
25	1.7	2500	67.1	5520	148	7000	188	8200	220	9610	258	10,100	271	10,630	285		
40	2.8	3500	94.0	7400	199	8410	226	9400	252	10,600	285	10,600	285				
60	4.1	4900	132	9600	258	9650	259	10,300	277	11,000	295	11,000	295				
100	6.9	7300	196	10,550	283	11,950	321										
125	8.6	9100	244	10,550	283												

Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on the Type CS803.
2. Type CS824 exhibits a 20% reduction in capacity for indicated orifice size. Multiply listed values by a factor of 0.8.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
1 psig	-5.5 in. w.c.	5.5 in. w.c.	14 to 30 in. w.c.	Dark Green
0.07 bar	-14 mbar	14 mbar	35 to 75 mbar	

Table 17. Types CS800, CS803 and CS804 Internal Registration Flow Capacities for 1 psig / 0.07 bar Setpoint for 2 In. / DN 50 Body Size at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35[1]	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 2 in. / DN 50															
2	0.14	650	17.4	1040	27.9	2200	59.1	2570	69.0	3200	85.9	3400	91.3	3600	96.6	4500	121
5	0.34	1100	29.5	2300	61.7	3200	85.9	3900	105	4800	129	6100	164	7700	207	10,000	269
15	1.0	1900	51.0	4000	107	6900	185	10,800	290	14,560	391	18,000	483	19,930	535	20,170	542
25	1.7	2600	69.8	5600	150	10,500	282	15,500	416	21,700	583	24,300	652	24,410	655		
40	2.8	3700	99.3	8000	215	14,500	389	20,100	540	27,000	725	27,810	747				
60	4.1	4900	132	10,940	294	19,500	524	24,900	669	29,050	780	29,050	780				
100	6.9	7700	207	16,680	448	29,500	792										
125	8.6	9600	258	20,200	542												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on the Type CS803.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
2 psig	-0.40 psig	0.40 psig	1 to 2.5 psig	Dark Blue
0.14 bar	-28 mbar	28 mbar	0.07 to 0.17 bar	

Table 18. Types CS820, CS823 and CS824 Internal Registration Flow Capacities for 2 psig / 0.14 bar Setpoint for 1-1/2 In. / DN 40 Body Size at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35[1]	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40															
3	0.21	820	22.0	1420	38.1	1960	52.6	2830	76.0	3200	85.9	3950	106	4160	112	4620	124
10	0.69	1590	42.7	3120	83.8	5230	140	6870	184	7600	204	8410	226	9580	257	11,220	301
20	1.4	2310	62.0	4880	131	8440	227	10,380	279	11,160	300	11,490	309	12,630	339		
30	2.1	2980	80.0	6340	170	10,670	286	12,360	332	12,960	348	12,990	349	13,920	374		
50	3.4	4360	117	9260	249	13,460	361	14,190	381	14,920	401	14,280	383				
80	5.5	6400	172	13,710	368	15,440	415	15,440	415	15,440	415						
125	8.6	9410	253	16,080	432												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on the Type CS823.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
2 psig	-0.40 psig	0.40 psig	1 to 2.5 psig	Dark Blue
0.14 bar	-28 mbar	28 mbar	0.07 to 0.17 bar	

Table 19. Types CS820, CS823[1][2] and CS824 Internal Registration Flow Capacities for 2 psig / 0.14 bar Setpoint for 2 In. / DN 50 Body Size at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25[1]		1-3/8 / 35[3][4]	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 2 in. / DN 50															
3	0.21	730	19.6	1280	34.4	2140	57.4	2890	77.6	3400[2]	91.3[2]	4190	113	4800	129	6490	174
10	0.69	1610	43.2	3260	87.5	5790	155	7870	211	9930	267	11,840	318	13,680	367	18,160	488
20	1.4	2330	62.6	4950	133	9250	248	12,990	349	16,570	445	19,760	531	20,610	553		
30	2.1	2940	78.9	6300	169	11,890	319	17,290	464	21,870	587	24,500	658	25,180	676		
50	3.4	4280	115	9200	247	17,600	473	24,860	667	27,290	733	29,870	802				
80	5.5	6310	169	13,710	368	25,880	695	32,240	866	32,240	866						
125	8.6	9360	251	20,220	543												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Type CS823 exhibits a 10% reduction in capacity for indicated orifice size. Multiply listed values by a factor of 0.9.
2. Due to droop, the Type CS823 exhibits a 15% reduction in capacity for indicated conditions. Multiply listed values by a factor of 0.85.
3. Not available on the Type CS823.
4. Type CS824 exhibits a 20% reduction in capacity for indicated orifice size. Multiply listed values by a factor of 0.8.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
5 psig	-1.0 psig	1.0 psig	2.5 to 5.5 psig	Yellow
0.34 bar	-69 mbar	69 mbar	0.17 to 0.38 bar	

Table 20. Types CS820, CS823 and CS824 Internal Registration Flow Capacities for 5 psig / 0.34 bar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35[1]	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 In. / DN 40															
10	0.69	1530	41.1	2710	72.8	4370	117	5880	158	6680	179	8470	227	9740	262	12,040	323
20	1.4	2310	62.0	4720	127	7850	211	10,140	272	11,480	308	13,870	372	14,580	391		
30	2.1	2880	77.3	6390	172	10,570	284	12,760	343	14,620	393	16,620	446	16,990	456		
50	3.4	4240	114	9360	251	14,840	398	16,650	447	18,310	492	21,270	571				
80	5.5	6310	169	13,840	372	19,090	513	20,400	548	22,710	610						
125	8.6	9390	252	19,280	518												
psig	bar	Body Size: 2 In. / DN 50															
10	0.69	1500	40.3	2840	76.2	4780	128	5970	160	8000	215	9400	252	10,550	283	13,590[2]	365[2]
20	1.4	2330	62.6	4700	126	8600	231	10,760	289	14,810	398	16,600	446	19,810	532		
30	2.1	2970	79.7	6500	175	11,660	313	15,530	417	20,540	551	20,950	562	24,770	665		
50	3.4	4320	116	9340	251	17,690	475	23,180	622	29,880	802	30,750	826				
80	5.5	6340	170	13,740	369	25,800	693	34,910	937	36,270	974						
125	8.6	9410	253	20,580	553												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on the Type CS823.
2. Type CS824 exhibits a 20% reduction in capacity for indicated orifice size. Multiply listed values by a factor of 0.8.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
10 psig	-2 psig	2 psig	5 to 10 psig	Green with White Stripe
0.69 bar	-1.4 bar	1.4 bar	345 to 690 bar	

Table 21. Type CS850 Internal Registration Flow Capacities for 10 psig / 0.69 bar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35	
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
psig	bar	Body Sizes: 1-1/2 and 2 in. / DN 40 and 50															
15	1.0	1820	48.8	3160	84.8	4670	125	6050	162	6650	178	8250	221	9420	252	11,730	314
25	1.7	2570	69.0	4920	132	8110	217	9780	262	11,240	301	14,080	377	14,750	395		
40	2.8	3620	97.0	7330	197	11,740	315	14,830	398	16,820	451	19,590	525				
60	4.1	4940	133	10,410	279	16,430	440	19,720	528	23,450	628	23,920	641				
100	6.9	7660	205	16,210	434	23,050	618										
125	8.6	9290	249	19,320	517.8												

□ - Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
7 in. w.c.	-2 in. w.c.	2 in. w.c.	5.5 to 8.5 in. w.c.	Black
17 mbar	-5 mbar	5 mbar	13 to 21 mbar	

Table 22. Types CS800, CS803 and CS804 External Registration Flow Capacities for 7 In. w.c. / 17 mbar Setpoint

CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35[1]	
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
psig	bar	Body Sizes: 1-1/2 and 2 in. / DN 40 and 50															
0.4	0.03	■	■	550	14.8	780	20.9	1090	29.3	1000	26.8	1390	37.3	1640	44.0	1780	47.8
1	0.07	500	13.4	830	22.3	1290	34.6	1730	46.4	1980	53.2	2320	62.3	2860	76.8	3780	102
3	0.21	870	23.4	1650	44.3	2500	67.1	3180	85.4	4130	111	4760	128	5250	141	7110	191
10	0.69	1480	39.7	2990	80.3	5010	135	6480	174	8420	226	9820	264	11,600	311	14,600	392
20	1.4	2170	58.3	4560	122	7720	207	10,750	289	13,660	367	15,080	405	18,520	497		
30	2.1	2770	74.4	5990	161	10,440	280	13,770	370	17,790	478	20,350	546				
50	3.4	4010	108	8700	234	14,510	390	18,750	503	24,220	650	26,390	709				
80	5.5	5960	160	12,550	337	19,580	526										
125	8.6	8150	219	16,990	456												

■ - Black areas show where indicated droop/boost would be exceeded regardless of capacity.
□ - Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
14 in. w.c.	-2 in. w.c.	2 in. w.c.	10 to 16 in. w.c.	White
35 mbar	-5 mbar	5 mbar	25 to 40 mbar	

Table 23. Types CS800, CS803 and CS804 External Registration Flow Capacities for 14 In. w.c. / 35 mbar Setpoint

CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35[1]	
		SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
psig	bar	Body Sizes: 1-1/2 and 2 in. / DN 40 and 50															
1	0.07	430	11.5	520	14.0	1210	32.5	1210	32.5	1290	34.6	1540	41.3	1790	48.1	2510	67.4
3	0.21	770	20.7	1350	36.2	1870	50.2	2540	68.2	2890	77.6	3730	100	4230	114	5660	152
10	0.69	1380	37.0	2560	68.7	4000	107	5110	137	6320	170	7700	207	8530	229	13,160	353
20	1.4	1970	52.9	4040	109	6270	168	8110	218	10,620	285	15,320	411	17,550	471		
30	2.1	2710	72.8	5320	143	8280	222	10,890	292	13,070	351	19,710	529				
50	3.4	3890	104	8290	223	12,990	349	16,060	431	18,020	484	30,650	823				
80	5.5	5770	155	12,450	334	18,900	507										
125	8.6	7900	212	16,680	448												

□ - Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
1 psig	-5.5 in. w.c.	5.5 in. w.c.	14 to 30 in. w.c.	Dark Green
69 mbar	-14 mbar	14 mbar	35 to 75 mbar	

Table 24. Types CS800, CS803 and CS804 External Registration Flow Capacities for 1 psig / 69 mbar Setpoint

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS																	
Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35(1)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Sizes: 1-1/2 and 2 in. / DN 40 and 50															
2	0.14	680	18.3	1090	29.3	1830	49.1	2540	68.2	2950	79.2	3390	91.0	4140	111	6030	162
5	0.34	1170	31.4	2050	55.0	3430	92.1	4690	126	6110	164	7000	188	8210	220	9760	262
15	1.0	1810	48.6	3790	102	6610	177	8740	235	10,590	284	11,840	318	13,980	375	20,000	537
25	1.7	2580	69.3	5590	150	9070	244	11,790	317	14,230	382	17,970	482	18,370	493		
50	3.4	4420	119	9360	251	15,480	416	18,380	493	22,670	609	24,280	652				
80	5.5	6460	173	13,140	353	20,770	558	23,970	644	27,780	746						
125	8.6	8730	234	19,710	529												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on Type CS803.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
2 psig	-0.40 psig	0.40 psig	1 to 2.5 psig	Dark Blue
138 mbar	-28 mbar	28 mbar	69 to 170 mbar	

Table 25. Types CS820, CS823 and CS824 External Registration Flow Capacities for 2 psig / 138 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS																	
Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35(1)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Sizes: 1-1/2 and 2 in. / DN 40 and 50															
3	0.21	760	20.4	1220	32.8	1820	48.9	2780	74.6	2780	74.6	4180	112	5360	144	5540	149
10	0.69	1460	39.2	2560	68.7	4400	118	6330	170	7400	197	8750	235	9180	246	12,710	341
20	1.4	2090	56.1	4310	116	6680	179	9610	258	11,940	321	13,420	360	14,300	384		
30	2.1	2710	72.8	5760	155	8980	241	12,410	333	15,040	404	15,770	423	17,220	462		
50	3.4	3970	107	8530	229	12,490	335	16,790	451	18,370	493	19,490	523				
80	5.5	5880	158	12,420	333	16,150	434	20,330	546	21,450	576						
125	8.6	8960	241	16,450	442												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on Type CS823.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
5 psig	-1 psig	1 psig	2.5 to 5.5 psig	Yellow
345 mbar	-69 mbar	69 mbar	170 to 380 mbar	

Table 26. Types CS820, CS823 and CS824 External Registration Flow Capacities for 5 psig / 345 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS																	
Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35(1)	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Sizes: 1-1/2 and 2 in. / DN 40 and 50															
10	0.69	1430	38.4	2320	62.3	4370	117	4780	128	5920	159	7360	198	8670	233	10,820	291
20	1.4	2120	56.9	4510	121	6640	178	8920	240	11,730	315	13,420	360	15,360	412		
30	2.1	2730	73.3	5960	160	9120	245	13,180	354	15,890	427	17,100	459	20,070	539		
50	3.4	4040	109	8640	232	13,540	364	17,940	482	21,260	571	24,110	647				
80	5.5	5880	158	12,840	345	20,480	550	25,360	681	29,700	797						
125	8.6	8910	239	20,320	546												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Not available on Type CS823.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
7 psig	-1.4 psig	1.4 psig	5 to 10 psig	Green with White Stripe
483 mbar	-96 mbar	96 mbar	345 to 690 mbar	

Table 27. Types CS850 and CS854 External Registration Flow Capacities for 7 psig / 483 mbar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS																	
Inlet Pressure		Orifice Size, In. / mm															
		1/4 / 6.4		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22		1 / 25		1-3/8 / 35	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Sizes: 1-1/2 and 2 in. / DN 40 and 50															
10	0.69	1410	37.9	1750	47.0	2030	54.5	3630	97.4	4130	111	4770	128	5390	145	7360	198
20	1.4	2230	59.9	3710	99.6	5200	140	6840	184	8520	229	9550	256	11,390	306		
30	2.1	2860	76.8	5140	138	7120	191	9970	268	12,780	343	14,020	376	14,890	400		
50	3.4	4290	115	7710	207	11,610	312	14,930	401	18,140	487	21,190	569				
80	5.5	6010	161	11,490	309	17,230	463	19,220	516	24,430	656						
125	8.6	9090	244	17,490	470												

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY		SPRING	
	Droop	Boost	Set Range	Color
7 in. w.c.	-1 in. w.c.	2 in. w.c.	5.5 to 8.5 in. w.c.	Black
17 mbar	-2.5 mbar	5 mbar	13 to 21 mbar	

Table 28. Types CS805 and CS806 Internal Registration Flow Capacities for 7 In. w.c. / 17 mbar Setpoint

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
Inlet Pressure		Orifice Size, In. / mm									
		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40									
0.51	0.04					730	19.6	850	22.8	910	24.4
2	0.14	900	24.2	1140	30.6	1520	40.8	1610	43.2	1610	43.2
5	0.34	1620	43.5	2120	56.9	2560	68.7	3370	90.5	3470	93.2
15	1.0	3150	84.6	5350	144	6400	172	7500	201	7140	192
25	1.7	4680	126	7600	204	7600	204	7600	204	8610	231
40	2.8	6140	165	7800	209	7900	212	7900	212	9550	256
60	4.1	7500	201	8000	215	8000	215	8000	215		
100	6.9	8500	228	8500	228						
125	8.6	8500	228								

- Black areas show where indicated droop/boost would be exceeded regardless of capacity.
- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
1 psig	-5.5 In. w.c.	5.5 In. w.c.	14 to 30 In. w.c.	Dark Green
0.07 bar	-14 mbar	14 mbar	35 to 75 mbar	

Table 29. Types CS805 and CS806 Internal Registration Flow Capacities for 1 psig / 0.07 bar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
Inlet Pressure		Orifice Size, In. / mm									
		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40									
2	0.14	1120	30.1	1710	45.9	2130	57.2	2600	69.8	2910	78.1
5	0.34	2250	60.4	3090	83.0	3650	98.0	5190	139	5230	140
15	1.0	3990	107	6310	169	8480	228	9390	252	10,000	269
25	1.7	5490	147	8860	238	11,100	298	11,880	319	12,340	331
40	2.8	7890	212	11,640	313	13,000	349	13,590	365	13,920	374
60	4.1	10,860	292	13,000	349	14,540	390	14,080	378		
100	6.9	13,750	369	14,360	386						
125	8.6	13,750	369								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
2 psig	-0.40 psig	0.40 psig	1 to 2.5 psig	Dark Blue
0.14 bar	-28 mbar	28 mbar	0.07 to 0.17 bar	

Table 30. Types CS825 and CS826 Internal Registration Flow Capacities for 2 psig / 0.14 bar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
Inlet Pressure		Orifice Size, In. / mm									
		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40									
3	0.21	1170	31.4	2020	54.2	2150	57.7	2570	69.0	3110	83.5
10	0.69	3080	82.7	4420	119	5370	144	6800	183	7330	197
20	1.4	4830	130	6970	187	9130	245	10,390	279	11,410	306
30	2.1	6180	166	9670	260	11,650	313	13,330	358	14,210	382
50	3.4	9250	248	13,800	371	15,660	420	16,330	438	17,440	468
80	5.5	13,170	354	16,800	451						
125	8.6	17,430	468								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

- continued -

Table 30. Types CS825 and CS826 Internal Registration Flow Capacities for 2 psig / 0.14 bar Setpoint at 20% Accuracy (continued)

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
Inlet Pressure		Orifice Size, In. / mm									
		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 2 in. / DN 50									
3	0.21	1070	28.7	1470	39.5	2080	55.8	2540	68.2	2710	72.8
10	0.69	2860	76.8	4260	114	5930	159	7190	193	8360	224
20	1.4	4740	127	7360	198	10,200	274	12,310	331	14,410	387
30	2.1	6310	169	10,150	273	14,290	384	17,140	460	19,320	519
50	3.4	9370	252	15,320	411	22,350	600	25,450	683	28,260	759
80	5.5	13,750	369	22,830	613						
125	8.6	20,510	551								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

SETPOINT	ACCURACY: + / - 20% GAUGE		SPRING	
	Droop	Boost	Set Range	Color
5 psig	-1.0 psig	1.0 psig	2.5 to 5.5 psig	Yellow
0.34 bar	-69 mbar	69 mbar	0.17 to 0.38 bar	

Table 31. Types CS825 and CS826 Internal Registration Flow Capacities for 5 psig / 0.34 bar Setpoint at 20% Accuracy

CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
Inlet Pressure		Orifice Size, In. / mm									
		3/8 / 9.5		1/2 / 13		5/8 / 16		3/4 / 19		7/8 / 22	
		SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
psig	bar	Body Size: 1-1/2 in. / DN 40									
10	0.69	2460	66.0	3650	98.0	4680	126	5880	158	6610	177
20	1.4	4370	117	6650	179	8300	223	10,120	272	11,110	298
30	2.1	6060	163	8980	241	11,440	307	13,520	363	15,180	408
50	3.4	9150	246	12,850	345	16,250	436	17,880	480	19,590	526
80	5.5	13,270	356	18,410	494						
125	8.6	18,730	503								
psig	bar	Body Size: 2 in. / DN 50									
10	0.69	2440	65.5	3650	98.0	4660	125	5740	154	6660	179
20	1.4	4480	120	6650	179	8720	234	10,670	286	12,370	332
30	2.1	6100	164	9370	252	12,540	337	15,440	415	17,410	467
50	3.4	9230	248	14,510	390	19,730	530	24,260	651	27,210	731
80	5.5	13,670	367	21,930	589						
125	8.6	20,310	545								

- Blank areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

Type CT88

Backpressure Regulator

Introduction

The Type CT88 backpressure regulator is used to maintain backpressure on Lease Automatic Custody Transfer (LACT) skids. It is designed to allow accurate measurement by the positive displacement pump or coriolis meter and protect other upstream LACT skid equipment. The high flow capability, as compared with other backpressure regulators, maximizes transfer efficiency.

Body Sizes

NPS 2, 3 and 4 / DN 50, 80 and 100

End Connection

CL150 RF

Maximum Inlet and Casing Pressure[1][3]

Based on CL150 RF Flange Pressure Rating, See Table 1

Backpressure Control Range[1]

30 to 145 psi / 2.1 to 10 bar

Wide-Open Flow Coefficients C_v

NPS 2 / DN 50–C_v: 59
NPS 3 / DN 80–C_v: 148
NPS 4 / DN 100–C_v: 240

Flow Sizing Coefficients C_v

See Table 2

Flow Characteristic

Quick Open

Shutoff Classification

ANSI Class VI

Temperature Capabilities[1][2]

Fluorocarbon (FKM)[4]:
20 to 248°F / -7 to 120°C[5]

Construction Materials

Body: Carbon steel (WCB)
Diaphragm and Seals: Fluorocarbon (FKM)
Trim Parts: 316 Stainless steel

Figure 1. *Type CT88 Backpressure Regulator*

Control Line Connection Size

1/4 NPT

Approximate Weight

See Table 3

Ordering Guide

To order this product, contact your local Sales Office.

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Application

- Liquid

Features

- High Capacity
- Bleed Plug
- Fully Balanced Plug
- Fast Speed of Response
- Simple Construction
- Easy Installation
- Easily Adjusted Setpoint
- CL150 Pressure Rating

1. The pressure/temperature limits in this Application Guide and any applicable standard limitation should not be exceeded.
2. It may be assumed that the material temperature is the same as the working fluid temperature.
3. Maximum inlet pressure depends on working temperature (Refer to ASME B16.42 or Table 1).
4. Fluorocarbon (FKM) is limited to 200°F / 93°C for hot water.
5. Increased working temperature may reduce the maximum inlet pressure range (Refer to ASME B16.42 or Table 1).

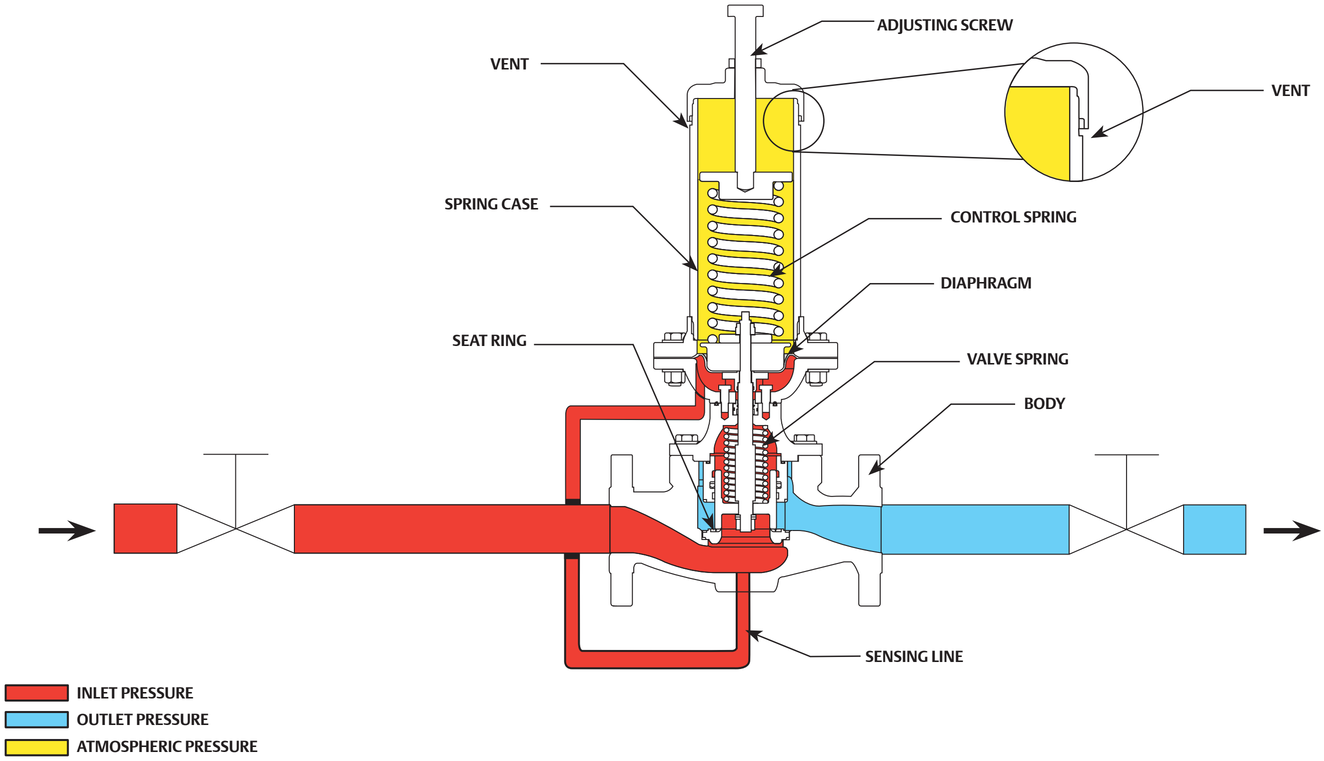

Figure 2. *Type CT88 Backpressure Regulator Operational Schematic*

Table 1. Pressure-Temperature Ratings for CL150 Carbon Steel (WCB)

TEMPERATURE[1]	MAXIMUM WORKING PRESSURE
°F	psi
20 to 100	285
200	260
248	245
°C	bar
-7 to 38	19.7
50	17.0
100	17.9
120	16.9

1. For intermediate temperatures, linear interpolation is permitted.

Table 2. Type CT88 Typical C_v Coefficient - Setpoint Made at 10% Flow

SET PRESSURE		10% BUILD-UP			20% BUILD-UP		
		Body Size			Body Size		
psi	bar	NPS 2 / DN 50	NPS 3 / DN 80	NPS 4 / DN 100	NPS 2 / DN 50	NPS 3 / DN 80	NPS 4 / DN 100
30	2.1	13.4	26.6	32.9	23.0	37.3	41.8
50	3.4	13.6	27.0	37.6	23.2	42.2	48.2
70	4.8	13.7	27.6	37.6	23.2	46.9	51.8
85	5.9	13.7	27.9	38.6	23.4	47.4	55.7
100	6.9	14.3	31.7	40.9	24.9	49.4	60.2

Table 3. Type CT88 Backpressure Approximate Weights

BODY SIZE		APPROXIMATE WEIGHT	
NPS	DN	Lbs	kg
2	50	89.3	40.5
3	80	131	59.5
4	100	184	83.5

1. Measured with the adjusting screw extended at maximum length.

EZH and EZHOSX Series

Pressure Reducing Regulator

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Introduction

Types EZH (Spring-to-Close version) and EZHSO (Spring-to-Open version) regulators are accurate pilot-operated, pressure balanced, soft-seated regulators. They are designed for use in power plants and turbines fuel supply especially for pressure control in boilers and fired heaters fuel gas systems. They provide smooth, reliable operation, tight shutoff and long life.

For underpressure or overpressure protection, the Types EZHOSX (Spring-to-Close) and EZHSO-OSX (Spring-to-Open) are available with an integral slam-shut device to completely shutoff the flow of gas to the downstream system.

Body Sizes

NPS 1 to 4 / DN 25 to 100

End Connection Styles and Structural Design Ratings

NPT or SWE: 1500 psig / 103 bar
CL150 RF: 290 psig / 20.0 bar
CL300 RF: 750 psig / 51.7 bar
CL600 RF or BWE: 1500 psig / 103 bar

Maximum Allowable Pressures

Inlet Pressure:
1500 psig / 103 bar
Outlet (Casing) Pressure:
1500 psig / 103 bar
Emergency Casing Pressure:
1500 psig / 103 bar

Main Valve Body Material

LCC or WCC Steel

Outlet Pressure Ranges

14.5 to 1160 psig / 1 to 80 bar in eight different ranges

Flow Capacities

See EZH and EZHOSX Series Product Bulletin

Ordering Guide

To order this product, contact your local Sales Office.

Complete Specifications

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Application

- Fuel Gas

Features

- No Gas Emissions
- Bubble-Tight Shutoff
- Long Life in Severe Service Applications
- Failure Mode Options
- Precise Pressure Control
- Quiet Operation
- Full Pressure Rating
- Integral Slam Shut Configurations
- Easy In-Line Maintenance
- High Turn Down Capability
- Travel Indicator
- Robust Main Diaphragm
- Common Body Platform for Easy Conversion
- Full Usable Capacity
- Disk Design for Better Abrasion Resistance

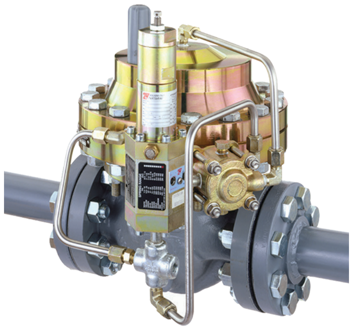

Figure 1. *Type EZH Pressure Reducing Regulator*

Figure 2. *Type EZHOSX Pressure Reducing Regulator with Type OS2 Slam-Shut Device*

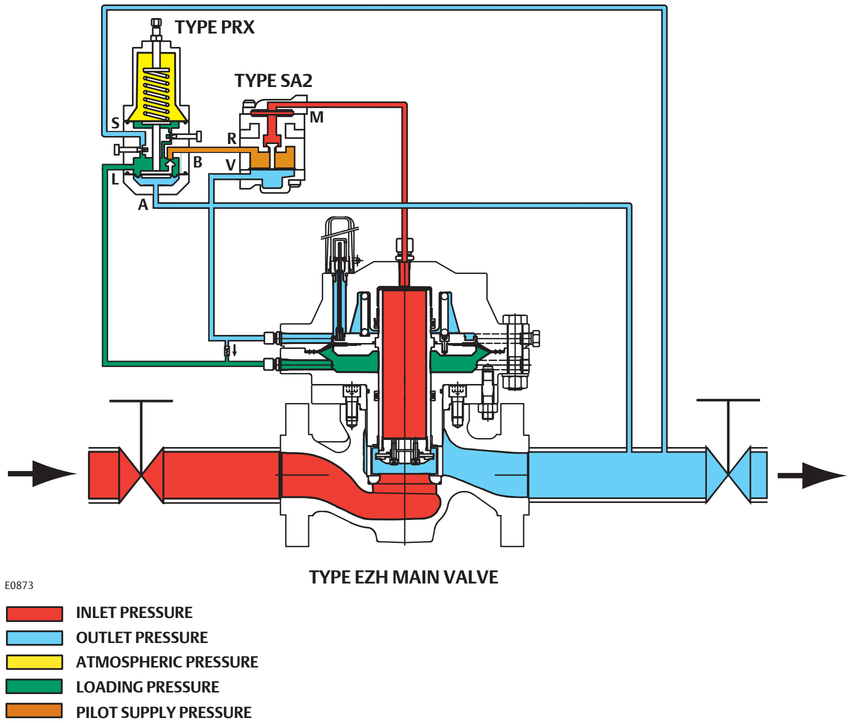

Figure 3. *Type EZH (Spring-to-Close Version) Operational Schematic*

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Introduction

The Type EZR pilot-operated, pressure reducing regulator is designed for fuel gas systems to provide accurate pressure control for various applications like fired heaters and boilers. The Type EZR provides smooth, quiet operation, tight shutoff and long life, even in dirty service. Its internally actuated metal plug eliminates disadvantages associated with boot-style regulators, and the specially engineered flow path deflects debris, protecting the seat from damage and erosion.

For underpressure and/or overpressure protection, Type EZROSX Regulator includes Type EZR Regulator with a slam-shut device. The slam-shut device can provide either overpressure or overpressure and underpressure protection by completely shutting off the flow of gas to the downstream system.

Main Valve Body Sizes
NPS 1 up to NPS 12 x 6 /
DN 25 up to DN 300 x 150

End Connection Styles and Structural Design Rating
NPT: 400 psig / 28.0 bar
SWE, BWE, CL600 RF: 1500 psig / 103 bar
CL125 FF: 200 psig / 14.0 bar
CL150 RF: 290 psig / 20.0 bar
CL250 RF: 500 psig / 34.0 bar
CL300 RF: 750 psig / 52.0 bar

Main Valve Body Material
Cast iron, WCC steel or LCC steel

Outlet (Control) Pressure Ranges
6 in. w.c. to 1000 psig / 15 mbar to 69 bar in 20 different ranges

Flow Capacities
See EZR Series Product Bulletin

Ordering Guide
To order this product, contact your local Sales Office.

Complete Specifications
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Application

- Fuel Gas

Features

- Tight Shutoff
- Debris Protection
- Quiet Operation
- High Accuracy
- Long Life
- Full Usable Capacity
- Thorough Laboratory Testing
- Easy In-Line Maintenance
- O-ring Design for Reduced Maintenance and Assembly Time
- In-Service Travel Indicator
- Versatile
- Easily Maintained Pilots
- Powder Paint Coating
- Slam-Shut Device

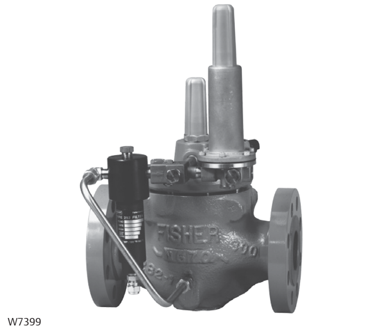

Figure 1. *Type EZR Pressure Reducing Regulator*

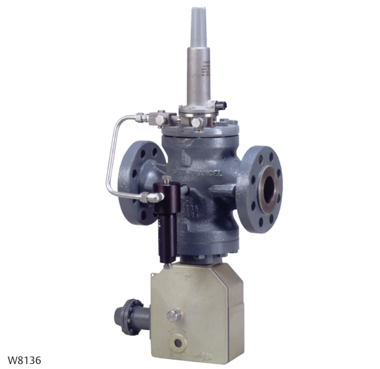

Figure 2. *Type EZROSX Pressure Reducing Regulator with Integral Slam-Shut Device*

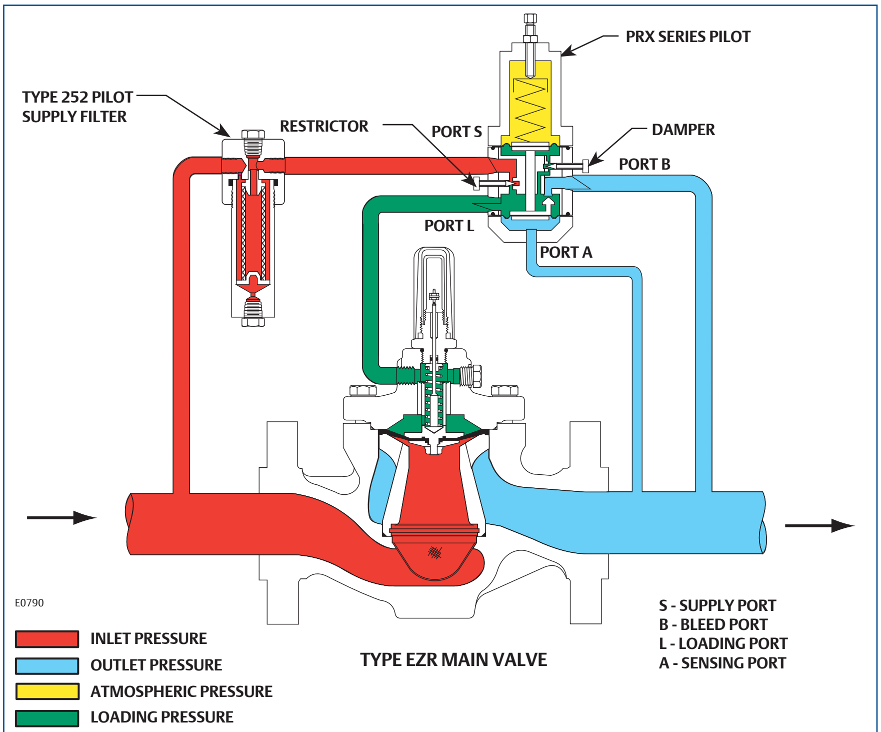

Figure 3. *Type EZR with PRX Series Pilot and Type 252 Filter Operational Schematic*

Introduction

The Type FL regulators are accurate pilot-operated, pressure-balanced, soft-seated regulators designed for power plant fuel supply and turbine fuel supply. The FL Series provides smooth, quiet operation, tight shutoff and long service life. The regulator uses a main valve actuator, a Type PRX pressure reducing pilot and a Type SA/2 pilot supply pressure regulator or a Type PS compact pressure reducing pilot.

This regulator's superior performance is due to the amplifying effect of the pilot and two-path control system. Changes in outlet pressure act quickly on the actuator diaphragm to provide fast response to system change. Then the pilot amplifies any small system changes to position the main valve for precise pressure control.

Body Sizes

Type FL: NPS 1, 2, 3, 4, 6, 8 and 10 / DN 25, 50, 80, 100, 150, 200 and 250
Type FL with Type SRS Silencer (Inlet x Outlet): NPS 1 x 4, 2 x 6, 3 x 10, 4 x 10, 6 x 12 and 8 x 16 / DN 25 x 100, 50 x 150, 80 x 250, 100 x 250, 150 x 300 and 200 x 400

Main Valve End Connection Style and Pressure Ratings

CL300 RF: 740 psig / 51.0 bar(1)
CL600 RF: 1480 psig / 102 bar(1)

Maximum Inlet and Outlet (Casing) Pressure

1480 psig / 102 bar(1)

Outlet (Control) Pressure Ranges

14.5 to 1160 psig / 1 to 80 bar in eight different ranges

Accuracy Class

Up to ± 1%

Complete Specifications

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Flow Capacities

See Type FL Product Bulletin

Ordering Guide

To order this product, contact your local Sales Office.

Application

Fuel Gas

Features

- No Atmospheric Bleed
- Quiet Operation
- High Capacity
- Long Life in Severe Service Applications
- Precise Pressure Control
- Easy In-Line Maintenance
- Bubble-Tight Shutoff
- Full Pressure Rating
- Versatility
- Travel Indicator
- High Turn Down Capability

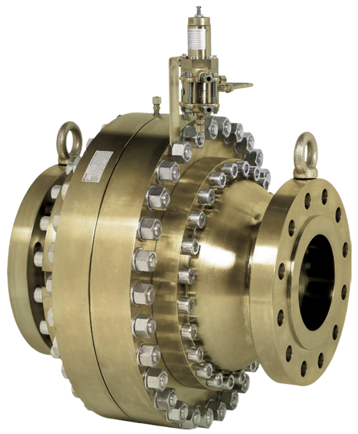

Figure 1. Type FL with PRX Series Pilot

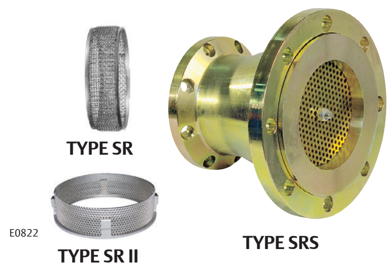

Figure 2. Noise Abatement Construction

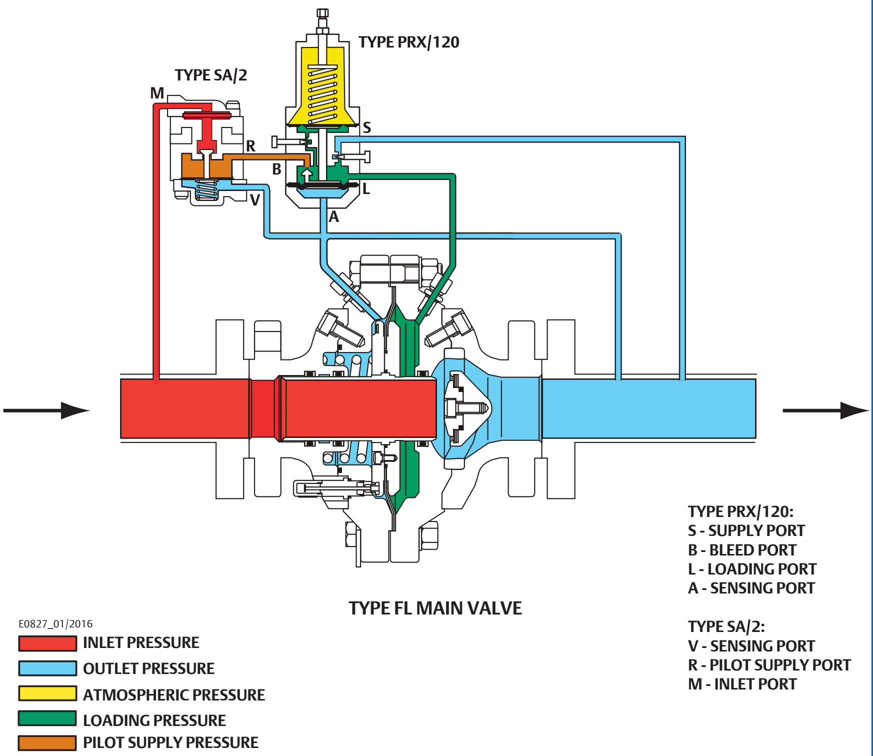

Figure 3. Type FL Operational Schematic

1. At average ambient temperature.

Introduction

The Type H120 direct-operated relief valve registers directly on a spring-opposed poppet assembly which includes a Nitrile (NBR) disk. When the inlet pressure increases above the spring setting, the poppet and disk assembly is pushed away from the metal seat. Springs are available that provide various fixed relief pressures from 35 to 350 psig / 2.4 to 24.1 bar.

With this simple operation and wide spring setting selection, the Type H120 relief valve may be used where venting to atmosphere is acceptable, where the process gas is compatible with the Nitrile (NBR) disk, where its relief capacity is adequate, and where some pressure relieving tolerance is acceptable. Common applications include use on pneumatic control lines of air drills, jackhammers and other similar equipment and on high-pressure installations such as the side outlet of a Type 1301F regulator.

Inlet Connection Size and Style

1/4 NPT

Maximum Allowable Relief (Inlet) Pressure

420 psig / 29.0 bar

Fixed Relief Pressures

35 to 350 psig / 2.4 to 24.1 bar
with nine fixed settings
See Table 1

Wide-Open Flow Coefficient

C_g: 0.80

IEC Sizing Coefficients

X_T: 0.78
F_D: 0.50
F_L: 0.89

Construction Materials

Body, Poppet and Spring Retainer: Brass and Stainless steel
Disk: Nitrile (NBR)
Spring: Stainless steel
Retainer Pin: Steel and Stainless steel

Temperature Capabilities

-20 to 160°F / -29 to 71°C

Approximate Shipping Weight

0.25 lb / 0.11 kg

Available Option

Type P206 raincap

Ordering Guide

To order this product, contact your local Sales Office.

Application

- **Air**
- **Fuel Gas**

Features

- **Space-Saving Construction**
- **Economical**
- **Durable**
- **Optional Protective Cap**

Additional Technical Data

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Figure 1. Type H120 Relief Valve

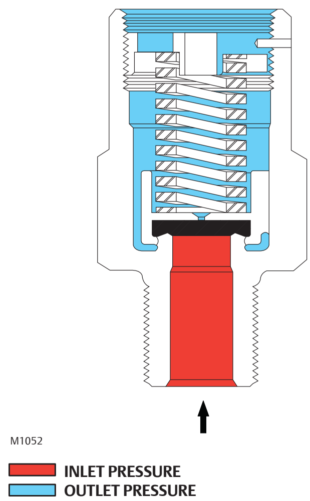

Figure 2. Operational Schematic

Table 1. Relief Pressure and Capacities

FIXED RELIEF PRESSURE SETTING(1)		BUILD-UP OVER RELIEF PRESSURE SETTING		CAPACITY IN SCFH / Nm³/h OF AIR		SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
psig	bar	psig	bar	SCFH	Nm³/h		in.	mm	in.	mm
35 60	2.4 4.1	25 25	1.7 1.7	4650 6336	125 170	Yellow	0.047	1.19	0.91	23.1
120	8.3	25	1.7	9939	267	Orange	0.051	1.30	0.94	23.9
150 175	10.3 12.1	30 35	2.1 2.4	11,540 13,485	309 361	Brown	0.056	1.42	1.17	29.7
200 225 275 350	13.8 15.5 19.0 24.1	40 45 55 70	2.8 3.1 3.8 4.8	15,771 16,856 18,232 26,784	422 452 488 718	Black	0.062	1.58	1.13	28.7

1. This is the initial leak point, the point at which the relief valve begins to discharge.

H200 Series
Relief Valve

FISHER

Introduction

The H200 Series Pop™ relief valves are direct-operated relief valves with preset and pinned spring retainers. The inlet pressure registers directly on a spring-opposed poppet assembly that includes a Nitrile (NBR) disk. When the inlet gas pressure increases above the spring setting, the poppet and disk assembly is pushed away from the orifice.

With this simple operation and wide spring setting selection, the H200 Series Pop relief valves may be used where venting to atmosphere is acceptable, where the process gas is compatible with the Nitrile (NBR) disk, where its relief capacity is adequate, and where some pressure relieving tolerance is acceptable. Common applications include use on pneumatic control lines of air drills, jackhammers and other similar equipment, and on farm tap installations.

Representative Wide-Open Flow Coefficient

C_g: 405

Maximum Allowable Relief (Inlet) Pressure

400 psig / 27.6 bar

Fixed Relief Pressures

25 to 300 psig / 1.7 to 20.7 bar with 12 fixed settings
See Table 2

Available Configurations and End Connection Style

Type H202: 3/4 NPT
Type H203: 1 NPT

Approximate Shipping Weight

0.5 lb / 0.2 kg

Temperature Capabilities

-20 to 160°F / -29 to 71°C

Option

Type P145 Raincap

Ordering Guide

To order this product, contact your local Sales Office.

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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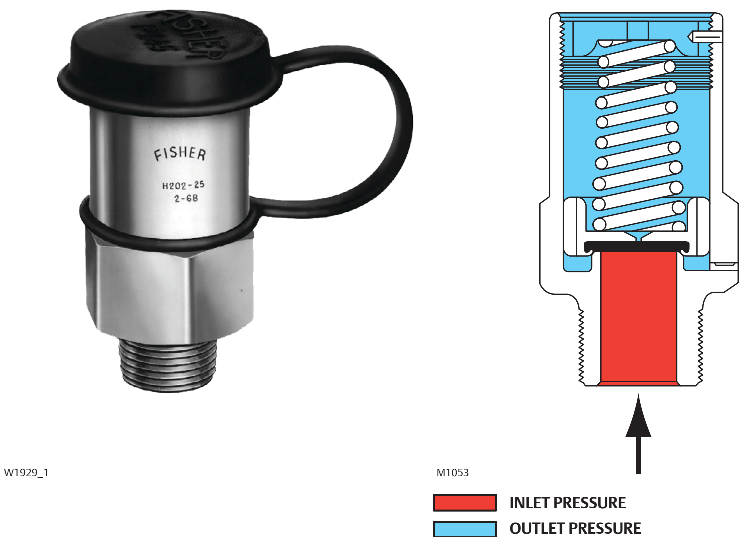

Figure 1. *H200 Series Relief Valve External View and Operational Schematic*

Application

- Air
- Fuel Gas

Features

- **Space-Saving Construction**
- **Economical**
- **Durable**

Table 1. Relief Pressure Spring Ranges

RELIEF PRESSURE SETTINGS		SPRING COLOR	RELIEF SETTING TOLERANCE	
psig	bar		psig	bar
25 to 30 31 to 55	1.7 to 2.1 2.1 to 3.8	Pink White	±5	±0.34
56 to 70 65 to 95 90 to 130	3.9 to 4.8 4.5 to 6.5 6.2 to 9.0	Blue Plain Purple	±8	±0.55
131 to 160 161 to 190 191 to 235 236 to 300	9.0 to 11.0 11.1 to 13.1 13.2 to 16.2 16.3 to 20.7	Yellow Green Brown Plain	±15	±1.03

Table 2. Relief Set Pressures and Capacities in SCFH / Nm^3/h of Air

RELIEF SET PRESSURE[1]		SET PRESSURE PLUS BUILD-UP		FLOW CAPACITY	
psig	bar	psig	bar	SCFH	Nm^3/h
25	1.7	50	3.4	26,505	710
50	3.4	75	5.2	36,735	984
75	5.2	100	6.9	46,500	1246
100	6.9	120	8.3	53,940	1445
125	8.6	150	10.3	64,635	1732
150	10.3	180	12.4	77,888	2087
175	12.1	210	14.5	91,140	2443
200	13.8	240	16.5	102,300	2742
225	15.5	270	18.6	116,250	3116
250	17.2	300	20.7	127,875	3427
275	19.0	330	22.7	139,500	3739
300	20.7	360	24.8	151,125	4050

1. This is the initial leak point, the point at which the relief valve begins to discharge.

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Type H800
Relief Valve

Introduction

The Type H800 relief valve is a compact, lightweight, direct-operated relief valve. It is used primarily between a pneumatic instrument and its supply pressure regulator to limit the instrument supply pressure to 50 psig / 3.4 bar should the supply pressure regulator fail open. The Type H800 relief valve can also be mounted on other equipment, such as an air compressor, where limited relief is desired.

Body Size and End Connection Style

1/4 NPT

Flow Coefficient

Wide-Open C_g: 55
K_m: 0.79

IEC Sizing Coefficient

X_T: 0.775
F_D: 0.50
F_L: 0.89

Maximum Allowable Inlet (Relief) Pressure

250 psig / 17.2 bar

Relief Pressure Range

Non-adjustable, start-to-discharge between 39 to 44 psig / 2.7 to 3.0 bar

Reseat Pressure

35 psig / 2.4 bar or higher

Temperature Capabilities

-20 to 150°F / -29 to 66°C

Construction Materials

Body and Spring Case: Aluminum
Spring Cap: Valox® 730 plastic
Diaphragm: Nitrile (NBR)
Diaphragm Disk: Zinc-plated steel
Spring: Plated steel
Disk Restriction and Screen: Stainless steel
Internal Retaining Ring: Plated steel

Approximate Shipping Weight

5 oz. / 140 gm

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Air

Figure 1. *Type H800 Relief Valve*

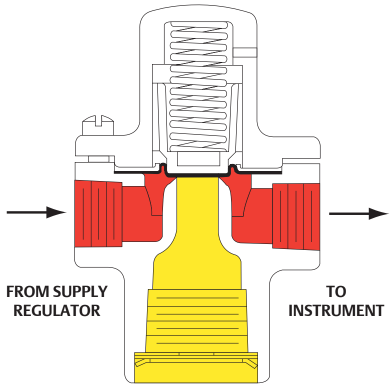

Figure 2. *Type H800 Operational Schematic*

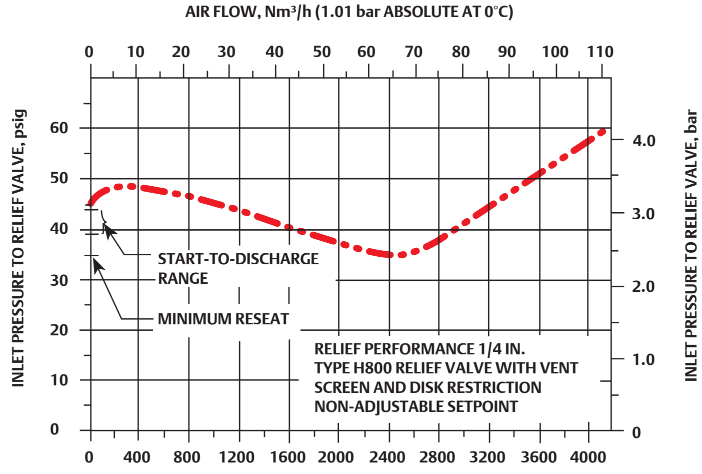

Figure 3. *Relief Capacities*

Features

- Application Dependability
- Easy Installation
- Economical
- Tamper-Resistant

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Type HSR
Pressure Reducing Regulator

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Introduction

The Type HSR direct-operated, spring-loaded regulators provide economical pressure reducing control in a variety of residential, commercial and industrial applications.

In addition, the Type HSR regulators have internal relief across the diaphragm to help minimize overpressure.

Body Sizes (Inlet x Outlet) and End Connections

Globe Body: 3/4, 3/4 x 1, 1 and 1-1/4 NPT
Angle Body: 3/4, 3/4 x 1 and 1 NPT

Allowable Inlet Pressures

Emergency: 150 psig / 10.3 bar
Maximum Operating Pressure:
See Table 3

Allowable Outlet Pressures

Emergency (Casing): 25 psig / 1.7 bar
Maximum Operating Pressure to Avoid Internal Parts Damage: 3 psi / 0.21 bar differential above outlet pressure setting

Outlet Pressure Ranges

See Table 2

Flow and Sizing Coefficients

See Table 5

Internal Relief Performance

Approximate Internal Relief Start-To-Discharge Point: 6 to 12 in. w.c. / 15 to 30 mbar above outlet pressure setting (Applies to 6 to 8 in. w.c. / 15 to 20 mbar and 8 to 10 in. w.c. / 20 to 25 mbar springs only)
Relief Performance:
See Figures 3 and 4 and Table 11

Temperature Capabilities

-20 to 160°F / -29 to 71°C

Pressure Registration

Internal

Spring Case Vent Connection

Standard: 1 NPT with removable screen
Optional: 3/4 NPT with removable screen

Figure 1. *Type HSR Pressure Reducing Regulator*

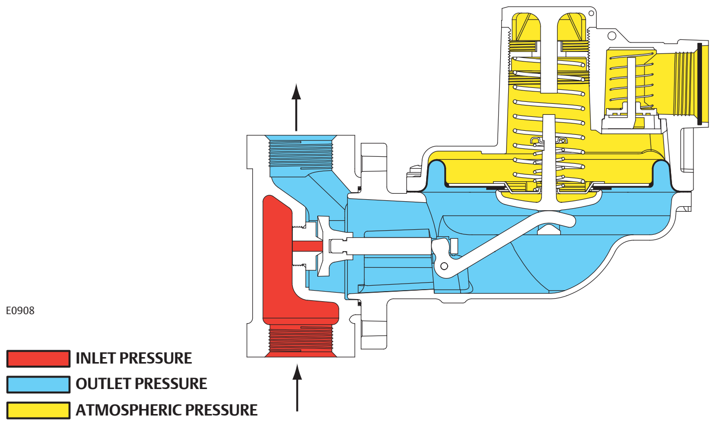

Figure 2. *Type HSR Pressure Regulator Operational Schematic*

Lockup During Normal Operation

See Table 4

Construction Materials

See Table 1

Globe Body Capacities

See Table 6 to 8

Angle Body Capacities

See Table 9 and 10

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Fuel Gas

Features

- Angle Bodies
- Globe Bodies
- Fixed Factor / PFM Accuracy
- Meets or Exceeds ANSI B109.4 / CSA 6.18 Requirements
- High Capacity Internal Relief
- Compact Design
- High Capacity

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Construction Material

BODY	BODY GASKET	CLOSING CAP	ADJUSTING SCREW	DIAPHRAGM CASE, SPRING CASE, DIAPHRAGM PLATE, ORIFICE AND VALVE STEM	PUSHER POST OR RELIEF VALVE SEAT	DIAPHRAGM AND DISK	CONTROL SPRING	RELIEF VALVE SPRING AND RETAINER, VENT SCREEN AND LEVER PIN	SPRING SEAT, LEVER AND OTHER METAL PARTS
Cast iron	Nitrile (NBR)	ASA thermoplastic (provides UV-ray protection)	Delrin®	Aluminum	Delrin®	Nitrile (NBR)	Zinc-plated steel	Stainless steel	Plated steel

Table 2. Outlet Pressure Range

OUTLET PRESSURE RANGE		SPRING COLOR	CLOSING CAP	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
In. w.c.	mbar			In.	mm	In.	mm
4 to 6	10 to 15	Orange	Black	0.062	1.58	3.40	86.4
6 to 8	15 to 20	Yellow	Black	0.067	1.70	3.61	91.4
8 to 10	20 to 25	Black	Black	0.067	1.70	3.71	94.0
10 to 12.5	25 to 31	Silver	Black	0.072	1.83	4.10	104
12.5 to 20	31 to 50	Gray	Black	0.080	2.03	3.60	91.4
20 to 35	50 to 87	Pink	Black	0.093	2.36	3.52	88.9
1.25 to 2.2 psig	0.09 to 0.15 bar	Light Blue	Red	0.105	2.67	3.66	94.0

Table 3. Maximum Operating Inlet Pressure

ORIFICE SIZE		WIDE-OPEN C_G FOR RELIEF SIZING	MAXIMUM OPERATING INLET PRESSURE TO OBTAIN GOOD REGULATING PERFORMANCE	
In.	mm		psig	bar
1/8	3.2	12.5	125	8.6
3/16	4.8	28.2	100	6.9
1/4	6.4	50.0	60	4.1
3/8	9.5	105	30	2.1
1/2	13	185	20	1.2

Table 4. Lockup Performance During Normal Operation

ORIFICE SIZE		LOCKUP ABOVE SETPOINT		LOCKUP ABOVE SETPOINT	
In.	mm	In. w.c.	mbar	psi	mbar
1/8	3.2	1	2	0.15	10.3
3/16	4.8	1	2	0.15	10.3
1/4	6.4	2	5	0.15	10.3
3/8	9.5	2.5	6	0.15	10.3
1/2	13	3	7	0.15	10.3

Table 5. Flow and Sizing Coefficient

ORIFICE SIZE		WIDE-OPEN FOR RELIEF SIZING		C_1	IEC SIZING COEFFICIENT		
In.	mm	C_g	C_v		X_T	F_D	F_L
1/8	3.2	12.5	0.36	35	0.78	0.82	0.89
3/16	4.8	28.2	0.81			0.82	
1/4	6.4	50	1.43			0.82	
3/8	9.5	105	3.00			0.79	
1/2	13	185	5.29			0.79	

Table 6. 3/4 NPT Globe Body Capacities

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
7 in. w.c. / 17 mbar 6 to 8 in. w.c. / 15 to 20 mbar 1 in. w.c. droop 2 in. w.c. boost	0.5	0.03	70	1.9	120	3.2	170	4.6	240	6.4	300	8.0
	1	0.07	100	2.7	180	4.8	240	6.4	340	9.1	430	11.5
	2	0.14	130	3.5	250	6.7	330	8.8	510	13.7	630	16.9
	3	0.21	170	4.6	340	9.1	420	11.3	680	18.2	770	20.6
	5	0.35	220	5.9	420	11.3	650	17.4	900	24.1	960	25.7
	10	0.69	330	8.8	730	19.6	1100	29.5	1310	35.1	1310	35.1
	15	1.0	430	11.5	1000	26.8	1380	37.0	1520	40.7	1520	40.7
	20	1.4	530	14.2	1200	32.2	1560	41.8	1620	43.4	1620	43.4
	30	2.1	680	18.2	1550	41.5	1840	49.3	1750	46.9		
	40	2.8	850	22.8	1900	50.9	1950	52.3				
	50	3.4	970	26.0	2200	59.0	2000	53.6				
	60	4.1	1150	30.8	2280	61.1	2100	56.3				
	80	5.5	1450	38.9	2350	63.0						
	100	6.9	1750	46.9	1900	50.9						
	125	8.6	2100	56.3								
11 in. w.c. / 27 mbar 10 to 12.5 in. w.c. / 25 to 31 mbar 1 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	150	4.0	200	5.4	240	6.4	330	8.8
	2	0.14	120	3.2	200	5.4	270	7.2	420	11.3	530	14.2
	3	0.21	150	4.0	250	6.7	350	9.4	530	14.2	680	18.2
	5	0.35	190	5.1	340	9.1	480	12.9	770	20.6	860	23.0
	10	0.69	290	7.8	550	14.7	910	24.4	1210	32.4	1210	32.4
	15	1.0	400	10.7	840	22.5	1210	32.4	1380	37.0	1380	37.0
	20	1.4	480	12.9	1140	30.6	1550	41.5	1590	42.6	1590	42.6
	30	2.1	670	18.0	1530	41.0	1830	49.0	1810	48.5		
	40	2.8	820	22.0	1970	52.8	1950	52.3				
	50	3.4	970	26.0	2150	57.6	1990	53.3				
	60	4.1	1120	30.0	2260	60.6	2050	54.9				
	80	5.5	1420	38.1	2390	64.1						
	100	6.9	1730	46.4	1950	52.3						
	125	8.6	2110	56.6								
14 in. w.c. / 35 mbar 12.5 to 20 in. w.c. / 31 to 50 mbar 2 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	140	3.8	190	5.1	290	7.8	330	8.8
	2	0.14	120	3.2	230	6.2	300	8.0	430	11.5	570	15.3
	3	0.21	160	4.3	290	7.8	360	9.6	580	15.5	730	19.6
	5	0.35	210	5.6	360	9.6	500	13.4	760	20.4	970	26.0
	10	0.69	320	8.6	570	15.3	890	23.9	1190	31.9	1290	34.6
	15	1.0	410	11.0	820	22.0	1210	32.4	1460	39.1	1560	41.8
	20	1.4	500	13.4	1050	28.1	1440	38.6	1660	44.5	1700	45.6
	30	2.1	670	18.0	1500	40.2	1790	48.0	1850	49.6		
	40	2.8	830	22.2	1830	49.0	2020	54.1				
	50	3.4	970	26.0	2100	56.3	2100	56.3				
	60	4.1	1140	30.6	2120	56.8	2180	58.4				
	80	5.5	1440	38.6	2220	59.5						
	100	6.9	1770	47.4	2250	60.3						
	125	8.6	2140	57.4								

- Gray areas indicate capacities limited by either droop or boost.
- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

- continued -

Table 6. 3/4 NPT Globe Body Capacities (continued)

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. /mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
28 in. w.c. / 70 mbar 20 to 35 in. w.c. / 50 to 87 mbar ± 2% ABS	2	0.14	150	4.0	310	8.3	470	12.6	710	19.0	930	24.9
	3	0.21	180	4.8	390	10.5	590	15.8	940	25.2	1230	33.0
	5	0.35	250	6.7	530	14.2	840	22.5	1290	34.6	1600	42.9
	10	0.69	360	9.7	810	21.7	1320	35.4	1890	50.7	2200	59.0
	15	1.0	430	11.5	1010	27.1	1650	44.2	2290	61.4	2530	67.8
	20	1.4	530	14.2	1200	32.2	1940	52.0	2490	66.7	2750	73.7
	30	2.1	670	18.0	1570	42.1	2430	65.1	2900	77.7		
	40	2.8	830	22.2	1920	51.5	2720	72.9				
	50	3.4	970	26.0	2280	61.1	2830	75.8				
	60	4.1	1130	30.3	2630	70.5	3050	81.7				
	80	5.5	1440	38.6	3050	81.7						
	100	6.9	1760	47.1	3150	84.4						
	125	8.6	2150	57.6								
2 psig / 0.14 bar 1.25 to 2.2 psig / 0.09 to 0.15 bar ± 2 % ABS	3	0.21	150	4.0	270	7.2	420	11.3	600	16.1	790	21.2
	5	0.35	210	5.6	420	11.3	620	16.6	960	25.7	1230	33.0
	10	0.69	340	9.1	700	18.8	1050	28.1	1430	38.3	1880	50.4
	15	1.0	440	11.8	940	25.2	1350	36.2	1880	50.4	2230	59.8
	20	1.4	520	13.9	1150	30.8	1620	43.4	2260	60.6	2540	68.1
	30	2.1	670	18.0	1540	41.3	2110	56.6	2520	67.5		
	40	2.8	830	22.2	1880	50.4	2430	65.1				
	50	3.4	970	26.0	2170	58.2	2640	70.8				
	60	4.1	1130	30.3	2460	65.9	2850	76.4				
	80	5.5	1450	38.9	2850	76.4						
	100	6.9	1750	46.9	3000	80.4						
	125	8.6	2100	56.3								

- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

Table 7. 1 NPT Globe Body Capacities

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
7 in. w.c. / 17 mbar 6 to 8 in. w.c. / 15 to 20 mbar 1 in. w.c. droop 2 in. w.c. boost	0.5	0.03	70	1.9	120	3.2	170	4.7	240	6.4	300	8.0
	1	0.07	100	2.7	180	4.8	240	6.4	340	9.1	430	11.5
	2	0.14	130	3.5	250	6.7	330	8.8	510	13.7	630	16.9
	3	0.21	170	4.7	340	9.1	420	11.3	680	18.2	770	20.6
	5	0.35	220	5.9	420	11.3	650	17.4	960	25.7	1080	28.9
	10	0.69	330	8.8	730	19.6	1100	29.5	1310	35.1	1600	42.9
	15	1.0	430	11.5	1000	26.8	1440	38.6	1770	47.4	1800	48.2
	20	1.4	530	14.2	1200	32.2	1810	48.5	2100	56.3	1960	52.5
	30	2.1	680	18.2	1550	41.5	2100	56.3	2450	65.7		
	40	2.8	850	22.8	1900	50.9	2150	57.6				
	50	3.4	970	26.0	2200	59.0	2690	72.1				
	60	4.1	1150	30.8	2280	61.1	3010	80.7				
	80	5.5	1450	38.9	2350	63.0						
	100	6.9	1750	46.9	1900	50.9						
	125	8.6	2100	56.3								

- Gray areas indicate capacities limited by either droop or boost.
- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

- continued -

Table 7. 1 NPT Globe Body Capacities (continued)

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
11 in. w.c. / 27 mbar 10 to 12.5 in. w.c. / 25 to 31 mbar 1 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	150	4.0	200	5.4	240	6.4	330	8.8
	2	0.14	120	3.2	200	5.4	270	7.2	420	11.3	530	14.2
	3	0.21	150	4.0	250	6.7	350	9.4	530	14.2	680	18.2
	5	0.35	190	5.1	340	9.1	480	12.9	770	20.6	870	23.3
	10	0.69	290	7.8	550	14.7	910	24.4	1230	33.0	1350	36.2
	15	1.0	400	10.7	840	22.5	1290	34.6	1450	38.9	1630	43.7
	20	1.4	480	12.9	1140	30.6	1420	38.1	1650	44.2	1870	50.1
	30	2.1	670	18.0	1530	41.0	1680	45.0	2100	56.3		
	40	2.8	820	22.0	1970	52.8	1750	46.9				
	50	3.4	970	26.0	2150	57.6	1840	49.3				
	60	4.1	1120	30.0	2260	60.6	2130	57.1				
	80	5.5	1420	38.1	2390	64.1						
	100	6.9	1730	46.4	1950	52.3						
	125	8.6	2110	56.6								
14 in. w.c. / 35 mbar 12.5 to 20 in. w.c. / 31 to 50 mbar 2 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	140	3.7	190	5.1	290	7.8	330	8.8
	2	0.14	120	3.2	230	6.2	300	8.0	430	11.5	570	15.3
	3	0.21	160	4.3	290	7.8	360	9.7	580	15.5	730	19.6
	5	0.35	210	5.6	360	9.7	500	13.4	760	20.4	970	26.0
	10	0.69	320	8.6	570	15.3	890	23.9	1190	31.9	1530	41.0
	15	1.0	410	11.0	820	22.0	1210	32.4	1460	39.1	1780	47.7
	20	1.4	500	13.4	1050	28.1	1440	38.6	1660	44.5	1950	52.3
	30	2.1	670	18.0	1500	40.2	1790	48.0	2200	59.0		
	40	2.8	830	22.2	1830	49.0	2020	54.1				
	50	3.4	970	26.0	2100	56.3	2100	56.3				
	60	4.1	1140	30.6	2350	63.0	2180	58.4				
	80	5.5	1440	38.6	3000	80.4						
	100	6.9	1770	47.4	2550	68.3						
	125	8.6	2140	57.4								
28 in. w.c. / 70 mbar 20 to 35 in. w.c. / 50 to 87 mbar ± 2% ABS	2	0.14	150	4.0	310	8.3	470	12.6	710	19.0	970	26.0
	3	0.21	180	4.8	390	10.5	590	15.8	940	25.2	1290	34.6
	5	0.35	250	6.7	530	14.2	840	22.5	1380	37.0	1710	45.8
	10	0.69	360	9.7	810	21.7	1320	35.4	2060	55.2	2500	67.0
	15	1.0	430	11.5	1010	27.1	1750	46.9	2550	68.3	3030	81.2
	20	1.4	530	14.2	1200	32.2	2130	57.1	2930	78.5	3380	90.6
	30	2.1	670	18.0	1570	42.1	2790	74.8	2550	68.3		
	40	2.8	830	22.2	1920	51.5	3400	91.1				
	50	3.4	970	26.0	2280	61.1	3800	102				
	60	4.1	1130	30.3	2630	70.5	4050	109				
	80	5.5	1440	38.6	3330	89.2						
	100	6.9	1760	47.2	4050	109						
	125	8.6	2150	57.6								
2 psig / 0.14 bar 1.25 to 2.2 psig / 0.09 to 0.15 bar ± 2 % ABS	3	0.21	150	4.0	270	7.2	420	11.3	600	16.1	790	21.2
	5	0.35	210	5.6	420	11.3	620	16.6	960	25.7	1230	33.0
	10	0.69	340	9.1	700	18.8	1050	28.1	1650	44.2	2000	53.6
	15	1.0	440	11.8	940	25.2	1450	38.9	2130	57.1	2580	69.1
	20	1.4	520	13.9	1150	30.8	1750	46.9	2600	69.7	2980	79.9
	30	2.1	670	18.0	1540	41.3	2290	61.4	3180	85.2		
	40	2.8	830	22.2	1880	50.4	2740	73.4				
	50	3.4	970	26.0	2220	59.5	2310	61.9				
	60	4.1	1130	30.3	2600	69.7	3600	96.5				
	80	5.5	1450	38.9	3340	89.5						
	100	6.9	1750	46.9	4000	107						
	125	8.6	2100	56.3								

- Gray areas indicate capacities limited by either droop or boost.
- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

Table 8. 1-1/4 NPT Globe Body Capacities

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
7 in. w.c. / 17 mbar 6 to 8 in. w.c. / 15 to 20 mbar 1 in. w.c. droop 2 in. w.c. boost	0.5	0.03	55	1.47	105	2.81	145	3.89	195	5.23	320	8.58
	1	0.07	90	2.41	145	3.89	215	5.76	310	8.31	340	9.11
	2	0.14	125	3.35	230	6.16	285	7.64	400	10.7	400	10.7
	3	0.21	170	4.56	225	6.03	365	9.78	545	14.6	580	15.5
	5	0.35	225	6.03	295	7.91	480	12.9	710	19.0	965	25.9
	10	0.69	275	7.37	450	12.1	670	18.0	1190	31.9	1495	40.1
	15	1.0	380	10.2	585	15.7	945	25.3	1745	46.8	1760	47.2
	20	1.4	475	12.7	780	20.9	1320	35.4	2275	61.0	2115	56.7
	30	2.1	625	16.8	1000	26.8	2275	61.0	3430	91.9		
	40	2.8	775	20.8	1045	28.0	3035	81.3				
	50	3.4	940	25.2	1570	42.1	3595	96.3				
	60	4.1	1065	28.5	1085	29.1	1200	32.2				
	80	5.5	1165	31.2	925	24.8						
	100	6.9	1260	33.8	995	26.7						
	125	8.6	1300	34.8								
11 in. w.c. / 27 mbar 10 to 12.5 in. w.c. / 25 to 31 mbar 1 in. w.c. droop 2 in. w.c. boost	1	0.07	70	1.88	125	3.35	145	3.89	205	5.49	220	5.90
	2	0.14	110	2.95	165	4.42	190	5.09	300	8.04	355	9.51
	3	0.21	160	4.29	190	5.09	255	6.83	370	9.92	470	12.6
	5	0.35	205	5.49	220	5.90	350	9.38	500	13.4	710	19.0
	10	0.69	255	6.83	325	8.71	485	13.0	855	22.9	1315	35.2
	15	1.0	310	8.31	420	11.3	605	16.2	1360	36.4	1615	43.3
	20	1.4	420	11.3	475	12.7	685	18.4	1930	51.7	1905	51.1
	30	2.1	530	14.2	625	16.8	800	21.4	2850	76.4		
	40	2.8	670	18.0	720	19.3	830	22.2				
	50	3.4	830	22.2	820	22.0	890	23.9				
	60	4.1	930	24.9	920	24.7	905	24.3				
	80	5.5	1030	27.6	1020	27.3						
	100	6.9	1075	28.8	945	25.3						
	125	8.6	1135	30.4								
14 in. w.c. / 35 mbar 12.5 to 20 in. w.c. / 31 to 50 mbar 2 in. w.c. droop 2 in. w.c. boost	1	0.07	70	1.88	125	3.35	220	5.90	220	5.90	310	8.31
	2	0.14	100	2.68	170	4.56	240	6.43	360	9.65	455	12.2
	3	0.21	150	4.02	175	4.69	310	8.31	420	11.3	620	16.6
	5	0.35	120	3.22	240	6.43	410	11.0	600	16.1	860	23.0
	10	0.69	180	4.82	415	11.1	605	16.2	860	23.0	1350	36.2
	15	1.0	345	9.25	530	14.2	740	19.8	1395	37.4	1690	45.3
	20	1.4	370	9.92	645	17.3	890	23.9	1710	45.8	1990	53.3
	30	2.1	585	15.7	830	22.2	1195	32.0	2900	77.7		
	40	2.8	625	16.8	1025	27.5	1825	48.9				
	50	3.4	825	22.1	1155	31.0	2565	68.7				
	60	4.1	1030	27.6	1360	36.4	3045	81.6				
	80	5.5	1110	29.7	1665	44.6						
	100	6.9	1190	31.9	1385	37.1						
	125	8.6	1290	34.6								

☐ - Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

- continued -

Table 8. 1-1/4 NPT Globe Body Capacities (continued)

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
28 in. w.c. / 70 mbar 20 to 35 in. w.c. / 50 to 87 mbar ± 2% ABS	2	0.14	110	2.95	240	6.43	410	11.0	570	15.3	875	23.4
	3	0.21	135	3.62	270	7.24	550	14.7	905	24.3	1200	32.2
	5	0.35	185	4.96	395	10.6	765	20.5	1220	32.7	1655	44.4
	10	0.69	270	7.24	540	14.5	915	24.5	2040	54.7	2490	66.7
	15	1.0	375	10.0	855	22.9	1530	41.0	2605	69.8	3045	81.6
	20	1.4	435	11.7	985	26.4	1760	47.2	3010	80.7	3750	100
	30	2.1	615	16.5	1355	36.3	2270	60.8	4250	114		
	40	2.8	650	17.4	1690	45.3	2900	77.7				
	50	3.4	905	24.3	2010	53.9	3515	94.2				
	60	4.1	955	25.6	2285	61.2	4095	110				
	80	5.5	1210	32.4	3020	80.9						
	100	6.9	1615	43.3	3645	97.7						
	125	8.6	2030	54.4								
2 psig / 0.14 bar 1.25 to 2.2 psig / 0.09 to 0.15 bar ± 2 % ABS	3	0.21	105	2.81	300	8.04	350	9.38	535	14.3	755	20.2
	5	0.35	125	3.35	350	9.38	530	14.2	885	23.7	1245	33.4
	10	0.69	235	6.30	580	15.5	950	25.5	1530	41.0	2010	53.9
	15	1.0	230	6.16	770	20.6	1240	33.2	2040	54.7	2565	68.7
	20	1.4	300	8.04	965	25.9	1505	40.3	2530	67.8	3070	82.3
	30	2.1	470	12.6	1310	35.1	1990	53.3	3410	91.4		
	40	2.8	530	14.2	1640	44.0	2710	72.6				
	50	3.4	675	18.1	1890	50.7	3140	84.2				
	60	4.1	805	21.6	2330	62.4	3790	102				
	80	5.5	1225	32.8	3010	80.7						
	100	6.9	1390	37.3	3480	93.3						
	125	8.6	1250	33.5								

- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

Table 9. 3/4 NPT Angle Body Capacities

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
7 in. w.c. / 17 mbar 6 to 8 in. w.c. / 15 to 20 mbar 1 in. w.c. droop 2 in. w.c. boost	0.5	0.03	70	1.9	120	3.2	170	4.6	240	6.4	300	8.0
	1	0.07	100	2.7	180	4.8	240	6.4	340	9.1	430	11.5
	2	0.14	130	3.5	250	6.7	330	8.8	510	13.7	630	16.9
	3	0.21	170	4.6	340	9.1	420	11.3	680	18.2	770	20.6
	5	0.35	220	5.9	420	11.3	650	17.4	900	24.1	960	25.7
	10	0.69	330	8.8	730	19.6	1100	29.5	1310	35.1	1310	35.1
	15	1.0	430	11.5	1000	26.8	1380	37.0	1520	40.7	1520	40.7
	20	1.4	530	14.2	1200	32.2	1560	41.8	1620	43.4	1620	43.4
	30	2.1	680	18.2	1550	41.5	1840	49.3	1750	46.9		
	40	2.8	850	22.8	1900	50.9	1950	52.3				
	50	3.4	970	26.0	2200	59.0	2000	53.6				
	60	4.1	1150	30.8	2280	61.1	2100	56.3				
	80	5.5	1450	38.9	2350	63.0						
	100	6.9	1750	46.9	1900	50.9						
	125	8.6	2100	56.3								

- Gray areas indicate capacities limited by either droop or boost.
- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

- continued -

Table 9. 3/4 NPT Angle Body Capacities (continued)

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS — Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
11 in. w.c. / 27 mbar 10 to 12.5 in. w.c. / 25 to 31 mbar 1 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	150	4.0	200	5.4	240	6.4	330	8.8
	2	0.14	120	3.2	200	5.4	270	7.2	420	11.3	530	14.2
	3	0.21	150	4.0	250	6.7	350	9.4	530	14.2	680	18.2
	5	0.35	190	5.1	340	9.1	480	12.9	770	20.6	860	23.1
	10	0.69	290	7.8	550	14.7	910	24.4	1210	32.4	1210	32.4
	15	1.0	400	10.7	840	22.5	1210	32.4	1380	37.0	1380	37.0
	20	1.4	480	12.9	1140	30.6	1550	41.5	1590	42.6	1590	42.6
	30	2.1	670	18.0	1530	41.0	1830	49.0	1780	47.7		
	40	2.8	820	22.0	1970	52.8	1950	52.3				
	50	3.4	970	26.0	2150	57.6	1990	53.3				
	60	4.1	1120	30.0	2260	60.6	2050	54.9				
	80	5.5	1420	38.0	2390	64.1						
	100	6.9	1730	46.4	1950	52.3						
	125	8.6	2110	56.6								
14 in. w.c. / 35 mbar 12.5 to 20 in. w.c. / 31 to 50 mbar 2 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	140	3.8	190	5.1	290	7.8	330	8.8
	2	0.14	120	3.2	230	6.2	300	8.0	430	11.5	570	15.3
	3	0.21	160	4.3	290	7.8	360	9.7	580	15.5	730	19.6
	5	0.35	210	5.6	360	9.7	500	13.4	760	20.4	970	26.0
	10	0.69	320	8.6	570	15.3	890	23.9	1190	31.9	1290	34.6
	15	1.0	410	11.0	820	22.0	1210	32.4	1460	39.1	1560	41.8
	20	1.4	500	13.4	1050	28.1	1440	38.6	1660	44.5	1700	45.6
	30	2.1	670	18.0	1500	40.2	1790	48.0	1850	49.6		
	40	2.8	830	22.2	1830	49.0	2020	54.1				
	50	3.4	970	26.0	2100	56.3	2100	56.3				
	60	4.1	1140	30.6	2120	56.8	2180	58.4				
	80	5.5	1440	38.6	2220	59.5						
	100	6.9	1770	47.4	2250	60.3						
	125	8.6	2140	57.4								
28 in. w.c. / 70 mbar 20 to 35 in. w.c. / 50 to 87 mbar ± 2% ABS	2	0.14	150	4.0	310	8.3	470	12.6	710	19.0	930	24.9
	3	0.21	180	4.8	390	10.5	590	15.8	940	25.2	1230	33.0
	5	0.35	250	6.7	530	14.2	840	22.5	1290	34.6	1600	42.9
	10	0.69	360	9.7	810	21.7	1320	35.4	1890	50.7	2200	59.0
	15	1.0	430	11.5	1010	27.1	1650	44.2	2290	61.4	2530	67.8
	20	1.4	530	14.2	1200	32.2	1940	52.0	2490	66.7	2750	73.7
	30	2.1	670	18.0	1570	42.1	2430	65.1	2900	77.7		
	40	2.8	830	22.2	1920	51.5	2720	72.9				
	50	3.4	970	26.0	2280	61.1	2830	75.8				
	60	4.1	1130	30.3	2630	70.5	3050	81.7				
	80	5.5	1440	38.6	3050	81.7						
	100	6.9	1760	47.2	3150	84.4						
	125	8.6	2150	57.6								
2 psig / 0.14 bar 1.25 to 2.2 psig / 0.09 to 0.15 bar ± 2 % ABS	3	0.21	150	4.0	270	7.2	420	11.3	600	16.1	790	21.2
	5	0.35	210	5.6	420	11.3	620	16.6	960	25.7	1230	32.9
	10	0.69	340	9.1	700	18.8	1050	28.1	1430	38.3	1880	50.4
	15	1.0	440	11.8	940	25.2	1350	36.2	1880	50.4	2230	59.8
	20	1.4	520	13.9	1150	30.8	1620	43.4	2260	60.6	2540	68.1
	30	2.1	670	18.0	1540	41.3	2110	56.6	2520	67.5		
	40	2.8	830	22.2	1880	50.4	2430	65.1				
	50	3.4	970	26.0	2170	58.2	2640	70.8				
	60	4.1	1130	30.3	2460	65.9	2850	76.4				
	80	5.5	1450	38.9	2850	76.4						
	100	6.9	1750	46.9	3000	80.4						
	125	8.6	2100	56.3								

- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

Table 10. 1 NPT Angle Body Capacities

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
7 in. w.c. / 17 mbar 6 to 8 in. w.c. / 15 to 20 mbar 1 in. w.c. droop 2 in. w.c. boost	0.5	0.03	70	1.9	120	3.2	170	4.6	240	6.4	300	8.0
	1	0.07	100	2.7	180	4.8	240	6.4	340	9.1	430	11.5
	2	0.14	130	3.5	250	6.7	330	8.8	510	13.7	630	16.9
	3	0.21	170	4.6	340	9.1	420	11.3	680	18.2	860	23.1
	5	0.35	220	5.9	420	11.3	650	17.4	1030	27.6	1130	30.3
	10	0.69	330	8.8	730	19.6	1100	29.5	1560	41.8	1520	40.7
	15	1.0	430	11.5	1000	26.8	1560	41.8	1830	49.0	1820	48.8
	20	1.4	530	14.2	1200	32.2	2220	59.5	2270	60.8	2370	63.5
	30	2.1	680	18.2	1550	41.5	2880	77.2	2770	74.2		
	40	2.8	850	22.8	1900	50.9	3550	95.1				
	50	3.4	970	26.0	2200	59.0	4000	107				
	60	4.1	1150	30.8	2280	61.1	4200	113				
	80	5.5	1450	38.9	2350	63.0						
	100	6.9	1750	46.9	1900	50.9						
	125	8.6	2100	56.3								
11 in. w.c. / 27 mbar 10 to 12.5 in. w.c. / 25 to 31 mbar 1 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	150	4.0	200	5.4	240	6.4	330	8.8
	2	0.14	120	3.2	200	5.4	270	7.2	420	11.3	530	14.2
	3	0.21	150	4.0	250	6.7	350	9.4	530	14.2	680	18.2
	5	0.35	190	5.1	340	9.1	480	12.9	770	20.6	970	26.0
	10	0.69	290	7.8	550	14.7	1050	28.1	1230	33.0	1430	38.3
	15	1.0	400	10.7	840	22.5	1470	39.4	1750	46.9	1760	47.2
	20	1.4	480	12.9	1140	30.6	1920	51.5	2230	59.8	2450	65.7
	30	2.1	670	18.0	1530	41.0	2430	65.1	2900	77.7		
	40	2.8	820	22.0	1970	52.8	2870	76.9				
	50	3.4	970	26.0	2150	57.6	3420	91.7				
	60	4.1	1120	30.0	2260	60.6	3750	101				
	80	5.5	1420	38.1	2390	64.0						
	100	6.9	1730	46.4	1950	52.3						
	125	8.6	2110	56.6								
14 in. w.c. / 35 mbar 12.5 to 20 in. w.c. / 31 to 50 mbar 2 in. w.c. droop 2 in. w.c. boost	1	0.07	80	2.1	140	3.8	190	5.1	290	7.8	330	8.8
	2	0.14	120	3.2	230	6.2	300	8.0	430	11.5	570	15.3
	3	0.21	160	4.3	290	7.8	360	9.7	580	15.5	730	19.6
	5	0.35	210	5.6	360	9.7	500	13.4	760	20.4	1000	26.8
	10	0.69	320	8.6	570	15.3	890	23.9	1290	34.6	1480	39.7
	15	1.0	410	11.0	820	22.0	1210	32.4	1570	42.1	1760	47.2
	20	1.4	500	13.4	1050	28.1	1510	40.5	1800	48.2	2400	64.3
	30	2.1	670	18.0	1500	40.2	1980	53.1	2430	65.1		
	40	2.8	830	22.2	1880	50.4	2250	60.3				
	50	3.4	970	26.0	2190	58.7	2570	68.9				
	60	4.1	1140	30.6	2450	65.7	3400	91.1				
	80	5.5	1440	38.6	3390	90.9						
	100	6.9	1770	47.4	2600	69.7						
	125	8.6	2140	57.4								

- Gray areas indicate capacities limited by either droop or boost.
- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

- continued -

Table 10. 1 NPT Angle Body Capacities (continued)

OUTLET PRESSURE SETTING, SPRING RANGE, DROOP AND BOOST	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS									
			Orifice Size, In. / mm									
			1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
28 in. w.c. / 70 mbar 20 to 35 in. w.c. / 50 to 87 mbar ± 2% ABS	2	0.14	150	4.0	310	8.3	470	12.6	710	19.0	1030	27.6
	3	0.21	180	4.8	390	10.5	590	15.8	940	25.2	1380	37.0
	5	0.35	250	6.7	530	14.2	840	22.5	1380	37.0	1850	49.6
	10	0.69	360	9.7	810	21.7	1320	35.3	2170	58.2	2650	71.0
	15	1.0	430	11.5	1010	27.1	1750	46.9	2800	75.0	3250	87.1
	20	1.4	530	14.2	1200	32.2	2130	57.1	3300	88.4	3650	97.8
	30	2.1	670	18.0	1570	42.1	2790	74.8	4000	107		
	40	2.8	830	22.2	1920	51.5	3550	95.1				
	50	3.4	970	26.0	2280	61.1	4150	111				
	60	4.1	1130	30.3	2630	70.5	4800	129				
	80	5.5	1440	38.6	3330	89.2						
	100	6.9	1760	47.2	4050	109						
	125	8.6	2150	57.6								
2 psig / 0.14 bar 1.25 to 2.2 psig / 0.09 to 0.15 bar ± 2 % ABS	3	0.21	150	4.0	270	7.2	420	11.3	600	16.1	790	21.2
	5	0.35	210	5.6	420	11.3	620	16.6	960	25.7	1320	35.4
	10	0.69	340	9.1	700	18.8	1050	28.1	1650	44.2	2150	57.6
	15	1.0	440	11.8	940	25.2	1450	38.9	2230	59.8	2720	72.9
	20	1.4	520	13.9	1150	30.8	1750	46.9	2730	73.2	3240	86.8
	30	2.1	670	18.0	1540	41.3	2470	66.2	3520	94.3		
	40	2.8	830	22.2	1880	50.4	2930	78.5				
	50	3.4	970	26.0	2220	59.5	3600	96.5				
	60	4.1	1130	30.3	2600	69.7	4200	113				
	80	5.5	1450	38.9	3340	89.5						
	100	6.9	1750	46.9	4000	107						
	125	8.6	2100	56.3								

- Blank areas indicate where maximum operating inlet pressure is exceeded for a given orifice.

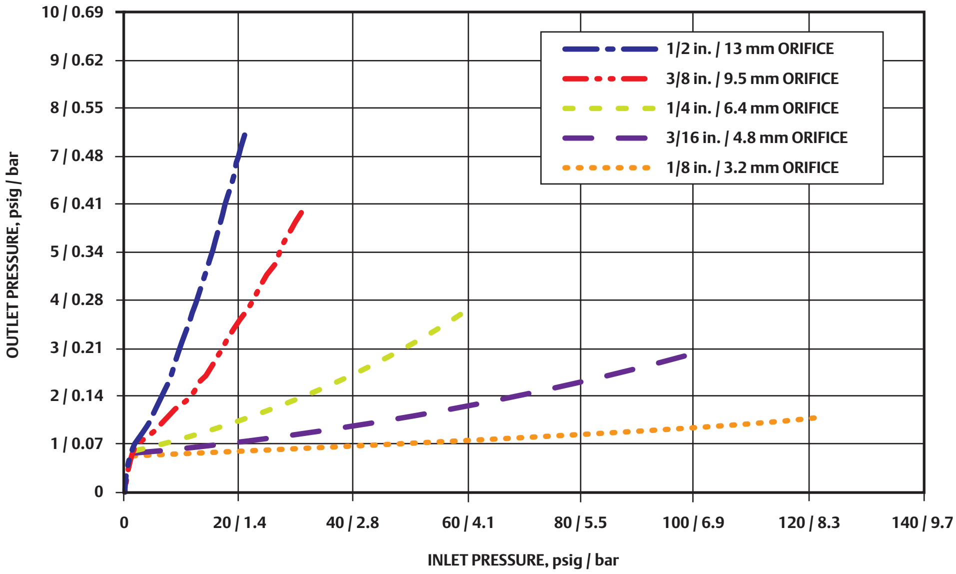

Figure 3. *7 in. w.c. / 17 mbar Setpoint Relief Curves (with Lever Disconnected, No Vent Piping and 3/4 or 1 NPT Vent)*

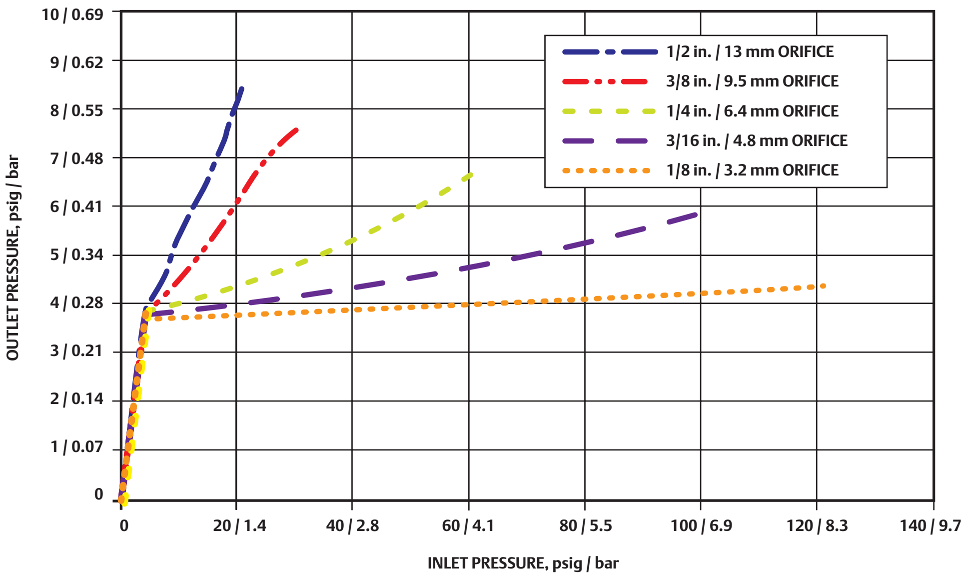

Figure 4. *2 psig / 0.14 bar Setpoint Relief Curves (with Lever Disconnected, No Vent Piping and 3/4 or 1 NPT Vent)*

Table 11. Relief Performance(1)

ORIFICE SIZE		MAXIMUM ALLOWABLE INLET PRESSURE IF OUTLET PRESSURE IS HELD AT OR BELOW 2 psig / 0.14 bar	
In.	mm	psig	bar
1/8 3/16	3.2 4.8	125 65	8.6 4.5
1/4 3/8 1/2	6.4 9.5 13	30 10 7	2.1 0.69 0.48

1. The relief performance testing is in accordance with ANSI B109.4 and CSA 6.18 with the regulator set at 7 in. w.c. / 17 mbar stem linkage disconnected and vented directly to atmosphere using the 3/4 or 1 NPT vent.

Introduction

The Type LR125 pilot-operated pressure reducing regulator is designed for liquid industrial/commercial applications. The Type LR125 provides smooth operation, tight shutoff and a long service life. Its internally actuated metal plug eliminates disadvantages associated with flexible element style regulators, and the specially engineered flow path deflects debris, protecting the seat from damage and erosion.

The Type LR125 is used in conjunction with a Type MR95H/MR95HP pilot and Type 112 restrictor. An internal inlet strainer prevents large particles from entering the main valve, limiting damage to internal parts.

The main valve flow is up through the center of the cage and down through the cage slots (see Figure 2).

Main Valve Body Sizes, End Connection Styles and Structural Design Ratings(2)

See Table 2

Maximum Inlet Pressures(1)

Type LR125 Main Valve: See Table 2
Type MR95H/MR95HP Pilot: See Table 5
Type 112 Restrictor: 1500 psig / 103 bar

Maximum Outlet Pressure

Type LR125 Main Valve: See Table 2
Type MR95H/MR95HP Pilot: See Table 5

Outlet (Control) Pressure Ranges

See Table 1

Main Valve Plug Travel

1 in. / DN 25: 0.37 in. / 9.4 mm
2 in. / DN 50: 0.68 in. / 17 mm
3 in. / DN 80: 0.98 in. / 25 mm
4 in. / DN 100: 1.19 in. / 30 mm

Main Valve Minimum Differential Pressures

See Table 6

Temperature Capabilities

Regulator temperature limits depend on Main Valve Diaphragm Material
See Table 4

Main Valve Internal Inlet Strainer Sizes

1 in. / DN 25:
12 Mesh (0.0661 in. / 1.68 mm)(2)
2, 3 and 4 in. / DN 50, 80 and 100:
10 Mesh (0.0787 in. / 2 mm)(2)

Flow Capacities

See Table 12

Flow and IEC Sizing Coefficients

Type LR125 Main Valve: See Table 7
Type MR95H/MR95HP Pilot: See Table 8
Type 112 Restrictor: See Table 9

Pressure Registration

External: 1/2 NPT control line connection

Spring Case Vent

Type Y602-12

Construction Materials

Type LR125 Main Valve
Body: WCC Steel, LCC Steel, CF8M or CF3M Stainless Steel
Diaphragm/O-rings: See Table 4

Type MR95H/MR95HP Pilot
Body/Spring Case: WCC Steel or CF8M Stainless Steel (LCC Steel and CF3M Stainless Steel available for special constructions)
Diaphragm: Neoprene (CR) or Fluorocarbon (FKM)
Disk: Nitrile (NBR) or Fluorocarbon (FKM)

Type 112 Restrictor
Body: 15-5 Stainless Steel
O-rings: Nitrile (NBR) or Fluorocarbon (FKM)

Approximate Weights

See Table 10

Ordering Guide

To order this product, contact your local Sales Office.

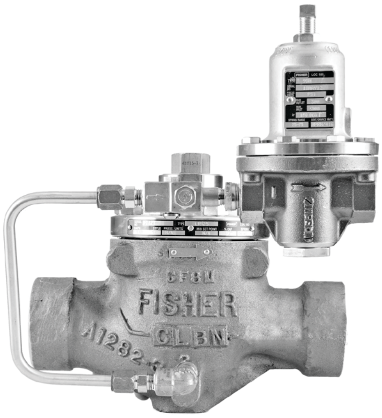

Figure 1. *Type LR125 Pressure Reducing Liquid Regulator*

Application

- Liquid

Features

- **Rugged "Boot Style" Design**
- **Proven Field Dependability**
- **Material Versatility**
- **Tight Shutoff Capability**
- **Full SST Construction Available for Harsh Environments**
- **API 614 Compliant**

Table 1. Outlet (Control) Pressure Ranges

PILOT	OUTLET PRESSURE RANGE		SPRING WIRE DIAMETER		SPRING FREE LENGTH		SPRING COLOR
	psig	bar	In.	mm	In.	mm	
Type MR95H	15 to 30 25 to 75 70 to 150	1.0 to 2.1 1.7 to 5.2 4.8 to 10.3	0.207 0.234 0.283	5.26 5.94 7.19	2.50 2.60 2.44	63.5 65.9 62.0	Yellow Green Red
Type MR95HP	15 to 100 80 to 400	1.0 to 6.9 5.5 to 27.6	0.281 0.375	7.14 9.53	2.50 2.60	63.5 63.5	Unpainted Unpainted

1. Ratings and end connections other than ASME standards can usually be provided; contact your local Sales Office.
2. Nominal sieve opening

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
9/15
www.Emerson.com

Type LR125

Pressure Reducing Liquid Regulator

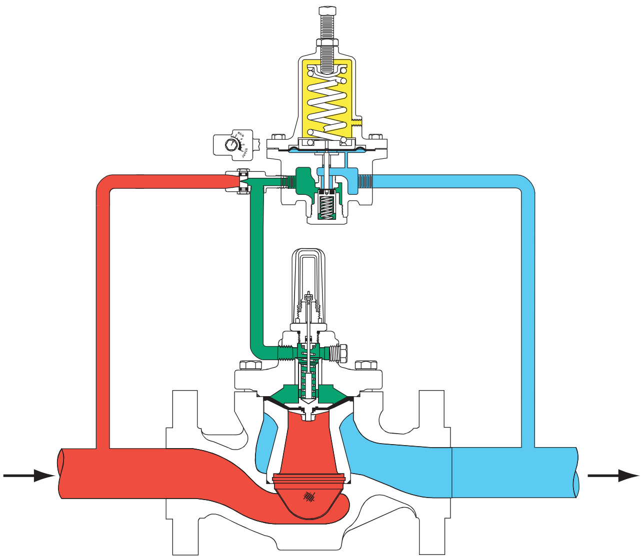

Figure 2. *Type LR125 Pressure Reducing Liquid Regulator Operational Schematic*

Table 2. Type LR125 Main Valve Body Sizes, End Connection Styles, Structural Design Ratings and Maximum Operating Inlet Pressures[1]

MAIN VALVE BODY SIZE		MAIN VALVE BODY MATERIAL	END CONNECTION STYLE[2]	STRUCTURAL DESIGN RATING[3]		MAXIMUM OPERATING INLET PRESSURE[3]	
In.	DN			psig	bar	psig	bar
1, 2, 3 and 4	25, 50, 80 and 100	WCC Steel	NPT or SWE (1 and 2 in. only)	1500	103	600	41.4
			CL150 RF	290	20.0	290	20.0
			CL300 RF	750	51.7	600	41.4
			CL600 RF	1500	103		
			PN 16/25/40 RF[4]	580	40.0		
		CF8M Stainless steel	NPT (1 and 2 in. only)	1440	99.2	550	37.9
			CL150 RF	275	19.0	275	19.0
			CL300 RF	720	49.6	550	37.9
			CL600 RF	1440	99.2		
			PN 16/25/40 RF[4]	580	40.0		

1. The pressure/temperature limits in this Application Guide and any applicable standard or code limitation should not be exceeded.
2. Ratings and end connections for other than ASME standard can usually be provided. Contact your local Sales Office for assistance.
3. Maximum cold working pressure (CWP) per ASME B16.34 or product Bulletin limit, whichever is lowest. Temperature may decrease these maximum pressures.
4. Not available for 4 in. / DN 100 body size.

Table 3. Main Valve Maximum Pressure Ratings, Diaphragm Selection Information and Main Spring Selection[1]

BODY SIZE		MAIN VALVE DIAPHRAGM MATERIAL	MAXIMUM OPERATING INLET PRESSURE[4]		MAXIMUM OPERATING DIFFERENTIAL PRESSURE[3][4]		MAXIMUM EMERGENCY INLET AND DIFFERENTIAL PRESSURE		MAIN SPRING COLOR
NPS	DN		psig	bar	psig	bar	psid	bar d	
1	25	17E68 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Black and Yellow
		17E97 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Black and Yellow
			600	41.4	600	41.4	600	41.4	Black and White[2]
		17E88 Fluorocarbon (FKM)	300	20.7	300	20.7	300	20.7	Black and Yellow
			600	41.4	500	34	600	41.4	Black and White[2]
2	50	17E68 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Green and White
		17E97 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Green and White
			600	41.4	600	41.4	600	41.4	Purple[2]
		17E88 Fluorocarbon (FKM)	300	20.7	300	20.7	300	20.7	Green and White
			600	41.4	500	34	600	41.4	Purple[2]
3	80	17E68 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Light Blue and White
		17E97 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Light Blue and White
			600	41.4	600	41.4	600	41.4	Black[2]
		17E88 Fluorocarbon (FKM)	300	20.7	300	20.7	300	20.7	Light Blue and White
			600	41.4	500	34	600	41.4	Black[2]
4	100	17E68 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Green and White
		17E97 Nitrile (NBR)	300	20.7	300	20.7	300	20.7	Green and White
			600	41.4	600	41.4	600	41.4	Red[2]
		17E88 Fluorocarbon (FKM)	300	20.7	300	20.7	300	20.7	Green and White
			600	41.4	500	34	600	41.4	Red[2]

1. See Table 2 for main valve structural design ratings and Table 5 for pilot ratings.
2. The black and white, purple, black and red springs are only recommended for applications where the maximum inlet pressure can exceed 300 psig / 20.7 bar.
3. Maximum differential pressures may be lower for applications where cavitation may be present.
4. These are recommendations that provide the best regulator performance for a typical application. Please contact your local Sales Office for further information if a deviation from the standard recommendations are required.

Table 4. Main Valve Diaphragm Material and Temperature Capabilities

	17E68 NITRILE (NBR)	17E97 NITRILE (NBR)	17E88 FLUOROCARBON (FKM)
Liquid Temperature	-20 to 150°F / -29 to 66°C	0 to 150°F / -18 to 66°C	0 to 250°F / -18 to 121°C[1][2]
General Applications	Best for low pressure differential and cold temperature service applications.	Best for abrasive or erosive service applications.	Best for high temperature applications.
Heavy Particle Erosion	Fair	Excellent	Good

1. Fluorocarbon (FKM) is limited to 200°F / 93°C in hot water.
2. For differential pressures above 400 psig / 28 bar diaphragm temperature is limited to 150°F / 66°C.

Table 5. Pilot Maximum Cold Working Pressure[1][2]

PILOT	BODY SIZE	BODY AND SPRING CASE MATERIAL	MAXIMUM INLET PRESSURE	MAXIMUM OUTLET PRESSURE
Type MR95H	1/2 NPT	Steel Stainless steel	300 psig / 20.7 bar 300 psig / 20.7 bar	300 psig / 20.7 bar 300 psig / 20.7 bar
Type MR95HP	1/2 NPT	Steel Stainless steel	600 psig / 41.4 bar 600 psig / 41.4 bar	600 psig / 41.4 bar 550 psig / 37.9 bar

1. The pressure/temperature limits in this Bulletin, and any applicable standard or code limitation should not be exceeded.
2. Temperature and/or the body end connection may decrease these maximum pressures.

Table 6. Main Valve Minimum Differential Pressures[1]

MAIN VALVE BODY SIZE		MAIN SPRING COLOR	DIAPHRAGM MATERIAL	MINIMUM DIFFERENTIAL, PERCENT OF CAPACITY			
				For 90% Capacity		For 100% Capacity	
In.	DN			psid	bar d	psid	bar d
1	25	Black and Yellow	17E68 and 17E88	30	2.1	30	2.1
			17E97	35	2.5	35	2.5
		Black and White	17E88 and 17E97	43	3.0	43	3.0
2	50	Green and White	17E68 and 17E88	18	1.2	19	1.3
			17E97	24	1.7	24	1.7
		Red	17E88 and 17E97	29	2.0	31	2.1
3	80	Light Blue and White	17E68 and 17E88	21	1.5	28	1.9
			17E97	23	1.6	23	1.6
		Black and White	17E88 and 17E97	32	2.2	38	2.6
4	100	Green and White	17E68 and 17E88	16	1.1	30	2.1
			17E97	16	1.1	34	2.3
		Red and White	17E88 and 17E97	21	1.5	40	2.8

1. See Table 2 for structural design ratings and Table 5 for pilot rating.

Table 7. Flow and Sizing Coefficients for Type LR125 Main Valve at 100% Capacity

MAIN VALVE BODY SIZE		REGULATING COEFFICIENTS		WIDE-OPEN COEFFICIENTS		K_m	IEC SIZING COEFFICIENTS		
IN.	DN	C_v	C_1	C_v	C_1		X_T	F_D	F_L
1	25	14.8	33.4	15.2	33.5	0.88	0.706	0.06	0.94
2	50	50.8	37.2	52.4	37.2	0.92	0.875	0.09	0.96
3	80	91.4	38.8	94.1	38.8	0.94	0.952	0.09	0.97
4	100	147	38.7	151	38.7	0.85	0.947	0.09	0.92

Table 8. Flow and Sizing Coefficients for Type MR95H/MR95HP Pilot

BODY SIZE, IN. / DN	WIDE-OPEN COEFFICIENT	C_1	K_m	IEC SIZING COEFFICIENTS		
	C_v			X_T	F_D	F_L
1/2 / 15	2.9	35.5	0.79	0.797	0.70	0.89

$K_m = F_L^2$

Table 9. Type 112 Restrictor Flow Coefficients

RESTRICTOR SETTING	C_v	C_1
2	0.03	35
4	0.07	
6	0.14	
8	0.17	

Table 10. Approximate Weights Including Type MR95H/MR95HP Pilot and Restrictor

BODY SIZE		MAIN VALVE BODY, LBS / kg			
In.	DN	NPT or SWE	CL150 RF	CL300 RF	CL600 RF
1	25	22 / 10	24 / 11	28 / 13	32 / 15
2	50	51 / 23	54 / 24	58 / 26	65 / 29
3	80	103 / 47	107 / 49	110 / 50	123 / 56
4	100	139 / 63	145 / 66	159 / 72	192 / 87

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Table 11. C_V[1] at % Droop (Pressure Offset Below Setpoint)[2]																				
SPRING RANGE AND COLOR	SET PRESSURE		INLET		1 IN. / DN 25				2 in. / DN 50				3 in. / DN 80				4 in. / DN 100			
	psig	bar	psig	bar	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
15 to 30 psig / 1.0 to 2.1 bar Yellow	15	1.0	45	3.1	14.8	14.8	14.8	14.8	39.7	44.2	48.3	50.8	83.0	89.2	91.4	91.4	133.4	143.4	147.0	147.0
			50	3.4	14.8	14.8	14.8	14.8	39.2	44.4	48.4	50.6	83.3	89.6	91.4	91.4	134.0	144.1	147.0	147.0
			60	4.1	14.8	14.8	14.8	14.8	38.3	44.9	48.5	50.0	84.1	90.4	91.4	91.4	135.2	145.4	147.0	147.0
			65	4.5	14.8	14.8	14.8	14.8	37.8	45.2	48.6	49.7	84.5	90.8	91.4	91.3	135.8	146.0	147.0	146.8
	20	1.4	50	3.4	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			60	4.1	14.8	14.8	14.8	14.8	48.5	50.7	50.7	50.4	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			70	4.8	14.8	14.8	14.8	14.8	46.1	50.0	50.4	49.9	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			75	5.2	14.8	14.8	14.8	14.8	44.9	49.7	50.3	49.7	91.2	91.4	91.4	91.4	146.7	147.0	147.0	146.1
	30	2.1	60	4.1	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			75	5.2	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.7	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			90	6.2	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.2	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			100	6.9	14.8	14.8	14.8	14.8	47.6	50.8	50.6	49.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
25 to 75 psig / 1.7 to 5.2 bar Green	25	1.7	55	3.8	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			75	5.2	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.6	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			80	5.5	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.5	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			90	6.2	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.3	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
	50	3.4	80	5.5	14.8	14.8	14.8	14.8	49.0	50.1	49.9	49.7	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			100	6.9	14.8	14.8	14.8	14.8	49.1	50.1	50.0	49.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			125	8.6	14.8	14.8	14.8	14.8	49.2	50.0	50.1	50.1	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			150	10.3	14.8	14.8	14.8	14.8	49.3	50.0	50.2	50.3	91.4	91.4	91.4	90.9	147.0	147.0	147.0	146.2
	75	5.2	110	7.6	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			125	8.6	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			150	10.3	14.8	14.8	14.8	14.8	49.8	49.8	49.5	49.9	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			175	12.1	14.7	14.8	14.8	14.8	45.3	46.4	46.4	47.1	86.1	87.9	88.0	88.7	138.5	141.3	141.6	142.6
			200	13.8	14.2	14.5	14.6	14.5	40.7	43.1	43.3	44.2	80.6	83.4	84.0	84.6	129.6	134.2	135.0	136.0
70 to 150 psig / 4.8 to 10.3 bar Red	70	4.8	100	6.9	14.8	14.8	14.8	14.8	50.5	49.4	49.3	49.9	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			125	8.6	14.8	14.8	14.8	14.8	46.1	46.0	46.6	47.5	87.7	88.6	89.5	91.4	141.1	142.5	143.9	147.0
			150	10.3	14.7	14.7	14.7	14.8	41.6	42.7	43.8	45.0	82.8	84.0	84.9	86.6	133.1	135.0	136.5	139.2
			175	12.1	14.6	14.8	14.8	14.8	44.6	46.0	46.0	46.7	85.2	87.0	87.2	87.9	137.1	139.9	140.2	141.4
			190	13.1	14.5	14.8	14.8	14.8	46.4	47.9	47.3	47.7	86.7	88.8	88.5	88.8	139.4	142.8	142.4	142.8
			200	13.8	14.5	14.8	14.8	14.8	47.7	49.2	48.2	48.4	87.7	90.0	89.5	89.3	141.0	144.7	143.9	143.7
	100	6.9	130	9.0	14.8	14.8	14.8	14.8	50.8	50.0	49.6	49.7	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			150	10.3	14.8	14.8	14.8	14.8	50.1	49.5	49.2	49.3	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			175	12.1	14.8	14.8	14.8	14.8	48.4	48.9	48.7	48.8	90.7	91.4	91.4	91.4	145.8	147.0	147.0	147.0
			200	13.8	14.8	14.8	14.8	14.8	46.7	48.3	48.2	48.4	88.1	90.3	90.4	90.4	141.6	145.2	145.4	145.3
			250	17.2	14.2	14.2	14.2	14.2	43.2	47.1	47.3	47.4	82.8	86.2	86.5	86.5	133.2	138.6	139.1	139.2
			275	19.0	13.9	13.7	13.7	13.7	41.5	46.5	46.8	46.9	80.2	84.1	84.5	84.6	129.0	135.3	135.9	136.1
	125	8.6	155	10.7	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			175	12.1	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.6	91.4	91.4	91.4	91.4	147.0	147.0	147.0	147.0
			200	13.8	14.8	14.8	14.8	14.8	45.8	47.5	48.3	48.3	88.4	90.5	91.2	91.2	142.2	145.5	146.6	146.7
			250	17.2	14.8	14.8	14.8	14.8	43.6	46.4	46.9	47.0	85.2	87.7	88.2	88.1	137.0	141.1	141.9	141.8
			275	19.0	14.7	14.6	14.6	14.6	42.5	45.8	46.3	46.3	83.6	86.3	86.7	86.6	134.4	138.9	139.5	139.3
			300	20.7	14.5	14.3	14.3	14.3	41.4	45.3	45.6	45.6	82.0	85.0	85.2	85.1	131.8	136.6	137.1	136.8
	150	10.3	180	12.4	14.8	14.8	14.8	14.8	45.4	47.2	49.0	49.0	89.2	91.3	91.4	91.4	143.5	146.8	147.0	147.0
			200	13.8	14.8	14.8	14.8	14.8	45.0	46.7	48.3	48.3	88.8	90.7	91.4	91.4	142.8	145.9	147.0	147.0
			225	15.5	14.8	14.8	14.8	14.8	44.5	46.2	47.5	47.5	88.2	90.0	90.9	90.9	141.8	144.7	146.3	146.2
			250	17.2	14.8	14.8	14.8	14.8	44.0	45.7	46.6	46.6	87.5	89.3	89.9	89.8	140.8	143.6	144.7	144.4
			275	19.0	14.8	14.8	14.8	14.8	43.5	45.2	45.8	45.7	86.9	88.5	88.9	88.6	139.8	142.4	143.0	142.5
			300	20.7	14.8	14.8	14.8	14.8	43.1	44.6	44.9	44.9	86.3	87.8	87.9	87.4	138.8	141.2	141.4	140.6
80 to 400 psig / 5.5 to 27.6 bar Silver Spring	200	13.8	250	17.2	14.8	14.8	14.8	14.8	48.9	48.0	46.6	45.7	88.9	89.7	89.6	89.2	143.1	144.3	144.0	143.5
			300	20.7	14.6	14.3	14.2	13.9	48.6	47.2	46.1	45.1	86.4	87.9	87.9	87.6	139.0	141.4	141.3	141.0
			400	27.6	14.2	14.1	14.0	13.5	41.1	41.5	41.9	40.4	81.3	84.2	84.5	84.4	130.8	135.5	135.9	135.9
	250	17.2	300	20.7	14.8	13.6	13.9	14.0	46.6	44.3	44.5	44.5	88.7	89.3	89.1	88.6	142.6	143.7	143.2	142.5
			400	27.6	14.4	14.1	14.1	14.1	43.6	43.7	43.3	42.8	83.6	85.7	85.7	85.4	134.5	137.9	137.8	137.4
			500	34.5	14.0	14.0	13.9	13.6	39.8	41.0	41.0	39.6	78.5	82.1	82.3	82.2	126.4	132.0	132.3	132.3
	300	20.7	350	24.1	14.8	12.7	13.0	12.1	46.4	44.9	44.1	43.8	88.4	89.0	88.6	87.9	142.2	143.1	142.4	141.5
			400	27.6	14.8	14.3	14.3	13.5	44.5	43.6	42.9	42.6	85.9	87.1	86.9	86.4	138.2	140.2	139.7	139.0
			500	34.5	14.2	14.0	14.0	13.6	41.0	41.5	42.0	40.0	80.8	83.5	83.5	83.2	130.0	134.4	134.2	133.9
			600	41.4	13.8	13.7	13.7	13.5	39.4	39.4	39.8	38.5	75.8	79.9	80.1	80.0	121.9	128.5	128.8	128.8
	400	27.6	450	31.0	14.8	14.3	14.3	14.0	46.4	46.1	44.0	43.5	87.9	88.2	87.6	86.7	141.4	142.0	140.8	139.5
			500	34.5	14.6	14.3	14.1	13.9	44.5	43.6	43.3	42.6	85.4	86.4	85.9	85.1	137.4	139.0	138.0	136.9
			600	41.4	14.2	14.0	14.0	13.6	41.0	41.5	41.2	39.2	80.3	82.8	82.5	81.9	129.2	133.2	132.6	131.8

(shaded) Exceeds recommended maximum pressure drop ratio of 0.65.
1. Type LR125 on liquid service with 1/2 NPT Type MR95H/MR95HP Pilot, 100% Cage Capacity with internal inlet strainer and Type 112 Restrictor Setting of "4".
2. Values published in this table are laboratory tested and are presented based on % droop (negative control deviation only) or pressure offset below setpoint.

EMERSON

Table 12. Capacity(1), Water (GPM / L/min) for 1 and 2 in. / DN 25 and 50 Bodies at % Droop (Pressure Offset Below Setpoint)(2)

SPRING RANGE AND COLOR	OUTLET PRESSURE		INLET		1 IN. / DN 25								2 in. / DN 50							
					10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	psig	bar	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min
15 to 30 psig / 1.0 to 2.1 bar Yellow	15	1.0	45	3.1	83	314	85	322	87	329	89	337	223	844	254	961	284	1075	305	1155
			50	3.4	89	337	91	344	93	352	95	360	237	897	274	1037	304	1151	324	1226
			60	4.1	101	382	103	390	104	394	106	401	261	988	311	1177	341	1291	357	1351
			65	4.5	106	401	108	409	109	413	111	420	272	1030	329	1245	359	1359	372	1408
	20	1.4	50	3.4	84	318	86	326	89	337	91	344	287	1086	296	1120	305	1155	313	1185
			60	4.1	96	363	98	371	100	379	103	390	314	1189	336	1272	344	1302	349	1321
			70	4.8	107	405	109	413	111	420	113	428	333	1261	368	1393	378	1431	380	1438
			75	5.2	112	424	114	432	116	439	117	443	339	1283	382	1446	393	1488	394	1491
	30	2.1	60	4.1	85	322	89	337	92	348	96	363	292	1105	305	1155	317	1200	329	1245
			75	5.2	103	390	106	401	109	413	112	424	352	1332	363	1374	373	1412	383	1450
			90	6.2	117	443	120	454	123	466	126	477	403	1526	413	1563	422	1597	426	1613
			100	6.9	126	477	129	488	132	500	134	507	407	1541	443	1677	450	1703	451	1707
25 to 75 psig / 1.7 to 5.2 bar Green	25	1.7	55	3.8	84	318	88	333	91	344	94	356	290	1098	301	1139	311	1177	321	1215
			75	5.2	107	405	110	416	112	424	115	435	368	1393	377	1427	385	1457	392	1484
			80	5.5	112	424	115	435	117	443	119	450	385	1457	393	1488	402	1522	407	1541
			90	6.2	122	462	124	469	126	477	128	485	417	1579	425	1609	433	1639	435	1647
	50	3.4	80	5.5	88	333	94	356	99	375	105	397	290	1098	317	1200	335	1268	351	1329
			100	6.9	110	416	115	435	119	450	124	469	364	1378	388	1469	403	1526	417	1579
			125	8.6	132	500	136	515	140	530	144	545	440	1666	461	1745	475	1798	488	1847
			150	10.3	152	575	155	587	159	602	162	613	505	1912	524	1984	538	2037	551	2086
	75	5.2	110	7.6	96	363	105	397	112	424	119	450	331	1253	359	1359	385	1457	410	1552
			125	8.6	112	424	119	450	126	477	132	500	385	1457	410	1552	433	1639	454	1719
			150	10.3	134	507	140	530	146	553	152	575	452	1711	472	1787	489	1851	511	1934
			175	12.1	153	579	159	602	164	621	169	640	469	1775	498	1885	514	1946	536	2029
			200	13.8	164	621	171	647	177	670	180	681	469	1775	510	1931	526	1991	551	2086
70 to 150 psig / 4.8 to 10.3 bar Red	70	4.8	100	6.9	90	341	98	371	106	401	113	428	307	1162	327	1238	352	1332	380	1438
			125	8.6	117	443	123	466	129	488	135	511	363	1374	382	1446	406	1537	432	1635
			150	10.3	137	519	143	541	148	560	154	583	388	1469	414	1567	440	1666	468	1772
			175	12.1	154	583	161	609	166	628	171	647	472	1787	501	1896	516	1953	539	2040
			190	13.1	164	621	171	647	176	666	180	681	523	1980	555	2101	562	2127	580	2196
			200	13.8	170	644	178	674	182	689	186	704	558	2112	591	2237	592	2241	608	2302
	100	6.9	130	9.0	94	356	105	397	115	435	124	469	321	1215	353	1336	384	1454	416	1575
			150	10.3	115	435	124	469	132	500	140	530	388	1469	414	1567	440	1666	468	1772
			175	12.1	136	515	144	545	152	575	159	602	446	1688	476	1802	499	1889	524	1984
			200	13.8	155	587	162	613	169	640	175	662	489	1851	529	2002	550	2082	572	2165
			250	17.2	180	681	185	700	191	723	196	742	547	2071	614	2324	634	2400	653	2472
			275	19.0	189	715	191	723	197	746	202	765	565	2139	649	2457	670	2536	687	2601
	125	8.6	155	10.7	96	363	110	416	122	462	132	500	331	1253	377	1427	417	1579	454	1719
			175	12.1	117	443	128	485	138	522	148	560	402	1522	440	1666	475	1798	506	1915
			200	13.8	138	522	148	560	157	594	165	625	429	1624	475	1798	512	1938	541	2048
			250	17.2	174	659	181	685	189	715	196	742	512	1938	568	2150	598	2264	622	2355
			275	19.0	187	708	193	731	200	757	206	780	542	2052	606	2294	633	2396	655	2479
			300	20.7	198	750	203	768	209	791	214	810	567	2146	640	2423	665	2517	684	2589
	150	10.3	180	12.4	99	375	115	435	128	485	140	530	305	1155	365	1382	424	1605	465	1760
			200	13.8	119	450	132	500	144	545	155	587	363	1374	418	1582	471	1783	507	1919
			225	15.5	140	530	152	575	162	613	172	651	422	1597	474	1794	520	1968	552	2090
			250	17.2	159	602	169	640	178	674	187	708	472	1787	521	1972	561	2124	589	2230
			275	19.0	175	662	184	697	193	731	201	761	515	1949	562	2127	597	2260	622	2355
			300	20.7	190	719	199	753	207	784	214	810	553	2093	599	2267	627	2373	650	2461
80 to 400 psig / 5.5 to 27.6 bar Silver Spring	200	13.8	250	17.2	141	534	156	591	168	636	187	708	409	1548	455	1722	489	1851	521	1972
			300	20.7	160.0	606	169	640	179	678	187	708	532	2014	558	2112	583	2207	605	2290
			400	27.6	210.0	795	219	829	226	856	226	856	609	2305	643	2434	676	2559	676	2559
	250	17.2	300	20.7	139.0	526	161	609	176	666	188	712	404	1529	443	1677	497	1881	545	2063
			400	27.6	191	723	200	757	212	803	223	844	577	2184	618	2339	650	2461	676	2559
			500	34.5	232	878	242	916	251	950	254	961	660	2498	710	2688	739	2797	741	2805
	300	20.7	350	24.1	139	526	155	587	172	651	172	651	415	1571	471	1783	522	1976	571	2161
			400	27.6	172	651	181	685	197	746	200	757	507	1919	552	2090	592	2241	632	2392
			500	34.5	215	814	226	856	238	901	243	920	622	2355	669	2532	715	2707	716	2710
			600	41.4	251	950	260	984	271	1026	277	1049	716	2710	748	2831	786	2975	789	2987
	400	27.6	450	31.0	140	530	163	617	186	704	203	768	440	1666	526	1991	574	2173	630	2385
			500	34.5	173	655	192	727	209	791	224	848	527	1995	585	2214	642	2430	687	2601
			600	41.4	220	833	234	886	250	946	258	977	635	2404	694	2627	737	2790	744	2816

Exceeds recommended maximum pressure drop ratio of 0.65.
1. Type LR125 on liquid service with 1/2 NPT Type MR95H/MR95HP Pilot, 100% Cage Capacity with internal inlet strainer and Type 112 Restrictor Setting of “4”.
2. Values published in this table are laboratory tested and are presented based on % droop (negative control deviation only) or pressure offset below setpoint.

Table 12. Capacity(1), Water (GPM / L/min) for 3 and 4 in. / DN 80 and 100 Bodies at % Droop (Pressure Offset Below Setpoint)(2) (continued)

SPRING RANGE AND COLOR	OUTLET PRESSURE		INLET		3 in. / DN 80								4 in. / DN 100							
					10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	psig	bar	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/MIN	GPM	L/MIN	GPM	L/MIN
15 to 30 psig / 1.0 to 2.1 bar Yellow	15	1.0	45	3.1	466	1764	512	1938	537	2033	548	2074	749	2835	824	3119	863	3267	882	3339
			50	3.4	503	1904	552	2090	574	2173	585	2214	810	3066	888	3361	924	3498	941	3562
			60	4.1	573	2169	626	2370	643	2434	653	2472	922	3490	1007	3812	1034	3914	1050	3975
			65	4.5	606	2294	661	2502	675	2555	683	2585	975	3691	1063	4024	1085	4107	1099	4160
	20	1.4	50	3.4	517	1957	533	2018	548	2074	563	2131	832	3149	857	3244	882	3339	906	3430
			60	4.1	592	2241	606	2294	620	2347	633	2396	953	3607	975	3691	997	3774	1018	3854
			70	4.8	659	2495	672	2544	684	2589	696	2635	1060	4013	1080	4088	1100	4164	1120	4240
			75	5.2	689	2608	702	2657	714	2703	725	2744	1107	4190	1129	4274	1148	4346	1160	4391
	30	2.1	60	4.1	525	1987	548	2074	571	2161	592	2241	844	3195	882	3339	918	3475	953	3607
			75	5.2	633	2396	653	2472	672	2544	690	2612	1018	3854	1050	3975	1080	4088	1110	4202
			90	6.2	725	2744	743	2813	759	2873	776	2937	1167	4418	1194	4520	1221	4622	1247	4720
			100	6.9	781	2956	797	3017	812	3074	828	3134	1256	4754	1282	4853	1307	4948	1331	5038
25 to 75 psig / 1.7 to 5.2 bar Green	25	1.7	55	3.8	521	1972	541	2048	560	2120	578	2188	838	3172	870	3293	900	3407	930	3520
			75	5.2	662	2506	678	2567	693	2623	708	2680	1065	4031	1090	4126	1115	4221	1139	4312
			80	5.5	693	2623	708	2680	723	2737	737	2790	1115	4221	1139	4312	1162	4399	1185	4486
			90	6.2	751	2843	765	2896	778	2945	792	2998	1208	4573	1230	4656	1252	4739	1273	4819
	50	3.4	80	5.5	541	2048	578	2188	613	2320	646	2445	870	3293	930	3520	986	3732	1039	3933
			100	6.9	678	2567	708	2680	737	2790	765	2896	1090	4126	1139	4312	1185	4486	1230	4656
			125	8.6	818	3096	843	3191	867	3282	891	3373	1315	4978	1355	5129	1395	5281	1433	5424
			150	10.3	937	3547	959	3630	980	3710	996	3770	1506	5701	1542	5837	1576	5966	1602	6064
	75	5.2	110	7.6	596	2256	646	2445	693	2623	737	2790	958	3626	1039	3933	1115	4221	1185	4486
			125	8.6	693	2623	737	2790	778	2945	818	3096	1115	4221	1185	4486	1252	4739	1315	4978
			150	10.3	830	3142	867	3282	903	3418	937	3547	1335	5054	1395	5281	1452	5496	1506	5701
			175	12.1	893	3380	942	3566	974	3687	1011	3827	1436	5436	1515	5735	1567	5932	1626	6155
			200	13.8	927	3509	987	3736	1020	3861	1053	3986	1492	5648	1588	6011	1640	6208	1693	6409
70 to 150 psig / 4.8 to 10.3 bar Red	70	4.8	100	6.9	556	2105	606	2294	653	2472	696	2635	894	3384	975	3691	1050	3975	1120	4240
			125	8.6	691	2616	736	2786	780	2953	833	3153	1111	4206	1184	4482	1255	4751	1339	5069
			150	10.3	772	2922	814	3081	853	3229	900	3407	1242	4701	1309	4955	1372	5194	1447	5477
			175	12.1	902	3414	949	3592	978	3702	1014	3838	1450	5489	1526	5777	1574	5958	1631	6174
			190	13.1	977	3698	1028	3891	1051	3978	1080	4088	1571	5947	1653	6257	1691	6401	1737	6575
			200	13.8	1026	3884	1080	4088	1099	4160	1123	4251	1650	6246	1737	6575	1768	6693	1806	6836
	100	6.9	130	9.0	578	2188	646	2445	708	2680	765	2896	930	3520	1039	3933	1139	4312	1230	4656
			150	10.3	708	2680	765	2896	818	3096	867	3282	1139	4312	1230	4656	1315	4978	1395	5281
			175	12.1	836	3165	891	3373	937	3547	980	3710	1345	5091	1433	5424	1506	5701	1576	5966
			200	13.8	924	3498	989	3744	1031	3903	1069	4047	1486	5625	1590	6019	1658	6276	1719	6507
			250	17.2	1048	3967	1124	4255	1160	4391	1193	4516	1685	6378	1807	6840	1866	7064	1918	7260
			275	19.0	1091	4130	1175	4448	1210	4580	1241	4698	1755	6643	1890	7154	1946	7366	1995	7552
	125	8.6	155	10.7	596	2256	678	2567	751	2843	818	3096	958	3626	1090	4126	1208	4573	1315	4978
			175	12.1	723	2737	792	2998	855	3237	914	3460	1162	4399	1273	4819	1375	5205	1470	5565
			200	13.8	827	3131	905	3426	967	3660	1020	3861	1330	5035	1455	5508	1555	5886	1640	6208
			250	17.2	999	3782	1074	4066	1124	4255	1166	4414	1607	6083	1728	6541	1808	6844	1875	7098
			275	19.0	1065	4031	1142	4323	1188	4497	1225	4637	1714	6488	1837	6954	1910	7230	1970	7457
			300	20.7	1122	4247	1201	4546	1243	4705	1276	4830	1805	6833	1932	7313	1999	7567	2052	7768
	150	10.3	180	12.4	599	2267	707	2676	792	2998	867	3282	963	3645	1137	4304	1273	4819	1395	5281
			200	13.8	716	2710	811	3070	891	3373	959	3630	1151	4357	1305	4940	1433	5424	1542	5837
			225	15.5	836	3165	922	3490	996	3770	1056	3997	1345	5091	1483	5614	1602	6064	1699	6431
			250	17.2	939	3555	1018	3854	1083	4100	1135	4296	1510	5716	1637	6197	1742	6594	1826	6912
			275	19.0	1029	3895	1102	4172	1160	4391	1205	4561	1654	6261	1773	6712	1865	7060	1938	7336
			300	20.7	1109	4198	1178	4459	1228	4648	1267	4796	1783	6749	1895	7173	1975	7476	2038	7715
80 to 400 psig / 5.5 to 27.6 bar Silver Spring	200	13.8	250	17.2	744	2816	851	3221	940	3558	1017	3850	1197	4531	1369	5182	1510	5716	1636	6193
			300	20.7	946	3581	1040	3937	1112	4209	1175	4448	1523	5765	1673	6333	1787	6765	1892	7162
			400	27.6	1206	4565	1304	4936	1363	5160	1412	5345	1940	7344	2099	7946	2191	8294	2274	8608
	250	17.2	300	20.7	768	2907	893	3380	996	3770	1085	4107	1235	4675	1437	5440	1601	6060	1745	6606
			400	27.6	1106	4187	1212	4588	1286	4868	1350	5110	1779	6734	1950	7382	2067	7824	2172	8222
			500	34.5	1302	4929	1422	5383	1484	5618	1538	5822	2096	7934	2286	8653	2385	9028	2475	9369
	300	20.7	350	24.1	791	2994	933	3532	1048	3967	1146	4338	1272	4815	1501	5682	1685	6378	1845	6984
			400	27.6	979	3706	1102	4172	1198	4535	1282	4853	1576	5966	1773	6712	1926	7291	2062	7806
			500	34.5	1225	4637	1346	5095	1422	5383	1488	5633	1972	7465	2167	8203	2285	8650	2395	9066
			600	41.4	1377	5213	1516	5739	1582	5989	1640	6208	2214	8381	2438	9229	2544	9630	2640	9993
	400	27.6	450	31.0	834	3157	1006	3808	1142	4323	1256	4754	1341	5076	1619	6129	1836	6950	2022	7654
			500	34.5	1010	3823	1159	4387	1274	4823	1372	5194	1626	6155	1865	7060	2047	7749	2207	8354
			600	41.4	1244	4709	1386	5247	1476	5587	1554	5883	2002	7578	2229	8438	2372	8979	2501	9467

Exceeds recommended maximum pressure drop ratio of 0.65.
1. Type LR125 on liquid service with 1/2 NPT Type MR95H/MR95HP Pilot, 100% Cage Capacity with internal inlet strainer and Type 112 Restrictor Setting of "4".
2. Values published in this table are laboratory tested and are presented based on % droop (negative control deviation only) or pressure offset below setpoint.

FISHER

Type LR128

Backpressure Liquid Regulator

Introduction

The Type LR128 pilot-operated backpressure regulator is designed for liquid industrial/commercial applications; the regulator also functions and is categorized as a pressure relief valve. The Type LR128 incorporates a field proven main valve design used in harsh petrochemical applications that provides smooth and reliable operation along with tight shutoff. Its internally actuated metal plug eliminates disadvantages associated with flexible element style regulators and the specially engineered flow path deflects debris, protecting the seat from damage and erosion.

The Type LR128 is used in conjunction with a Type MR98H pilot and Type 112 restrictor. An internal inlet strainer prevents large particles from entering the main valve, limiting damage to internal parts.

Main Valve Body Sizes and End Connection Styles(1)

See Table 1

Maximum Inlet Pressures

Type LR128 Main Valve: See Table 1
Type MR98H Pilot: 450 psig / 31.0 bar
Type 112 Restrictor: 1500 psig / 103 bar

Maximum Outlet Pressures

Type LR128 Main Valve: See Table 1
Type MR98H Pilot: 450 psig / 31.0 bar

Relief Set Pressure/Backpressure Control Ranges

See Table 3

Main Valve Plug Travel

1 in. / DN 25: 0.37 in. / 9.4 mm
2 in. / DN 50: 0.68 in. / 17 mm
3 in. / DN 80: 0.98 in. / 25 mm
4 in. / DN 100: 1.19 in. / 30 mm

Main Valve Minimum Differential Pressures

See Table 4

Main Valve Maximum Differential Pressures

See Table 5

Pressure Build-Up and Reseat Values

See Table 9

Pressure Registration

External: 1/8 NPT control line connection

Main Valve Internal Inlet Strainer Sizes

1 in. / DN 25:
12 Mesh (0.0661 in. / 1.68 mm)(2)
2, 3 and 4 in. / DN 50, 80 and 100:
10 Mesh (0.0787 in. / 2 mm)(2)

Flow and IEC Sizing Coefficients

Type LR128 Main Valve: See Table 7
Type MR98H Pilot: See Table 6
Type 112 Restrictor: See Table 8

Flow Capacities

For C_V regulating values: See Table 13
For laboratory recorded GPM capacities: See Table 12

Temperature Capabilities

See Table 10

Approximate Weights

See Table 11

Construction Materials

Type LR128 Main Valve
Body: WCC Steel or CF8M Stainless steel (LCC Steel and CF3M Stainless steel available for special constructions)
Diaphragm/O-rings: See Table 10

Type MR98H Pilot
Body/Spring Case: WCC Steel or CF8M Stainless steel (LCC Steel and CF3M Stainless steel available for special constructions)
Gasket/O-rings: Nitrile (NBR) or Fluorocarbon (FKM)
Diaphragm: Neoprene (CR) or Fluorocarbon (FKM)

Type 112 Restrictor
Body: 15-5 Stainless steel
O-rings: Nitrile (NBR) or Fluorocarbon (FKM)

Ordering Guide

To order this product, contact your local Sales Office.

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
11/14
www.Emerson.com

Figure 1. *Type LR128 Backpressure Regulator*

Application

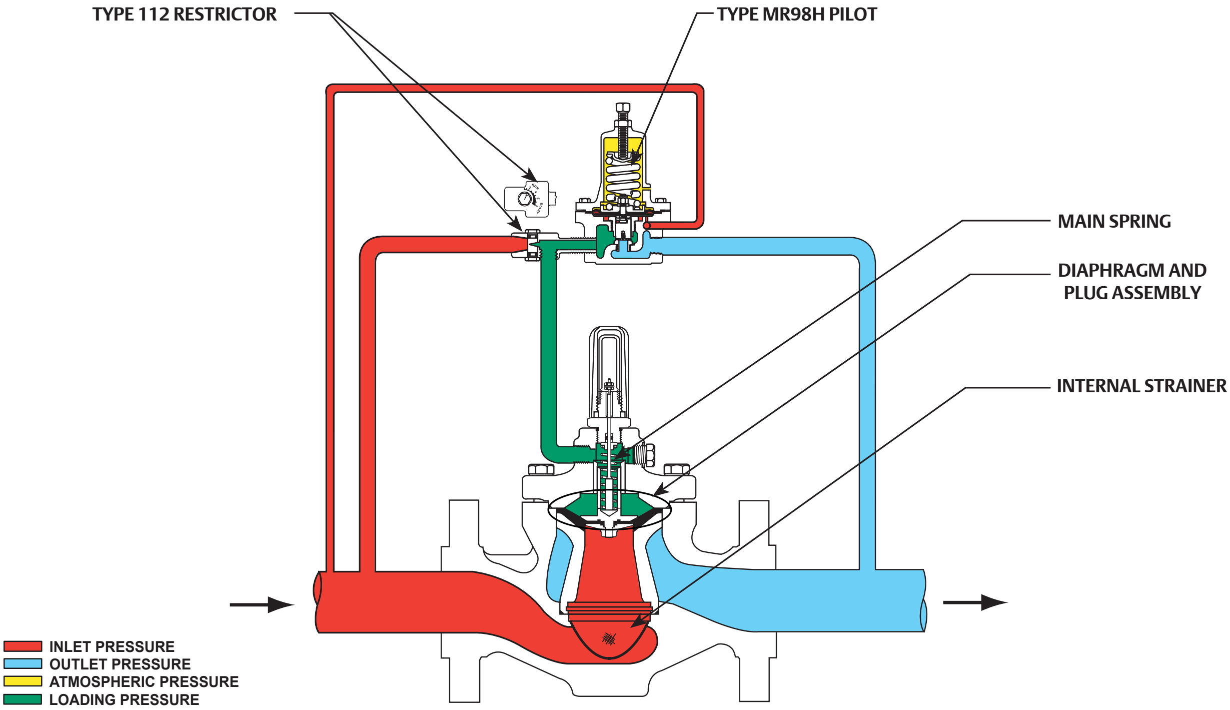
Liquid

Features

- Specially Engineered Flow Path Design and Rugged Construction Materials Provide Longer Service Life
- Top Entry and Easy to Change Trim Assembly Translates Into Reduced Maintenance Time
- Incorporates Dependable O-rings Instead of Gaskets for Optimal Sealing
- Quiet Operation Using Innovative Cage Design, also Accounts for Dependable Performance
- Shared 'E-Body' Used by Other Emerson Branded Regulators and Control Valves
- Easy to Replace Existing Installations
- Robust Construction Material Offering for Application Versatility in Harsh Environments
- API 614 Compliant

1. Ratings and end connections other than ASME standards can usually be provided; contact your local Sales Office.
2. Nominal sieve opening

EMERSON



TYPE LR128 WITH TYPE MR98H PILOT AND TYPE 112 RESTRICTOR

Figure 2. *Type LR128 Operational Schematic*

Table 1. Type LR128 Main Valve Body Sizes, End Connection Styles, Structural Design Ratings and Maximum Operating Relief (Inlet) Pressures(1)

MAIN VALVE BODY SIZE		MAIN VALVE BODY MATERIAL	END CONNECTION STYLE(2)	STRUCTURAL DESIGN RATING(3)		MAXIMUM OPERATING RELIEF (INLET) PRESSURE INCLUDING BUILD-UP(3)		MAXIMUM OPERATING OUTLET PRESSURE	
In.	DN			psig	bar	psig	bar	psig	bar
1, 2, 3 and 4	25, 50, 80 and 100	WCC Steel	NPT or SWE (1 and 2 in. only)	1500	103	450	31.0	450	31.0
			CL150 RF	290	20.0	290	20.0	290	20.0
			CL300 RF	750	51.7	450	31.0	450	31.0
			CL600 RF	1500	103				
			PN 16/25/40 RF	580	40.0				
		CF8M Stainless steel	NPT (1 and 2 in. only)	1440	99.2	450	31.0	450	31.0
			CL150 RF	275	19.0	275	19.0	275	19.0
			CL300 RF	720	49.6	450	31.0	450	31.0
			CL600 RF	1440	99.2				
			PN 16/25/40 RF	580	40.0				

1. The pressure/temperature limits in this Application Guide and any applicable standard or code limitation should not be exceeded.
2. Ratings and end connections other than ASME standard can usually be provided. Contact your local Sales Office for assistance.
3. Maximum cold working pressure (CWP) per ASME B16.34 or product bulletin limit, whichever is lowest. Temperature may decrease these maximum pressure.

Table 2. Type MR98H Pilot Maximum Cold Working Pressures(1)(2)

BODY SIZE	BODY AND SPRING CASE MATERIAL	MAXIMUM INLET PRESSURE	MAXIMUM OUTLET PRESSURE
1/2 NPT	Steel Stainless steel	450 psig / 31.0 bar	450 psig / 31.0 bar

1. The pressure/temperature limits in this Application Guide and any applicable standard or code limitation should not be exceeded.
2. Temperature and/or the body end connection may decrease these maximum pressure.

Table 3. Relief Set Pressure or Backpressure Control Ranges

PILOT	SET PRESSURE RANGE		SPRING WIRE DIAMETER		SPRING FREE LENGTH		SPRING MATERIAL	SPRING COLOR
	psig	bar	In.	mm	In.	mm		
Type MR98H	25 to 75	1.7 to 5.2	0.234	5.94	2.595	65.9	Powder-coated steel	Green
	70 to 140	4.8 to 9.7	0.283	7.19	2.44	62.0	Powder-coated steel	Red
	130 to 200	9.0 to 13.8	0.331	8.41	2.250	57.2	Powder-coated steel	Blue
	150 to 375(1)	10.3 to 25.9(1)	0.394	10.0	5.063	129	Powder-coated steel	Unpainted

1. 150 to 375 psig / 10.3 to 25.9 bar spring range is for the Type MR98HH pilot construction.

Table 4. Type LR128 Main Valve Minimum Differential Pressures(1)

MAIN VALVE BODY SIZE		DIAPHRAGM		MINIMUM DIFFERENTIAL, PERCENT OF CAPACITY			
				For 90% Capacity		For 100% Capacity	
In.	DN	Diaphragm Code	Diaphragm Material	psid	bar d	psid	bar d
1	25	17E68 (standard)	Nitrile (NBR), Low Minimum Differential	30	2.1	30	2.1
		17E97	Nitrile (NBR), High Erosion Resistance	35	2.5	35	2.5
		17E88	Fluorocarbon (FKM), High Temperature Capability	30	2.1	30	2.1
2	50	17E68 (standard)	Nitrile (NBR), Low Minimum Differential	18	1.2	19	1.3
		17E97	Nitrile (NBR), High Erosion Resistance	24	1.7	24	1.7
		17E88	Fluorocarbon (FKM), High Temperature Capability	18	1.2	19	1.3
3	80	17E68 (standard)	Nitrile (NBR), Low Minimum Differential	21	1.5	28	1.9
		17E97	Nitrile (NBR), High Erosion Resistance	23	1.6	23	1.6
		17E88	Fluorocarbon (FKM), High Temperature Capability	21	1.5	28	1.9
4	100	17E68 (standard)	Nitrile (NBR), Low Minimum Differential	16	1.1	30	2.1
		17E97	Nitrile (NBR), High Erosion Resistance	16	1.1	34	2.3
		17E88	Fluorocarbon (FKM), High Temperature Capability	16	1.1	30	2.1

1. See Table 1 for Type LR128 main valve structural design ratings and Table 2 for Type MR98H pilot rating.

Table 5. Type LR128 Maximum Pressure Ratings(1)

BODY SIZE		MAIN VALVE DIAPHRAGM MATERIAL	MAXIMUM OPERATING INLET PRESSURE(3)		MAXIMUM OPERATING DIFFERENTIAL PRESSURE(3)		MAXIMUM EMERGENCY INLET AND DIFFERENTIAL PRESSURE		DIAPHRAGM STYLE
In.	DN		psig	bar	psid	bar d	psid	bar d	
1	25	17E68 Nitrile (NBR), Low temperature	450	31.0	400	27.6	450	31.0	130
		17E97 Nitrile (NBR), High-pressure and/or erosion resistance	450	31.0	450(2)	31.0(2)	450	31.0	
		17E88 Fluorocarbon (FKM), High aromatic hydrocarbon content resistance	450	31.0	450(2)	31.0(2)	450	31.0	
2	50	17E68 Nitrile (NBR), Low temperature	450	31.0	400	27.6	450	31.0	
		17E97 Nitrile (NBR), High-pressure and/or erosion resistance	450	31.0	450(2)	31.0(2)	450	31.0	
		17E88 Fluorocarbon (FKM), High aromatic hydrocarbon content resistance	450	31.0	450(2)	31.0(2)	450	31.0	
3	80	17E68 Nitrile (NBR), Low temperature	360	24.8	300	20.7	450	31.0	
		17E97 Nitrile (NBR), High-pressure and/or erosion resistance	450	31.0	450(2)	31.0(2)	450	31.0	
		17E88 Fluorocarbon (FKM), High aromatic hydrocarbon content resistance	450	31.0	450(2)	31.0(2)	450	31.0	
4	100	17E68 Nitrile (NBR), Low temperature	360	24.8	300	20.7	450	31.0	
		17E97 Nitrile (NBR), High-pressure and/or erosion resistance	450	31.0	450(2)	31.0(2)	450	31.0	
		17E88 Fluorocarbon (FKM), High aromatic hydrocarbon content resistance	450	31.0	450(2)	31.0(2)	450	31.0	

1. See Table 1 for main valve structural design ratings and Table 2 for pilot ratings.
2. For differential pressure above 400 psid / 27.6 bar d diaphragm temperatures are limited to 150°F / 66°C.
3. These are recommendations that provide the best regulator performance for a typical application. Please contact your local Sales Office for further information if a deviation from the standard recommendations are required.

Table 6. Flow and Sizing Coefficients for Type MR98H Pilot

BODY SIZE	WIDE-OPEN COEFFICIENT		C_1	K_m	IEC SIZING COEFFICIENTS		
	C_v	C_g			X_T	F_D	F_L
1/2 in. / DN 15	3.4	120	35.3	0.88	0.787	0.78	0.94

$K_m = F_L^2$

Table 7. Flow and Sizing Coefficients for Type LR128 Main Valve at 100% Capacity

MAIN VALVE BODY SIZE		REGULATING COEFFICIENTS		WIDE-OPEN COEFFICIENTS		K_m	IEC SIZING COEFFICIENTS		
In.	DN	C_v	C_1	C_v	C_1		X_T	F_D	F_L
1	25	14.8	33.4	15.2	33.5	0.88	0.706	0.06	0.94
2	50	50.8	37.2	52.4	37.2	0.92	0.875	0.09	0.96
3	80	91.4	38.8	94.1	38.8	0.94	0.952	0.09	0.97
4	100	147	38.7	151	38.7	0.85	0.947	0.09	0.92

Table 8. Type 112 Restrictor Flow Coefficients

RESTRICTOR SETTING	C_v	C_1
Setting 2	0.03	35
Setting 4	0.07	
Setting 6	0.14	
Setting 8	0.17	

Table 9. Build-up Pressure Needed to Begin Opening and Fully Open Main Valve and Pressure Drop Needed to Reseat Pilot

SPRING RANGE AND SPRING COLOR	SET PRESSURE[1]		BUILDUP OVER SET PRESSURE NEEDED TO BEGIN OPENING OF MAIN VALVE[2]		BUILDUP OVER SET PRESSURE NEEDED TO FULLY OPEN MAIN VALVE[3]		PRESSURE DROP BELOW SET PRESSURE NEEDED TO RESEAT PILOT	
	psig	bar	psig	bar	psig	bar	psig	bar
25 to 75 psig / 1.7 to 5.2 bar Green	25	1.7	1	0.07	1	0.07	2	0.14
	50	3.4	1	0.07	1	0.07	2	0.14
	75	5.2	1	0.07	6	0.41	2	0.14
70 to 140 psig / 4.8 to 9.7 bar Red	70	4.8	1	0.07	4	0.28	5	0.34
	100	6.9	1	0.07	10	0.69	5	0.34
	125	8.6	1	0.07	13	0.90	5	0.34
	140	9.7	1	0.07	16	1.1	5	0.34
130 to 200 psig / 9.0 to 13.8 bar Blue	130	9.0	1	0.07	14	0.97	6	0.41
	150	10.3	1	0.07	14	0.97	6	0.41
	175	12.1	1	0.07	17	1.2	6	0.41
	200	13.8	1	0.07	17	1.2	6	0.41
150 to 375 psig / 10.3 to 25.9 bar Unpainted	150	10.3	1	0.07	9	0.62	7	0.48
	200	13.8	1	0.07	10	0.69	7	0.48
	250	17.2	1	0.07	11	0.76	7	0.48
	300	20.7	1	0.07	15	1.03	7	0.48
	350	24.1	1	0.07	15	1.03	7	0.48
	375	25.9	1	0.07	25	1.7	7	0.48

1. Set pressure is defined as the pressure at which the pilot starts-to-discharge.
2. Crack point pressure of the main valve of the inlet pressure buildup over the set pressure at which the main valve starts audible flow.
3. Inlet pressure buildup over the set pressure for the main valve to achieve wide-open flow capacity.

Table 10. Main Valve Diaphragms and Temperature Capabilities

CRITERIA	17E68 NITRILE (NBR) (STANDARD)	17E97 NITRILE (NBR)	17E88 FLUOROCARBON (FKM)
Liquid Temperature	-20 to 150°F / -29 to 66°C	0 to 150°F / -18 to 66°C	0 to 250°F / -18 to 121°C[1]
General Applications	Best for low pressure differential and cold temperature service applications.	Best for abrasive or erosive service applications.	Best for high temperature applications.
Heavy Particle Erosion	Fair	Excellent	Good

1. Fluorocarbon (FKM) is limited to 200°F / 93°C in hot water.

Table 11. Approximate Weights Including Type MR98H Pilot and Restrictor

BODY SIZE		MAIN VALVE BODY, lbs / kg			
In.	DN	NPT or SWE	CL150 RF	CL300 RF	CL600 RF
1	25	22 / 10	24 / 11	28 / 13	32 / 15
2	50	51 / 23	54 / 24	58 / 26	65 /29
3	80	103 / 47	107 / 49	110 / 50	123 / 56
4	100	139 / 63	145 / 66	159 / 72	192 / 87

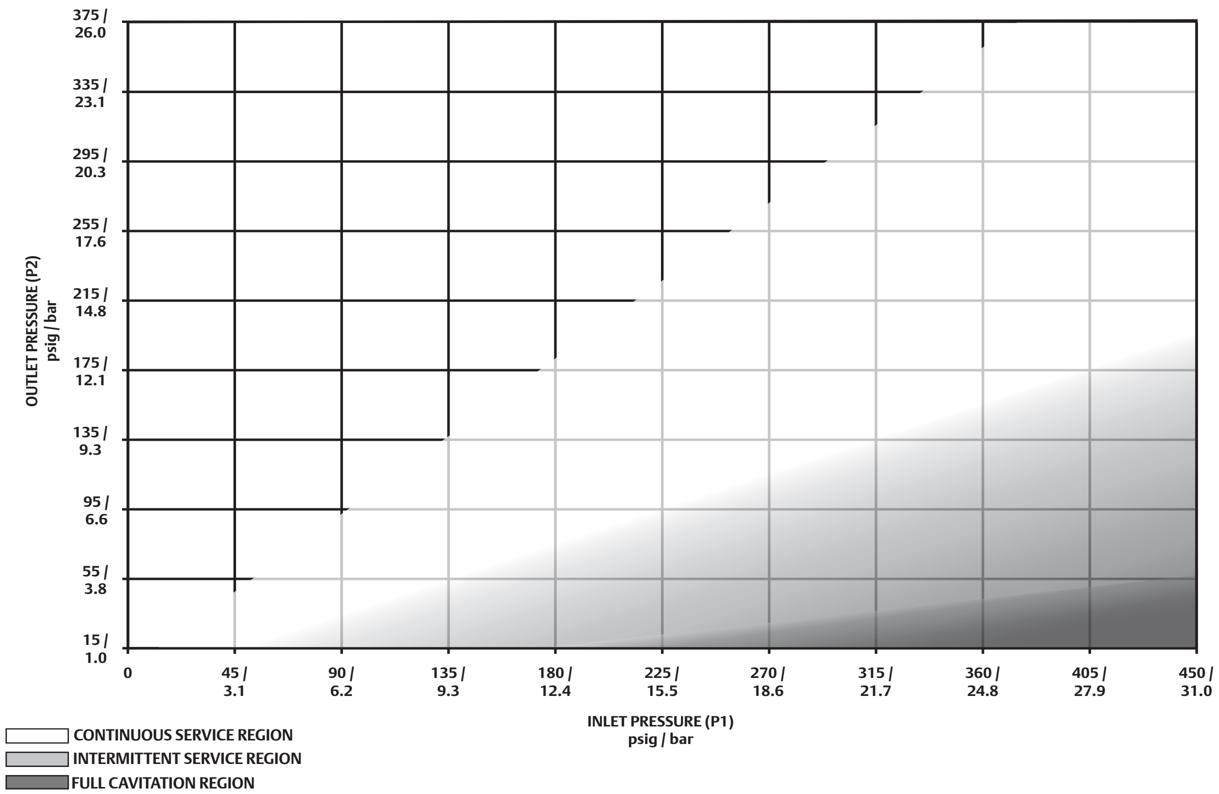


Figure 3. *Cavitation Sizing for Water*

Table 12. Capacity(1), Water (GPM / L/min) for 1 and 2 in. / DN 25 and 50 Bodies at % Offset (Pressure Build-Up Above Setpoint)(2)

SPRING RANGE AND SPRING COLOR	SET PRESSURE		BODY SIZE															
			1 In. / DN 25								2 In. / DN 50							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min
35 to 75 psig / 2.4 to 5.2 bar Green	35	2.4	92	348	81	307	84	318	88	333	266	1007	278	1052	290	1098	301	1139
	50	3.4	110	416	115	435	119	450	124	469	377	1427	393	1488	410	1552	425	1609
	75	5.2	134	507	140	530	146	553	152	575	461	1745	482	1824	502	1900	521	1972
70 to 140 psig / 4.8 to 9.7 bar Red	70	4.8	130	492	136	515	141	534	147	556	446	1688	466	1764	485	1834	503	1904
	100	6.9	155	587	162	613	169	640	175	662	533	2017	556	2104	579	2192	601	2275
	125	8.6	147	556	181	685	189	715	196	742	504	1908	622	2354	648	2453	672	2544
	140	9.7	165	625	192	727	200	757	207	783	642	2430	658	2491	685	2593	711	2691
130 to 200 psig / 9.0 to 13.8 bar Blue	130	9.0	143	541	185	700	192	727	200	757	621	2350	634	2400	660	2498	685	2593
	150	10.3	190	719	199	753	207	783	214	810	653	2472	682	2581	709	2684	736	2786
	175	12.1	205	776	214	810	223	844	232	878	705	2668	736	2786	766	2899	795	3009
	200	13.8	220	833	229	867	239	905	248	937	753	2850	787	2979	819	3100	850	3217
100 to 375 psig / 6.9 to 26.0 bar Unpainted	100	6.9	155	587	162	613	169	640	175	662	533	2017	556	2104	579	2192	601	2275
	150	10.3	190	720	199	753	207	783	214	810	653	2472	682	2581	709	2684	736	2786
	200	13.8	220	833	229	867	239	905	248	939	753	2850	787	2979	819	3100	850	321
	250	17.2	245	927	256	969	267	1011	277	1048	842	3187	880	3331	916	3467	950	3596
	300	20.7	269	1018	281	1064	292	1105	303	1147	923	3494	964	3649	1003	3796	1041	3940
	350	24.1	290	1098	303	1147	316	1196	328	1241	997	3774	1041	3940	1084	4103	1125	4258
	375	25.9	301	1139	314	1188	327	1238	339	1283	1032	3906	1078	4080	1122	4247	1164	4406

1. Type LR128 on liquid service with 1/2 NPT Type MR98H Pilot, 100% Cage Capacity with Strainer and Type 112 Restrictor Setting of "6" for the 1 and 2 in. / DN 25 and 50 body sizes.
2. Values published in this table are laboratory tested and are presented based on % offset (positive control deviation only) or pressure build-up above setpoint.

- continue -

Table 12. Capacity(1), Water (GPM / L/min) for 3 and 4 in. / DN 80 and 100 Bodies at % Offset (Pressure Build-Up Above Setpoint)(2) (continued)

SPRING RANGE AND SPRING COLOR	SET PRESSURE		BODY SIZE															
			3 In. / DN 80								4 In. / DN 100							
	psig	bar	10%		20%		30%		40%		10%		20%		30%		40%	
			GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min	GPM	L/min
35 to 75 psig / 2.4 to 5.2 bar Green	35	2.4	479	1813	501	1896	521	1972	541	2048	771	2918	805	3047	838	3172	870	3293
	50	3.4	678	2566	708	2680	737	2790	765	2895	1090	4126	1139	4311	1185	4485	1230	4656
	75	5.2	830	3142	867	3282	903	3418	937	3547	1335	5053	1395	5280	1452	5496	1506	5700
70 to 140 psig / 4.8 to 9.7 bar Red	70	4.8	802	3036	838	3172	872	3301	905	3425	1290	4883	1347	5098	1402	5307	1455	5507
	100	6.9	959	3630	1001	3789	1042	3944	1081	4092	1542	5836	1610	6094	1676	6344	1739	6582
	125	8.6	907	3433	1119	4235	1165	4410	1209	4576	1459	5522	1800	6813	1874	7093	1945	7362
	140	9.7	1088	4118	1185	4485	1233	4667	1280	4845	1750	6624	1905	7210	1983	7506	2058	7790
130 to 200 psig / 9.0 to 13.8 bar Blue	130	9.0	1001	3789	1142	4322	1188	4497	1233	4667	1610	6094	1836	6949	1911	7233	1983	7506
	150	10.3	1174	4444	1226	4640	1276	4830	1325	5015	1888	7146	1972	7464	2053	7771	2130	8062
	175	12.1	1268	4799	1325	5015	1379	5220	1431	5416	2040	7721	2130	8062	2217	8391	2301	8709
	200	13.8	1356	5132	1416	5360	1474	5579	1529	5787	2180	8251	2277	8618	2370	8970	2460	9311
100 to 375 psig / 6.9 to 26.0 bar Unpainted	100	6.9	959	3630	1001	3789	1042	3944	1081	4092	1542	5836	1610	6094	1676	6344	1739	6582
	150	10.3	1174	4444	1226	4640	1276	4830	1325	5015	1888	7146	1972	7464	2053	7771	2130	8062
	200	13.8	1356	5132	1416	5360	1474	5579	1529	5787	2180	8251	2277	8618	2370	8970	2460	9311
	250	17.2	1516	5738	1583	5992	1648	6238	1710	6472	2438	9228	2546	9637	2650	10,030	2750	10,409
	300	20.7	1660	6283	1734	6563	1805	6832	1873	7089	2670	10,106	2789	10,556	2903	10,988	3013	11,404
	350	24.1	1793	6787	1873	7089	1950	7381	2023	7657	2884	10,916	3013	11,404	3136	11,870	3254	12,316
	375	25.9	1856	7025	1939	7339	2018	7638	2094	7926	2986	11,302	3118	11,802	3246	12,286	3368	12,748

1. Type LR128 on liquid service with 1/2 NPT Type MR98H Pilot, 100% Cage Capacity with Strainer and Type 112 Restrictor Setting of "6" or "8" for the 3 in. / DN 80 body size and "8" for the 4 in. / DN 100 body size.
2. Values published in this table are laboratory tested and are presented based on % offset (positive control deviation only) or pressure build-up above setpoint.

Table 13. C_V(1) at % Offset (Pressure Build-Up Above Setpoint)(2)

SPRING RANGE AND SPRING COLOR	SET PRESSURE		BODY SIZE															
			1 In. / DN 25				2 In. / DN 50				3 In. / DN 80				4 In. / DN 100			
	psig	bar	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
35 to 75 psig / 2.4 to 5.2 bar Green	35	2.4	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	50	3.4	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	75	5.2	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
70 to 140 psig / 4.8 to 9.7 bar Red	70	4.8	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	100	6.9	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	125	8.6	12.5	14.8	14.8	14.8	43.0	50.8	50.8	50.8	77.4	91.4	91.4	91.4	124	147	147	147
	140	9.7	13.3	14.8	14.8	14.8	51.7	50.8	50.8	50.8	87.7	91.4	91.4	91.4	141	147	147	147
130 to 200 psig / 9.0 to 13.8 bar Blue	130	9.0	12.0	14.8	14.8	14.8	51.9	50.8	50.8	50.8	83.7	91.4	91.4	91.4	135	147	147	147
	150	10.3	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	175	12.1	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	200	13.8	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
100 to 375 psig / 6.9 to 26.0 bar Unpainted	100	6.9	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	150	10.3	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	200	13.8	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	250	17.2	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	300	20.7	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	350	24.1	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147
	375	25.9	14.8	14.8	14.8	14.8	50.8	50.8	50.8	50.8	91.4	91.4	91.4	91.4	147	147	147	147

1. Type LR128 on liquid service with 1/2 NPT Type MR98H Pilot, 100% Cage Capacity with Strainer and Type 112 Restrictor Setting of "6" for the 1 and 2 in. / DN 25 and 50 body sizes, "6" or "8" for the 3 in. / DN 80 body size and "8" for the 4 in. / DN 100 body size.
2. Values published in this table are laboratory tested and are presented based on % offset (positive control deviation only) or pressure build-up above setpoint.

Type MR95H

Pressure Reducing Regulator

Introduction

Type MR95H regulators are compact, large-capacity, direct-operated pressure regulators. The units are available in 1/4 NPT through 2 in. / DN 50 sizes and are offered in several different end connection configurations. They are designed to handle pressures up to 1000 psig / 68.9 bar and temperatures up to 650°F / 343°C.

These products can help solve the toughest pressure control applications. Typical applications include superheated steam, steam injection, steam tracing, nitrogen purging, boiler feed water, process chemicals, cooling water, test fixtures, wash tanks, sterilizers/ autoclaves, fuel lines, pneumatic supply and many others.

Available Configurations

See Table 1

Body Sizes, End Connections and Port Options

See Table 2

Orifice Sizes

1/4 NPT body:
0.284 in. / 7.22 mm orifice
1/2 in. / DN 15 body:
0.416 in. / 10.56 mm orifice
3/4 and 1 in. / DN 20 and 25 bodies:
0.631 in. / 16.02 mm orifice
1-1/2 and 2 in. / DN 40 and 50 bodies:
1.142 in. / 29 mm orifice

Construction Material Options

See Table 3

Spring Case Construction

Drilled Untapped Hole: Standard for Types MR95H, MR95HP and MR95HT
1/4 NPT Vent: Standard for Types MR95HD and MR95HDP; Optional for other types

Flow and Sizing Coefficients

Type MR95H Sizing: See Table 4
Reduced Port Option Sizing: See Table 5

Pressure Registration

Internal (Standard) or External

Shutoff Classification Per ANSI/FCI 70-3-2004

Metal Seats: Class IV
Elastomer Seats: Class VI or better
PTFE: Class IV

Pressure Ranges

5 to 400 psig / 0.34 to 27.5 bar in different ranges; See Table 6

Approximate Weights

5 to 55 lbs / 2.3 to 25 kg; See Table 7

Maximum Cold Working Pressures of Body Size and Material

Up to 1000 psig / 68.9 bar; See Table 8

Temperature Capabilities

-40 to 650°F / -40 to 340°C; See Table 9

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Liquid
- Process Gas
- Steam

Features

- Up to 1000 psig / 68.9 bar Inlet Pressure
- Set pressures up to 400 psig / 27.6 bar
- Inlet Equals Outlet Pressure Rating up to 300 psig/20.7 bar
- Elastomer Seat Option for Tight Shutoff
- Graphite Gaskets for High Temperature Applications
- Rugged Construction
- Differential Pressure Capability
- Optional Materials for Special Service Capability (e.g., Sour Gases, Cryogenics, Steam)
- Large Turdown Ratio
- Multiple End Connection Options
- Handwheels/Tee Handles Option
- Inlet/Outlet Gauge Ports and Reduced Port Options
- Easy Maintenance
- API 614 Compliant

Figure 1. Type MR95H Direct-Operated Pressure Reducing Regulator

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

01/17

www.Emerson.com

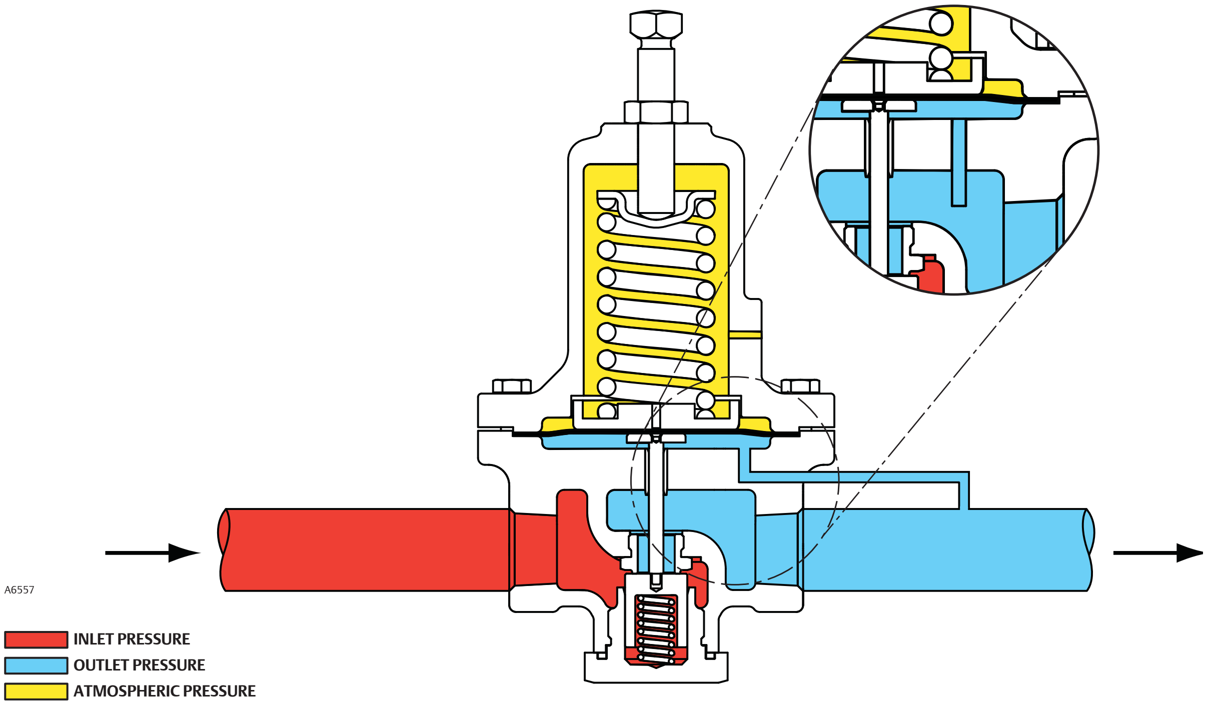


Figure 2. *Type MR95H Operational Schematic with External Registration and Standard Internal Registration (inset)*

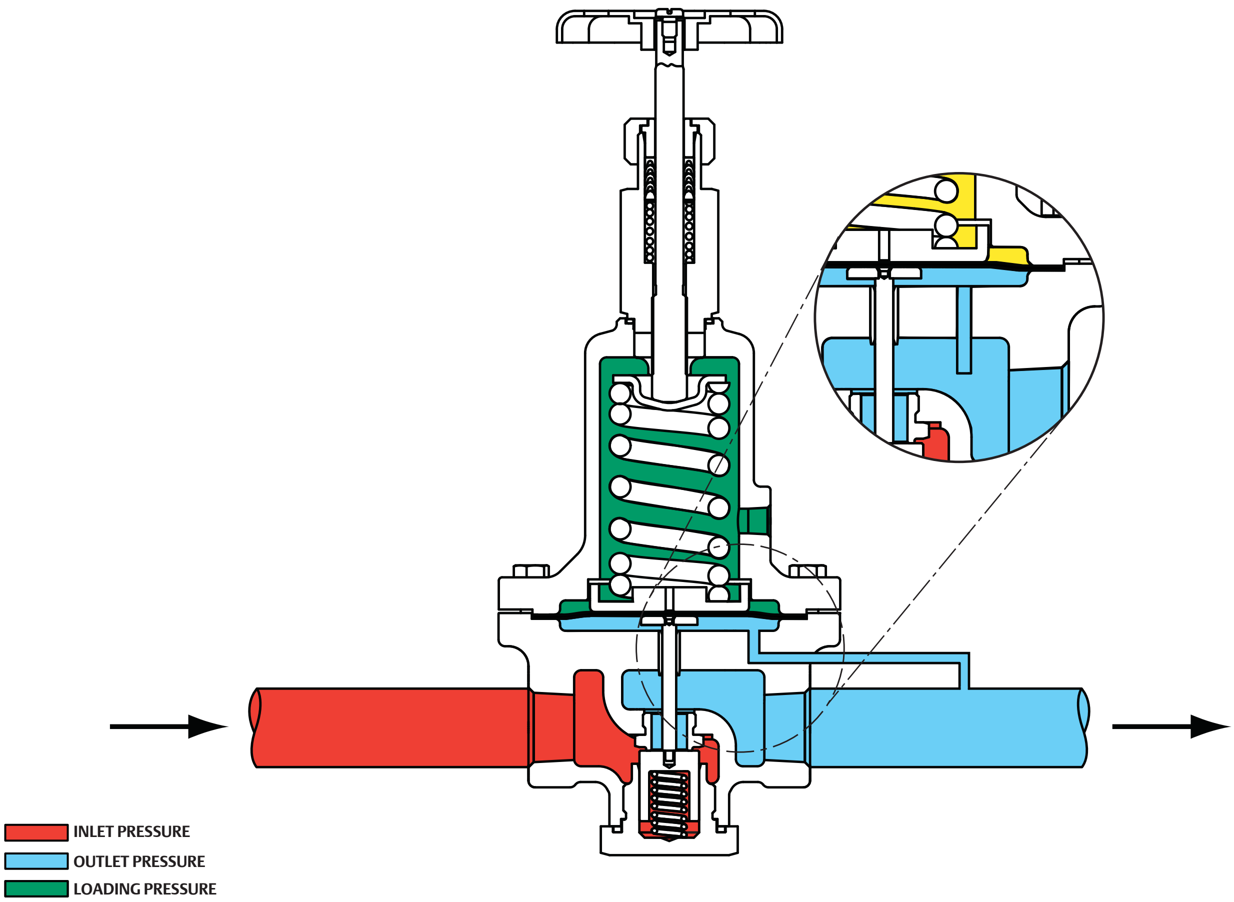


Figure 3. *Type MR95HD Operational Schematic with External Registration and Standard Internal Registration (inset)*

Table 1. Available Configurations	
TYPE	CONFIGURATION
MR95H	Pressure reducing regulator for outlet pressures from 5 to 150 psig / 0.34 to 10.3 bar.
MR95HP	Pressure reducing regulator for outlet pressures from 15 to 400 psig / 1.0 to 27.6 bar (soft-seated).
MR95HT	High temperature pressure reducing regulator for outlet pressures from 15 to 300 psig / 1.0 to 20.7 bar (metal seat) and up to 650°F / 343°C.
MR95HD	Pressure reducing differential regulator for differential set pressures from 5 to 150 psi / 0.34 to 10.3 bar with maximum inlet/outlet pressures up to 300 psig / 20.7 bar.
MR95HDP	Pressure reducing differential regulator for differential set pressures from 5 to 150 psi / 0.34 to 10.3 bar with maximum inlet/outlet pressures up to 600 psi / 41.4 bar.

Table 2. Body Sizes, End Connections and Port Options		
BODY SIZES	END CONNECTIONS	PORT OPTIONS
1/4 NPT 1/2 in. / DN 15 3/4 in. / DN 20 1 in. / DN 25 1-1/2 in. / DN 40 2 in. / DN 50	NPT SWE Welded/Integral CL150 RF Welded/Integral CL300 RF Welded/Integral CL600 RF Welded/Integral PN 16/25/40 RF	Inlet and Outlet Gauge Ports Option Reduced Port (Orifice) Option

Table 3. Construction Material Options		
BODY	SPRING CASE	REGULATOR SPRING
Gray Cast Iron (1) LCC/WCC Steel CF8M/CF3M Stainless steel (2) Hastelloy® C (2) Monel® (2)	Gray Cast Iron LCC/WCC Steel CF8M Stainless steel Hastelloy® C Monel®	Steel (standard) Inconel® 302 Stainless steel 17-4 PH Stainless steel

1. Gray cast iron body material is available for Types MR95H and MR95HD only.
2. Meets the chemical and physical requirements of NACE MR0175-2002 and NACE MR0103.

TRIM MATERIAL		
Elastomer Seat		
Part Name	**Standard**	**Optional**
Diaphragm	Neoprene (CR)	302 Stainless steel(1), Fluorocarbon (FKM)(1), Ethylenepropylene (EPDM)(1), Monel®(1), Hastelloy® C(1) or PTFE protector available with Neoprene (CR) and Fluorocarbon (FKM)(1) diaphragm
Disk	Nitrile (NBR)	Fluorocarbon (FKM), Polytetrafluoroethylene (PTFE), Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM)
Disk Holder	Brass or 416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Valve Plug Guide	316 Stainless steel	Monel® or Hastelloy® C
Orifice	Brass or 416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Stem Assembly	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Metal Seat		
Diaphragm	302 Stainless steel(1)	Monel®(1), Hastelloy® C(1), Fluorocarbon (FKM)(1), Ethylenepropylene (EPDM)(1) or PTFE protector available with Neoprene (CR) and Fluorocarbon (FKM)(1) diaphragm
Valve Plug	416 Stainless steel	316 Stainless steel, Monel®, Hastelloy® C or Alloy 6
Valve Plug Guide	316 Stainless steel	Monel® or Hastelloy® C
Orifice	416 Stainless steel	316 Stainless steel, Monel®, Hastelloy® C or Alloy 6
Stem Assembly	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Gasket	Composition	Graphite

1. Two diaphragms are used.

Table 4. Flow and Sizing Coefficients									
BODY SIZE		WIDE-OPEN COEFFICIENTS (FOR RELIEF SIZING)			C_1	K_m	IEC SIZING COEFFICIENTS		
In.	DN	C_v	C_g	C_s			X_T	F_D	F_L
1/4	- - - -	1.1	37	1.85	33.6	0.74	0.715	0.62	0.86
1/2	15	2.9	103	5.15	35.5	0.79	0.797	0.70	0.89
3/4 and 1	20 and 25	6.0	221	11.05	36.8	0.88	0.857	0.68	0.94
1-1/2 and 2	40 and 50	18.1	700	35.00	38.7	0.88	0.945	0.65	0.94

$K_m = F_L^2$

Table 5. Relief Sizing Coefficients for Type MR95H Regulators with Reduced Flow Orifices[1]

BODY SIZE		WIDE-OPEN COEFFICIENTS FOR TYPE MR95H REDUCED FLOW OPTION	WIDE-OPEN COEFFICIENTS FOR LEGACY 95 SERIES
In.	DN	C_g	C_g
1/4	- - - -	28	28
1/2	15	70	67
3/4 and 1	20 and 25	156	156
1-1/2 and 2	40 and 50	482	475

1. The reduced flow orifice option offers similar flow capacity as the equivalent 95 Series configuration.

Table 6. Pressure Ranges and Spring Information

TYPE	BODY SIZE		OUTLET OR DIFFERENTIAL PRESSURE RANGE[1]		SPRING WIRE DIAMETER		SPRING FREE LENGTH		SPRING MATERIAL[2]	SPRING COLOR
	In.	DN	psi/psig	bar	In.	mm	In.	mm		
MR95H, MR95HD and MP95HDP	1/4	- - - -	15 to 30	1.0 to 2.1	0.148	3.76	2.00	50.8	Zinc-plated steel	Yellow
			25 to 75	1.7 to 5.2	0.170	4.32	2.00	50.8	Zinc-plated steel	Green
			70 to 150	4.8 to 10.3	0.207	5.26	1.94	49.2	Powder-coated steel[3]	Red
	1/2	15	15 to 30	1.0 to 2.1	0.207	5.26	2.50	63.5	Powder-coated steel[3]	Yellow
			25 to 75	1.7 to 5.2	0.234	5.94	2.60	65.9	Powder-coated steel[3]	Green
			70 to 150	4.8 to 10.3	0.283	7.19	2.44	62.0	Powder-coated steel[3]	Red
	3/4 and 1	20 and 25	15 to 30	1.0 to 2.1	0.306	7.77	4.00	102	Powder-coated steel[3]	Yellow
			25 to 75	1.7 to 5.2	0.343	8.71	4.00	102	Powder-coated steel[3]	Green
			70 to 150	4.8 to 10.3	0.406	10.31	4.00	102	Powder-coated steel[3]	Red
			15 to 30	1.0 to 2.1	0.306	7.77	4.00	102	Powder-coated Stainless steel	Yellow
			25 to 75	1.7 to 5.2	0.375	9.53	3.88	98.6	Stainless steel	Unpainted
			70 to 150	4.8 to 10.3	0.437	11.1	4.00	102	Stainless steel	Unpainted
	1-1/2 and 2	40 and 50	5 to 80	0.34 to 5.5	0.500	12.7	6.50	165	Powder-coated steel	Black with Light Blue Stripe
			60 to 120	4.1 to 8.3	0.562	14.3	6.56	167	Powder-coated steel	Light Gray
			100 to 140	6.9 to 9.7	0.594	15.1	6.56	167	Enamel-coated steel	Yellow
			120 to 150	8.3 to 10.3	0.625	15.9	6.57	167	Powder-coated steel	Black
			5 to 60	0.34 to 4.1	0.5	12.7	6.5	165	Inconel®	Unpainted
			50 to 120	3.4 to 8.3	0.625	15.9	6.5	165	Inconel®	Unpainted
MR95HT	1/4	- - - -	15 to 100	1.0 to 6.9	0.192	4.88	2.00	50.8	Inconel®	Unpainted
			80 to 300	5.5 to 20.7	0.281	7.14	2.00	50.8	Inconel®	Unpainted
	1/2	15	15 to 100	1.0 to 6.9	0.281	7.14	2.50	63.5	Inconel®	Unpainted
			80 to 300	5.5 to 20.7	0.375	9.53	2.60	66.0	Inconel®	Unpainted
	3/4 and 1	20 and 25	15 to 100	1.0 to 6.9	0.437	11.1	4.08	104	17-4 PH Stainless steel	Unpainted
			80 to 300	5.5 to 20.7	0.562	14.3	4.08	104	17-4 PH Stainless steel	Unpainted
	1-1/2 and 2	40 and 50	15 to 100	1.0 to 6.9	0.625	15.9	6.70	170	17-4 PH Stainless steel	Unpainted
			60 to 260	4.1 to 17.9	0.812	20.6	6.70	170	17-4 PH Stainless steel	Unpainted
MR95HP	1/4	- - - -	15 to 100	1.0 to 6.9	0.192	4.88	2.00	50.8	Inconel®	Unpainted
			80 to 400	5.5 to 27.6	0.281	7.14	2.00	50.8	Inconel®	Unpainted
	1/2	15	15 to 100	1.0 to 6.9	0.281	7.14	2.50	63.5	Inconel®	Unpainted
			80 to 400	5.5 to 27.6	0.375	9.53	2.60	66.0	Inconel®	Unpainted
	3/4 and 1	20 and 25	15 to 100	1.0 to 6.9	0.437	11.1	4.08	104	17-4 PH Stainless steel	Unpainted
			80 to 400	5.5 to 27.6	0.562	14.3	4.08	104	17-4 PH Stainless steel	Unpainted
	1-1/2 and 2	40 and 50	15 to 100	1.0 to 6.9	0.625	15.9	6.70	170	17-4 PH Stainless steel	Unpainted
			60 to 300	4.1 to 20.7	0.812	20.6	6.70	170	17-4 PH Stainless steel	Unpainted

1. For Types MR95HD and MR95HDP regulators, the pressure ranges indicate the differential pressure that can be obtained with the indicated spring. The differential pressure (spring setting) is added to the spring case loading pressure to determine the actual outlet pressure.
2. Springs meet NACE MR0175-2002 and NACE MR0103 requirements only for applications in which the spring is not exposed to the sour gas.
3. Available in Inconel®.

Table 7. Approximate Weights

BODY SIZE		APPROXIMATE WEIGHT	
In.	DN	lbs	kg
1/4	- - - -	5	2.3
1/2	15	10	4.5
3/4 and 1	20 and 25	22	10
1-1/2 and 2	40 and 50	55	25

Table 8. Maximum Cold Working Pressures of Body Size and Material(1)(2)

TYPE	BODY SIZE	SPRING CASE MATERIAL	MAXIMUM INLET PRESSURE		MAXIMUM OUTLET PRESSURE		MAXIMUM SPRING CASE PRESSURE	
			psig	bar	psig	bar	psig	bar
MR95H and MR95HD	All available sizes(3)	Gray Cast Iron	250	17.2	250	17.2	250	17.2
		WCC Steel	300	20.7	300	20.7	300	20.7
		LCC Steel	300	20.7	300	20.7	300	20.7
		CF8M Stainless steel	300	20.7	300	20.7	300	20.7
		CF3M Stainless steel	300	20.7	300	20.7	300	20.7
		Monel®(4)	300	20.7	300	20.7	300	20.7
		Hastelloy® C(4)	300	20.7	300	20.7	300	20.7
MR95HDP	All available sizes(3)	WCC Steel	600	41.4	600	41.4	600	41.4
		LCC Steel	600	41.4	600	41.4	600	41.4
		CF8M Stainless steel	600	41.4	550	37.9	550	37.9
		CF3M Stainless steel	600	41.4	550	37.9	550	37.9
		Monel®(4)	600	41.4	550	37.9	550	37.9
		Hastelloy® C(4)	600	41.4	550	37.9	550	37.9
MR95HP	All available sizes(3)	WCC Steel	1000	68.9	600	41.4	600	41.4
		LCC Steel	1000	68.9	600	41.4	600	41.4
		CF8M Stainless steel	1000	68.9	550	37.9	550	37.9
		CF3M Stainless steel	1000	68.9	550	37.9	550	37.9
		Monel®(4)	1000	68.9	550	37.9	550	37.9
		Hastelloy® C(4)	1000	68.9	550	37.9	550	37.9
MR95HT	1/4 NPT and 1/2 to 1 in. / DN 15 to 25	WCC Steel	600	41.4	600	41.4	600	41.4
		LCC Steel	600	41.4	600	41.4	600	41.4
		CF8M Stainless steel	600	41.4	550	37.9	550	37.9
		CF3M Stainless steel	600	41.4	550	37.9	550	37.9
		Monel®(4)	600	41.4	550	37.9	550	37.9
		Hastelloy® C(4)	600	41.4	550	37.9	550	37.9
	1-1/2 and 2 in. / DN 40 and 50	WCC Steel	600	41.4	450	31.0	450	31.0
		LCC Steel	600	41.4	450	31.0	450	31.0
		CF8M Stainless steel	600	41.4	450	31.0	450	31.0
		CF3M Stainless steel	600	41.4	450	31.0	450	31.0
		Monel®	600	41.4	450	31.0	450	31.0
		Hastelloy® C	600	41.4	450	31.0	450	31.0

1. The pressure/temperature limits in this Application Guide and any applicable standard or code limitation should not be exceeded.
2. The pressure limits given are based on the body size and body materials only. Actual pressure limits of the assembled regulator may decrease and vary depending on the temperature, body end connection, diaphragm, seat and/or trim material of the regulator.
3. See Table 6 for all available body sizes.
4. Not available for 1/4 NPT body size.

Table 9. MR95 Series Temperature Capabilities(1)(2)

TRIM MATERIAL	SEAT	DIAPHRAGM	O-RING	DIAPHRAGM PROTECTOR	GASKET	TEMPERATURE	
						°F	°C
Nitrile (NBR)	✓		✓			-40 to 180	-40 to 82
Neoprene (CR)		✓				-40 to 180	-40 to 82
Fluorocarbon (FKM)(3)	✓	✓	✓			0 to 300, Limited to 200°F for hot water	-18 to 149, Limited to 93°C for hot water
Ethylenepropylene (EPDM)	✓	✓	✓			20 to 275	-7 to 135
Perfluoroelastomer (FFKM)	✓		✓			0 to 425	-18 to 218
PTFE	✓			✓		-40 to 400	-40 to 204
Metal	✓	✓				-40 to 650	-40 to 343
Composition					✓	-40 to 400, Limited to 300°F for steam	-40 to 204, Limited to 149°C for steam
Graphite					✓	-40 to 650	-40 to 343

BODY MATERIAL	TEMPERATURE	
	°F	°C
Gray cast iron	-20 to 406	-29 to 208
WCC Steel(4)	-20 to 650	-29 to 343
LCC Steel(4)	-40 to 650	-40 to 343
Stainless(4), Monel® or Hastelloy® C	-40 to 550	-40 to 288

1. The pressure/temperature limits in this Application Guide and any applicable standard limitation should not be exceeded.
2. The temperature limits given are based on the body size and body materials only. Actual temperature limits of the assembled regulator may decrease and vary depending on the body end connection, diaphragm, seat and/or trim material of the regulator.
3. Not for use on steam service.
4. Meets API 614 requirements (with Stainless steel trim).

Air

Table 10. Air Capacities(1)(2) in SCFH / Nm³/h for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95H, MR95HD and MR95HDP Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 / 15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
15 to 30 / 1.0 to 2.1	15	1.0	30	2.1	430	11.5	780	20.9	1000	27.2	1700	44.5	2100	56	3300	88.3	2300	62.8	4100	110
			40	2.8	530	14.2	940	25.3	1200	32.6	1900	51.4	2500	65.9	3900	104	3100	82.3	5300	143
			50	3.4	640	17	1100	29.7	1400	38	2200	58.4	2800	75.8	4500	120	3800	102	6600	176
			75	5.2	850	22.9	1500	40.1	1600	43.7	2400	64.8	3700	99.4	5500	147	5200	138	8300	223
			100	6.9	1100	28.8	1900	50.6	1800	49.3	2700	71.2	4600	123	6500	174	6500	174	10,000	269
			150	10.3	1600	44.1	2200	59.2	2500	68	3300	88.2	5700	154	7300	196	8400	226	12,000	327
			200	13.8	2200	59.4	2500	67.8	3200	86.6	3900	105	6900	185	8200	219	10,000	277	14,000	385
			250	17.2	2300	61.4	2600	70.8	3700	99.1	4300	115	7200	192	8600	231	12,000	315	16,000	428
			300	20.7	2400	63.3	2800	73.8	4200	112	4700	126	7400	198	9100	244	13,000	354	18,000	472
	30	2.1	40	2.8	750	20.1	1400	36.2	1700	45.8	3000	81.5	3500	93.8	6000	161	4000	107	8000	214
			50	3.4	1000	27.4	1600	42.4	2000	53.7	3400	90.3	4100	110	7100	189	5600	149	10,000	269
			75	5.2	1400	36.9	2200	58.3	2500	66.9	3900	104	5400	144	8500	227	7600	203	13,000	350
			100	6.9	1700	46.5	2800	74.2	3000	80.1	4400	117	6700	179	9900	264	9600	258	16,000	431
			150	10.3	2000	54.8	3200	85.4	3500	94.1	5100	137	6600	176	10,000	273	12,000	329	19,000	496
			200	13.8	2400	63.1	3600	96.5	4000	108	5800	157	6400	173	10,000	281	15,000	401	21,000	561
			250	17.2	2900	76.9	3900	104	4800	129	6400	172	6400	172	11,000	284	15,000	401	21,000	568
			300	20.7	3400	90.7	4100	111	5600	150	7000	186	6400	172	11,000	288	15,000	400	21,000	576
25 to 75 / 1.7 to 5.2	50	3.4	60	4.1	1000	26.8	2000	53.6	2500	66.2	4500	121	5900	158	9500	255	5500	147	12,000	327
			75	5.2	1400	38.5	2500	68.1	3100	83.6	5200	140	6500	175	11,000	287	8500	228	14,000	385
			100	6.9	1800	48.8	3200	86.2	3800	101	6200	165	8100	218	13,000	340	10,000	272	18,000	488
			150	10.3	2500	66.7	4100	110	4800	128	7300	196	9500	255	15,000	394	14,000	382	22,000	595
			200	13.8	3200	84.6	5000	134	5800	156	8500	227	11,000	292	17,000	447	18,000	493	26,000	702
			250	17.2	3800	102	5300	142	6500	173	8900	238	12,000	310	17,000	465	18,000	471	28,000	740
			300	20.7	4400	119	5600	149	7100	191	9300	250	12,000	329	18,000	482	17,000	448	29,000	777
	75	5.2	100	6.9	2400	65.4	3900	105	3000	80.6	6700	179	10,000	278	17,000	445	12,000	316	19,000	519
			125	8.6	3000	79.8	4700	127	4100	109	7700	205	12,000	313	18,000	491	15,000	393	24,000	636
			150	10.3	3500	94.2	5500	149	5200	138	8600	231	13,000	349	20,000	537	18,000	470	28,000	752
			200	13.8	4600	123	7200	192	7300	196	11,000	283	16,000	420	24,000	630	23,000	624	37,000	985
			250	17.2	5300	141	7600	205	8300	222	12,000	313	16,000	438	25,000	657	24,000	650	38,000	1030
			300	20.7	5900	159	8100	217	9300	249	13,000	344	17,000	456	26,000	684	25,000	677	40,000	1070
70 to 150 / 4.8 to 10.3	100	6.9	125	8.6	2200	58.7	3600	96.6	5400	144	8900	239	12,000	323	20,000	525	13,000	343	21,000	573
			150	10.3	2700	73.1	4500	122	6400	172	10,000	277	14,000	381	23,000	610	17,000	459	27,000	736
			175	12.1	3100	83.6	5200	139	7100	191	11,000	298	16,000	438	25,000	684	19,000	512	31,000	838
			200	13.8	3500	94.2	5800	157	7900	211	12,000	320	18,000	495	28,000	758	21,000	564	35,000	939
			250	17.2	4200	112	6700	179	8900	240	13,000	360	20,000	540	30,000	808	25,000	668	40,000	1080
			300	20.7	4800	129	7500	202	10,000	269	15,000	399	22,000	586	32,000	858	29,000	771	45,000	1210
	150	10.3	175	12.1	3400	91	5400	144	8900	238	14,000	371	13,000	357	26,000	709	18,000	481	30,000	793
			200	13.8	4200	114	6500	174	10,000	272	16,000	429	16,000	425	31,000	835	25,000	665	36,000	961
			225	15.5	4900	132	7400	198	11,000	290	17,000	443	18,000	473	33,000	894	28,000	747	41,000	1110
			250	17.2	5600	151	8200	221	12,000	309	17,000	457	19,000	521	36,000	954	31,000	829	47,000	1260
			300	20.7	7000	188	10,000	267	13,000	346	18,000	485	23,000	616	40,000	1070	37,000	994	58,000	1560

1. To obtain capacities for Type MR95HT (metal diaphragm), multiply the table values by 0.6.
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

Process Gas

Regulating capacities at selected pressures and outlet pressure flows in Tables 10-13 are given in SCFH (60°F and 14.7 psia) of air. To determine the equivalent capacities for other gases, multiply the table capacities in Tables 10-13 by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm³/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

Air

Table 11. Air Capacities[1] in SCFH / Nm³/h for 1-1/2 through 2 in. / DN 40 through 50
Types MR95H, MR95HD and MR95HDP Regulators with Elastomer or Stainless Steel Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN											
	Outlet/ Differential Setting		Inlet		1-1/2 / 40						2 / 50					
					Droop						Droop					
					10%		20%		40%		10%		20%		40%	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 80 / 0.34 to 5.5	5	0.34	10	0.69	1000	27.5	1500	40.7	2500	68.2	1000	26.9	1400	38.6	2600	70.8
			20	1.4	1600	41.7	2200	58.4	3700	99.8	1600	42.6	2300	61.7	4000	107
			30	2.1	2100	56	2800	76.2	4900	131	2200	58.3	3200	84.9	5400	144
			50	3.4	3200	84.5	4200	112	7300	195	3300	89.7	4900	131	8100	216
			75	5.2	4100	109	5700	153	9800	264	5000	134	7200	193	15,000	392
			100	6.9	5000	134	7200	194	12,000	333	6600	177	9500	256	21,000	568
			150	10.3	5500	146	7900	213	13,000	347	10,000	270	26,000	695	36,000	959
			200	13.8	5900	159	8600	231	13,000	360	14,000	363	42,000	1130	50,000	1350
			250	17.2	7500	200	10,000	273	15,000	415	21,000	569	47,000	1250	51,000	1350
			300	20.7	9000	241	12,000	315	18,000	471	29,000	775	51,000	1360	51,000	1360
	30	2.1	40	2.8	7900	212	13,000	340	21,000	551	10,000	275	18,000	471	30,000	814
			50	3.4	8100	216	14,000	362	23,000	629	13,000	346	22,000	590	38,000	1010
			75	5.2	14,000	372	22,000	585	37,000	987	19,000	516	43,000	1150	58,000	1560
			100	6.9	20,000	527	30,000	807	50,000	1340	26,000	687	64,000	1710	79,000	2110
			150	10.3	21,000	568	33,000	872	52,000	1380	57,000	1540	86,000	2300	93,000	2500
			200	13.8	23,000	610	35,000	937	53,000	1420	89,000	2390	110,000	2890	110,000	2890
			250	17.2	29,000	772	41,000	1100	57,000	1530	100,000	2700	110,000	2980	110,000	2980
			300	20.7	35,000	934	47,000	1260	61,000	1640	110,000	3010	110,000	3060	110,000	3060
	50	3.4	60	4.1	13,000	349	27,000	724	48,000	1290	14,000	383	32,000	869	50,000	1340
			75	5.2	19,000	516	33,000	873	52,000	1400	21,000	570	42,000	1120	55,000	1490
			100	6.9	26,000	697	41,000	1100	65,000	1750	34,000	925	67,000	1810	76,000	2030
			150	10.3	29,000	779	47,000	1250	72,000	1920	77,000	2050	110,000	2820	110,000	2960
			200	13.8	32,000	860	53,000	1410	78,000	2090	120,000	3180	140,000	3840	150,000	3900
			250	17.2	42,000	1110	60,000	1620	87,000	2330	140,000	3700	150,000	4100	150,000	4120
			300	20.7	51,000	1370	68,000	1820	96,000	2570	160,000	4220	160,000	4350	160,000	4350
	75	5.2	100	6.9	28,000	753	48,000	1280	68,000	1830	33,000	875	62,000	1650	71,000	1910
			125	8.6	35,000	939	59,000	1590	82,000	2190	55,000	1480	82,000	2190	90,000	2410
			150	10.3	42,000	1120	71,000	1900	95,000	2560	78,000	2090	100,000	2730	110,000	2920
			200	13.8	56,000	1490	94,000	2530	120,000	3290	120,000	3300	140,000	3800	150,000	3930
			250	17.2	62,000	1660	97,000	2600	130,000	3560	170,000	4440	180,000	4750	180,000	4810
			300	20.7	68,000	1830	100,000	2670	140,000	3840	210,000	5580	210,000	5690	210,000	5690
60 to 120 / 4.1 to 8.3	100	6.9	125	8.6	33,000	881	60,000	1600	81,000	2160	38,000	1020	70,000	1880	86,000	2310
			150	10.3	37,000	987	65,000	1740	94,000	2520	60,000	1620	90,000	2420	110,000	2830
			175	12.1	41,000	1090	70,000	1880	110,000	2890	83,000	2230	110,000	2960	120,000	3340
			225	15.5	49,000	1300	81,000	2170	130,000	3610	130,000	3440	150,000	4050	160,000	4360
			250	17.2	48,000	1290	84,000	2260	140,000	3730	150,000	3920	170,000	4580	180,000	4820
			300	20.7	47,000	1270	91,000	2440	150,000	3980	180,000	4900	210,000	5650	210,000	5750
100 to 140 / 6.9 to 97	125	8.6	150	10.3	40,000	1070	69,000	1840	94,000	2520	38,000	1020	76,000	2030	100,000	2710
			175	12.1	46,000	1240	83,000	2220	110,000	3020	44,000	1190	100,000	2670	120,000	3260
			200	13.8	53,000	1410	97,000	2600	130,000	3520	50,000	1350	120,000	3310	140,000	3800
			225	15.5	63,000	1700	110,000	2960	150,000	3910	81,000	2170	140,000	3870	160,000	4310
			250	17.2	74,000	1990	120,000	3310	160,000	4310	110,000	2990	160,000	4420	180,000	4830
			300	20.7	96,000	2560	150,000	4020	190,000	5110	170,000	4640	210,000	5530	220,000	5860
120 to 150 / 8.3 to 10.3	150	10.3	175	12.1	38,000	1030	70,000	1870	110,000	2980	38,000	1020	76,000	2040	110,000	3080
			200	13.8	46,000	1240	80,000	2150	130,000	3450	47,000	1270	93,000	2490	140,000	3650
			225	15.5	51,000	1360	87,000	2330	140,000	3770	54,000	1450	120,000	3160	160,000	4190
			250	17.2	55,000	1480	94,000	2520	150,000	4080	61,000	1630	140,000	3840	180,000	4730
			300	20.7	64,000	1710	110,000	2890	180,000	4710	74,000	1990	190,000	5190	220,000	5810

1. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

Air

Table 12. Air Capacities(1)(2) in SCFH / Nm³/h for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Type MR95HP (Elastomer Diaphragm) Regulator

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 / 15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	200	5.36	300	8.04	350	9.47	410	10.9	1100	29.6	2500	67.3	2000	54.1	3600	96.5
			40	2.8	210	5.63	330	8.71	610	16.4	790	21.1	1500	39.3	2900	78	2200	59	3900	104
			50	3.4	220	5.9	350	9.38	810	21.8	1100	29.1	1700	46.9	3200	86.3	2400	64	4100	111
			75	5.2	230	6.17	400	10.7	1200	31.5	1600	43.6	2300	60.5	3800	101	2900	76.4	4800	129
			100	6.9	250	6.62	450	11.9	1200	32	1900	50.5	2800	74.4	4300	115	3300	88.9	5500	147
			150	10.3	370	10	610	16.2	1800	47.9	2600	69.3	3000	81	4700	125	4200	114	6900	184
			200	13.8	500	13.5	770	20.5	2400	63.9	3300	88.2	3300	87.6	5000	135	5200	139	8200	220
			250	17.2	510	13.7	830	22.3	2400	64.3	3300	87.8	3700	100	5400	146	5500	148	9100	245
			300	20.7	520	13.9	900	24.1	2400	64.6	3300	87.5	4200	113	5800	156	5900	157	10,000	269
			400	27.6	640	17.2	950	25.5	2700	71.1	3600	96.8	4400	117	6100	164	6700	179	11,000	298
			500	34.5	780	20.8	1000	27.8	2800	75.1	4100	110	4600	124	6400	172	7200	194	12,000	323
			600	41.4	910	24.4	1100	30.1	2900	79	4600	123	4900	131	6700	179	7700	205	13,000	343
			1000	69.0	910	24.4	1100	30.1	3500	93.3	5000	135	5500	148	7400	198	8900	239	15,000	400
	50	3.4	60	4.1	880	23.6	1500	40.4	3000	80.4	5100	137	6500	174	10,000	268	6000	161	11,000	295
			75	5.2	920	24.7	1600	41.8	3200	85.5	5300	143	6800	182	10,000	276	6700	180	12,000	317
			100	6.9	1000	26.9	1600	42.5	3500	94	5700	154	7300	195	11,000	290	7900	211	13,000	354
			150	10.3	1100	30.5	1800	48.8	4300	115	6600	178	8200	221	12,000	328	10,000	277	17,000	450
			200	13.8	1300	34	2100	55	5100	136	7500	201	9200	246	14,000	367	13,000	343	20,000	547
			250	17.2	1400	38.2	2200	57.7	5700	152	8200	221	10,000	268	15,000	391	15,000	393	23,000	607
			300	20.7	1600	42.4	2300	60.3	6200	167	9000	241	11,000	289	16,000	416	17,000	444	25,000	667
			400	27.6	1700	46.3	2400	64.7	7000	188	9300	250	9300	248	14,000	379	19,000	510	29,000	778
			500	34.5	1700	46.8	2500	65.7	7200	193	9500	254	10,000	272	15,000	405	21,000	564	31,000	835
			600	41.4	1800	47.4	2500	66.7	7400	199	9600	258	11,000	296	16,000	430	23,000	617	33,000	893
			1000	69.0	1800	48.3	2500	67	7300	195	10,000	273	13,000	353	18,000	478	28,000	741	38,000	1030
	100	6.9	125	8.6	2000	54.4	3100	84.2	6600	176	10,000	277	12,000	314	19,000	499	13,000	361	22,000	583
			150	10.3	2100	57.3	3300	89.1	7200	192	11,000	303	13,000	357	21,000	556	16,000	430	26,000	708
			175	12.1	2200	60.3	3500	94	7800	208	12,000	328	15,000	399	23,000	613	19,000	499	31,000	834
			200	13.8	2400	63.2	3700	99	8400	224	13,000	354	16,000	442	25,000	671	21,000	569	36,000	959
			250	17.2	2600	69.1	3900	105	9800	262	15,000	396	19,000	497	27,000	724	25,000	670	40,000	1090
			300	20.7	2800	75.1	4100	111	11,000	300	16,000	438	21,000	553	29,000	776	29,000	771	45,000	1210
			400	27.6	3100	81.8	4300	116	12,000	312	18,000	480	16,000	439	25,000	673	33,000	896	50,000	1350
			500	34.5	3100	83.6	4400	119	12,000	323	17,000	468	18,000	479	27,000	716	36,000	970	54,000	1450
			600	41.4	3200	85.5	4500	122	12,000	333	17,000	456	19,000	518	28,000	759	39,000	1040	57,000	1540
			1000	69.0	3200	85.8	4500	121	14,000	381	19,000	514	21,000	557	31,000	820	46,000	1230	66,000	1770
80 to 300 / 5.5 to 20.7	125	8.6	150	10.3	1400	37.1	2300	60.6	4500	119	7600	205	9600	257	16,000	424	9700	261	17,000	447
			175	12.1	1500	39.9	2400	64.9	5100	136	8400	226	11,000	287	17,000	468	11,000	305	19,000	507
			200	13.8	1600	42.7	2600	69.3	5700	153	9200	247	12,000	317	19,000	513	13,000	348	21,000	568
			225	15.5	1700	45.2	2700	73.3	6000	162	9800	263	13,000	340	20,000	550	14,000	380	23,000	624
			250	17.2	1800	47.7	2900	77.3	6400	171	10,000	279	14,000	363	22,000	587	15,000	411	25,000	679
			300	20.7	2000	52.8	3200	85.4	7100	190	12,000	311	15,000	410	25,000	661	18,000	474	29,000	791
			400	27.6	2200	60	3500	93.1	8900	240	14,000	387	17,000	454	27,000	713	22,000	592	36,000	966
			500	34.5	2500	65.8	3900	104	10,000	270	16,000	427	19,000	499	29,000	765	26,000	700	41,000	1110
			600	41.4	2700	71.5	4300	114	11,000	301	17,000	467	20,000	543	30,000	817	30,000	807	46,000	1240
			1000	69.0	2000	53	4000	108	15,000	395	21,000	553	27,000	722	38,000	1020	40,000	1070	65,000	1750
	200	13.8	225	15.5	2300	62.3	4000	107	8000	216	14,000	362	16,000	435	27,000	714	18,000	479	31,000	830
			250	17.2	2600	68.4	4200	113	9000	242	15,000	396	18,000	474	30,000	796	20,000	528	34,000	912
			300	20.7	3000	80.6	4700	127	11,000	293	17,000	463	21,000	553	36,000	958	23,000	628	40,000	1080
			350	24.1	3200	85.1	5100	136	12,000	330	20,000	523	24,000	637	42,000	1120	27,000	723	47,000	1250
			400	27.6	3300	89.5	5400	144	14,000	368	22,000	583	27,000	721	48,000	1280	31,000	818	53,000	1430
			450	31.0	3500	93.9	5600	150	15,000	391	23,000	619	27,000	736	47,000	1260	34,000	909	57,000	1540
			500	34.5	3700	98.3	5800	156	15,000	414	24,000	655	28,000	752	46,000	1240	37,000	1000	61,000	1640
			600	41.4	4000	107	6200	167	17,000	461	27,000	727	29,000	782	45,000	1210	44,000	1180	69,000	1860
			1000	69.0	4500	120	6900	186	22,000	585	31,000	834	41,000	1090	59,000	1590	56,000	1510	87,000	2340
	300	20.7	350	24.1	4000	106	6800	181	14,000	386	24,000	646	25,000	677	40,000	1080	32,000	850	56,000	1500
			400	27.6	4400	118	7200	194	17,000	444	28,000	761	26,000	704	41,000	1100	37,000	987	65,000	1740
			450	31.0	4700	126	7600	205	18,000	484	30,000	814	31,000	826	48,000	1290	42,000	1130	73,000	1950
			500	34.5	5000	135	8000	215	20,000	524	32,000	866	35,000	949	55,000	1480	47,000	1270	81,000	2160
			550	37.9	5300	143	8400	225	21,000	564	34,000	919	40,000	1070	62,000	1680	53,000	1410	89,000	2380
			600	41.4	5600	151	8800	236	23,000	604	36,000	971	44,000	1190	70,000	1870	58,000	1560	96,000	2590
			1000	69.0	6300	169	10,000	268	30,000	812	46,000	1230	57,000	1530	85,000	2290	80,000	2160	100,000	2750
80 to 400 / 5.5 to 27.6 Type MR95HP Only	400	27.6	500	34.5	5700	152	9800	263	21,000	559	35,000	944	38,000	1010	64,000	1710	49,000	1320	86,000	2310
			600	41.4	6500	174	11,000	292	26,000	693	42,000	1130	45,000	1210	79,000	2120	59,000	1590	110,000	2860
			1000	69.0	9000	241	13,000	355	35,000	934	54,000	1450	61,000	1640	100,000	2700	80,000	2150	140,000	3650

1. To obtain capacities for Type MR95HT (metal diaphragm), multiply the table values by 0.6. Capacity data for 1000 psig / 69.0 bar inlet is not applicable for Type MR95HT (Type MR95HT max. inlet = 600 psig / 41.4 bar).
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

Air

Table 13. Air Capacities(1) in SCFH / Nm³/h for 1-1/2 through 2 in. / DN 40 through 50 Type MR95HP (Elastomer Diaphragm) Regulator

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN											
	Outlet/ Differential Setting		Inlet		1-1/2 / 40						2 / 50					
					Droop						Droop					
					10%		20%		40%		10%		20%		40%	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	4000	108	6000	160	11,000	286	4000	107	6700	179	13,000	338
			40	2.8	5000	134	7600	205	13,000	346	5700	152	9300	250	18,000	484
			50	3.4	6000	161	9300	249	15,000	405	7400	198	12,000	322	23,000	629
			75	5.2	8400	226	13,000	343	21,000	566	11,000	301	26,000	709	38,000	1020
			100	6.9	11,000	292	16,000	437	27,000	727	15,000	404	41,000	1100	53,000	1420
			150	10.3	12,000	321	20,000	524	31,000	820	43,000	1150	60,000	1620	66,000	1780
			200	13.8	13,000	351	23,000	611	34,000	913	71,000	1890	80,000	2150	80,000	2150
			250	17.2	14,000	379	22,000	596	34,000	924	45,000	1210	81,000	2180	81,000	2180
			300	20.7	15,000	407	22,000	582	35,000	934	35,000	937	82,000	2210	82,000	2210
			400	27.6	11,000	306	17,000	454	35,000	936	35,000	937	82,000	2210	82,000	2210
			500	34.5	7700	205	12,000	327	35,000	938	35,000	937	82,000	2210	82,000	2210
			600	41.4	11,000	282	14,000	363	35,000	938	35,000	937	82,000	2210	82,000	2210
			1000	69.0	12,000	313	17,000	461	35,000	938	35,000	937	82,000	2210	82,000	2210
	50	3.4	60	4.1	11,000	306	21,000	553	38,000	1020	13,000	361	24,000	642	44,000	1170
			75	5.2	14,000	387	27,000	712	48,000	1280	19,000	496	39,000	1050	57,000	1540
			100	6.9	19,000	521	36,000	978	63,000	1700	27,000	722	64,000	1720	80,000	2140
			150	10.3	27,000	712	51,000	1370	80,000	2140	78,000	2100	100,000	2800	110,000	3080
			200	13.8	34,000	902	66,000	1770	97,000	2590	130,000	3480	140,000	3880	150,000	4020
			250	17.2	42,000	1120	70,000	1890	97,000	2600	92,000	2450	160,000	4340	160,000	4410
			300	20.7	50,000	1340	75,000	2010	97,000	2600	92,000	2450	180,000	4800	180,000	4800
			400	27.6	46,000	1240	70,000	1890	97,000	2600	92,000	2450	180,000	4800	180,000	4800
			500	34.5	42,000	1140	66,000	1770	97,000	2600	92,000	2450	180,000	4800	180,000	4800
			600	41.4	27,000	730	54,000	1450	98,000	2630	92,000	2450	180,000	4800	180,000	4800
			1000	69.0	28,000	762	73,000	1960	100,000	2690	92,000	2450	180,000	4800	180,000	4800
	100	6.9	125	8.6	29,000	791	56,000	1510	86,000	2290	40,000	1080	75,000	2010	89,000	2390
			150	10.3	38,000	1010	75,000	2000	100,000	2760	72,000	1930	98,000	2640	110,000	2950
			200	13.8	54,000	1440	110,000	2990	140,000	3700	140,000	3620	150,000	3890	150,000	4080
			250	17.2	59,000	1580	110,000	3010	150,000	4100	180,000	4760	180,000	4950	190,000	5080
			300	20.7	65,000	1730	110,000	3030	170,000	4500	220,000	5910	220,000	6020	230,000	6080
			400	27.6	68,000	1810	120,000	3190	170,000	4610	230,000	6030	230,000	6170	240,000	6430
			500	34.5	71,000	1890	120,000	3350	180,000	4720	230,000	6030	230,000	6170	240,000	6430
			600	41.4	81,000	2160	130,000	3580	180,000	4710	230,000	6030	230,000	6170	240,000	6430
			1000	69.0	100,000	2680	140,000	3840	180,000	4780	230,000	6030	230,000	6170	250,000	6700
60 to 260 / 4.1 to 17.9	125	8.6	150	10.3	23,000	616	37,000	1000	71,000	1900	26,000	697	46,000	1240	91,000	2440
			175	12.1	27,000	724	44,000	1190	83,000	2220	30,000	817	57,000	1520	110,000	2970
			200	13.8	31,000	831	51,000	1380	95,000	2550	35,000	938	67,000	1800	130,000	3510
			225	15.5	34,000	920	56,000	1490	100,000	2750	41,000	1110	87,000	2340	150,000	4020
			250	17.2	38,000	1010	60,000	1600	110,000	2960	48,000	1290	110,000	2890	170,000	4540
			300	20.7	44,000	1190	68,000	1830	130,000	3360	61,000	1640	150,000	3980	210,000	5570
			400	27.6	54,000	1440	89,000	2370	140,000	3870	73,000	1940	180,000	4830	230,000	6190
			500	34.5	63,000	1680	110,000	2920	160,000	4380	84,000	2250	210,000	5710	260,000	7010
			600	41.4	75,000	2010	120,000	3290	180,000	4750	93,000	2490	240,000	6430	280,000	7600
			1000	69.0	77,000	2060	120,000	3290	190,000	5100	94,000	2520	240,000	6430	300,000	8040
	200	13.8	225	15.5	39,000	1040	68,000	1810	130,000	3380	43,000	1150	85,000	2270	150,000	4010
			250	17.2	45,000	1200	76,000	2050	140,000	3770	49,000	1320	100,000	2810	170,000	4600
			300	20.7	57,000	1520	94,000	2520	170,000	4570	62,000	1650	150,000	3900	220,000	5770
			350	24.1	64,000	1710	110,000	2830	190,000	5100	72,000	1920	180,000	4770	250,000	6630
			400	27.6	71,000	1910	120,000	3140	210,000	5630	80,000	2150	210,000	5530	270,000	7320
			450	31.0	79,000	2110	130,000	3450	230,000	6160	88,000	2360	230,000	6200	300,000	8010
			500	34.5	86,000	2300	140,000	3770	250,000	6690	95,000	2540	250,000	6800	320,000	8690
			600	41.4	100,000	2710	170,000	4480	280,000	7390	110,000	2860	290,000	7850	360,000	9610
			1000	69.0	130,000	3450	230,000	6090	290,000	7690	140,000	3760	350,000	9380	370,000	10,000
	250	17.2	275	19.0	53,000	1430	94,000	2520	160,000	4400	51,000	1370	110,000	2820	180,000	4870
			300	20.7	63,000	1680	110,000	2840	190,000	5000	63,000	1700	130,000	3550	200,000	5490
			350	24.1	73,000	1960	120,000	3280	210,000	5670	81,000	2160	130,000	3610	230,000	6240
			400	27.6	84,000	2250	140,000	3720	240,000	6340	92,000	2470	150,000	4100	260,000	6970
			450	31.0	95,000	2540	160,000	4160	260,000	7000	100,000	2790	170,000	4580	290,000	7700
			500	34.5	110,000	2820	170,000	4600	290,000	7670	120,000	3100	190,000	5060	310,000	8440
			550	37.9	110,000	2950	180,000	4870	310,000	8200	120,000	3240	200,000	5360	340,000	9030
			600	41.4	110,000	3070	190,000	5150	330,000	8740	130,000	3380	210,000	5660	360,000	9610
			1000	69.0	160,000	4400	240,000	6320	390,000	10,500	180,000	4840	260,000	6950	430,000	11,500
60 to 300 / 4.1 to 20.7 Type MR95HP Only	300	20.7	350	24.1	75,000	2010	140,000	3750	230,000	6030	80,000	2140	200,000	5360	250,000	6640
			400	27.6	89,000	2380	150,000	4040	260,000	6860	98,000	2620	170,000	4450	280,000	7540
			450	31.0	100,000	2690	170,000	4680	280,000	7640	110,000	2960	190,000	5150	310,000	8400
			500	34.5	110,000	2990	200,000	5320	310,000	8420	120,000	3290	220,000	5850	350,000	9260
			550	37.9	120,000	3180	210,000	5510	330,000	8840	130,000	3490	230,000	6060	360,000	9730
			600	41.4	130,000	3360	210,000	5690	350,000	9260	140,000	3700	230,000	6260	380,000	10,200
			1000	69.0	190,000	5090	330,000	8770	460,000	12,400	210,000	5600	360,000	9650	510,000	13,600

- Denotes capacities limited by boost.
1. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

Steam

Table 14. Steam Capacities(1)(2) for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95H, MR95HD and MR95HDP Regulators with Metal Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE: Outlet/ Differential Setting		PRESSURE: Inlet		REGULATOR BODY SIZE, IN. / DN: 1/4 NPT, Droop 10%		1/4 NPT, Droop 20%		1/2 / 15, Droop 10%		1/2 / 15, Droop 20%		3/4 / 20, Droop 10%		3/4 / 20, Droop 20%		1 / 25, Droop 10%		1 / 25, Droop 20%	
	psig	bar	psig	bar	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h
15 to 30 / 1.0 to 2.1	15	1.0	30	2.1	11	5.2	21	9.41	27	12.1	45	20.6	56	25.5	88	40	62	28	110	49.7
			40	2.8	14	6.34	25	11.2	32	14.4	50	22.8	66	30.2	100	46.9	82	37.4	140	63.8
			50	3.4	17	7.6	29	13	37	16.7	58	26.2	74	33.6	120	53.9	100	45.6	170	79
			75	5.2	22	9.98	39	17.6	42	18.9	62	28.3	97	43.9	140	65.2	140	61.7	220	98.4
			100	6.9	28	12.9	49	22.3	47	21.1	70	31.7	120	54.3	170	76.6	170	76.7	260	118
			150	10.3	41	18.8	57	25.8	65	29.3	85	38.7	150	66.9	190	85.7	220	98.6	310	141
			200	13.8	57	25.8	65	29.3	83	37.5	100	45.8	180	81	210	96.2	260	117	360	164
			250	17.2	59	27	67	30.5	96	43.4	110	50.5	190	84.5	220	101	310	141	410	188
			300	20.7	62	28.2	72	32.8	110	49.3	120	55.1	190	86.8	230	107	340	153	460	211
	30	2.1	40	2.8	20	9.17	37	17	46	20.8	81	36.6	94	42.9	160	73.3	110	49	220	97.7
			50	3.4	27	12.1	42	19.3	53	24.3	91	41.2	110	49.9	190	86.2	150	68.2	270	121
			75	5.2	37	16.7	57	26.1	66	30	100	46.6	140	64.9	220	102	200	91.4	340	156
			100	6.9	44	20	72	32.9	78	35.6	110	52.1	180	79.9	260	118	250	114	420	190
			150	10.3	52	23.5	83	37.5	91	41.1	130	59.9	170	77.9	260	118	310	142	490	224
			200	13.8	62	28.2	93	42.2	100	46.9	150	68	170	75.2	260	117	390	176	540	247
			250	17.2	75	34	100	45.8	120	56.3	170	75.1	170	75.1	280	129	390	176	540	247
			300	20.7	88	39.9	110	48.1	140	65.7	180	82.1	170	75.1	280	129	390	176	540	246
25 to 75 / 1.7 to 5.2	50	3.4	60	4.1	27	12.3	54	24.4	68	30.7	120	55	160	72.5	260	116	150	67.6	320	147
			75	5.2	37	17	66	30.2	83	37.7	140	63	170	79.2	290	134	230	104	370	170
			100	6.9	47	21.6	84	38.2	100	45.7	160	74.4	220	97.8	340	156	270	121	480	217
			150	10.3	65	29.5	110	48.2	130	57	190	86.4	250	113	390	178	370	167	580	262
			200	13.8	83	37.5	130	58.7	150	68.3	220	99.9	290	130	440	201	470	213	680	307
			250	17.2	98	44.6	140	62.2	170	76.3	230	104	310	141	440	200	470	212	720	329
			300	20.7	110	51.6	140	65.7	180	83.3	240	109	310	141	470	211	440	200	750	341
	75	5.2	100	6.9	64	29.2	99	45	81	36.6	180	81.5	270	122	460	207	320	147	510	231
			125	8.6	80	36.2	120	56.4	110	49.6	200	92.8	320	146	480	218	400	182	640	290
			150	10.3	92	41.9	140	65.5	140	62.5	230	103	340	157	530	240	480	217	740	336
			200	13.8	120	54.3	190	84.8	190	86.8	290	130	420	191	630	286	600	275	970	441
			250	17.2	140	62.2	200	89.2	220	98	310	141	420	190	650	296	630	285	990	450
			300	20.7	150	69.2	210	95	240	109	340	153	440	201	670	307	650	295	1000	472
70 to 150 / 4.8 to 10.3	100	6.9	125	8.6	59	26.9	96	43.7	150	66.1	240	108	320	147	540	244	350	159	560	256
			150	10.3	72	32.7	120	54.2	170	77.7	270	121	370	170	610	279	460	207	720	327
			175	12.1	82	37.3	140	62.2	190	85.7	290	132	430	194	660	301	510	230	820	374
			200	13.8	92	41.8	150	69	210	94.9	320	144	480	217	740	336	560	253	920	420
			250	17.2	110	49.7	170	79	230	106	340	154	530	239	790	358	660	299	1000	477
			300	20.7	120	56.4	190	88	260	118	390	177	580	262	840	380	760	345	1200	534
	150	10.3	175	12.1	92	41.7	140	65.8	240	109	380	171	350	160	700	318	490	221	810	367
			200	13.8	110	51.1	170	78.7	270	122	430	194	430	195	830	377	670	305	960	438
			225	15.5	130	59.3	200	89	290	134	450	205	480	219	880	400	750	341	1100	497
			250	17.2	150	67.4	220	98.2	320	145	450	205	510	230	960	434	830	376	1200	567
			300	20.7	180	83.5	260	119	340	156	470	215	610	277	1100	480	980	445	1500	695

1. Capacities are based in lbs/h / kg/h of saturated steam.
2. To obtain capacities for regulators with reduce flow orifices, multiply the table values by 0.7.

Steam

Table 15. Steam Capacities(1)(2) for 1-1/2 through 2 in. / DN 40 through 50 Types MR95H, MR95HD and MR95HDP Regulators with Metal Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN											
	Outlet/ Differential Setting		Inlet		1-1/2 / 40						2 / 50					
					Droop						Droop					
					10%		20%		40%		10%		20%		40%	
	psig	bar	psig	bar	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h
5 to 80 / 0.34 to 5.5	5	0.34	10	0.69	45	20.4	67	30.6	110	50.9	45	20.4	63	28.6	120	52.9
			20	1.4	71	32.2	97	44.3	160	74.3	71	32.2	100	46.3	180	80.3
			30	2.1	92	41.9	120	55.8	210	97.6	97	43.9	140	63.8	240	108
			50	3.4	140	63.2	180	82.9	320	144	140	65.2	210	96.7	350	160
			75	5.2	180	80.4	250	112	420	192	220	98	310	141	650	294
			100	6.9	210	97.6	310	140	510	234	280	129	410	185	900	410
			150	10.3	240	107	340	154	560	253	430	194	1100	505	1500	700
			200	13.8	250	115	370	167	560	252	600	272	1800	816	2100	971
			250	17.2	320	146	430	194	640	291	900	408	2000	912	2200	990
			300	20.7	380	175	510	233	770	349	1200	563	2200	990	2200	990
	30	2.1	40	2.8	350	161	580	265	930	424	450	204	810	366	1300	606
			50	3.4	360	164	620	283	1000	462	580	264	980	445	1700	763
			75	5.2	620	280	970	440	1600	735	840	381	1900	859	2500	1150
			100	6.9	870	397	1300	595	2200	987	1100	517	2800	1270	3400	1550
			150	10.3	910	413	1400	648	2200	1020	2500	1120	3700	1690	4000	1820
			200	13.8	990	450	1500	684	2300	1030	3800	1740	4700	2150	4700	2150
			250	17.2	1200	566	1800	799	2400	1110	4300	1950	4700	2140	4700	2140
			300	20.7	1500	682	2000	915	2600	1190	4700	2140	4700	2140	4700	2140
	50	3.4	60	4.1	590	266	1200	551	2000	887	630	287	1400	653	2000	887
			75	5.2	850	386	1500	668	2300	1040	940	427	1900	850	2400	1100
			100	6.9	1200	523	1800	822	2800	1290	1500	684	3000	1340	3300	1510
			150	10.3	1300	576	2000	932	3100	1420	3400	1530	4800	2180	4800	2170
			200	13.8	1400	631	2300	1040	3400	1530	5200	2370	6100	2760	6400	2930
			250	17.2	1800	825	2600	1180	3700	1700	6000	2750	6500	2940	6400	2930
			300	20.7	2200	998	2900	1330	4100	1870	6900	3130	6900	3130	6900	3120
	75	5.2	100	6.9	1300	571	2100	974	3000	1370	1500	672	2800	1260	3100	1430
			125	8.6	1600	707	2600	1190	3600	1640	2400	1110	3600	1650	4000	1800
			150	10.3	1900	844	3100	1420	4200	1890	3400	1570	4400	2000	4800	2190
			200	13.8	2500	1110	4100	1870	5200	2370	5300	2390	6100	2780	6400	2910
			250	17.2	2700	1230	4200	1910	5600	2550	7400	3360	7800	3550	7800	3530
			300	20.7	2900	1340	4300	1970	6000	2740	9100	4140	9100	4130	9000	4110
60 to 120 / 4.1 to 8.3	100	6.9	125	8.6	1500	674	2700	1220	3600	1630	1700	776	3100	1420	3800	1730
			150	10.3	1700	750	2900	1310	4100	1880	2700	1220	4000	1820	4700	2130
			175	12.1	1800	827	3100	1410	4800	2190	3700	1670	4900	2210	5300	2390
			225	15.5	2200	980	3600	1610	5700	2570	5700	2600	6600	2990	7000	3170
			250	17.2	2100	957	3700	1670	6100	2760	6600	2990	7400	3380	7800	3550
			300	20.7	2100	932	4000	1800	6500	2950	7900	3570	9100	4150	9100	4130
100 to 140 / 6.9 to 9.7	125	8.6	150	10.3	1800	818	3100	1400	4200	1890	1700	777	3400	1550	4400	2020
			175	12.1	2100	935	3700	1680	4900	2210	2000	894	4500	2020	5300	2410
			200	13.8	2400	1070	4300	1950	5700	2600	2200	1010	5300	2420	6100	2800
			225	15.5	2800	1270	4900	2210	6600	2980	3600	1630	6200	2810	7000	3180
			250	17.2	3300	1480	5300	2400	7000	3170	4900	2210	7000	3200	7800	3550
			300	20.7	4200	1910	6600	2980	8300	3750	7500	3390	9200	4180	9400	4260
120 to 150 / 8.3 to 10.3	150	10.3	175	12.1	1700	778	3100	1430	4900	2220	1700	778	3400	1550	4900	2220
			200	13.8	2100	936	3600	1620	5700	2610	2100	957	4100	1880	6000	2740
			225	15.5	2300	1030	3900	1760	6200	2800	2400	1090	5300	2420	6900	3120
			250	17.2	2400	1110	4200	1890	6600	2990	2700	1230	6200	2810	7700	3500
			300	20.7	2800	1280	4800	2200	7900	3570	3300	1480	8400	3800	9300	4230

1. Capacities are based in lbs/h / kg/h of saturated steam.
2. To obtain capacities for regulators with reduce flow orifices, multiply the table values by 0.7.

FISHER™

Steam

Table 16. Steam Capacities(1)(2) for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Type MR95HT Regulators with Metal Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 / 15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	4.8	2.19	7.2	3.28	8.5	3.85	9.9	4.49	27	12.1	60	27.5	48	22	87	39.5
			40	2.8	5	2.28	7.8	3.57	15	6.64	19	8.58	36	16.4	70	31.6	53	24	94	42.5
			50	3.4	5.2	2.37	8.3	3.75	19	8.76	26	11.9	41	18.5	76	34.7	57	26.1	98	44.4
			75	5.2	5.4	2.44	9.3	4.25	28	12.8	38	17.1	54	24.7	90	40.8	69	31.2	110	51.5
			100	6.9	5.8	2.65	11	4.78	28	12.8	44	20.2	66	29.9	100	45.9	78	35.2	130	58.7
			150	10.3	8.6	3.93	14	6.48	42	19.1	61	27.6	70	31.9	110	50	98	44.7	160	73.3
			200	13.8	12	5.31	18	8.18	56	25.5	77	35.1	77	35.1	120	53.1	120	55.2	190	87.1
			250	17.2	12	5.42	19	8.82	56	25.5	77	35.1	86	39.3	130	57.4	130	58.4	210	96.7
			300	20.7	12	5.52	21	9.56	56	25.5	77	35.1	98	44.6	140	61.6	140	62.7	230	106
			400	27.6	15	6.8	22	10.1	63	28.7	84	38.2	100	46.8	140	64.8	160	71.2	260	117
			500	34.5	18	8.29	23	10.6	65	29.7	96	43.6	110	48.9	150	68	170	76.5	280	128
			600	41.4	21	9.67	26	11.7	68	30.8	110	48.9	110	52.1	160	71.2	180	81.8	300	138
	50	3.4	60	4.1	21	9.77	36	16.6	73	33.3	120	56.4	160	72.3	240	111	150	66.7	270	122
			75	5.2	22	10.1	38	17.5	78	35.3	130	58.2	170	75.1	240	110	160	74	290	132
			100	6.9	24	10.8	38	17.3	84	38.2	140	61.9	180	79.8	260	120	190	86.4	310	142
			150	10.3	26	11.7	42	19.2	100	46.2	160	70.7	190	88.5	280	129	240	108	400	183
			200	13.8	30	13.8	49	22.3	120	54.4	180	79.8	220	98.6	330	150	310	139	470	214
			250	17.2	33	14.9	51	23.4	130	60.6	190	87.2	230	107	350	160	350	160	540	245
			300	20.7	37	17	54	24.4	140	65.9	210	95.6	260	117	370	170	400	181	580	266
			400	27.6	40	18.1	56	25.5	160	74.4	220	98.8	220	98.8	330	149	440	202	680	308
			500	34.5	40	18.1	58	26.6	170	76.5	220	101	230	106	350	159	490	223	720	329
			600	41.4	42	19.1	58	26.6	170	78.6	220	102	260	117	370	170	540	244	770	351
	100	6.9	125	8.6	49	22.1	75	34.1	160	73.1	240	110	290	133	460	210	320	144	530	243
			150	10.3	51	23	79	36	170	79.2	260	120	320	143	510	230	390	176	630	285
			175	12.1	53	23.9	83	37.9	190	85.3	290	131	360	164	550	251	460	208	740	338
			200	13.8	57	26	88	39.8	200	91.3	310	141	380	175	600	272	500	229	860	391
			250	17.2	61	27.8	92	41.6	230	106	350	161	450	206	640	291	600	271	950	432
			300	20.7	66	29.8	96	43.6	260	118	380	171	500	226	690	311	690	312	1100	483
			400	27.6	72	32.9	100	45.7	280	128	420	191	380	171	590	267	780	353	1200	534
			500	34.5	72	32.9	100	46.7	280	127	400	181	420	192	630	287	840	383	1300	575
			600	41.4	75	34	110	47.8	280	127	400	181	440	202	650	298	910	415	1300	606
80 to 300 / 5.5 to 20.7	125	8.6	150	10.3	34	15.5	56	25.3	110	49.9	180	83.9	230	107	390	177	240	108	410	188
			175	12.1	36	16.5	58	26.2	120	56.2	200	92.2	270	121	410	187	270	121	460	209
			200	13.8	38	17.5	62	28.3	140	62.5	220	100	290	132	460	208	310	143	510	230
			225	15.5	41	18.5	64	29.2	140	65.5	230	106	310	142	480	218	340	153	550	251
			250	17.2	43	19.5	69	31.2	150	69.6	240	108	340	153	530	239	360	164	600	272
			300	20.7	47	21.4	75	34.2	170	76.6	280	129	360	163	590	270	430	195	690	313
			400	27.6	51	23.4	82	37.2	210	95.2	330	149	400	183	640	289	520	236	850	386
			500	34.5	58	26.6	91	41.4	230	106	370	170	450	203	680	309	610	278	960	437
			600	41.4	63	28.7	100	45.7	260	117	400	181	470	213	700	319	700	320	1100	489
	200	13.8	225	15.5	56	25.6	97	44.2	200	89	340	155	390	178	660	299	440	200	760	344
			250	17.2	63	28.7	100	46.1	220	99.7	360	165	440	200	730	331	490	222	830	375
			300	20.7	72	32.9	110	51.2	270	121	410	186	510	231	870	395	560	253	960	438
			350	24.1	77	34.8	120	55.1	290	131	480	217	580	263	1000	458	650	296	1100	512
			400	27.6	78	35.6	130	58	330	152	520	238	650	294	1100	521	740	338	1300	575
			450	31.0	83	37.6	130	59.9	360	162	540	248	640	293	1100	508	810	369	1400	616
			500	34.5	87	39.6	140	61.8	360	162	570	257	670	303	1100	496	880	400	1400	657
			600	41.4	94	42.5	140	65.9	400	182	630	288	690	312	1100	483	1000	473	1600	740
	300	20.7	350	24.1	98	44.4	160	74.9	340	155	580	265	610	278	970	443	780	356	1400	620
			400	27.6	110	48.5	170	78.8	410	188	680	308	630	287	990	451	900	409	1600	715
			450	31.0	110	51.4	180	82.7	430	198	720	328	750	341	1200	526	1000	462	1800	800
			500	34.5	120	54.4	190	86.6	480	219	770	348	840	384	1300	600	1100	515	1900	884
			550	37.9	130	57.4	200	90.5	500	229	810	369	960	437	1500	674	1300	579	2100	968
			600	41.4	130	60.4	210	94.5	550	250	860	389	1100	479	1700	759	1400	632	2300	1040

1. Capacities are based in lbs/h / kg/h of saturated steam.
2. To obtain capacities for regulators with reduce flow orifices, multiply the table values by 0.7.

EMERSON.

Steam

Table 17. Steam Capacities(1)(2) for 1-1/2 through 2 in. / DN 40 through 50 Type MR95HT Regulators with Metal Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN											
	Outlet/ Differential Setting		Inlet		1-1/2 / 40						2 / 50					
					Droop						Droop					
					10%		20%		40%		10%		20%		40%	
	psig	bar	psig	bar	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	160	73.4	240	110	440	200	160	73.4	270	123	520	237
			40	2.8	200	91	300	138	520	235	230	104	370	169	720	326
			50	3.4	240	109	370	168	590	270	290	134	480	217	910	414
			75	5.2	330	150	510	233	820	375	430	197	1000	465	1500	678
			100	6.9	430	196	630	285	1100	479	590	267	1600	729	2100	940
			150	10.3	470	212	780	353	1200	547	1700	760	2300	1060	2600	1160
			200	13.8	500	229	890	405	1300	598	2800	1250	3100	1410	3100	1410
			250	17.2	540	246	850	387	1300	598	1700	792	3100	1430	3100	1420
			300	20.7	580	264	850	387	1400	615	1400	615	3200	1440	3200	1440
			400	27.6	430	193	660	299	1400	615	1400	615	3200	1440	3200	1440
			500	34.5	300	135	460	211	1400	615	1400	615	3200	1440	3200	1440
			600	41.4	430	193	540	246	1400	615	1400	615	3200	1440	3200	1440
	50	3.4	60	4.1	450	204	850	388	1500	696	530	241	970	443	1800	803
			75	5.2	570	257	1100	495	1900	873	770	349	1600	715	2300	1030
			100	6.9	760	346	1400	654	2500	1140	1100	492	2600	1160	3000	1370
			150	10.3	1100	486	2000	915	3100	1430	3100	1400	3900	1790	4300	1960
			200	13.8	1300	607	2600	1180	3800	1720	5100	2320	5500	2500	5800	2650
			250	17.2	1600	747	2700	1240	3800	1720	3600	1640	6200	2840	6200	2830
			300	20.7	1900	886	2900	1330	3800	1710	3600	1630	7000	3180	7000	3180
			400	27.6	1800	812	2700	1230	3800	1710	3600	1620	7000	3170	7000	3170
			500	34.5	1600	740	2600	1160	3800	1710	3600	1620	7000	3170	7000	3170
			600	41.4	1000	475	2100	950	3800	1720	3600	1620	7000	3170	7000	3160
	100	6.9	125	8.6	1200	536	2300	1030	3400	1570	1600	739	3000	1380	3500	1570
			150	10.3	1500	698	3000	1370	4000	1810	2900	1320	3900	1790	4200	1930
			200	13.8	2200	981	4400	1990	5500	2520	5400	2480	5600	2530	5700	2600
			250	17.2	2300	1060	4400	1980	5900	2680	7000	3170	7000	3200	7100	3250
			300	20.7	2600	1170	4300	1970	6700	3030	8400	3830	8500	3850	8500	3880
			400	27.6	2700	1210	4700	2130	6600	3010	9000	4100	9000	4090	9300	4250
			500	34.5	2800	1260	4700	2130	7000	3180	9000	4080	9000	4070	9300	4240
			600	41.4	3200	1430	5100	2300	7000	3170	8900	4070	8900	4060	9300	4230
60 to 260 / 4.1 to 17.9	125	8.6	150	10.3	940	426	1500	682	2900	1300	1100	481	1900	848	3700	1660
			175	12.1	1100	497	1800	806	3300	1510	1200	552	2300	1040	4400	2000
			200	13.8	1200	568	2000	930	3800	1720	1400	641	2700	1220	5200	2350
			225	15.5	1400	620	2200	1020	4000	1800	1600	747	3500	1580	5900	2700
			250	17.2	1500	690	2400	1090	4300	1980	1900	872	4400	1990	6700	3050
			300	20.7	1700	795	2700	1220	5100	2320	2400	1100	5900	2700	8300	3750
			400	27.6	2100	967	3500	1590	5500	2490	2900	1310	7100	3220	9000	4090
			500	34.5	2500	1120	4300	1960	6200	2830	3300	1500	8200	3730	10,000	4600
			600	41.4	2900	1330	4700	2130	7000	3180	3600	1650	9400	4250	11,000	4940
	200	13.8	225	15.5	1600	724	2800	1260	5200	2380	1800	798	3500	1570	5800	2650
			250	17.2	1800	831	3100	1400	5600	2550	2000	905	4000	1840	6600	3020
			300	20.7	2300	1050	3800	1720	6800	3080	2500	1140	6000	2740	8200	3720
			350	24.1	2600	1170	4400	2000	7500	3420	2900	1310	7200	3270	9700	4400
			400	27.6	2800	1290	4800	2170	8300	3770	3200	1450	8400	3800	11,000	4840
			450	31.0	3100	1430	5200	2340	9100	4110	3500	1590	9100	4140	12,000	5370
			500	34.5	3400	1550	5500	2520	9800	4460	3800	1710	9900	4490	13,000	5710
			600	41.4	3900	1790	6700	3040	11,000	4980	4300	1970	11,000	5180	14,000	6400
	250	17.2	275	19.0	2200	984	3800	1740	6400	2920	2100	947	4500	2030	7000	3190
			300	20.7	2600	1170	4500	2030	7600	3460	2600	1170	5300	2390	7800	3570
			350	24.1	3000	1340	4800	2200	8400	3810	3300	1490	7200	3290	9200	4170
			400	27.6	3400	1540	5600	2550	9500	4330	3700	1680	8400	3830	10,000	4690
			450	31.0	3800	1730	6400	2900	10,000	4680	4000	1820	9200	4170	11,000	5220
			500	34.5	4400	2000	6800	3070	11,000	5200	4800	2180	10,000	4700	12,000	5560
			550	37.9	4400	1990	7100	3240	12,000	5550	4800	2170	11,000	4870	13,000	6080
			600	41.4	4400	1980	7500	3420	13,000	5890	5200	2350	11,000	5210	14,000	6430

- Denotes capacities limited by boost.
1. Capacities are based in lbs/h / kg/h of saturated steam.
2. To obtain capacities for regulators with reduce flow orifices, multiply the table values by 0.7.

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Table 18. Water Capacities(1)(2) in GPM / L/min for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95H, MR95HD and MR95HDP Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 / 15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
15 to 30 / 1.0 to 2.1	15	1.0	30	2.1	1.0	3.8	3.0	11.3	4.0	15.1	7.0	26.5	7.0	26.5	12.0	45.4	8.0	30.3	15.0	56.7
			40	2.8	1.5	5.7	3.5	13.2	4.5	17.0	8.0	30.3	8.5	32.2	13.5	51.1	10.0	37.8	19.0	71.9
			50	3.4	2.0	7.6	4.0	15.1	5.0	18.9	9.0	34.0	10.0	37.8	15.0	56.7	12.0	45.4	23.0	87.0
			75	5.2	3.0	11.3	6.0	22.7	6.0	22.7	10.0	37.8	11.5	43.5	17.0	64.3	12.0	45.4	24.0	90.8
			100	6.9	4.0	15.1	8.0	30.3	7.0	26.5	11.0	41.6	13.0	49.2	19.0	71.9	12.0	45.4	25.0	94.6
			150	10.3	4.0	15.1	8.0	30.3	9.0	34.0	13.0	49.2	14.5	54.9	20.0	75.7	17.0	64.3	30.5	115
			200	13.8					11.0	41.6	15.0	56.7	16.0	60.5	21.0	79.4	22.0	83.2	36.0	136
			250	17.2					12.0	45.4	16.0	60.5	17.0	64.3	22.0	83.2	23.0	87.0	37.0	140
			300	20.7					13.0	49.2	17.0	64.3								
	30	2.1	40	2.8	2.0	7.5	4.3	16.2	6.0	22.7	10.0	37.8	10.0	37.8	18.0	68.1	12.0	45.4	23.0	87.0
			50	3.4	3.0	11.3	6.0	22.7	7.0	26.5	12.0	45.4	12.0	45.4	20.0	75.7	15.0	56.7	26.0	98.4
			75	5.2	4.5	17.0	8.5	32.2	8.5	32.2	14.5	54.9	14.5	54.9	23.5	88.9	21.0	79.4	36.0	136
			100	6.9	6.0	22.7	11.0	41.6	10.0	37.8	17.0	64.3	17.0	64.3	27.0	102	27.0	102	46.0	174
			150	10.3	7.6	28.9	13.7	51.9	11.0	41.6	18.0	68.1	18.5	70.0	29.0	110	29.0	110	48.0	182
			200	13.8	8.9	33.6	15.8	59.7	12.0	45.4	19.0	71.9	20.0	75.7	31.0	117	31.0	117	50.0	189
			250	17.2	9.8	37.2	17.4	65.8	13.5	51.1	19.5	73.8	20.5	77.6	32.0	121	38.0	144	57.5	218
			300	20.7	10.6	40.1	18.7	70.7	15.0	56.7	20.0	75.7	21.0	79.4	33.0	125	45.0	170	65.0	246
25 to 75 / 1.7 to 5.2	50	3.4	60	4.1	3.0	11.4	4.5	17.1	6.8	25.7	13.1	49.5	13.3	50.3	22.8	86.4	17.0	64.3	30.0	113
			75	5.2	4.0	15.1	6.0	22.7	8.0	30.3	14.0	53.0	14.0	53.0	24.0	90.8	18.0	68.1	31.0	117
			100	6.9	5.0	18.9	9.0	34.0	9.0	34.0	17.0	64.3	18.0	68.1	29.0	110	25.0	94.6	41.0	155
			150	10.3	6.5	24.6	11.5	43.5	10.0	37.8	18.0	68.1	21.0	79.4	34.0	129	27.0	102	48.0	182
			200	13.8	8.0	30.3	14.0	53.0	11.0	41.6	19.0	71.9	24.0	90.8	39.0	148	29.0	110	55.0	208
			250	17.2	8.8	33.1	15.7	59.5	12.5	47.3	21.0	79.4	24.5	92.7	39.0	148	36.0	136	61.0	231
			300	20.7	9.5	35.9	17.2	65.0	14.0	53.0	23.0	87.0	25.0	94.6	39.0	148	43.0	163	67.0	253
	75	5.2	100	6.9	5.0	18.9	8.0	30.3	10.0	37.8	18.0	68.1	18.0	68.1	30.0	113	22.0	83.2	38.0	144
			125	8.6	6.0	22.7	9.5	35.9	11.3	42.6	19.5	73.8	20.5	77.6	33.3	126	27.5	104	46.3	175
			150	10.3	7.0	26.5	11.0	41.6	12.5	47.3	21.0	79.4	23.0	87.0	36.5	138	33.0	125	54.5	206
			200	13.8	9.0	34.0	14.0	53.0	15.0	56.7	24.0	90.8	28.0	106	43.0	163	44.0	166	71.0	269
			250	17.2	10.1	38.4	15.7	59.4	15.5	58.6	25.0	94.6	30.0	113	46.5	176	46.5	176	74.0	280
			300	20.7	11.2	42.4	17.3	65.4	16.0	60.5	26.0	98.4	32.0	121	50.0	189	49.0	185	77.0	291
70 to 150 / 4.8 to 10.3	100	6.9	125	8.6	4.0	15.1	7.0	26.5	8.3	31.2	14.3	53.9	19.0	71.9	31.0	117	22.0	83.2	37.0	140
			150	10.3	5.0	18.9	9.0	34.0	10.5	39.7	18.0	68.1	23.0	87.0	37.0	140	28.0	106	46.0	174
			175	12.1	6.0	22.7	11.0	41.6	11.6	44.0	20.3	76.6	26.0	98.4	40.5	153	33.0	125	54.0	204
			200	13.8	7.0	26.5	13.0	49.2	12.8	48.2	22.5	85.1	29.0	110	44.0	166	38.0	144	62.0	235
			250	17.2	8.3	31.5	15.7	59.3	13.5	51.1	22.5	85.1	31.0	117	47.5	180	43.0	163	73.0	276
			300	20.7	9.5	35.9	18.0	68.1	14.3	53.9	22.5	85.1	33.0	125	51.0	193	48.0	182	84.0	318
	150	10.3	175	12.1	5.0	18.9	9.0	34.0	9.0	34.0	16.5	62.4	23.0	87.0	39.0	148	30.0	113	44.0	166
			200	13.8	7.0	26.5	12.0	45.4	12.8	48.2	20.3	76.6	28.0	106	45.0	170	36.0	136	52.0	197
			225	15.5	8.0	30.3	13.5	51.1	13.9	52.5	22.1	83.7	30.5	115	48.3	183	41.3	156	59.5	225
			250	17.2	9.0	34.0	15.0	56.7	15.0	56.7	24.0	90.8	33.0	125	51.5	195	46.5	176	67.0	253
			300	20.7	11.0	41.6	18.0	68.1	17.3	65.3	27.8	105	38.0	144	58.0	219	57.0	216	82.0	310

- Capacities not tested due to cavitation regime.
1. To obtain capacities for regulators with metal diaphragms, multiply the table values by 0.6.
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

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Table 19. Water Capacities(1) in GPM / L/min for 1-1/2 through 2 in. / DN 40 through 50 Types MR95H, MR95HD and MR95HDP Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN											
	Outlet/ Differential Setting		Inlet		1-1/2 / 40						2 / 50					
					Droop						Droop					
					10%		20%		40%		10%		20%		40%	
	psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
5 to 80 / 0.34 to 5.5	5	0.34	10	0.69	6.0	22.7	8.0	30.3	14.0	53.0	6.0	22.7	8.0	30.3	14.0	53.0
			20	1.4	8.5	32.2	11.3	42.6	19.8	74.7	8.3	31.2	10.5	39.7	17.5	66.2
			30	2.1	11.0	41.6	14.5	54.9	25.5	96.5	10.5	39.7	13.0	49.2	21.0	79.4
			50	3.4	16.0	60.5	21.0	79.4	37.0	140	15.0	56.7	18.0	68.1	28.0	106
			75	5.2	27.5	104	38.0	144	52.5	199	19.0	71.9	25.0	94.6	37.0	140
			100	6.9	39.0	148	55.0	208	68.0	257	23.0	87.0	92.0	348	114	431
			150	10.3	47.0	178	98.5	373	119	448	40.5	153	79.0	299	99.5	376
			200	13.8	55.0	208	142	537	169	639	58.0	219	66.0	250	85.0	322
			250	17.2	72.5	274	159	600	174	658	52.5	199	59.5	225	75.0	284
			300	20.7	90.0	340	175	662	179	677	47.0	178	53.0	200	65.0	246
	15	1.0	30	2.1	14.0	53.0	27.0	102	47.0	178	14.0	53.0	22.0	83.2	42.0	159
			40	2.8	19.5	73.8	33.0	125	53.5	202	18.0	68.1	28.5	108	52.0	197
			50	3.4	25.0	94.6	39.0	148	60.0	227	22.0	83.2	35.0	132	62.0	235
			75	5.2	31.5	119	49.5	187	74.0	280	25.0	94.6	40.0	151	118	445
			100	6.9	38.0	144	60.0	227	88.0	333	75.0	284	132	499	173	654
			150	10.3	67.5	255	84.5	320	148	560	77.0	291	124	469	153	579
			200	13.8	97.0	367	109	412	208	787	91.0	344	116	439	133	503
			250	17.2	115	433	184	694	235	889	82.0	310	107	403	132	497
			300	20.7	132	499	258	976	262	991	73.0	276	97.0	367	130	492
	50	3.4	60	4.1	27.9	106	63.7	241	95.0	359	25.5	96.7	50.7	192	100	378
			75	5.2	34.0	129	66.0	250	111	420	37.0	140	68.0	257	127	480
			100	6.9	51.0	193	95.0	359	138	522	47.0	178	82.0	310	157	594
			150	10.3	62.0	235	103	390	169	639	64.0	242	108	407	198	747
			200	13.8	73.0	276	111	420	200	757	81.0	306	133	503	238	900
			250	17.2	99.5	376	179	677	236	891	85.0	322	140	530	267	1010
			300	20.7	126	477	247	934	271	1030	154	583	178	673	295	1120
	75	5.2	100	6.9	47.0	178	84.0	318	129	488	45.0	170	82.0	310	138	522
			125	8.6	55.3	209	94.8	358	150	567	54.3	205	97.8	370	161	608
			150	10.3	63.5	240	106	399	171	647	63.5	240	114	429	184	694
			200	13.8	80.0	303	127	480	213	806	82.0	310	145	549	229	866
			250	17.2	87.0	329	189	713	241	912	85.0	322	150	567	260	982
			300	20.7	94.0	356	250	946	269	1020	191	723	276	1040	290	1100
60 to 120 / 4.1 to 8.3	100	6.9	125	8.6	47.0	178	92.0	348	135	511	46.0	174	90.0	340	147	556
			150	10.3	55.8	211	107	404	155	587	54.8	207	106	401	170	643
			175	12.1	64.5	244	122	460	176	664	63.5	240	122	462	193	730
			225	15.5	82.0	310	151	571	216	817	81.0	306	154	583	239	904
			250	17.2	88.3	334	154	581	229	868	85.3	323	163	617	255	965
			300	20.7	101	382	159	601	256	968	94.0	356	181	685	287	1090
100 to 140 / 6.9 to 9.7	125	8.6	150	10.3	43.7	165	86.4	327	148	560	47.0	178	91.0	344	158	598
			175	12.1	55.4	209	105	398	168	636	58.5	221	110	414	183	690
			200	13.8	67.0	253	124	469	188	711	70.0	265	128	484	207	783
			225	15.5	74.5	282	139	526	204	773	78.3	296	142	535	224	847
			250	17.2	82.0	310	154	583	221	834	86.5	327	155	586	241	912
			300	20.7	97.0	367	184	696	253	957	103	390	182	689	275	1040
120 to 150 / 8.3 to 10.3	150	10.3	175	12.1	40.0	151	79.0	299	145	549	42.0	159	90.0	340	169	639
			200	13.8	52.0	197	98.0	371	169	639	56.0	212	108	409	198	749
			225	15.5	59.5	225	108	409	188	709	63.8	241	121	459	215	812
			250	17.2	67.0	253	118	446	206	779	71.5	270	135	509	232	876
			300	20.7	82.0	310	138	522	243	919	87.0	329	161	609	265	1000

- Denotes capacities limited by boost.

1. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

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Table 20. Water Capacities(1)(2) in GPM / L/min for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Type MR95HP (Elastomer Diaphragm) Regulator

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 / 15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	0.8	3.0	1.3	4.9	2.4	9.1	3.7	14.0	6.0	22.7	8.0	30.3	6.0	22.7	10.0	37.8
			40	2.8	1.3	4.9	1.9	7.2	2.9	11.0	4.3	16.3	6.5	24.6	8.5	32.2	7.0	26.5	11.0	41.6
			50	3.4	1.8	6.8	2.5	9.5	3.4	12.9	4.9	18.5	7.0	26.5	9.0	34.0	8.0	30.3	12.0	45.4
			75	5.2	2.2	8.1	3.3	12.5	4.3	16.1	6.1	22.9	8.5	32.2	11.5	43.5	9.5	35.9	13.5	51.1
			100	6.9	2.5	9.5	4.1	15.5	5.1	19.3	7.2	27.2	10.0	37.8	14.0	53.0	11.0	41.6	15.0	56.7
			150	10.3	2.9	11.0	4.6	17.2	5.8	21.9	8.1	30.6	11.5	43.5	15.5	58.6	13.5	51.1	20.0	75.7
			200	13.8	3.3	12.5	5.0	18.9	6.5	24.6	9.0	34.0	13.0	49.2	17.0	64.3	16.0	60.5	25.0	94.6
			250	17.2	3.6	13.6	5.3	20.0	7.6	28.8	10.2	38.4	14.0	53.0	18.0	68.1	18.5	70.0	30.7	116
			300	20.7	3.9	14.8	5.6	21.2	8.7	32.9	11.3	42.7	15.0	56.7	19.0	71.9	21.0	79.4	36.4	138
			400	27.6									16.8	63.6	19.0	71.9	24.0	90.8	37.0	140
			500	34.5																
			600	41.4																
			1000	69.0																
	75	5.2	100	6.9	4.2	15.9	7.0	26.5	8.0	30.3	14.0	53.0	16.0	60.5	25.0	94.6	18.0	68.1	31.0	117
			125	8.6	5.5	20.6	8.5	32.1	9.0	34.0	15.5	58.6	18.0	68.1	28.8	109	21.5	81.3	37.3	141
			150	10.3	6.7	25.3	10.0	37.6	10.0	37.8	17.0	64.3	20.0	75.7	32.5	123	25.0	94.6	43.5	165
			200	13.8	9.2	34.8	12.9	48.8	12.0	45.4	20.0	75.7	24.0	90.8	40.0	151	32.0	121	56.0	212
			250	17.2	10.2	38.4	14.7	55.4	13.0	49.2	21.5	81.3	26.5	100	43.0	163	35.5	134	62.5	236
			300	20.7	11.1	42.0	16.4	62.0	14.0	53.0	23.0	87.0	29.0	110	46.0	174	39.0	148	69.0	261
			400	27.6	12.5	47.3	17.0	64.3	14.5	54.9	23.0	87.0	30.3	115	53.0	200	41.0	155	80.0	303
			500	34.5	13.0	49.2	18.0	68.1	15.0	56.7	23.0	87.0	30.3	115	53.0	200	41.0	155	80.0	303
			600	41.4	14.0	53.0	18.0	68.1	15.0	56.7	23.0	87.0	30.3	115	53.0	200	41.0	155	80.0	303
			1000	69.0																
	100	6.9	125	8.6	4.9	18.5	7.0	26.5	9.0	34.0	16.0	60.5	19.0	71.9	32.0	121	21.0	79.4	36.0	136
			150	10.3	6.17	23.3	8.9	33.8	10.7	40.4	18.0	68.1	22.7	85.7	36.7	139	26.7	101	44.0	166
			175	12.1	7.43	28.1	10.9	41.1	12.3	46.7	20.0	75.7	26.3	99.6	41.3	156	32.3	122	52.0	197
			200	13.8	8.7	32.9	12.8	48.4	14.0	53.0	22.0	83.2	30.0	113	46.0	174	38.0	144	60.0	227
			250	17.2	10.3	39.0	14.9	56.4	15.0	56.7	23.5	88.9	31.0	117	50.0	189	42.0	159	68.5	259
			300	20.7	11.9	45.0	17.0	64.3	16.0	60.5	25.0	94.6	32.0	121	54.0	204	46.0	174	77.0	291
			400	27.6	14.2	53.6	20.4	77.2	16.0	60.5	26.0	98.4	33.5	127	56.7	214	51.5	195	81.0	306
			500	34.5	16	60.4	23.0	86.9	16.0	60.5	27.0	102	37.1	140	59.5	225	57.0	216	85.0	322
			600	41.4	17.4	65.9	25.1	94.9	18.0	68.1	28.0	106	37.1	140	59.5	225	57.0	216	85.0	322
			1000	69.0					18.0	68.1	28.0	106	37.1	140	59.5	225	57.0	216	85.0	322
80 to 300 / 5.5 to 20.7	125	8.6	150	10.3	1.9	7.2	3.5	13.2	6.0	22.7	10.0	37.8	10.0	37.8	19.0	71.9	12.0	45.4	25.0	94.6
			175	12.1	2.4	9.1	4.1	15.5	7.0	26.5	12.0	45.4	13.5	51.1	24.0	90.8	16.0	60.5	30.0	113
			200	13.8	2.9	11.0	4.7	17.8	8.0	30.3	14.0	53.0	17.0	64.3	29.0	110	20.0	75.7	35.0	132
			225	15.5	3.2	12.1	5.2	19.5	8.8	33.1	15.0	56.7	18.5	70.0	31.0	117	22.0	83.2	38.0	144
			250	17.2	3.5	13.2	5.6	21.2	9.5	35.9	16.0	60.5	20.0	75.7	33.0	125	24.0	90.8	41.0	155
			300	20.7	4.1	15.5	6.5	24.6	11.0	41.6	18.0	68.1	23.0	87.0	37.0	140	28.0	106	47.0	178
			400	27.6	5.0	18.9	7.7	29.0	11.5	43.5	19.0	71.9	26.0	98.4	39.5	149	36.0	136	57.5	218
			500	34.5	5.7	21.6	8.6	32.6	12.0	45.4	20.0	75.7	29.0	110	42.0	159	44.0	166	68.0	257
			600	41.4	6.3	23.8	9.4	35.6	14.0	53.0	22.0	83.2	29.3	111	43.2	163	45.0	170	72.0	272
			1000	69.0					14.0	53.0	22.0	83.2	32.5	123	51.0	193	50.0	189	85.0	322
	200	13.8	225	15.5	2.6	9.8	5.0	18.9	8.0	30.3	15.0	56.7	16.0	60.5	30.0	113	19.0	71.9	37.0	140
			250	17.2	3.1	11.6	5.7	21.4	9.3	35.3	17.0	64.3	19.0	71.9	34.7	131	23.0	87.0	42.3	160
			300	20.7	4.0	15.1	7.0	26.5	12.0	45.4	21.0	79.4	25.0	94.6	44.0	166	31.0	117	53.0	200
			400	27.6	5.4	20.4	9.0	34.0	15.0	56.7	25.0	94.6	29.5	112	49.0	185	37.5	142	65.0	246
			500	34.5	6.5	24.6	10.6	39.9	18.0	68.1	29.0	110	34.0	129	54.0	204	44.0	166	77.0	291
			600	41.4	7.4	27.9	11.8	44.8	19.0	71.9	31.0	117	37.0	140	57.0	216	45.0	170	82.0	310
			1000	69.0	9.9	37.4	15.4	58.3	20.0	75.7	32.0	121	40.0	151	60.0	227	75.0	284	125	473
	300	20.7	350	24.1	4.6	17.2	8.1	30.5	13.0	49.2	23.0	87.0	24.0	90.8	44.0	166	27.0	102	53.0	200
			400	27.6	5.3	19.9	9.1	34.4	15.0	56.7	26.0	98.4	28.0	106	49.0	185	33.0	125	63.3	240
			500	34.5	6.7	25.2	11.2	42.4	19.0	71.9	32.0	121	36.0	136	59.0	223	45.0	170	84.0	318
			600	41.4	7.4	27.8	12.3	46.3	21.0	79.4	35.0	132	42.0	159	65.0	246	59.0	223	98.0	371
			1000	69.0	9.1	34.4	15.8	59.6	26.0	98.4	45.0	170	50.0	189	77.0	291	70.0	265	127	480
80 to 400 / 5.5 to 27.6 Type MR95HP Only	400	27.6	500	34.5	6.7	25.2	11.2	42.4	19.0	71.9	32.0	121	32.0	121	55.0	208	43.0	163	73.0	276
			600	41.4	7.7	29.1	13.0	49.0	22.0	83.2	37.0	140	40.0	151	65.0	246	52.0	197	92.0	348
			1000	69.0	10.6	40.3	17.9	67.5	30.4	115	51.0	193	53.0	200	84.0	318	84.0	318	135	511

- Capacities not tested due to cavitation regime.
1. To obtain capacities for regulators with metal diaphragms or for Type MR95HT, multiply the table values by 0.6. Capacity data for 1000 psig / 69.0 bar inlet is not applicable for Type MR95HT (Type MR95HT max. inlet = 600 psig / 41.4 bar).
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

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Table 21. Water Capacities[1][2] in GPM / L/min for 1-1/2 through 2 in. / DN 40 through 50 Type MR95HP (Elastomer Diaphragm) Regulator

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN											
	Outlet/ Differential Setting		Inlet		1-1/2 / 40						2 / 50					
					Droop						Droop					
					10%		20%		40%		10%		20%		40%	
	psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	12.0	45.4	20.0	75.7	36.0	136	11.0	41.6	18.0	68.1	33.0	125
			40	2.8	15.5	58.6	25.0	94.6	41.5	157	15.5	58.6	23.0	87.0	40.5	153
			50	3.4	19.0	71.9	30.0	113	47.0	178	20.0	75.7	28.0	106	48.0	182
			75	5.2	23.0	87.0	36.5	138	59.5	225	22.5	85.1	32.0	121	59.0	223
			100	6.9	27.0	102	43.0	163	72.0	272	25.0	94.6	36.0	136	70.0	265
			150	10.3	41.0	155	62.0	235	134	505	35.0	132	139	526	158	596
			200	13.8	55.0	208	81.0	306	195	738	45.0	170	242	915	245	927
			250	17.2	76.5	289	148	560	217	819	98.0	371	115	435	132	499
			300	20.7	98.0	371	215	813	238	900	98.0	371	115	435	132	499
			400	27.6												
			500	34.5												
			600	41.4												
			1000	69.0												
	50	3.4	60	4.1	19.0	71.9	39.0	148	81.0	306	20.0	75.7	41.0	155	91.0	344
			75	5.2	26.9	102	49.9	189	101	382	27.1	103	54.5	206	112	424
			100	6.9	40.0	151	68.0	257	134	507	39.0	148	77.0	291	147	556
			150	10.3	53.0	200	85.5	323	172	651	56.0	212	144	545	192	724
			200	13.8	66.0	250	103	390	210	794	73.0	276	211	798	236	893
			250	17.2	86.5	327	147	554	240	908	137	516	231	872	265	1000
			300	20.7	107.0	405	190	719	270	1020	200	757	250	946	294	1110
			400	27.6	107.0	405	190	719	270	1020	200	757	250	946	294	1110
			500	34.5	107.0	405	190	719	270	1020	200	757	250	946	294	1110
			600	41.4	107.0	405	190	719	270	1020	200	757	250	946	294	1110
			1000	69.0												
	100	6.9	125	8.6	41.0	155	78.0	295	138	522	42.0	159	91.0	344	146	552
			150	10.3	52.3	198	95.7	362	159	603	57.3	217	117	444	169	639
			175	12.1	63.7	241	113	429	181	683	72.7	275	144	543	192	726
			200	13.8	75.0	284	131	496	202	764	88.0	333	170	643	215	813
			250	17.2	83.5	316	145	547	234	883	136	513	219	827	247	934
			300	20.7	92.0	348	158	598	265	1000	183	692	267	1010	279	1060
			400	27.6	111	422	180	681	265	1000	183	692	267	1010	279	1060
			500	34.5	125	471	200	757	265	1000	183	692	267	1010	279	1060
			600	41.4	135	512	200	757	265	1000	183	692	267	1010	279	1060
			1000	69.0	166	626	200	757	265	1000	183	692	267	1010	279	1060
60 to 260 / 4.1 to 17.9	125	8.6	150	10.3	28.0	106	55.0	208	111	420	31.0	117	56.0	212	119	450
			175	12.1	36.5	138	66.5	252	131	496	38.0	144	70.0	265	144	545
			200	13.8	45.0	170	78.0	295	151	571	45.0	170	84.0	318	169	639
			225	15.5	51.0	193	85.5	323	168	636	50.8	192	93.3	353	188	711
			250	17.2	57.0	216	93.0	352	186	702	56.5	214	103	388	207	783
			300	20.7	69.0	261	108	409	220	832	68.0	257	121	458	245	927
			400	27.6	75.0	284	125	473	250	946	78.8	298	138	520	275	1040
			500	34.5	90.0	340	140	530	266	1010	94.5	357	154	583	293	1110
			600	41.4	100	378	145	549	276	1040	105	397	160	603	303	1150
			1000	69.0	105	397	150	567	285	1080	110	417	165	624	314	1190
	200	13.8	225	15.5	38.0	144	76.0	288	160	605	31.0	117	69.0	261	154	583
			250	17.2	47.7	180	90.0	340	179	677	42.0	159	86.0	325	178	673
			300	20.7	67.0	253	118	446	217	821	64.0	242	120	454	226	855
			350	24.1	70.3	266	121	458	220	833	73.8	279	133	504	242	916
			400	27.6	73.5	278	124	469	226	854	77.2	292	136	516	248	939
			450	31.0	76.8	290	127	480	231	874	80.6	305	140	528	254	962
			500	34.5	80.0	303	130	492	237	895	84.0	318	143	541	260	985
			600	41.4	85.0	322	135	511	246	929	89.3	338	149	562	270	1020
			1000	69.0	105	397	150	567	273	1030	110	417	165	624	300	1140
	250	17.2	275	19.0	43.0	163	91.0	344	185	700	45.0	170	95.0	359	194	734
			300	20.7	50.0	189	101	382	203	768	56.0	212	110	416	219	828
			350	24.1	55.8	211	108	407	204	773	58.6	222	118	447	225	850
			400	27.6	61.7	233	114	431	217	819	64.8	245	125	474	238	901
			450	31.0	67.5	255	121	456	229	866	70.9	268	133	501	252	953
			500	34.5	73.3	277	127	480	241	913	77.0	291	140	528	265	1000
			550	37.9	79.2	299	134	505	254	960	83.1	314	147	556	279	1060
			600	41.4	85.0	322	140	530	266	1010	89.3	338	154	583	293	1110
			1000	69.0	95.0	359	155	586	295	1110	99.8	377	171	645	324	1230
60 to 300 / 4.1 to 20.7 Type MR95HP Only	300	20.7	350	24.1	55.0	208	110	416	209	791	57.8	218	121	458	230	870
			400	27.6	68.0	257	125	473	238	898	71.4	270	138	520	261	988
			450	31.0	79.0	299	135	511	257	970	83.0	314	149	562	282	1070
			500	34.5	90.0	340	145	549	276	1040	94.5	357	160	603	303	1150
			550	37.9	92.5	350	148	558	280	1060	97.1	367	162	614	308	1170
			600	41.4	95.0	359	150	567	285	1080	99.8	377	165	624	314	1190
			1000	69.0	125	473	190	719	361	1370	131	497	209	791	397	1500

- Denotes capacities limited by boost.
- Capacities not tested due to cavitation regime.

1. To obtain capacities for Type MR95HT (metal diaphragm), multiply the table values by 0.6. Capacity data for 1000 psig / 69.0 bar inlet is not applicable for Type MR95HT (Type MR95HT max. inlet = 600 psig / 41.4 bar).
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

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Table 22. Water Capacities(1)(2) in C_v for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95H, MR95HD and MR95HDP Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN							
	Outlet/Differential Setting		Inlet		1/4 NPT		1/2 / 15		3/4 / 20		1 / 25	
					Droop		Droop		Droop		Droop	
					10%	20%	10%	20%	10%	20%	10%	20%
	psig	bar	psig	bar	C_v							
15 to 30 / 1.0 to 2.1	15	1.0	30	2.1	0.25	0.71	0.98	1.65	1.72	2.83	1.97	3.54
			40	2.8	0.29	0.66	0.87	1.51	1.65	2.55	1.94	3.59
			50	3.4	0.33	0.65	0.83	1.46	1.66	2.43	1.99	3.73
			75	5.2	0.38	0.76	0.77	1.26	1.47	2.14	1.53	3.02
			100	6.9	0.44	0.87	0.75	1.17	1.40	2.03	1.29	2.67
			150	10.3	0.36	0.73	0.79	1.14	1.24	1.70	1.46	2.60
			200	13.8			0.84	1.15	1.17	1.53	1.61	2.63
			250	17.2			0.83	1.11	1.11	1.44	1.51	2.42
			300	20.7			0.82	1.08				
	30	2.1	40	2.8	0.55	1.07	1.66	2.50	2.77	4.50	3.33	5.75
			50	3.4	0.63	1.10	1.46	2.35	2.50	3.92	3.13	5.10
			75	5.2	0.65	1.10	1.23	2.03	2.09	3.29	3.03	5.04
			100	6.9	0.70	1.10	1.17	1.95	1.99	3.10	3.16	5.28
			150	10.3	0.69	1.10	0.99	1.60	1.67	2.58	2.61	4.28
			200	13.8	0.70	1.10	0.92	1.46	1.52	2.34	2.36	3.77
			250	17.2	0.70	1.10	0.93	1.35	1.37	2.13	2.54	3.82
			300	20.7	0.70	1.10	0.95	1.27	1.27	1.99	2.72	3.91
25 to 75 / 1.7 to 5.2	50	3.4	60	4.1	0.77	1.01	1.75	2.90	3.43	5.10	4.39	6.00
			75	5.2	0.73	1.01	1.46	2.37	2.56	4.06	3.29	5.24
			100	6.9	0.67	1.10	1.21	2.19	2.43	3.74	3.37	5.29
			150	10.3	0.63	1.10	0.98	1.72	2.05	3.24	2.63	4.58
			200	13.8	0.64	1.10	0.88	1.50	1.93	3.08	2.33	4.35
			250	17.2	0.63	1.10	0.87	1.45	1.71	2.69	2.51	4.21
			300	20.7	0.62	1.10	0.89	1.46	1.57	2.42	2.69	4.16
	75	5.2	100	6.9	0.88	1.10	1.75	2.85	3.16	4.74	3.86	6.00
			125	8.6	0.79	1.10	1.49	2.42	2.70	4.13	3.63	5.74
			150	10.3	0.77	1.10	1.38	2.21	2.53	3.85	3.63	5.74
			200	13.8	0.78	1.10	1.30	2.03	2.43	3.63	3.82	6.00
			250	17.2	0.75	1.10	1.15	1.81	2.22	3.37	3.44	5.37
			300	20.7	0.73	1.10	1.05	1.68	2.10	3.23	3.21	4.97
70 to 150 / 4.8 to 10.3	100	6.9	125	8.6	0.68	1.04	1.39	2.13	3.21	4.62	3.72	5.52
			150	10.3	0.65	1.08	1.36	2.15	2.97	4.42	3.61	5.50
			175	12.1	0.65	1.10	1.26	2.08	2.82	4.16	3.58	5.54
			200	13.8	0.67	1.10	1.22	2.05	2.77	4.02	3.62	5.66
			250	17.2	0.66	1.10	1.07	1.73	2.45	3.64	3.40	5.60
			300	20.7	0.66	1.10	0.99	1.52	2.28	3.44	3.31	5.66
	150	10.3	175	12.1	0.79	1.10	1.42	2.22	3.64	5.26	4.74	5.93
			200	13.8	0.87	1.10	1.59	2.27	3.47	5.03	4.47	5.81
			225	15.5	0.84	1.10	1.47	2.16	3.21	4.71	4.35	5.81
			250	17.2	0.84	1.10	1.40	2.10	3.08	4.52	4.34	5.88
			300	20.7	0.86	1.10	1.35	2.07	2.96	4.32	4.44	6.00

- Capacities not tested due to cavitation regime.
1. To obtain capacities for regulators with metal diaphragms, multiply the table values by 0.6.
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

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Table 23. Water Capacities(1) in C_v for 1-1/2 through 2 in. / DN 40 through 50 Types MR95H, MR95HD and MR95HDP Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN					
	Outlet/Differential Setting		Inlet		1-1/2 / 40			2 / 50		
					Droop			Droop		
					10%	20%	40%	10%	20%	40%
	psig	bar	psig	bar	C_v					
5 to 80 / 0.34 to 5.5	5	0.34	10	0.69	2.56	3.27	5.29	2.56	3.27	5.29
			20	1.4	2.16	2.83	4.80	2.10	2.63	4.24
			30	2.1	2.18	2.84	4.91	2.08	2.55	4.04
			50	3.4	2.37	3.10	5.40	2.22	2.65	4.08
			75	5.2	3.28	4.51	6.19	2.26	2.97	4.36
			100	6.9	3.99	5.61	6.90	2.35	9.39	11.57
			150	10.3	3.90	8.18	9.81	3.36	6.56	8.21
			200	13.8	4.00	10.32	12.04	4.22	4.80	6.06
			250	17.2	4.74	10.41	11.07	3.44	3.89	4.77
			300	20.7	5.40	10.50	10.39	2.82	3.18	3.77
	15	1.0	30	2.1	3.45	6.36	10.26	3.45	5.19	9.17
			40	2.8	3.79	6.24	9.61	3.50	5.39	9.34
			50	3.4	4.14	6.33	9.37	3.64	5.68	9.68
			75	5.2	4.02	6.24	9.11	3.19	5.04	14.52
			100	6.9	4.09	6.40	9.22	8.06	14.07	18.10
			150	10.3	5.78	7.19	12.46	6.59	10.56	12.88
			200	13.8	7.10	7.95	15.05	6.66	8.46	9.62
			250	17.2	7.53	12.04	15.14	5.37	7.00	8.50
			300	20.7	7.92	15.48	15.36	4.38	5.82	7.62
	50	3.4	60	4.1	7.20	14.24	17.34	6.58	11.34	18.10
			75	5.2	6.21	11.16	16.55	6.76	11.49	18.10
			100	6.9	6.88	12.26	16.49	6.34	10.59	18.10
			150	10.3	6.05	9.82	15.43	6.25	10.30	18.07
			200	13.8	5.86	8.78	15.34	6.51	10.51	18.10
			250	17.2	6.95	12.35	15.91	5.94	9.66	18.00
			300	20.7	7.89	15.32	16.49	9.64	11.04	17.95
	75	5.2	100	6.9	8.24	13.28	17.39	7.89	12.97	18.10
			125	8.6	7.29	11.76	16.77	7.16	12.13	18.00
			150	10.3	6.99	11.17	16.69	6.99	12.02	17.96
			200	13.8	6.95	10.73	17.11	7.12	12.25	18.10
			250	17.2	6.44	13.71	16.83	6.29	10.88	18.10
			300	20.7	6.16	16.14	16.85	12.53	17.82	18.10
60 to 120 / 4.1 to 8.3	100	6.9	125	8.6	7.94	13.71	16.74	7.78	13.42	18.10
			150	10.3	7.20	12.79	16.34	7.07	12.67	17.92
			175	12.1	7.00	12.52	16.41	6.89	12.52	18.00
			225	15.5	7.06	12.54	16.82	6.97	12.79	18.10
			250	17.2	6.98	11.81	16.61	6.74	12.50	18.10
			300	20.7	6.97	10.72	16.52	6.49	12.20	18.10
100 to 140 / 6.9 to 9.7	125	8.6	150	10.3	7.14	12.22	17.09	7.68	12.87	18.10
			175	12.1	7.01	12.12	16.80	7.40	12.70	18.10
			200	13.8	7.16	12.40	16.82	7.48	12.80	18.10
			225	15.5	7.02	12.43	16.66	7.38	12.70	18.10
			250	17.2	6.99	12.57	16.71	7.38	12.66	18.10
			300	20.7	7.08	13.01	16.87	7.52	12.87	18.10
120 to 150 / 8.3 to 10.3	150	10.3	175	12.1	6.32	10.65	15.73	6.64	12.14	18.10
			200	13.8	6.45	10.96	16.11	6.95	12.07	18.10
			225	15.5	6.27	10.54	16.18	6.73	11.81	18.10
			250	17.2	6.25	10.35	16.29	6.67	11.84	18.10
			300	20.7	6.38	10.29	16.77	6.77	12.00	18.10

- Denotes capacities limited by boost.
1. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

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Table 24. Water Capacities(1)(2) in C_v for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Type MR95HP Regulator with Elastomer Diaphragm

RECOMMENDED OUTLET/DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN							
	Outlet/Differential Setting		Inlet		1/4 NPT		1/2 / 15		3/4 / 20		1 / 25	
					Droop		Droop		Droop		Droop	
					10%	20%	10%	20%	10%	20%	10%	20%
	psig	bar	psig	bar	C_v							
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	0.20	0.31	0.59	0.87	1.48	1.89	1.48	2.36
			40	2.8	0.25	0.36	0.56	0.81	1.26	1.61	1.36	2.08
			50	3.4	0.30	0.41	0.56	0.79	1.16	1.46	1.32	1.95
			75	5.2	0.27	0.42	0.54	0.76	1.08	1.45	1.21	1.70
			100	6.9	0.27	0.45	0.55	0.77	1.08	1.49	1.18	1.60
			150	10.3	0.26	0.41	0.51	0.71	0.98	1.32	1.16	1.70
			200	13.8	0.26	0.40	0.50	0.69	0.95	1.24	1.17	1.82
			250	17.2	0.26	0.38	0.53	0.71	0.92	1.18	1.21	2.01
			300	20.7	0.26	0.37	0.55	0.72	0.90	1.14	1.26	2.18
			400	27.6					0.88	0.99	1.25	1.93
			500	34.5								
			600	41.4								
			1000	69.0								
	75	5.2	100	6.9	0.74	1.10	1.40	2.21	2.81	3.95	3.16	4.90
			125	8.6	0.72	1.05	1.19	1.92	2.37	3.57	2.84	4.63
			150	10.3	0.74	1.05	1.10	1.79	2.20	3.43	2.75	4.59
			200	13.8	0.80	1.09	1.04	1.69	2.08	3.38	2.78	4.73
			250	17.2	0.76	1.07	0.96	1.56	1.96	3.12	2.63	4.53
			300	20.7	0.73	1.08	0.92	1.48	1.90	2.97	2.56	4.45
			400	27.6	0.71	0.97	0.80	1.27	1.66	2.87	2.25	4.34
			500	34.5	0.67	0.92	0.74	1.14	1.46	2.53	1.97	3.81
			600	41.4	0.66	0.84	0.68	1.04	1.31	2.28	1.78	3.44
			1000	69.0								
	100	6.9	125	8.6	0.83	1.04	1.52	2.39	3.21	4.77	3.55	5.37
			150	10.3	0.80	1.07	1.38	2.15	2.93	4.39	3.45	5.26
			175	12.1	0.81	1.10	1.33	2.05	2.85	4.24	3.50	5.34
			200	13.8	0.83	1.10	1.33	2.01	2.86	4.20	3.62	5.48
			250	17.2	0.81	1.10	1.19	1.80	2.45	3.83	3.32	5.25
			300	20.7	0.82	1.10	1.10	1.69	2.21	3.64	3.17	5.19
			400	27.6	0.81	1.10	0.91	1.45	1.90	3.17	2.93	4.53
			500	34.5	0.82	1.10	0.79	1.34	1.83	2.90	2.82	4.15
			600	41.4	0.82	1.10	0.82	1.27	1.64	2.61	2.52	3.73
			1000	69.0			0.64	0.99	1.24	1.99	1.90	2.84
80 to 300 / 5.5 to 20.7	125	8.6	150	10.3	0.31	0.49	0.98	1.41	1.63	2.69	1.96	3.54
			175	12.1	0.30	0.47	0.89	1.39	1.71	2.77	2.02	3.46
			200	13.8	0.31	0.47	0.86	1.40	1.82	2.90	2.14	3.50
			225	15.5	0.30	0.46	0.82	1.34	1.74	2.77	2.07	3.40
			250	17.2	0.30	0.46	0.81	1.31	1.71	2.69	2.05	3.35
			300	20.7	0.30	0.46	0.80	1.27	1.68	2.62	2.04	3.32
			400	27.6	0.30	0.44	0.68	1.10	1.53	2.28	2.12	3.32
			500	34.5	0.29	0.44	0.61	1.00	1.47	2.10	2.24	3.40
			600	41.4	0.29	0.44	0.63	1.00	1.33	1.93	2.04	3.22
			1000	69.0			0.49	0.78	1.09	1.70	1.68	2.84
	200	13.8	225	15.5	0.39	0.62	1.19	1.86	2.39	3.72	2.83	4.59
			250	17.2	0.37	0.60	1.12	1.79	2.27	3.66	2.75	4.46
			300	20.7	0.37	0.59	1.10	1.77	2.28	3.72	2.83	4.48
			400	27.6	0.36	0.58	1.01	1.61	1.99	3.16	2.53	4.20
			500	34.5	0.36	0.57	1.01	1.57	1.90	2.93	2.46	4.18
			600	41.4	0.36	0.56	0.93	1.48	1.81	2.72	2.20	3.91
			1000	69.0	0.36	0.56	0.71	1.13	1.40	2.07	2.62	4.31
	300	20.7	350	24.1	0.51	0.77	1.45	2.19	2.68	4.20	3.02	5.05
			400	27.6	0.46	0.72	1.32	2.06	2.46	3.87	2.89	5.00
			500	34.5	0.44	0.69	1.25	1.98	2.37	3.66	2.97	5.21
			600	41.4	0.40	0.65	1.16	1.84	2.31	3.43	3.25	5.17
			1000	69.0	0.34	0.58	0.96	1.63	1.85	2.79	2.59	4.61
80 to 400 / 5.5 to 27.6 Type MR95HP Only	400	27.6	500	34.5	0.56	0.83	1.61	2.39	2.70	4.10	3.63	5.44
			600	41.4	0.50	0.78	1.42	2.21	2.58	3.88	3.36	5.50
			1000	69.0	0.42	0.69	1.20	1.96	2.10	3.22	3.32	5.18

- Capacities not tested due to cavitation regime.
1. To obtain capacities for regulators with metal diaphragms or for Type MR95HT, multiply the table values by 0.6. Capacity data for 1000 psig / 69.0 bar inlet is not applicable for Type MR95HT (Type MR95HT max. inlet = 600 psig / 41.4 bar).
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

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Table 25. Water Capacities(1)(2) in C_v for 1-1/2 through 2 in. / DN 40 through 50 Type MR95HP Regulator with Elastomer Diaphragm

RECOMMENDED OUTLET/DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN					
	Outlet/Differential Setting		Inlet		1-1/2 / 40			2 / 50		
					Droop			Droop		
					10%	20%	40%	10%	20%	40%
	psig	bar	psig	bar	C_v					
15 to 100 / 1.0 to 6.9	15	1.0	30	2.1	2.95	4.71	7.86	2.71	4.24	7.20
			40	2.8	3.01	4.72	7.45	3.01	4.35	7.27
			50	3.4	3.14	4.87	7.34	3.31	4.54	7.50
			75	5.2	2.93	4.60	7.32	2.87	4.03	7.26
			100	6.9	2.90	4.58	7.55	2.69	3.84	7.34
			150	10.3	3.51	5.28	11.28	3.00	11.83	13.31
			200	13.8	4.03	5.91	14.17	3.30	17.65	17.81
			250	17.2	5.01	9.69	14.20	6.41	7.53	8.64
			300	20.7	5.88	12.90	14.28	5.88	6.90	7.92
			400	27.6						
			500	34.5						
			600	41.4						
			1000	69.0						
	50	3.4	60	4.1	4.91	8.72	14.79	5.16	9.17	16.61
			75	5.2	4.91	8.43	15.06	4.95	9.21	16.70
			100	6.9	5.39	8.78	16.02	5.26	9.94	17.57
			150	10.3	5.17	8.15	15.70	5.47	13.73	17.53
			200	13.8	5.30	8.14	16.11	5.86	16.68	18.10
			250	17.2	6.04	10.14	16.18	9.57	15.94	17.87
			300	20.7	6.70	11.78	16.43	12.52	15.50	17.89
			400	27.6	5.68	10.01	14.11	10.61	13.18	15.37
			500	34.5	5.02	8.91	12.67	9.38	11.73	13.79
			600	41.4	4.59	8.16	11.59	8.59	10.73	12.62
			1000	69.0						
	100	6.9	125	8.6	6.93	11.63	17.12	7.10	13.57	18.10
			150	10.3	6.75	11.44	16.76	7.40	13.98	17.81
			175	12.1	6.91	11.59	16.88	7.89	14.77	17.90
			200	13.8	7.15	11.96	17.07	8.39	15.52	18.10
			250	17.2	6.60	11.12	16.98	10.75	16.80	17.92
			300	20.7	6.35	10.65	17.11	12.63	18.00	18.01
			400	27.6	6.30	10.06	14.37	10.39	14.93	15.13
			500	34.5	6.17	9.76	12.63	9.04	13.03	13.30
			600	41.4	5.98	8.77	11.40	8.10	11.71	12.01
			1000	69.0	5.55	6.68	8.85	6.11	8.92	9.32
60 to 260 / 4.1 to 17.9	125	8.6	150	10.3	4.57	7.78	12.82	5.06	7.92	13.74
			175	12.1	4.62	7.68	13.10	4.81	8.08	14.40
			200	13.8	4.81	7.80	13.51	4.81	8.40	15.12
			225	15.5	4.81	7.65	13.72	4.79	8.35	15.35
			250	17.2	4.86	7.59	14.06	4.82	8.41	15.65
			300	20.7	5.04	7.64	14.67	4.97	8.56	16.33
			400	27.6	4.42	7.22	13.87	4.65	7.97	15.25
			500	34.5	4.57	7.00	12.90	4.80	7.70	14.21
			600	41.4	4.53	6.48	12.05	4.76	7.16	13.22
			1000	69.0	3.52	5.01	9.52	3.69	5.51	10.49
	200	13.8	225	15.5	5.66	9.43	15.61	4.62	8.56	15.03
			250	17.2	5.70	9.49	15.70	5.02	9.07	15.61
			300	20.7	6.12	9.97	16.17	5.84	10.14	16.85
			350	24.1	5.39	8.78	14.51	5.66	9.65	15.96
			400	27.6	4.96	8.00	13.51	5.20	8.78	14.82
			450	31.0	4.67	7.46	12.72	4.91	8.22	13.98
			500	34.5	4.47	7.05	12.16	4.70	7.76	13.34
			600	41.4	4.15	6.44	11.23	4.36	7.10	12.32
			1000	69.0	3.67	5.18	9.20	3.84	5.69	10.11
	250	17.2	275	19.0	6.08	10.51	16.55	6.36	10.97	17.35
			300	20.7	5.77	10.10	16.57	6.47	11.00	17.88
			350	24.1	4.99	8.82	14.42	5.24	9.63	15.91
			400	27.6	4.66	8.06	13.72	4.90	8.84	15.05
			450	31.0	4.50	7.65	13.22	4.73	8.41	14.55
			500	34.5	4.42	7.33	12.88	4.64	8.08	14.16
			550	37.9	4.39	7.16	12.70	4.61	7.86	13.95
			600	41.4	4.39	7.00	12.54	4.61	7.70	13.81
			1000	69.0	3.41	5.48	10.12	3.58	6.05	11.11
60 to 300 / 4.1 to 20.7 Type MR95HP Only	300	20.7	350	24.1	6.15	10.49	16.03	6.46	11.54	17.64
			400	27.6	5.96	9.88	16.05	6.26	10.91	17.60
			450	31.0	5.89	9.32	15.64	6.19	10.28	17.16
			500	34.5	5.93	8.99	15.43	6.23	9.92	16.94
			550	37.9	5.53	8.41	14.56	5.80	9.20	16.01
			600	41.4	5.23	7.91	13.91	5.49	8.70	15.32
			1000	69.0	4.63	6.89	12.61	4.85	7.58	13.86

- Denotes capacities limited by boost.
- Capacities not tested due to cavitation regime.

1. To obtain capacities for Type MR95HT (metal diaphragm), multiply the table values by 0.6. Capacity data for 1000 psig / 69.0 bar inlet is not applicable for Type MR95HT (Type MR95HT max. inlet = 600 psig / 41.4 bar).
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

Type MR95L

Pressure Reducing Regulator

FISHER

Introduction

Type MR95L regulators are compact, large-capacity, direct-operated pressure regulators. The units are available in 1/4 NPT through 1 in. / DN 25 sizes and are offered in several different end connection configurations. They are designed to handle pressures up to 300 psig / 20.7 bar and temperatures up to 450°F / 232°C.

These products can help solve the toughest pressure control applications. Typical applications include superheated steam, steam injection, steam tracing, nitrogen purging, boiler feed water, process chemicals, cooling water, test fixtures, wash tanks, sterilizers/autoclaves, fuel lines, pneumatic supply and many others.

Available Configurations

See Table 1

Body Sizes, End Connections and Port Options

See Table 2

Orifice Sizes

1/4 NPT body:
0.284 in. / 7.22 mm orifice
1/2 in. / DN 15 body:
0.416 in. / 10.56 mm orifice
3/4 and 1 in. / DN 20 and 25 bodies:
0.631 in. / 16.02 mm orifice

Construction Material Options

See Table 3

Spring Case Construction

Drilled Untapped Hole: Standard for Type MR95L
1/4 NPT Vent: Standard for Type MR95LD; Optional for Type MR95L

Flow and Sizing Coefficients

Type MR95L Sizing: See Table 4
Reduced Port Option Sizing: See Table 5

Pressure Registration

Internal (Standard) or External

Shutoff Classification Per ANSI/FCI 70-3-2004

Metal Seats: Class IV
Elastomer Seats: Class VI or better
PTFE: Class IV

Pressure Ranges

2 to 30 psig / 0.14 to 2.1 bar in different ranges; See Table 6

Figure 1. *Type MR95L Direct-Operated Pressure Reducing Regulator*

Approximate Weights

7 to 35 lbs / 3.2 to 16 kg; See Table 7

Maximum Cold Working Pressures of Body Size and Material

Up to 300 psig / 20.7 bar; See Table 8

Temperature Capabilities

-40 to 450°F / -40 to 232°C; See Table 9

Applications

- Air
- Liquid
- Process Gas
- Steam

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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www.Emerson.com

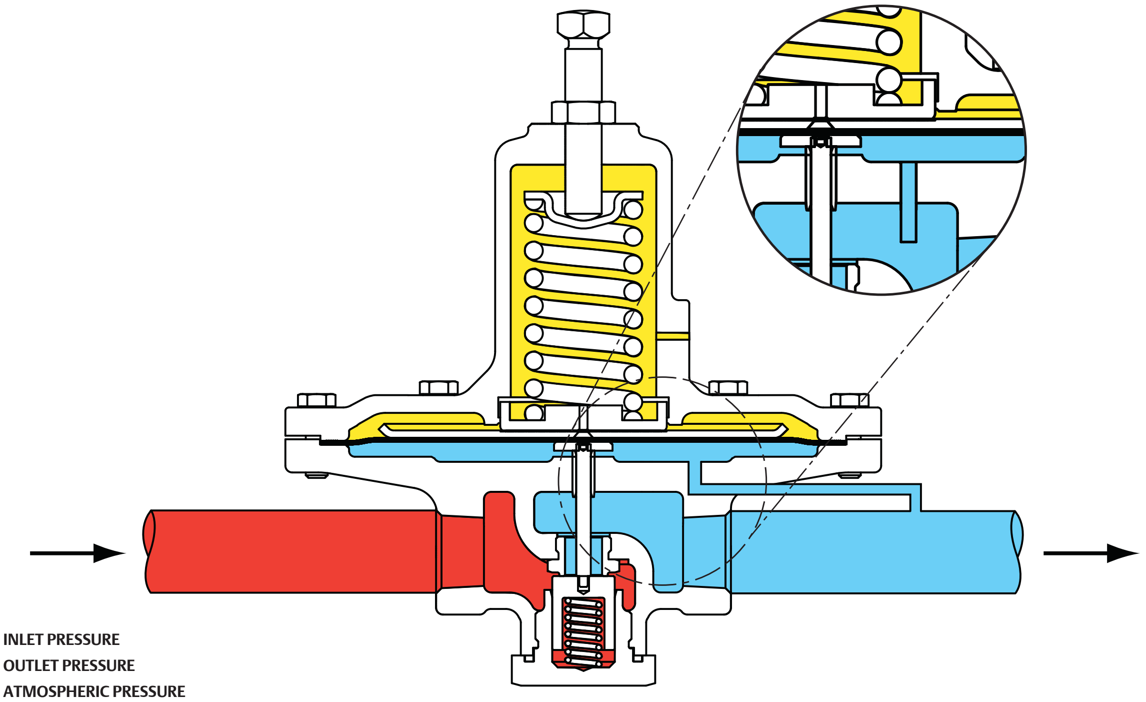
Ordering Guide

To order this product, contact your local Sales Office.

Features

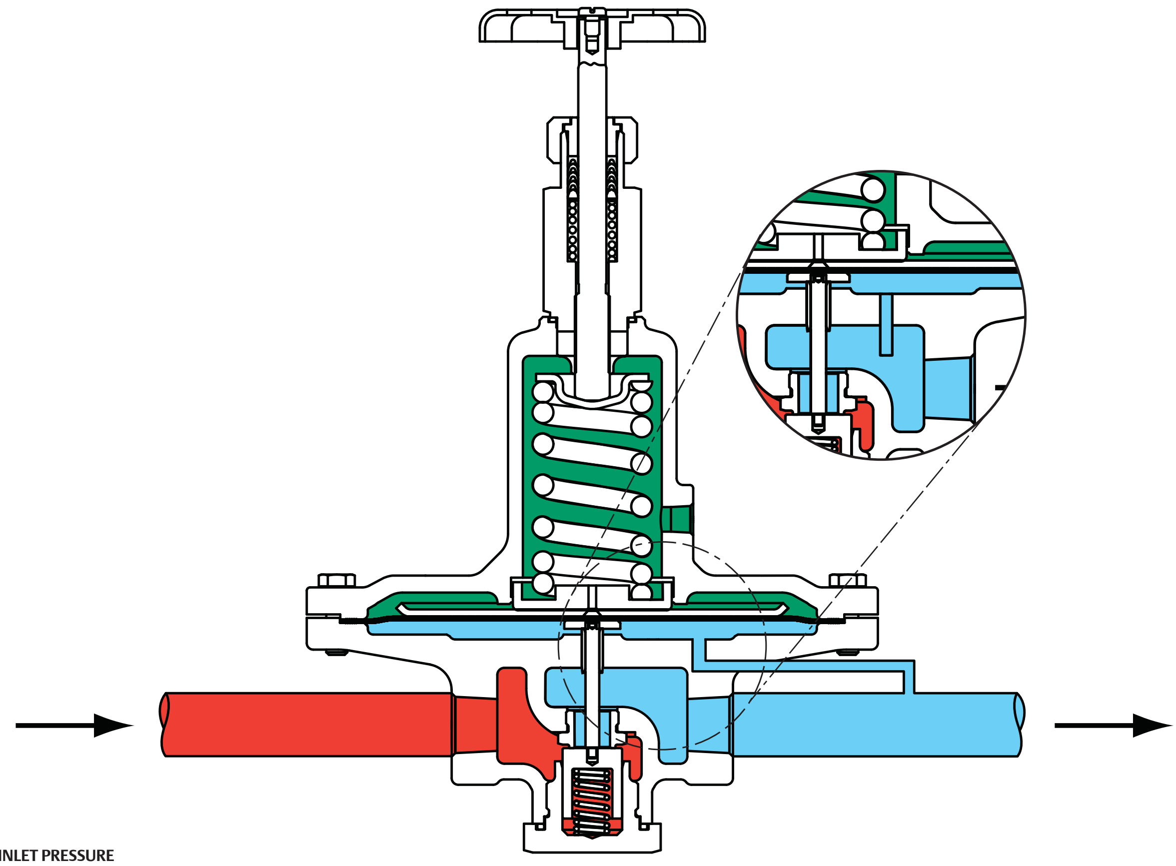
- Up to 300 psig / 20.7 bar Inlet Pressure
- Set pressures up to 30 psig / 2.1 bar
- Elastomer Seat Option for Tight Shutoff
- Rugged Construction
- Differential Pressure Capability
- Optional Materials for Special Service Capability (e.g., Sour Gases, Cryogenics, Steam)
- Large Turndown Ratio
- Multiple End Connection Options
- Handwheel/Tee Handle Option
- Inlet/Outlet Gauge Ports and Reduced Port Options
- Easy Maintenance
- API 614 Compliant

EMERSON



INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE

Figure 2. *Type MR95L Operational Schematic with External Registration and Standard Internal Registration (inset)*



INLET PRESSURE
OUTLET PRESSURE
LOADING PRESSURE

Figure 3. *Type MR95LD Operational Schematic with External Registration and Standard Internal Registration (inset)*

Table 1. Available Configurations

TYPE	CONFIGURATION
MR95L	Pressure reducing regulator for outlet pressures from 2 to 30 psig / 0.14 to 2.1 bar. 1/4 in. to 1 in. body sizes only.
MR95LD	Pressure reducing differential regulator for differential set pressures from 2 to 30 psi / 0.14 to 2.1 bar with maximum inlet pressure up to 300 psi / 20.7 bar and maximum outlet pressure up to 125 psi / 8.6 bar. 1/4 in. to 1 in. body sizes only.

Table 2. Body Sizes, End Connections and Port Options

BODY SIZES	END CONNECTIONS	PORT OPTIONS
1/4 NPT 1/2 in. / DN 15 3/4 in. / DN 20 1 in. / DN 25	NPT SWE Welded CL150 RF Welded CL300 RF Welded PN 16/25/40 RF	Inlet and Outlet Gauge Ports Option Reduced Port (Orifice) Option

Table 3. Construction Material Options

BODY	SPRING CASE	REGULATOR SPRING
Gray Cast Iron LCC/WCC Steel CF8M/CF3M Stainless steel (1) Hastelloy® C (1) Monel® (1)	Gray Cast Iron(2) LCC/WCC Steel CF8M Stainless steel Hastelloy® C Monel®	Steel (standard) Inconel® 302 Stainless steel

1. Meets the chemical and physical requirements of NACE MR0175-ISO 15156, MR0175-2002 and MR0103.
2. Gray cast iron spring case is not available for Type MR95LD.

TRIM MATERIAL		
Elastomer Seat		
Part Name	**Standard**	**Optional**
Diaphragm	Neoprene (CR)	302 Stainless steel(1), Fluorocarbon (FKM)(2), Ethylenepropylene (EPDM)(2), Monel®(1), Hastelloy® C(1) or PTFE protector available with Neoprene (CR) and Fluorocarbon (FKM)(2) diaphragm
Disk	Nitrile (NBR)	Fluorocarbon (FKM), Polytetrafluoroethylene (PTFE), Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM)
Disk Holder	Brass or 416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Valve Plug Guide	316 Stainless steel	Monel® or Hastelloy® C
Orifice	Brass or 416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Stem Assembly	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Metal Seat		
Diaphragm	302 Stainless steel(1)	Monel®(1), Hastelloy® C(1), Fluorocarbon (FKM)(2), Ethylenepropylene (EPDM)(2) or PTFE protector available with Neoprene (CR) and Fluorocarbon (FKM)(2) diaphragm
Valve Plug	416 Stainless steel	316 Stainless steel, Monel®, Hastelloy® C or Alloy 6
Valve Plug Guide	316 Stainless steel	Monel® or Hastelloy® C
Orifice	416 Stainless steel	316 Stainless steel, Monel®, Hastelloy® C or Alloy 6
Stem Assembly	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Gasket	Composition	Graphite

1. Two Diaphragms are used for metal diaphragm except Types MR95L and MR95LD 1/4 NPT Body, range 2 to 6 psig / 0.14 to 0.41 bar.
2. Two Diaphragms are used.

Table 4. Flow and Sizing Coefficients

BODY SIZE		WIDE-OPEN COEFFICIENTS (FOR RELIEF SIZING)			C_1	K_m	IEC SIZING COEFFICIENTS		
In.	DN	C_v	C_g	C_s			X_T	F_D	F_L
1/4	- - - -	1.1	37	1.85	33.6	0.74	0.715	0.62	0.86
1/2	15	2.9	103	5.15	35.5	0.79	0.797	0.70	0.89
3/4 and 1	20 and 25	6.0	221	11.05	36.8	0.88	0.857	0.68	0.94

$K_m = F_L^2$

Table 5. Relief Sizing Coefficients for Type MR95L Regulators with Reduced Flow Orifices(1)

BODY SIZE		WIDE-OPEN COEFFICIENTS FOR TYPE MR95L REDUCED FLOW OPTION	WIDE-OPEN COEFFICIENTS FOR LEGACY 95 SERIES
In.	DN	C_g	C_g
1/4	- - - -	28	28
1/2	15	70	67
3/4 and 1	20 and 25	156	156

1. The reduced flow orifice option offers similar flow capacity as the equivalent 95 Series configuration.

Table 6. Pressure Ranges and Spring Information

TYPE	BODY SIZE		OUTLET OR DIFFERENTIAL PRESSURE RANGE[1]		SPRING WIRE DIAMETER		SPRING FREE LENGTH		SPRING MATERIAL[2]	SPRING COLOR
	In.	DN	psi/psig	bar	In.	mm	In.	mm		
MR95L and MR95LD	1/4	- - - -	2 to 6	0.14 to 0.41	0.148	3.76	2.00	50.8	Zinc-plated steel	Yellow
			5 to 15	0.34 to 1.0	0.170	4.32	2.00	50.8	Zinc-plated steel	Green
			13 to 30	0.90 to 2.1	0.207	5.26	1.94	49.2	Powder-coated steel	Red
	1/2	15	2 to 6	0.14 to 0.41	0.207	5.26	2.50	63.5	Powder-coated steel[3]	Yellow
			5 to 15	0.34 to 1.0	0.234	5.94	2.60	65.9	Powder-coated steel[3]	Green
			13 to 30	0.90 to 2.1	0.283	7.19	2.44	62.0	Powder-coated steel[3]	Red
	3/4 and 1	20 and 25	2 to 6	0.14 to 0.41	0.306	7.77	4.00	102	Powder-coated steel[3]	Yellow
			5 to 15	0.34 to 1.0	0.343	8.71	4.00	102	Powder-coated steel[3]	Green
			13 to 30	0.90 to 2.1	0.406	10.31	4.00	102	Powder-coated steel[3]	Red
			2 to 6	0.14 to 0.41	0.306	7.77	4.00	102	Powder-coated Stainless steel	Yellow
			5 to 15	0.34 to 1.0	0.375	9.53	3.88	98.6	Stainless steel	Unpainted
			13 to 30	0.90 to 2.1	0.437	11.1	4.00	102	Stainless steel	Unpainted

1. For Types MR95LD regulators, the pressure ranges indicate the differential pressure that can be obtained with the indicated spring. The differential pressure (spring setting) is added to the spring case loading pressure to determine the actual outlet pressure.
2. Springs meet NACE MR0175-2002 and NACE MR0103 requirements only for applications in which the spring is not exposed to the sour gas.
3. Available in Inconel®.

Table 7. Approximate Weights

BODY SIZE		APPROXIMATE WEIGHT	
In.	DN	lbs	kg
1/4	- - - -	7	3.2
1/2	15	15	6.8
3/4 and 1	20 and 25	35	16

Table 8. Maximum Cold Working Pressures of Body Size and Material[1][2]

TYPE	BODY SIZE	SPRING CASE MATERIAL	MAXIMUM INLET PRESSURE		MAXIMUM OUTLET PRESSURE		MAXIMUM SPRING CASE PRESSURE	
			psig	bar	psig	bar	psig	bar
MR95L and MR95LD	All available sizes[3]	Gray Cast Iron	250	17.2	50	3.4	50	3.4
		WCC Steel	300	20.7	125	8.6	125	8.6
		LCC Steel	300	20.7	125	8.6	125	8.6
		CF8M Stainless steel	300	20.7	125	8.6	125	8.6
		CF3M Stainless steel	300	20.7	125	8.6	125	8.6
		Monel®[4]	300	20.7	125	8.6	125	8.6
		Hastelloy® C[4]	300	20.7	125	8.6	125	8.6

1. The pressure/temperature limits in this Application Guide and any applicable standard or code limitation should not be exceeded.
2. The pressure limits given are based on the body size and body materials only. Actual pressure limits of the assembled regulator may decrease and vary depending on the temperature, body end connection, diaphragm, seat and/or trim material of the regulator.
3. See Table 6 for all available body sizes.
4. Not available for 1/4 NPT body size.

Table 9. MR95 Series Temperature Capabilities[1][2]

TRIM MATERIAL	SEAT	DIAPHRAGM	O-RING	DIAPHRAGM PROTECTOR	GASKET	TEMPERATURE	
						°F	°C
Nitrile (NBR)	✓		✓			-40 to 180	-40 to 82
Neoprene (CR)		✓				-40 to 180	-40 to 82
Fluorocarbon (FKM)[3]	✓	✓	✓			0 to 300, Limited to 200°F for hot water	-18 to 149, Limited to 93°C for hot water
Ethylenepropylene (EPDM)	✓	✓	✓			20 to 275	-7 to 135
Perfluoroelastomer (FFKM)	✓		✓			0 to 425	-18 to 218
PTFE	✓			✓		-40 to 400	-40 to 204
Metal	✓	✓				-40 to 650	-40 to 343
Composition					✓	-40 to 400, Limited to 300°F for steam	-40 to 204, Limited to 149°C for steam
Graphite					✓	-40 to 650	-40 to 343

BODY MATERIAL	TEMPERATURE	
	°F	°C
Gray cast iron	-20 to 406	-29 to 208
WCC Steel[4]	-20 to 650	-29 to 343
LCC Steel[4]	-40 to 650	-40 to 343
Stainless[4], Monel® or Hastelloy® C	-40 to 550	-40 to 288

1. The pressure/temperature limits in this Application Guide and any applicable standard limitation should not be exceeded.
2. The temperature limits given are based on the body size and body materials only. Actual temperature limits of the assembled regulator may decrease and vary depending on the body end connection, diaphragm, seat and/or trim material of the regulator.
3. Not for use on steam service.
4. Meets API 614 requirements (with Stainless steel trim).

FISHER

Air

Table 10. Air Capacities(1)(2) in SCFH / Nm³/h for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95L and MR95LD Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 /15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
2 to 6 / 0.14 to 0.41	5	0.34	20	1.4	740	19.8	910	24.5	1000	27.2	1500	41.2	1200	32.8	2200	59.5	2800	74.7	4600	124
			30	2.1	950	25.4	1100	30.2	1100	28.9	1600	42.7	1400	37.8	2500	67.9	3300	87.5	5200	139
			50	3.4	1400	36.5	1500	41.5	1200	32.4	1700	45.5	1800	47.7	3200	84.7	4200	113	6300	169
			75	5.2	1600	43.3	1700	46.9	1300	34.1	1800	47.5	2300	60.5	3500	94.7	4400	118	6700	180
			100	6.9	1800	48.3	1900	52.2	1300	35.9	1800	49.5	2700	73.3	3900	105	4600	123	7100	191
			150	10.3	1800	48.3	2000	53.6	1500	39	2000	52.6	2400	65	4000	106	4600	123	7400	197
			200	13.8	1800	48.3	2000	53.6	1600	42.1	2100	55.6	2100	56.7	4000	107	4600	122	7600	203
			250	17.2	1800	48.3	2000	53.6	1500	41	2100	56.4	2000	52.8	3800	102	4900	131	7900	212
5 to 15 / 0.34 to 1.0	10	0.69	20	1.4	670	18.1	930	24.9	1200	31.8	1900	50.6	1700	45.2	2700	72.7	3000	80.1	4700	127
			30	2.1	950	25.5	1200	31.6	1300	36	2000	54.9	1900	52.1	3100	82.8	3600	97.1	5800	156
			50	3.4	1500	40.4	1700	44.9	1700	44.3	2400	63.5	2500	66.1	3800	103	4900	131	8000	215
			75	5.2	1800	48.5	2000	53.3	1700	46.7	2500	67.7	2800	76	4300	115	5700	153	8700	234
			100	6.9	2100	56.6	2300	61.7	1800	49.1	2700	71.8	3200	85.9	4700	127	6500	175	9400	252
			150	10.3	2200	60.3	2300	62.9	2000	52.4	2900	76.5	3500	92.6	5200	139	6600	178	9800	264
			200	13.8	2400	64	2400	64	2100	55.7	3000	81.1	3700	99.2	5700	152	6700	180	10,000	275
			250	17.2	2400	64	2400	64	2300	61.2	3200	84.9	4300	116	6100	164	6900	184	11,000	292
	15	1.0	20	1.4	600	16.1	830	22.3	1500	41.3	2200	59.5	1600	42.8	2500	66.3	3200	85	4700	126
			30	2.1	930	25	1200	32	1800	47.9	2500	66.7	1900	51.4	3000	81.7	4300	115	6600	176
			50	3.4	1600	42.8	1900	51.4	2300	61.1	3000	81.2	2600	68.7	4200	112	6500	174	10,000	276
			75	5.2	2000	54.9	2300	62	2400	63.8	3300	87.1	3000	80.7	4800	127	7600	204	12,000	310
			100	6.9	2500	67	2700	72.7	2500	66.5	3500	93.1	3500	92.8	5300	142	8700	233	13,000	344
			150	10.3	2600	70.6	2800	74.1	2700	71.6	3800	101	3900	104	5900	159	8800	237	13,000	359
			200	13.8	2800	74.2	2800	75.6	2900	76.6	4100	109	4300	115	6600	177	9000	240	14,000	373
			250	17.2	2800	76	2800	76	2900	78.3	4100	110	4700	126	7200	193	9200	247	14,000	380
13 to 30 / 0.90 to 2.1	20	1.4	30	2.1	710	19	1100	29.1	1800	49	2900	77.2	2000	54.3	3400	90.8	4400	117	7000	188
			40	2.8	970	25.9	1400	37.5	2100	56.1	3200	86.9	2200	57.7	3600	97.8	5500	146	8800	237
			50	3.4	1200	32.9	1700	45.9	2400	63.2	3600	96.6	2300	61.2	3900	105	6500	176	11,000	286
			75	5.2	1700	44.6	2200	59	2600	68.6	3800	103	2900	77	4900	130	8000	215	13,000	338
			100	6.9	2100	56.3	2700	72	2800	74	4000	108	3500	92.8	5800	156	9500	254	15,000	391
			150	10.3	2500	66.5	2900	77.5	3000	80.1	4400	117	4000	107	6300	170	11,000	282	16,000	418
			200	13.8	2900	76.7	3100	83.1	3200	86.3	4700	125	4500	122	6800	184	12,000	309	17,000	446
			250	17.2	3000	80.5	3100	82.6	3500	93.1	4800	129	5000	134	7900	212	12,000	315	17,000	458
	30	2.1	40	2.8	880	23.6	1400	38.6	2700	71	4200	113	2400	63	3500	93.8	6500	174	9000	241
			50	3.4	1300	35.3	1800	48.7	2900	77.7	4500	121	2700	73.2	4100	110	7900	212	11,000	302
			75	5.2	1900	51.8	2500	67.2	3300	89.5	5000	134	3400	90.2	5200	141	10,000	272	15,000	415
			100	6.9	2500	68.2	3200	85.6	3800	101	5500	147	4000	107	6400	171	12,000	333	20,000	527
			150	10.3	3100	83.2	3600	96.2	4100	109	5900	159	4900	132	7700	205	14,000	376	21,000	565
			200	13.8	3700	98.1	4000	107	4400	117	6300	170	5900	157	8900	240	16,000	420	23,000	604
			250	17.2	3900	104	4000	108	4700	125	6600	176	6600	178	10,000	271	16,000	429	23,000	623

1. To obtain capacities for regulators using metal diaphragms, multiply the table values by 0.8.
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

Process Gas

Regulating capacities at selected pressures and outlet pressure flows in Tables 10 is given in SCFH (60°F and 14.7 psia) of air. To determine the equivalent capacities for other gases, multiply the table capacity in Table 10 by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm3/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

EMERSON

Steam

Table 11. Steam Capacities(1)(2) for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95L and MR95LD Regulators with Metal Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 / 15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h	lb/h	kg/h
2 to 6 / 0.14 to 0.41	5	0.34	20	1.4	26	11.8	32	14.5	35	16.1	53	24.1	43	19.3	78	35.4	99	45.1	160	74.1
			30	2.1	33	15	38	17.4	39	17.5	56	25.4	49	22.4	88	39.9	120	52.7	180	83
			50	3.4	48	21.9	52	23.5	41	18.9	59	26.7	63	28.4	110	50.5	150	66.3	220	99.4
			75	5.2	55	25	58	26.6	45	20.3	62	28.2	79	36.1	120	54.9	150	69	230	105
			100	6.9	62	28.1	65	29.7	45	20.3	62	28.2	93	42.3	130	61	160	72	240	111
			150	10.3	62	28.2	69	31.3	52	23.5	69	31.3	83	37.5	140	62.6	160	72	250	116
			200	13.8	62	28.2	69	31.3	55	25	72	32.8	72	32.9	140	62.6	160	72	260	119
			250	17.2	62	28.2	69	31.3	52	23.5	72	32.9	69	31.3	130	59.5	170	76.7	270	124
5 to 15 / 0.34 to 1.0	10	0.69	20	1.4	24	10.8	33	15	43	19.5	68	30.8	61	27.6	96	43.8	110	48.8	170	76.3
			30	2.1	33	15.2	42	19.1	46	20.9	71	32	67	30.6	110	49.8	130	57.9	210	93.2
			50	3.4	52	23.6	59	26.7	59	26.9	83	37.9	87	39.7	130	60.3	170	77.9	280	127
			75	5.2	62	28.1	69	31.3	59	26.7	86	39.2	97	44.1	150	67.7	200	89.8	300	137
			100	6.9	72	32.8	79	36	62	28.2	93	42.2	110	50.2	160	73.7	220	102	320	147
			150	10.3	76	34.4	79	36	69	31.3	100	45.4	120	54.8	180	81.3	230	103	340	153
			200	13.8	83	37.5	83	37.5	72	32.8	100	46.9	130	57.9	200	89.2	230	105	340	156
			250	17.2	83	37.5	83	37.5	79	36	110	50.1	150	67.3	210	95.4	240	108	380	172
	15	1.0	20	1.4	22	9.81	30	13.5	54	24.6	79	35.9	58	26.2	90	40.9	120	52.4	170	76.8
			30	2.1	33	15	42	19.3	64	29.1	89	40.3	68	30.8	110	48.5	150	69.7	230	107
			50	3.4	56	25.3	66	30	81	36.6	100	47.7	91	41.6	150	67	230	104	350	160
			75	5.2	69	31.3	79	36	83	37.8	110	51.9	100	47.5	170	75.8	260	120	420	190
			100	6.9	86	39.1	93	42.2	86	39.2	120	54.8	120	55	180	83.3	300	137	450	204
			150	10.3	89	40.7	96	43.8	93	42.2	130	59.4	130	61.1	200	92.4	300	138	450	203
			200	13.8	96	43.8	96	43.8	100	45.4	140	64.1	150	67.3	230	103	310	141	480	219
			250	17.2	96	43.8	96	43.8	100	45.4	140	64.1	160	73.5	250	113	320	144	480	219
13 to 30 / 0.90 to 2.1	20	1.4	30	2.1	25	11.5	39	17.8	65	29.3	100	47.1	72	32.6	120	55.3	160	71.8	250	114
			40	2.8	34	15.6	49	22.4	75	33.9	110	51.5	78	35.6	130	58.1	200	89	310	142
			50	3.4	42	19.1	59	27	85	38.5	130	57.5	81	37	140	62.5	230	104	390	176
			75	5.2	59	26.7	76	34.5	91	41.2	130	60	100	46.1	170	77.7	280	127	450	206
			100	6.9	72	32.8	93	42.2	97	44	140	62.7	120	55.2	200	91.4	330	150	520	236
			150	10.3	86	39.1	100	45.4	100	46.9	150	68.8	140	62.7	220	98.7	380	172	550	251
			200	13.8	100	45.4	110	48.5	110	50.1	160	73.5	150	70.4	230	106	410	188	590	266
			250	17.2	100	46.9	110	48.5	120	54.8	170	75.1	170	78.2	270	124	410	188	590	266
	30	2.1	40	2.76	32	14.3	50	22.7	97	44.1	150	68.3	86	39.2	130	57	230	106	320	147
			50	3.4	46	21	64	29	100	47	160	72.6	96	43.8	150	66.3	280	128	390	178
			75	5.2	66	30.2	87	39.6	120	52.7	180	79.6	120	54.5	180	83.1	350	160	530	240
			100	6.9	86	39.3	110	50.2	130	60.1	190	86.8	140	63.6	220	102	420	191	700	317
			150	10.3	110	48.5	120	56.3	140	64.3	200	92.4	170	77.1	270	121	480	220	730	330
			200	13.8	130	57.9	140	62.6	150	68.8	220	98.5	200	92.5	310	139	550	251	790	360
			250	17.2	130	61	140	62.6	160	73.5	230	103	230	103	340	157	550	250	790	360

1. Capacities are based in lbs/h / kg/h of saturated steam.
2. To obtain capacities for regulators with reduce flow orifices, multiply the table values by 0.7.

Liquid

Table 12. Water Capacities(1)(2) in GPM / L/min for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95L and MR95LD Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/ DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN															
	Outlet/ Differential Setting		Inlet		1/4 NPT				1/2 / 15				3/4 / 20				1 / 25			
					Droop				Droop				Droop				Droop			
					10%		20%		10%		20%		10%		20%		10%		20%	
	psig	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
2 to 6 / 0.14 to 0.41	5	0.34	10	0.69	3.8	14.4	4.0	15.1	3.0	11.3	6.0	22.7	4.5	17.0	10	37.8	6.0	22.7	11.0	41.6
			20	1.4	5.0	18.9	5.0	18.9	4.0	15.1	7.0	26.5	8.0	30.3	14	53.0	10.0	37.8	15.2	57.5
			30	2.1	6.0	22.7	6.7	25.2	4.7	17.7	7.3	27.7	9.7	36.6	15.3	58.0	10.9	41.2	17.2	64.9
			50	3.4	8.0	30.3	10.0	37.8	6.0	22.7	8.0	30.3	13.0	49.2	18.0	68.1	12.7	48.0	21.1	79.8
			75	5.2	8.0	30.3	10.0	37.8	6.0	22.7	8.5	32.2	15.2	57.4	20.7	78.5	16.9	63.7	23.1	87.2
			100	6.9	4.0	15.1	5.0	18.9	6.0	22.7	9.0	34.0	18.9	71.5	22.5	85.1	21.0	79.4	25.0	94.6
			150	10.3									19.8	74.9	23.9	90.2	22.0	83.2	26.5	100
			200	13.8									20.7	78.3	25.2	95.3	23.0	87.0	28.0	106
			250	17.2									22.5	85.1	25.2	95.3	25.0	94.6	28.0	106
5 to 15 / 0.34 to 1.0	10	0.69	20	1.4	2.0	7.6	4.0	15.1	5.0	18.9	8.0	30.3	10.0	37.8	16.0	60.5	10.0	37.8	16.0	60.5
			30	2.1	3.3	12.6	5.7	21.4	5.7	21.4	9.0	34.0	11.7	44.1	18.0	68.1	12.3	46.7	19.3	73.1
			50	3.4	6.0	22.7	9.0	34.0	7.0	26.5	11.0	41.6	15.0	56.7	22.0	83.2	17.0	64.3	26.0	98.4
			75	5.2	6.0	22.7	9.0	34.0	7.5	28.4	11.5	43.5	18.5	69.8	26.1	98.7	20.5	77.6	29.0	110
			100	6.9	6.0	22.7	9.0	34.0	8.0	30.3	12.0	45.4	21.6	81.7	28.8	109	24.0	90.8	32.0	121
			150	10.3					8.5	32.2	12.0	45.4	23.4	88.5	30.2	114	26.0	98.4	33.5	127
			200	13.8									25.2	95.3	31.5	119	28.0	106	35.0	132
			250	17.2									28.8	109	34.2	129	32.0	121	38.0	144
	15	1.0	20	1.4	2.0	7.6	4.0	15.1	5.0	18.9	8.0	30.3	10.0	37.8	15.0	56.7	10.0	37.8	15.0	56.7
			30	2.1	3.7	13.9	6.0	22.7	6.0	22.7	9.7	36.6	12.7	47.9	19.0	71.9	13.3	50.4	20.0	75.7
			50	3.4	7.0	26.5	10.0	37.8	8.0	30.3	13.0	49.2	18.0	68.1	27.0	102	20.0	75.7	30.0	113
			75	5.2	10.5	39.7	12.5	47.3	8.5	32.2	14.0	53.0	20.7	78.3	30.6	116	23.0	87.0	34.0	129
			100	6.9	14.0	53.0	15.0	56.7	9.0	34.0	15.0	56.7	23.4	88.5	34.2	129	26.0	98.4	38.0	144
			150	10.3	14.0	53.0	15.0	56.7	10.0	37.8	15.0	56.7	25.2	95.3	36.9	140	28.0	106	41.0	155
			200	13.8					11.0	41.6	15.0	56.7	27.0	102	39.6	150	30.0	113	44.0	166
			250	17.2									30.6	116	40.5	153	34.0	129	45.0	170
13 to 30 / 0.90 to 2.1	20	1.4	30	2.1	2.9	10.8	4.8	18.0	6.0	22.7	10.0	37.8	12.0	45.4	19.0	71.9	12.0	45.4	19.0	71.9
			40	2.8	4.3	16.2	6.7	25.2	7.0	26.5	11.5	43.5	13.5	51.1	21.2	80.0	15.0	56.7	23.5	88.9
			50	3.4	5.7	21.6	8.6	32.3	8.0	30.3	13.0	49.2	17.0	64.3	26.0	98.4	18.0	68.1	28.0	106
			75	5.2	8.6	32.3	11.4	43.1	9.5	35.9	14.5	54.9	18.5	69.8	29.3	111	20.5	77.6	32.5	123
			100	6.9	11.4	43.1	14.3	53.9	11.0	41.6	16.0	60.5	21.0	79.4	32.0	121	23.0	87.0	37.0	140
			150	10.3	11.4	43.1	14.3	53.9	11.5	43.5	16.5	62.4	25.2	95.3	37.8	143	28.0	106	42.0	159
			200	13.8	11.4	43.1	14.3	53.9	12.0	45.4	17.0	64.3	29.7	112	42.3	160	33.0	125	47.0	178
			250	17.2					12.0	45.4	18.0	68.1	30.6	116	45.0	170	34.0	129	50.0	189
	30	2.1	40	2.8	4.4	16.5	6.6	25.1	7.5	28.4	12.0	45.4	16.0	60.5	26.0	98.4	17.0	64.3	27.0	102
			50	3.4	5.7	21.6	7.6	28.8	9.0	34.0	14.0	53.0	18.0	68.1	29.0	110	19.0	71.9	29.0	110
			75	5.2	8.6	32.3	10.5	39.5	10.5	39.7	16.0	60.5	22.0	83.2	34.0	129	23.5	88.9	36.5	138
			100	6.9	11.4	43.1	13.3	50.3	12.0	45.4	18.0	68.1	26.0	98.4	39.0	148	28.0	106	44.0	166
			150	10.3	13.3	50.3	14.7	55.7	13.0	49.2	19.5	73.8	31.5	119	44.6	169	35.0	132	49.5	187
			200	13.8	15.2	57.5	16.2	61.1	14.0	53.0	21.0	79.4	37.8	143	49.5	187	42.0	159	55.0	208
			250	17.2	17.1	64.7	18.1	68.3	14.0	53.0	22.0	83.2	37.8	143	52.2	197	42.0	159	58.0	219

(grey shading) - Capacities not tested due to cavitation regime.
1. To obtain capacities for regulators with metal diaphragms, multiply the table values by 0.8.
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

Liquid

Table 13. Water Capacities(1)(2) in C_v for 1/4 NPT and 1/2 through 1 in. / DN 15 through 25 Types MR95L and MR95LD Regulators with Elastomer Diaphragm

RECOMMENDED OUTLET/DIFFERENTIAL PRESSURE RANGE, psig/psi / bar	PRESSURE				REGULATOR BODY SIZE, IN. / DN							
	Outlet/Differential Setting		Inlet		1/4 NPT		1/2 / 15		3/4 / 20		1 / 25	
					Droop		Droop		Droop		Droop	
					10%	20%	10%	20%	10%	20%	10%	20%
	psig	bar	psig	bar	C_v							
2 to 6 / 0.14 to 0.41	5	0.34	10	0.69	1.10	1.10	1.28	2.45	1.92	4.08	2.56	4.49
			20	1.4	1.10	1.10	1.02	1.75	2.03	3.50	2.54	3.80
			30	2.1	1.10	1.10	0.92	1.44	1.91	3.00	2.16	3.37
			50	3.4	1.10	1.10	0.89	1.18	1.93	2.65	1.88	3.11
			75	5.2	0.98	1.10	0.71	1.01	1.81	2.46	2.01	2.74
			100	6.9	0.44	0.54	0.63	0.95	1.93	2.30	2.15	2.55
			150	10.3					1.64	1.98	1.83	2.20
			200	13.8					1.50	1.83	1.67	2.04
			250	17.2					1.47	1.65	1.64	1.83
5 to 15 / 0.34 to 1.0	10	0.69	20	1.4	0.60	1.10	1.51	2.31	3.02	4.62	3.02	4.62
			30	2.1	0.73	1.10	1.24	1.92	2.55	3.84	2.68	4.11
			50	3.4	0.94	1.10	1.09	1.70	2.34	3.39	2.65	4.01
			75	5.2	0.74	1.10	0.92	1.40	2.28	3.19	2.52	3.54
			100	6.9	0.65	0.98	0.84	1.26	2.26	3.00	2.52	3.34
			150	10.3			0.75	1.05	1.97	2.53	2.19	2.81
			200	13.8					1.83	2.29	2.04	2.54
			250	17.2					1.88	2.24	2.09	2.49
	15	1.0	20	1.4	0.78	1.10	1.96	2.83	3.92	5.30	3.92	5.30
			30	2.1	0.90	1.10	1.48	2.28	3.13	4.48	3.27	4.71
			50	3.4	1.10	1.10	1.32	2.11	2.98	4.38	3.31	4.87
			75	5.2	1.10	1.10	1.08	1.76	2.64	3.86	2.93	4.28
			100	6.9	1.10	1.10	0.97	1.60	2.52	3.65	2.80	4.05
			150	10.3	1.10	1.10	0.88	1.32	2.16	3.14	2.40	3.49
			200	13.8			0.84	1.15	1.98	2.89	2.20	3.21
			250	17.2					2.00	2.65	2.23	2.95
13 to 30 / 0.90 to 2.1	20	1.4	30	2.1	0.87	1.10	1.73	2.67	3.46	5.08	3.46	5.08
			40	2.8	0.96	1.10	1.49	2.35	2.88	4.33	3.20	4.80
			50	3.4	1.06	1.10	1.41	2.23	3.01	4.46	3.18	4.80
			75	5.2	1.10	1.10	1.26	1.89	2.45	3.81	2.72	4.23
			100	6.9	1.10	1.10	1.21	1.75	2.32	3.49	2.54	4.04
			150	10.3	1.09	1.10	1.01	1.45	2.19	3.27	2.44	3.63
			200	13.8	0.95	1.10	0.92	1.31	2.20	3.12	2.45	3.46
			250	17.2			0.83	1.24	2.01	2.95	2.23	3.27
	30	2.1	40	2.8	1.10	1.10	2.08	2.90	4.44	6.00	4.71	6.00
			50	3.4	1.10	1.10	1.88	2.75	3.75	5.69	3.96	5.69
			75	5.2	1.10	1.10	1.52	2.24	3.18	4.76	3.39	5.11
			100	6.9	1.10	1.10	1.40	2.06	3.04	4.47	3.28	5.05
			150	10.3	1.10	1.10	1.17	1.74	2.84	3.97	3.16	4.41
			200	13.8	1.10	1.10	1.07	1.61	2.87	3.73	3.19	4.15
			250	17.2	1.10	1.10	0.97	1.52	2.53	3.47	2.81	3.86

- Capacities not tested due to cavitation regime.
1. To obtain capacities for regulators with metal diaphragms, multiply the table values by 0.8.
2. To obtain capacities for regulators with reduced flow orifices, multiply the table values by 0.7.

MR98H Series

Backpressure/Relief Valve

Introduction

The MR98H Series are used for backpressure or relief applications in liquid, gas, air and steam service. The Types MR98H and MR98HH are direct-operated and spring-loaded. The Types MR98HD, MR98HDP and MR98HHD use additional pressure loading to maintain relief differential pressures, backpressures or for remote setpoint adjustment. These constructions are used for differential control in steam applications such as steam atomization of fuel gas for a boiler. Other liquid applications include seal oil systems. Typical applications include use in but not limited to pump recirculation, wash tanks, small heaters, fuel and oil lines, air supply system, test fixtures and sterilizers.

Available Configurations

See Table 1

Body Sizes and End Connection Styles

See Table 2

Construction Materials

See Table 3

Temperature Capabilities

See Table 4

Set Pressure Ranges

See Table 5

Orifice Sizes

1/4 NPT body: 0.284 in. / 7.22 mm
1/2 in. / DN 15 body: 0.416 in. / 10.56 mm
3/4 and 1 in. / DN 20 and 25 bodies: 0.631 in. / 16.02 mm
1-1/2 and 2 in. / DN 40 and 50 bodies: 1.142 in. / 29 mm

Maximum Cold Working Pressures of Body Size and Material

See Table 6

Maximum Inlet and Outlet Pressure Ratings

See Table 6
Maximum Spring Case Loading Pressure for Types MR98HD, MR98HDP and MR98HHD are shown in the same table[1].

Flow Coefficients

See Table 7

IEC Sizing Coefficients

See Table 8

Flow Capacities

Types MR98H, MR98HD and MR98HDP: See Tables 9 to 13
Types MR98HH and MR98HHD: See Tables 14 to 18

Shutoff Classification Per ANSI/FCI 70-3-2004

Metal Seats: Class IV
Polytetrafluoroethylene (PTFE): Class IV
Elastomer Seats: Class VI or better

Pressure Registration

Internal **(standard)** or External

Approximate Weights

1/4 NPT body: 5 lbs / 2.3 kg
1/2 in. / DN 15 body: 10 lbs / 4.5 kg
3/4 and 1 in. / DN 20 and 25 bodies: 22 lbs / 10 kg
1-1/2 and 2 in. / DN 40 and 50 bodies: 55 lbs / 25 kg

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Liquid
- Process Gas
- Steam

P1753

***Figure 1.** MR98H Series Backpressure/Relief Valve*

Features

- Application Versatility
- Excellent Fluid Compatibility with Wide Selection of Materials
- Rugged and Field Proven Design
- Compact
- Differential Pressure Capability
- Options Including Handwheel Adjustment, Control Line and Gauge Port
- Sour Gas Service Capability with NACE Constructions
- API 614 Compliant Constructions

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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www.Emerson.com

Table 1. Available Configurations

TYPE	CONFIGURATION
MR98H	Backpressure regulator / relief valve for spring settings range from 5 to 200 psig / 0.34 to 13.8 bar
MR98HH	Backpressure regulator / relief valve for spring settings range from 150 to 375 psig /10.3 to 25.9 bar
MR98HD	Differential pressure relief valve for differential set pressures from 5 to 200 psi / 0.34 to 13.8 bar with maximum inlet / outlet pressure up to 300 psi / 20.7 bar
MR98HDP	Differential pressure relief valve for differential set pressures range from 5 to 200 psi / 0.34 to 13.8 bar with maximum inlet / outlet pressure up to 600 psi / 41.4 bar
MR98HHD	Differential pressure relief valve for differential set pressures range from 150 to 375 psi / 10.3 to 25.9 bar with maximum inlet / outlet pressure up to 400 psi / 27.6 bar

1. Loading pressure plus spring setting should not exceed maximum inlet pressure.

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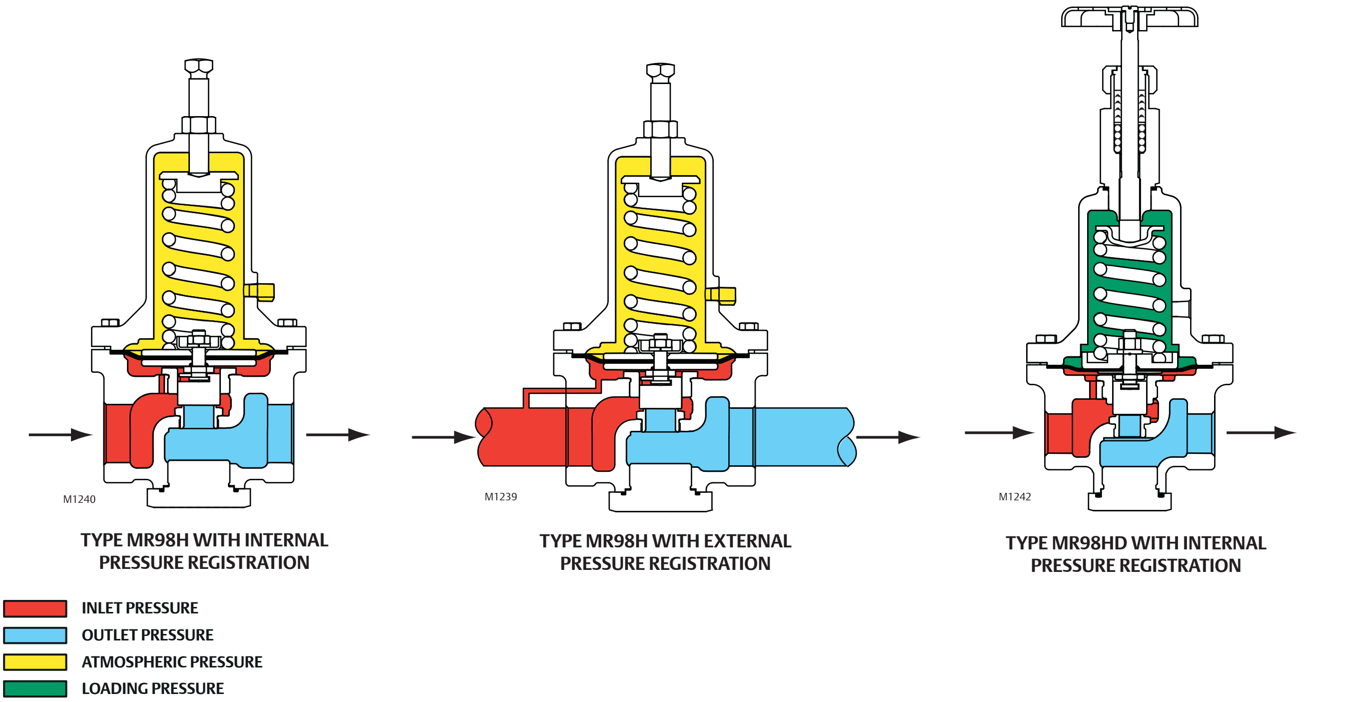

Figure 2. *MR98H Series Operational Schematic*

Table 2. Body Sizes, End Connections and Port Options[1]

BODY SIZES	END CONNECTIONS	PORT OPTIONS
1/4 NPT 1/2 in. / DN 15 3/4 in. / DN 20 1 in. / DN 25 1-1/2 in. / DN 40 2 in. / DN 50	NPT SWE Welded/Integral CL150 RF Welded/Integral CL300 RF Welded/Integral PN 16/25/40 RF	Inlet Gauge and Control Line

1. Please refer to the Instruction Manual for end connections available for each size. The table above displays all options which are not available to each body size.

Table 3. MR98H Series Construction Materials

MAIN VALVE MATERIALS		
Body	**Spring Case**	**Control Spring**
Gray cast iron, WCC/LCC steel, CF8M/CF3M Stainless steel, Monel®, Hastelloy® C	Gray cast iron, WCC/LCC steel, CF8M Stainless steel, Monel® or Hastelloy® C	Zinc-plated steel, Stainless steel, Powder-coated steel or Powder-coated stainless steel

- continued -

Table 3. MR98H Series Construction Materials (continued)

TRIM MATERIALS		
Part Name	**Standard**	**Optional**
Elastomer Seat		
Seat	Nitrile (NBR)	Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM)
Diaphragm	Neoprene (CR)	302 Stainless steel(1), Fluorocarbon (FKM)(2), Ethylenepropylene (EPDM)(2), Monel®(1), Hastelloy® C(1) or with PTFE protector(3)
Orifice, Valve Plug, Valve Plug Guide and Pusher Post	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Washer	302 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Metal Seat		
Seat, Orifice and Valve Plug	416 Stainless steel	316 Stainless steel, Stellite®(4), Monel®, Hastelloy® C or Alloy 6
Diaphragm	302 Stainless steel(1)	Monel®(1), Hastelloy® C(1), Fluorocarbon (FKM)(2), Ethylenepropylene (EPDM)(2), Neoperene (CR) or with PTFE protector(3)
Valve Plug Guide and Pusher Post	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Washer	302 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C

1. Two diaphragms are required if metal diaphragm is to be used.
2. Two diaphragms are required if Fluorocarbon (FKM) or Ethylenepropylene (EPDM) diaphragm is to be used.
3. PTFE protector is only available for Fluorocarbon (FKM), Neoprene (CR) or 302 Stainless steel diaphragm.
4. Stellite® material is only available as Seat, Orifice and Valve Plug; Not available on the 1/4 in. size.

Table 4. Temperature Capabilities[1][2]

MATERIAL	SEAT	DIAPHRAGM	O-RING	DIAPHRAGM PROTECTOR	TEMPERATURE	
					°F	°C
Nitrile (NBR)	✓		✓		-40 to 180	-40 to 82
Neoprene (CR)		✓			-40 to 180	-40 to 82
Fluorocarbon (FKM)[3]	✓	✓	✓		0 to 300, Limited to 200°F for hot water	-18 to 149,Limited to 93°C for hot water
Ethylenepropylene (EPDM)	✓	✓	✓		20 to 275	-7 to 135
Perfluoroelastomer (FFKM)	✓		✓		0 to 425	-18 to 218
PTFE				✓	-40 to 400	-40 to 204
Metal	✓	✓			-40 to 450	-40 to 232

BODY MATERIAL	TEMPERATURE	
	°F	°C
Gray cast iron	-20 to 406	-29 to 208
WCC Steel[4]	-20 to 450	-29 to 232
LCC Steel[4]	-40 to 450	-40 to 232
CF8M/CF3M Stainless steel[4], Monel® or Hastelloy® C	-40 to 450	-40 to 232

1. The pressure/temperature limits in this document and any applicable standard limitation should not be exceeded.
2. Pressure and/or the body end connection may decrease these maximum temperatures.
3. Not for use on steam service.
4. Meets API 614 requirements (with Stainless steel trim).

Table 5. MR98 Series Body Sizes, Pressure Ranges and Spring Information

TYPE	BODY SIZE		CONTROL PRESSURE RANGE[1]		SPRING WIRE DIAMETER		SPRING FREE LENGTH		SPRING MATERIAL	SPRING COLOR
	In.	DN	psig	bar	In.	mm	In.	mm		
MR98H, MR98HD and MR98HDP	1/4	- - - -	15 to 35	1.0 to 2.4	0.148	3.76	2.00	50.8	Zinc-plated steel	Yellow
			25 to 75	1.7 to 5.2	0.170	4.32	2.00	50.8	Zinc-plated steel	Green
			70 to 140	4.8 to 9.7	0.207	5.26	1.938	49.2	Powder-coated steel	Red
			130 to 200	9.0 to 13.8	0.225	5.72	2.086	53.0	Powder-coated steel	Blue
	1/2	15	15 to 35	1.0 to 2.4	0.207	5.26	2.50	63.5	Powder-coated steel	Yellow
			25 to 75	1.7 to 5.2	0.234	5.94	2.595	65.9	Powder-coated steel	Green
			70 to 140	4.8 to 9.7	0.283	7.19	2.44	62.0	Powder-coated steel	Red
			130 to 200	9.0 to 13.8	0.331	8.41	2.250	57.2	Powder-coated steel	Blue
	3/4 and 1	20 and 25	15 to 35	1.0 to 2.4	0.306	7.77	4.00	102	Powder-coated steel	Yellow
			25 to 75	1.7 to 5.2	0.343	8.71	4.00	102	Powder-coated steel	Green
			70 to 140	4.8 to 9.7	0.406	10.3	4.00	102	Powder-coated steel	Red
			130 to 200	9.0 to 13.8	0.468	11.9	3.75	95.3	Powder-coated steel	Blue
	3/4 and 1	20 and 25	15 to 35	1.0 to 2.4	0.306	7.77	4.00	102	Powder-coated Stainless steel	Yellow
			25 to 75	1.7 to 5.2	0.375	9.53	3.88	98.6	Stainless steel	Unpainted
			70 to 140	4.8 to 9.7	0.437	11.1	4.00	102	Stainless steel	Unpainted
	1-1/2 and 2	40 and 50	5 to 35	0.34 to 2.4	0.468	11.9	6.562	167	Powder-coated steel	Dark Gray
			20 to 65	1.4 to 4.5	0.500	12.7	6.50	165	Powder-coated steel	Black with Light Blue Stripe
			50 to 100	3.4 to 6.9	0.562	14.3	6.562	167	Powder-coated steel	Light Gray
			75 to 170	5.2 to 11.7	0.625	15.9	6.565	167	Powder-coated steel	Black
MR98HH and MR98HHD	1/4	- - - -	150 to 375	10.3 to 25.9	0.281	7.14	4.125	105	Powder-coated steel	Unpainted
	1/2	15	150 to 375	10.3 to 25.9	0.394	10.0	5.063	129	Powder-coated steel	Unpainted
	3/4 and 1	20 and 25	150 to 375	10.3 to 25.9	0.593	15.1	6.380	162	Chromium-silicon steel	Light Gray

1. All springs may be backed off to 0 psig / 0 bar. However, highest capacities and best performances are obtained by using these springs in their recommended ranges.

Table 6. Maximum Cold Working Pressures of Body Size and Materials[1][2]										
REGULATOR TYPE	BODY SIZE		BODY AND SPRING CASE MATERIAL	MAXIMUM INLET PRESSURE[3]		MAXIMUM OUTLET PRESSURE		MAXIMUM SPRING CASE PRESSURE		
	In.	DN		psig	bar	psig	bar	psig	bar
MR98H/ MR98HD	1/4, 1/2, 3/4, 1, 1-1/2, 2	- - - -, 15, 20, 25, 40, 50	Gray cast iron	300	20.7	300	20.7	250	17.2
			Steel	300	20.7	300	20.7	300	20.7
			Stainless steel	300	20.7	300	20.7	300	20.7
	1/2, 3/4, 1, 1-1/2, 2	15, 20, 25, 40, 50	Monel®	300	20.7	300	20.7	300	20.7
			Hastelloy® C	300	20.7	300	20.7	300	20.7
			Aluminum-Bronze	300	20.7	300	20.7	300	20.7
MR98HDP[4]	1/4, 1/2, 3/4, 1, 1-1/2, 2	- - - -, 15, 20, 25, 40, 50	Steel	600	41.4	600	41.4	600	41.4
			Stainless steel	550	37.9	550	37.9	550	37.9
	1/2, 3/4, 1, 1-1/2, 2	15, 20, 25, 40, 50	Monel®	550	37.9	550	37.9	550	37.9
			Hastelloy® C	550	37.9	550	37.9	550	37.9
			Aluminum-Bronze	550	37.9	550	37.9	550	37.9
MR98HH/ MR98HHD[4]	1/4, 1/2, 3/4, 1	- - - -, 15, 20, 25	Steel	400	27.6	400	27.6	400	27.6
			Stainless steel	400	27.6	400	27.6	400	27.6
	1/2, 3/4, 1	15, 20, 25	Monel®	400	27.6	400	27.6	400	27.6
			Hastelloy® C	400	27.6	400	27.6	400	27.6
			Aluminum-Bronze	400	27.6	400	27.6	400	27.6

1. The pressure/temperature limits in this document and any applicable standard limitation should not be exceeded.
2. Temperature, trim material and/or the body end connection may decrease these maximum pressures.
3. Maximum inlet pressure equals set pressure plus build-up.
4. Maximum differential pressure between inlet pressure and loading pressure should never exceed 300 psig / 20.7 bar.

Table 7. Flow Coefficients

BODY SIZE		C_V	C_G	C_1
In.	DN			
1/4 NPT	- - - -	1.4	48	34.3
1/2	15	3.4	120	35.3
3/4 and 1	20 and 25	6.5	250	38.5
1-1/2 and 2	40 and 50	20.0	780	39.0

Table 8. IEC Sizing Coefficients

BODY SIZE		X_T	F_D	F_L	K_m
In.	DN				
1/4 NPT	- - - -	0.743	0.74	0.95	0.90
1/2	15	0.787	0.78	0.94	0.88
3/4 and 1	20 and 25	0.935	0.70	0.91	0.83
1-1/2 and 2	40 and 50	0.961	0.69	0.94	0.88

Process Gas

Relieving capacities at selected pressures and outlet pressure flows are given in SCFH (60°F and 14.7 psia) of air in Tables 12, 13, 17 and 18. To determine the equivalent capacities for other gases, multiply the table capacities by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in normal cubic meters per hour (Nm³/h) at 0°C and 1.01325 bar, multiply SFCH by 0.0268.

Liquid

Table 9. Water Relief Capacities in GPM / L/min, Types MR98H, MR98HD and MR98HDP with Elastomer Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						5 / 0.34		7 / 0.48		10 / 0.69		15 / 1.0		20 / 1.4	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	4.5	17	5.2	19.7	6.3	23.8	7	26.3	7.6	28.8
				25	1.7	5.2	19.7	6	22.8	7.3	27.6	8	30.3	8.7	32.9
				35	2.4	5.4	20.4	6.5	24.5	8.1	30.6	9	34	9.9	37.5
	25 to 75	1.7 to 5.2	Green	35	2.4	4.8	18.2	5.8	21.8	7.2	27.2	8.3	31.4	9.4	35.6
				50	3.4	4.7	17.8	5.9	22.3	7.7	29.1	9.1	34.4	11	39.7
				75	5.2	5.2	19.7	6.5	24.7	8.5	32.2	10	38.2	12	44.3
	70 to 140	4.8 to 9.7	Red	75	5.2	3.8	14.4	4.8	18.2	6.3	23.8	7.9	29.7	9.4	35.6
				100	6.9	4.2	15.9	5.1	19.2	6.4	24.2	8.2	31	10	37.8
				125	8.6	4	15.1	5	19.1	6.6	25	8.6	32.5	11	40.1
	130 to 200	9.0 to 13.8	Blue	150	10.3	4.4	16.6	5.3	20.1	6.7	25.3	8.5	32	10	38.6
				175	12.1	4.4	16.6	5.2	19.8	6.5	24.6	8.4	31.8	10	39
				200	13.8	4.3	16.3	5.3	20	6.8	25.7	8.6	32.3	10	39
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	12	46.5	14	53	17	62.8	18	69.8	20	76.8
				25	1.7	14	52.6	16	60	19	71.1	21	79.3	23	87.4
				35	2.4	15	57.1	18	66.5	21	80.6	23	88.5	26	96.5
	25 to 75	1.7 to 5.2	Green	35	2.4	12	43.5	14	53.2	18	67.7	21	79.4	24	91.2
				50	3.4	12	46.9	15	57.5	19	73.4	23	86.8	27	100
				75	5.2	13	49.2	17	62.5	22	82.5	26	98.7	30	115
	70 to 140	4.8 to 9.7	Red	75	5.2	10	37.8	13	48.9	17	65.4	22	83.4	27	101
				100	6.9	12	46.5	15	57.3	19	73.4	24	92.5	30	112
				125	8.6	12	45.8	15	55.6	19	70.4	24	91.7	30	113
	130 to 200	9.0 to 13.8	Blue	150	10.3	8.5	32.2	10	39.3	13	49.9	18	66.2	22	82.5
				175	12.1	8.8	33.3	11	41.2	14	53	18	69.6	23	86.3
				200	13.8	9.1	34.4	11	41.4	14	51.8	18	68.5	23	85.1
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	23	87.8	27	100	32	120	35	133	39	146
				25	1.7	28	106	31	119	37	138	40	151	43	164
				35	2.4	31	118	35	132	40	153	44	167	48	181
	25 to 75	1.7 to 5.2	Green	35	2.4	24	91.5	28	108	35	132	41	155	47	177
				50	3.4	27	101	32	120	39	148	45	172	52	196
				75	5.2	29	109	35	132	44	166	51	192	58	219
	70 to 140	4.8 to 9.7	Red	75	5.2	22	84.7	28	105	36	136	44	165	51	194
				100	6.9	23	85.9	29	109	38	143	47	178	56	213
				125	8.6	25	96.1	33	123	43	164	52	198	61	231
	130 to 200	9.0 to 13.8	Blue	150	10.3	19	71.5	24	90	31	118	41	155	51	192
				175	12.1	21	79.8	26	98.9	34	127	44	167	55	207
				200	13.8	23	85.1	28	104	35	133	46	176	58	218
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	43	164	53	202	69	260	83	314	97	368
				10	0.69	56	211	66	250	82	308	96	362	110	416
				15	1.0	63	237	74	278	90	340	100	391	120	441
				25	1.7	69	260	82	310	100	387	120	441	130	495
				35	2.4	80	303	94	357	120	438	130	494	150	550
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	57	215	70	264	89	337	110	404	120	471
				35	2.4	58	220	73	278	96	364	110	432	130	500
				50	3.4	62	235	81	305	110	409	130	485	150	561
				65	4.5	70	266	90	342	120	456	140	530	160	603
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	53	202	69	260	92	348	110	431	140	515
				75	5.2	59	224	77	291	100	391	130	486	150	582
				100	6.9	65	246	85	322	120	435	140	529	160	623
	75 to 170	5.2 to 11.7	Black	75	5.2	46	174	57	217	74	281	100	381	130	481
				100	6.9	52	195	64	241	82	309	110	414	140	519
				125	8.6	56	213	70	264	90	340	120	445	150	549
				170	11.7	65	246	77	292	96	361	120	464	150	567

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Liquid

Table 9. Water Relief Capacities in GPM / L/min, Types MR98H, MR98HD and MR98HDP with Elastomer Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						30 / 2.1		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	8.5	32.3	10	39.3	12	45.8	14	52.2
				25	1.7	9.6	36.2	11	42.7	12	46.9	14	51.1
				35	2.4	11	40.1	12	45.4	13	48.8	14	52.2
	25 to 75	1.7 to 5.2	Green	35	2.4	10	39.1	12	46.2	14	51.6	15	57.1
				50	3.4	11	43	13	49.6	15	55	16	60.5
				75	5.2	13	48	15	55.6	16	60.3	17	65.1
	70 to 140	4.8 to 9.7	Red	75	5.2	11	41.9	14	54.5	16	59.8	17	65.1
				100	6.9	12	44.5	15	57.9	17	63.9	19	70
				125	8.6	13	47.5	17	62.4	18	68.9	20	75.3
	130 to 200	9.0 to 13.8	Blue	150	10.3	12	46.9	17	63.6	19	71.1	21	78.7
				175	12.1	13	47.7	17	65.1	19	73.4	22	81.7
				200	13.8	13	48.3	18	67	20	73.8	21	80.6
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	23	86.3	28	105	32	122	37	140
				25	1.7	25	96.1	30	113	34	129	38	145
				35	2.4	28	105	32	121	36	135	40	150
	25 to 75	1.7 to 5.2	Green	35	2.4	27	101	32	121	36	135	40	150
				50	3.4	29	110	35	131	38	144	42	157
				75	5.2	33	125	38	145	41	156	45	168
	70 to 140	4.8 to 9.7	Red	75	5.2	30	115	38	143	41	156	45	169
				100	6.9	33	126	41	154	44	167	48	180
				125	8.6	34	130	43	164	47	177	50	190
	130 to 200	9.0 to 13.8	Blue	150	10.3	27	104	39	147	45	170	51	194
				175	12.1	29	109	41	153	46	175	52	197
				200	13.8	29	109	41	157	48	181	54	206
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	43	163	52	196	59	224	67	252
				25	1.7	47	178	55	208	62	235	69	263
				35	2.4	51	194	58	221	65	246	72	272
	25 to 75	1.7 to 5.2	Green	35	2.4	51	192	58	221	65	246	72	272
				50	3.4	55	210	63	238	69	262	76	286
				75	5.2	62	233	69	263	75	285	81	307
	70 to 140	4.8 to 9.7	Red	75	5.2	57	216	69	260	75	283	81	306
				100	6.9	62	235	74	280	80	303	86	325
				125	8.6	67	255	80	302	85	323	91	345
	130 to 200	9.0 to 13.8	Blue	150	10.3	60	229	80	302	87	331	95	360
				175	12.1	64	243	84	317	92	347	100	377
				200	13.8	67	255	87	328	95	360	100	391
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	110	433	150	563	180	666	200	769
				10	0.69	130	474	160	591	180	690	210	790
				15	1.0	130	499	160	614	190	710	210	806
				25	1.7	140	547	170	650	200	742	220	834
				35	2.4	160	598	180	693	210	780	230	867
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	140	533	170	657	200	747	220	838
				35	2.4	150	564	180	693	210	780	230	867
				50	3.4	170	625	200	751	220	832	240	914
				65	4.5	180	666	210	790	230	875	250	959
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	150	586	190	728	220	819	240	911
				75	5.2	170	655	210	802	240	893	260	984
				100	6.9	190	702	230	861	250	953	280	1050
	75 to 170	5.2 to 11.7	Black	75	5.2	150	567	200	740	230	852	250	963
				100	6.9	160	610	210	793	240	906	270	1020
				125	8.6	170	645	220	835	250	956	280	1080
				170	11.7	180	673	230	885	270	1020	300	1150

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Table 10. Water Relief Capacities in GPM / L/min, Types MR98H, MR98HD and MR98HDP with Metal Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						5 / 0.34		7 / 0.48		10 / 0.69		15 / 1.0		20 / 1.4	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	2.3	8.7	2.9	11.1	3.9	14.8	5.1	19.1	6.2	23.5
				25	1.7	2.7	10.2	3.4	12.8	4.4	16.6	5.6	21.2	6.8	25.7
				35	2.4	2.8	10.6	3.5	13.2	4.5	17	5.8	21.8	7	26.5
	25 to 75	1.7 to 5.2	Green	35	2.4	2.6	9.84	3.4	12.7	4.5	17	5.7	21.4	6.8	25.7
				50	3.4	2.6	9.84	3.2	12.1	4.1	15.5	5.6	21	7	26.5
				75	5.2	3	11.3	3.6	13.8	4.6	17.4	6	22.5	7.3	27.6
	70 to 140	4.8 to 9.7	Red	75	5.2	2.7	10.2	3.3	12.3	4.1	15.5	5.3	20	6.5	24.6
				100	6.9	2.6	9.84	3.2	12.1	4.1	15.5	5.4	20.2	6.6	25
				125	8.6	2.9	11	3.5	13.1	4.3	16.3	5.5	20.8	6.7	25.3
	130 to 200	9.0 to 13.8	Blue	150	10.3	3	11.3	3.5	13.2	4.2	15.9	5.4	20.2	6.5	24.6
				175	12.1	2.9	11	3.4	12.9	4.2	15.9	5.4	20.2	6.5	24.6
				200	13.8	3.2	12.1	3.7	13.9	4.4	16.6	5.4	20.4	6.4	24.2
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	12	44.6	13	48.6	14	54.5	16	60.5	18	66.6
				25	1.7	11	41.2	13	48.6	16	59.8	18	67	20	74.1
				35	2.4	9.7	36.7	12	45.6	16	59	18	68.7	21	78.3
	25 to 75	1.7 to 5.2	Green	35	2.4	5.5	20.8	7.4	28.1	10	39	14	54.5	19	70
				50	3.4	6.6	25	8.8	33.4	12	46.2	16	60.3	20	74.5
				75	5.2	7.2	27.2	9	34.2	12	44.6	16	59.4	20	74.1
	70 to 140	4.8 to 9.7	Red	75	5.2	6	22.7	7.3	27.5	9.2	34.8	13	48.2	16	61.7
				100	6.9	6.9	26.1	8.4	31.9	11	40.5	14	53.9	18	67.3
				125	8.6	7.2	27.2	8.6	32.4	11	40.1	14	52.4	17	64.7
	130 to 200	9.0 to 13.8	Blue	150	10.3	6.6	25	7.4	28	8.6	32.5	11	41.6	13	50.7
				175	12.1	7	26.5	7.8	29.7	9.1	34.4	12	43.9	14	53.3
				200	13.8	7.3	27.6	8.2	31.1	9.6	36.3	12	45	14	53.7
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	16	58.6	18	67.9	22	81.7	25	94.4	28	107
				25	1.7	17	62.4	19	73.6	24	90.4	28	104	31	118
				35	2.4	16	60.5	19	73.5	25	93.1	29	109	33	126
	25 to 75	1.7 to 5.2	Green	35	2.4	15	56	18	67.6	23	85.1	27	103	32	121
				50	3.4	16	59.8	19	71.9	24	90	29	110	34	130
				75	5.2	16	58.6	19	71.2	24	90	30	113	36	135
	70 to 140	4.8 to 9.7	Red	75	5.2	14	51.1	16	61.7	21	77.6	26	98.5	32	120
				100	6.9	14	54.1	17	64.5	21	80.2	27	103	33	125
				125	8.6	14	53.7	17	64.8	22	81.3	27	103	33	125
	130 to 200	9.0 to 13.8	Blue	150	10.3	14	53	16	61	19	73	25	92.9	30	113
				175	12.1	14	54.5	17	62.8	20	75.3	25	94.6	30	114
				200	13.8	15	55.2	17	63.7	20	76.4	25	95.9	31	115
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	35	133	44	166	57	214	67	255	78	295
				10	0.69	45	168	52	198	64	243	76	286	87	329
				15	1.0	49	185	57	217	70	265	82	309	93	352
				25	1.7	52	198	63	237	78	296	91	344	100	391
				35	2.4	53	201	64	243	81	305	96	364	110	422
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	43	161	53	199	68	257	83	314	98	371
				35	2.4	48	181	57	217	72	272	90	339	110	405
				50	3.4	50	190	60	229	76	287	95	358	110	428
				65	4.5	54	204	64	244	80	303	100	378	120	452
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	44	165	53	200	67	254	86	326	110	397
				75	5.2	47	179	57	214	71	267	91	343	110	419
				100	6.9	45	170	55	207	70	263	92	347	110	431
	75 to 170	5.2 to 11.7	Black	75	5.2	40	150	47	178	59	221	78	295	97	368
				100	6.9	44	168	53	200	65	247	84	319	100	392
				125	8.6	46	173	54	205	67	253	86	326	110	398
				170	11.7	50	190	59	224	73	274	91	345	110	416

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Table 10. Water Relief Capacities in GPM/ L/min, Types MR98H, MR98HD and MR98HDP with Metal Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						30 / 2.1		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	7.4	27.9	9.7	36.7	11	42.7	13	48.8
				25	1.7	7.9	30	10	38.6	12	43.5	13	48.4
				35	2.4	8.3	31.3	11	40.9	12	43.5	12	46.2
	25 to 75	1.7 to 5.2	Green	35	2.4	8.1	30.8	11	40.9	13	47.5	14	54.1
				50	3.4	8.5	32.2	12	43.5	13	49.9	15	56.4
				75	5.2	8.9	33.7	12	45.8	14	53.2	16	60.5
	70 to 140	4.8 to 9.7	Red	75	5.2	8.2	31.1	12	44.3	14	51.6	16	59
				100	6.9	8.4	31.7	12	45	14	53.5	16	62
				125	8.6	8.5	32.3	12	46.2	15	55.4	17	64.7
	130 to 200	9.0 to 13.8	Blue	150	10.3	8.3	31.3	12	44.6	15	55	17	65.4
				175	12.1	8.3	31.4	12	45	15	55.6	18	66.2
				200	13.8	8.3	31.3	12	45.4	15	56.6	18	67.7
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	20	75.7	25	93.8	29	111	34	128
				25	1.7	22	82.5	26	99.1	31	116	35	132
				35	2.4	23	87	28	104	32	120	36	136
	25 to 75	1.7 to 5.2	Green	35	2.4	21	80.2	27	101	31	117	36	134
				50	3.4	23	86	29	109	33	125	37	140
				75	5.2	23	88.3	31	117	35	133	39	149
	70 to 140	4.8 to 9.7	Red	75	5.2	20	77.3	29	109	34	127	39	146
				100	6.9	22	83.7	31	117	36	136	41	155
				125	8.6	22	82.5	31	118	37	139	42	160
	130 to 200	9.0 to 13.8	Blue	150	10.3	17	66.1	26	96.8	32	123	39	149
				175	12.1	18	69	27	100	33	126	40	152
				200	13.8	18	69.6	27	101	34	128	41	154
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	33	125	43	162	50	190	58	219
				25	1.7	36	135	45	170	53	199	60	227
				35	2.4	38	143	47	179	55	207	62	235
	25 to 75	1.7 to 5.2	Green	35	2.4	37	139	46	175	54	206	63	236
				50	3.4	39	149	49	185	57	215	65	246
				75	5.2	42	157	53	200	61	230	69	259
	70 to 140	4.8 to 9.7	Red	75	5.2	38	144	51	192	59	222	67	253
				100	6.9	40	151	53	202	62	234	70	266
				125	8.6	41	154	56	211	65	245	74	278
	130 to 200	9.0 to 13.8	Blue	150	10.3	38	142	53	200	63	239	73	277
				175	12.1	38	145	55	206	65	245	75	284
				200	13.8	39	147	55	210	66	251	77	293
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	93	352	120	465	150	556	170	647
				10	0.69	100	381	130	487	150	573	170	659
				15	1.0	110	403	130	504	160	587	180	671
				25	1.7	120	440	140	538	160	621	190	703
				35	2.4	120	470	150	567	170	647	190	727
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	110	426	140	536	160	619	190	702
				35	2.4	120	459	150	567	170	649	190	730
				50	3.4	130	486	160	603	180	685	200	767
				65	4.5	140	516	170	644	190	725	210	805
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	120	462	160	592	180	680	200	768
				75	5.2	130	494	170	643	190	734	220	824
				100	6.9	140	515	180	683	210	778	230	873
	75 to 170	5.2 to 11.7	Black	75	5.2	120	453	160	622	190	719	220	816
				100	6.9	130	484	180	667	200	769	230	870
				125	8.6	130	496	180	692	210	801	240	911
				170	11.7	140	523	200	738	230	860	260	982

Steam

Table 11. Steam Relief Capacities in lbs/h / kg/h, Types MR98H, MR98HD and MR98HDP with Metal Diaphragm Only

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						5 / 0.34		7 / 0.48		10 / 0.69		15 / 1.0		20 / 1.4	
	psi	bar		psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	22	10.1	32	14.4	46	20.8	69	31.2	91	41.6
				25	1.7	26	11.8	36	16.5	52	23.5	78	35.6	100	47.6
				35	2.4	31	14	42	18.9	58	26.3	87	39.7	120	53.1
	25 to 75	1.7 to 5.2	Green	35	2.4	28	12.9	38	17.3	52	23.9	78	35.6	100	47.4
				50	3.4	34	15.4	44	20	59	26.9	86	39.2	110	51.5
				75	5.2	42	19.2	53	24.2	70	31.9	99	44.9	130	58
	70 to 140	4.8 to 9.7	Red	75	5.2	35	15.9	43	19.7	56	25.4	80	36.1	100	46.9
				100	6.9	42	19.2	52	23.7	67	30.4	92	42	120	53.5
				125	8.6	48	21.9	59	26.7	74	33.8	100	46.6	130	59.4
	130 to 200	9.0 to 13.8	Blue	150	10.3	55	25.1	65	29.4	79	35.9	130	60.1	190	84.3
				175	12.1	61	27.5	71	32.3	87	39.5	140	64.9	200	90.2
				200	13.8	68	31	79	35.8	95	43	150	69.6	210	96.1
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	23	10.5	63	28.9	120	56.2	170	78.5	220	101
				25	1.7	47	21.2	90	41	160	70.5	210	95.3	260	120
				35	2.4	64	29.1	100	47.6	170	75.3	230	105	300	134
	25 to 75	1.7 to 5.2	Green	35	2.4	36	16.2	55	25	84	38.1	150	67.4	210	96.7
				50	3.4	60	27.4	84	38	120	53.9	180	81.7	240	110
				75	5.2	78	35.7	99	45.1	130	59.2	200	88.7	260	118
	70 to 140	4.8 to 9.7	Red	75	5.2	72	32.7	89	40.5	110	52	170	77.7	230	103
				100	6.9	87	39.3	100	47.3	130	59.2	190	85	240	111
				125	8.6	99	45.2	120	54.1	150	67.4	200	92.2	260	117
	130 to 200	9.0 to 13.8	Blue	150	10.3	120	54.3	140	61.6	160	72.4	200	92.3	250	112
				175	12.1	140	61.4	150	69.1	180	80.6	220	102	270	123
				200	13.8	150	66.6	160	74.4	190	86.2	240	109	290	131
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	160	73.2	200	91.7	260	119	330	148	390	177
				25	1.7	160	74.7	210	96.1	280	128	370	166	450	204
				35	2.4	190	85.6	240	107	310	139	400	184	500	228
	25 to 75	1.7 to 5.2	Green	35	2.4	150	66.9	190	88.4	270	121	360	163	450	205
				50	3.4	160	71.7	210	93.6	280	126	380	174	490	222
				75	5.2	200	90.9	250	112	320	144	440	201	570	258
	70 to 140	4.8 to 9.7	Red	75	5.2	170	76.5	210	97.4	280	129	390	176	490	224
				100	6.9	210	93.7	250	115	320	147	440	202	560	256
				125	8.6	220	101	270	123	340	156	470	213	600	271
	130 to 200	9.0 to 13.8	Blue	150	10.3	270	124	310	143	380	173	500	225	610	278
				175	12.1	310	142	360	163	430	193	560	255	690	316
				200	13.8	340	156	390	178	460	211	590	270	720	328
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	320	144	420	191	580	261	760	345	940	428
				10	0.69	500	229	620	281	790	358	950	431	1100	503
				15	1.0	540	247	650	295	810	368	1000	464	1200	560
				25	1.7	680	311	820	371	1000	461	1200	560	1400	659
				35	2.4	780	355	930	422	1100	521	1400	641	1700	761
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	500	228	610	278	780	352	1000	462	1300	572
				35	2.4	580	264	740	334	970	440	1200	561	1500	682
				50	3.4	660	299	820	371	1100	478	1400	620	1700	762
				65	4.5	750	341	910	412	1100	519	1500	687	1900	854
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	480	219	600	274	780	356	1100	492	1400	629
				75	5.2	690	312	840	380	1100	481	1400	656	1800	830
				100	6.9	860	393	1000	470	1300	585	1700	764	2100	943
	75 to 170	5.2 to 11.7	Black	75	5.2	540	244	630	286	770	349	1000	476	1300	604
				100	6.9	730	330	860	390	1100	479	1400	627	1700	774
				125	8.6	840	381	1000	459	1300	575	1600	743	2000	911
				170	11.7	1100	508	1300	597	1600	731	2000	928	2500	1120

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Steam

Table 11. Steam Relief Capacities in lbs/h / kg/h, Types MR98H, MR98HD and MR98HDP with Metal Diaphragm Only (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						30 / 2.1		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar		psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	110	52.2	160	73.5	220	98.1	270	122
				25	1.7	130	59.2	180	82.4	240	108	290	131
				35	2.4	150	66	200	91.8	260	117	310	140
	25 to 75	1.7 to 5.2	Green	35	2.4	140	61.7	200	90.4	260	117	310	140
				50	3.4	150	68.3	220	102	280	129	340	154
				75	5.2	170	79	270	121	330	150	390	178
	70 to 140	4.8 to 9.7	Red	75	5.2	150	68.3	240	111	310	143	380	174
				100	6.9	170	77.5	280	126	350	160	430	195
				125	8.6	190	85.3	300	137	390	178	480	218
	130 to 200	9.0 to 13.8	Blue	150	10.3	220	101	300	134	400	182	510	230
				175	12.1	240	108	310	143	430	195	550	248
				200	13.8	250	114	330	150	440	202	560	254
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	280	125	390	175	520	237	660	298
				25	1.7	320	145	430	196	570	258	700	320
				35	2.4	360	162	480	218	620	281	760	344
	25 to 75	1.7 to 5.2	Green	35	2.4	270	125	400	181	520	236	640	291
				50	3.4	310	143	460	210	580	265	700	319
				75	5.2	350	160	540	244	660	302	790	361
	70 to 140	4.8 to 9.7	Red	75	5.2	330	148	520	237	650	297	790	357
				100	6.9	350	161	580	262	720	329	870	396
				125	8.6	370	170	610	277	790	358	970	439
	130 to 200	9.0 to 13.8	Blue	150	10.3	350	160	560	256	810	369	1100	482
				175	12.1	380	173	600	272	860	391	1100	510
				200	13.8	400	183	630	285	910	414	1200	543
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	490	224	700	317	940	426	1200	536
				25	1.7	560	253	770	352	1000	463	1300	575
				35	2.4	620	282	850	388	1100	503	1400	619
	25 to 75	1.7 to 5.2	Green	35	2.4	580	263	830	378	1100	499	1400	621
				50	3.4	640	290	940	426	1200	551	1500	676
				75	5.2	750	340	1100	504	1400	637	1700	771
	70 to 140	4.8 to 9.7	Red	75	5.2	680	309	1100	480	1400	617	1700	755
				100	6.9	770	352	1200	543	1500	697	1900	850
				125	8.6	830	377	1300	589	1700	765	2100	940
	130 to 200	9.0 to 13.8	Blue	150	10.3	850	387	1300	604	1800	839	2400	1080
				175	12.1	940	429	1400	655	2000	900	2500	1140
				200	13.8	990	450	1500	693	2100	960	2700	1230
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	1300	579	1900	878	2700	1210	3400	1540
				10	0.69	1400	650	2100	944	2800	1280	3600	1620
				15	1.0	1500	703	2200	990	2900	1330	3700	1680
				25	1.7	1800	805	2400	1100	3200	1430	3900	1770
				35	2.4	2000	910	2700	1210	3400	1550	4200	1900
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	1600	721	2200	1020	3000	1370	3800	1710
				35	2.4	1800	840	2500	1150	3300	1490	4000	1830
				50	3.4	2100	936	2800	1290	3600	1620	4300	1960
				65	4.5	2300	1040	3100	1410	3900	1780	4700	2140
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	1700	785	2400	1100	3300	1490	4200	1890
				75	5.2	2300	1040	3200	1450	4000	1820	4800	2200
				100	6.9	2600	1190	3700	1690	4600	2100	5500	2510
	75 to 170	5.2 to 11.7	Black	75	5.2	1800	797	2600	1180	3600	1630	4600	2080
				100	6.9	2300	1040	3500	1570	4400	2000	5300	2430
				125	8.6	2700	1210	4000	1810	5000	2260	6000	2720
				170	11.7	3300	1510	5000	2280	6100	2790	7300	3300

Air

Table 12. Air Relief Capacities in SCFH / Nm³/h, Types MR98H, MR98HD and MR98HDP with Elastomer Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						5 / 0.34		7 / 0.48		10 / 0.69		15 / 1.0		20 / 1.4	
	psi	bar		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	1200	32.2	1500	39.8	1900	51.3	2200	59.3	2500	67.2
				25	1.7	1500	40.7	1900	49.7	2400	63.1	2700	72.4	3000	81.7
				35	2.4	1600	42.4	2000	54.6	2700	72.9	3100	83.4	3500	93.8
	25 to 75	1.7 to 5.2	Green	35	2.4	1200	31.4	1600	44.2	2400	63.4	2900	77.8	3400	92.2
				50	3.4	1300	33.8	1900	50.2	2800	74.9	3400	92.4	4100	110
				75	5.2	1800	47.5	2500	66.8	3600	95.7	4400	118	5200	141
	70 to 140	4.8 to 9.7	Red	75	5.2	1400	36.3	1800	48.2	2500	66.2	3500	92.7	4400	119
				100	6.9	1600	42.3	2100	56	2900	76.6	4100	109	5300	141
				125	8.6	1900	51	2400	65.7	3300	87.6	4500	122	5800	155
	130 to 200	9.0 to 13.8	Blue	150	10.3	1900	51.2	2400	64.3	3100	84.1	4300	115	5400	146
				175	12.1	2100	56.6	2700	71.9	3500	94.8	4400	118	5300	142
				200	13.8	2500	66.6	3100	82.2	3900	106	4800	129	5700	153
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	2400	64.5	3300	87.8	4600	123	5400	145	6300	168
				25	1.7	3100	82.8	4100	110	5700	152	6600	176	7500	200
				35	2.4	3700	98	4900	132	6800	182	7800	209	8800	235
	25 to 75	1.7 to 5.2	Green	35	2.4	2500	68.4	3700	98.5	5400	144	6800	183	8300	222
				50	3.4	3200	86.6	4600	122	6600	176	8300	222	10,000	269
				75	5.2	4200	114	5700	152	7900	211	10,000	279	13,000	346
	70 to 140	4.8 to 9.7	Red	75	5.2	3600	97.5	4900	131	6700	181	9400	251	12,000	322
				100	6.9	4500	121	6000	161	8300	222	11,000	308	15,000	394
				125	8.6	5200	140	6900	185	9400	251	13,000	349	17,000	446
	130 to 200	9.0 to 13.8	Blue	150	10.3	4000	107	4800	130	6100	164	8400	226	11,000	287
				175	12.1	4400	117	5300	143	6800	182	9300	248	12,000	315
				200	13.8	5500	147	6600	176	8200	220	11,000	298	14,000	376
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	5700	153	6900	185	8700	233	10,000	276	12,000	320
				25	1.7	7100	191	8800	235	11,000	300	13,000	340	14,000	379
				35	2.4	8500	228	10,000	277	13,000	351	15,000	401	17,000	451
	25 to 75	1.7 to 5.2	Green	35	2.4	6500	173	8500	227	11,000	307	14,000	374	16,000	441
				50	3.4	7600	203	10,000	269	14,000	367	17,000	446	20,000	526
				75	5.2	9000	241	12,000	327	17,000	456	21,000	558	25,000	661
	70 to 140	4.8 to 9.7	Red	75	5.2	8000	215	10,000	276	14,000	368	18,000	494	23,000	620
				100	6.9	9900	264	13,000	340	17,000	453	22,000	597	28,000	741
				125	8.6	12,000	314	15,000	405	20,000	542	26,000	708	33,000	873
	130 to 200	9.0 to 13.8	Blue	150	10.3	8700	232	11,000	286	14,000	368	19,000	515	25,000	662
				175	12.1	10,000	280	13,000	349	17,000	452	23,000	620	29,000	789
				200	13.8	7100	191	10,000	279	15,000	410	22,000	603	30,000	795
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	7900	212	12,000	311	17,000	460	22,000	596	27,000	733
				10	0.69	12,000	323	16,000	421	21,000	569	26,000	706	31,000	844
				15	1.0	16,000	428	19,000	515	24,000	644	30,000	792	35,000	939
				25	1.7	20,000	534	23,000	626	29,000	765	35,000	940	42,000	1110
				35	2.4	22,000	583	27,000	730	35,000	950	42,000	1130	49,000	1310
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	13,000	362	18,000	472	24,000	636	31,000	829	38,000	1020
				35	2.4	17,000	442	21,000	569	28,000	759	36,000	961	43,000	1160
				50	3.4	22,000	579	28,000	756	38,000	1020	47,000	1250	55,000	1470
				65	4.5	23,000	620	31,000	840	44,000	1170	53,000	1420	62,000	1660
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	15,000	399	21,000	555	29,000	789	40,000	1060	50,000	1340
				75	5.2	20,000	536	27,000	711	36,000	973	50,000	1340	64,000	1710
				100	6.9	26,000	698	34,000	915	46,000	1240	63,000	1680	79,000	2120
	75 to 170	5.2 to 11.7	Black	75	5.2	15,000	404	19,000	507	25,000	661	36,000	959	47,000	1260
				100	6.9	20,000	524	24,000	650	31,000	840	46,000	1220	60,000	1610
				125	8.6	25,000	672	31,000	830	40,000	1070	56,000	1490	72,000	1920
				170	11.7	30,000	814	39,000	1040	51,000	1380	71,000	1900	90,000	2420

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Air

Table 12. Air Relief Capacities in SCFH / Nm³/h, Types MR98H, MR98HD and MR98HDP with Elastomer Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						30 / 2.1		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	3000	81	4000	108	5300	142	6600	176
				25	1.7	3600	95.6	4600	123	5800	156	7000	189
				35	2.4	4000	108	5100	136	6300	169	7500	202
	25 to 75	1.7 to 5.2	Green	35	2.4	4000	106	5000	135	6300	168	7500	201
				50	3.4	4700	126	5900	157	7100	190	8300	223
				75	5.2	5900	158	7200	194	8400	225	9600	256
	70 to 140	4.8 to 9.7	Red	75	5.2	5300	142	7000	187	8300	222	9600	257
				100	6.9	6300	168	8200	221	9500	256	11,000	291
				125	8.6	7000	187	9300	250	11,000	287	12,000	324
	130 to 200	9.0 to 13.8	Blue	150	10.3	7700	207	10,000	271	11,000	307	13,000	343
				175	12.1	7000	188	11,000	282	12,000	319	13,000	357
				200	13.8	7500	201	11,000	296	12,000	331	14,000	366
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	7400	200	9800	264	13,000	346	16,000	429
				25	1.7	8700	232	11,000	298	14,000	381	17,000	464
				35	2.4	10,000	268	12,000	333	16,000	417	19,000	501
	25 to 75	1.7 to 5.2	Green	35	2.4	9600	257	12,000	327	15,000	411	18,000	495
				50	3.4	11,000	307	14,000	383	17,000	466	20,000	548
				75	5.2	15,000	391	18,000	479	21,000	556	24,000	634
	70 to 140	4.8 to 9.7	Red	75	5.2	14,000	372	18,000	472	20,000	544	23,000	616
				100	6.9	17,000	448	21,000	556	24,000	638	27,000	720
				125	8.6	19,000	507	24,000	630	27,000	717	30,000	804
	130 to 200	9.0 to 13.8	Blue	150	10.3	15,000	402	23,000	630	28,000	751	33,000	873
				175	12.1	17,000	443	26,000	699	31,000	825	36,000	952
				200	13.8	19,000	512	29,000	785	34,000	915	39,000	1040
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	14,000	381	19,000	505	25,000	671	31,000	838
				25	1.7	17,000	445	21,000	576	28,000	739	34,000	901
				35	2.4	19,000	517	24,000	648	30,000	809	36,000	969
	25 to 75	1.7 to 5.2	Green	35	2.4	19,000	508	24,000	643	30,000	803	36,000	963
				50	3.4	22,000	600	28,000	746	34,000	905	40,000	1060
				75	5.2	28,000	745	34,000	915	40,000	1070	46,000	1220
	70 to 140	4.8 to 9.7	Red	75	5.2	27,000	718	34,000	916	40,000	1080	46,000	1240
				100	6.9	32,000	850	40,000	1070	46,000	1230	52,000	1390
				125	8.6	37,000	995	46,000	1240	52,000	1400	58,000	1570
	130 to 200	9.0 to 13.8	Blue	150	10.3	33,000	876	49,000	1300	57,000	1530	66,000	1760
				175	12.1	38,000	1010	54,000	1450	63,000	1690	72,000	1920
				200	13.8	39,000	1060	59,000	1580	65,000	1750	71,000	1910
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	35,000	951	52,000	1390	72,000	1940	93,000	2490
				10	0.69	39,000	1050	54,000	1450	75,000	2020	96,000	2580
				15	1.0	43,000	1160	60,000	1600	80,000	2130	99,000	2660
				25	1.7	50,000	1330	66,000	1770	86,000	2310	106,000	2840
				35	2.4	57,000	1530	74,000	1990	91,000	2440	108,000	2900
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	47,000	1250	63,000	1700	83,000	2230	103,000	2760
				35	2.4	53,000	1410	71,000	1910	90,000	2420	110,000	2940
				50	3.4	64,000	1710	82,000	2200	101,000	2710	120,000	3220
				65	4.5	72,000	1930	92,000	2470	112,000	3010	132,000	3540
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	61,000	1620	82,000	2190	102,000	2740	122,000	3280
				75	5.2	75,000	2020	98,000	2630	120,000	3220	142,000	3810
				100	6.9	91,000	2450	116,000	3100	138,000	3710	161,000	4320
	75 to 170	5.2 to 11.7	Black	75	5.2	61,000	1640	89,400	2400	111,000	2980	133,000	3560
				100	6.9	76,000	2030	107,000	2880	130,000	3480	152,000	4080
				125	8.6	88,000	2360	121,000	3250	145,000	3900	170,000	4550
				170	11.7	111,000	2970	151,000	4060	178,000	4790	206,000	5510

Air

Table 13. Air Relief Capacities in SCFH / Nm^3/h, Types MR98H, MR98HD and MR98HDP with Metal Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						5 / 0.34		7 / 0.48		10 / 0.69		15 / 1.0		20 / 1.4	
	psi	bar		psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	510	13.7	730	19.5	1100	28.3	1600	42.6	2100	56.9
				25	1.7	600	16.1	840	22.5	1200	32.2	1800	48.7	2400	65.3
				35	2.4	710	19.1	970	25.9	1300	36.1	2000	54.4	2700	72.8
	25 to 75	1.7 to 5.2	Green	35	2.4	660	17.7	880	23.7	1200	32.7	1800	48.8	2400	65
				50	3.4	790	21.1	1000	27.4	1400	36.9	2000	53.7	2600	70.6
				75	5.2	980	26.3	1200	33.2	1600	43.7	2300	61.6	3000	79.5
	70 to 140	4.8 to 9.7	Red	75	5.2	810	21.7	1000	26.9	1300	34.8	1800	49.5	2400	64.3
				100	6.9	980	26.3	1200	32.5	1600	41.7	2100	57.5	2700	73.4
				125	8.6	1100	30.1	1400	36.6	1700	46.3	2400	63.8	3000	81.4
	130 to 200	9.0 to 13.8	Blue	150	10.3	1300	34.4	1500	40.3	1800	49.1	3100	82.3	4300	115
				175	12.1	1400	37.7	1700	44.3	2000	54.2	3300	88.9	4600	124
				200	13.8	1600	42.5	1800	49.1	2200	59	3600	95.3	4900	132
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	530	14.2	1500	39	2800	76.2	4000	107	5100	138
				25	1.7	1100	28.9	2100	55.8	3600	96.2	4900	130	6100	165
				35	2.4	1500	39.7	2400	65.1	3800	103	5400	144	6900	184
	25 to 75	1.7 to 5.2	Green	35	2.4	830	22.2	1300	34.2	1900	52.2	3400	92.4	4900	132
				50	3.4	1400	37.6	1900	52.1	2800	73.9	4200	112	5600	150
				75	5.2	1800	48.9	2300	61.8	3000	81.1	4500	122	6000	162
	70 to 140	4.8 to 9.7	Red	75	5.2	1700	44.9	2100	55.4	2700	71.3	4000	107	5300	142
				100	6.9	2000	53.9	2400	64.8	3000	81.2	4300	116	5700	152
				125	8.6	2300	61.9	2800	74.1	3400	92.4	4700	126	6000	160
	130 to 200	9.0 to 13.8	Blue	150	10.3	2800	74.4	3100	84.4	3700	99.3	4700	127	5700	154
				175	12.1	3100	84.2	3500	94.7	4100	111	5200	140	6300	169
				200	13.8	3400	91.3	3800	102	4400	118	5600	149	6700	180
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	3600	97.9	4600	123	6000	160	7400	199	8900	239
				25	1.7	3800	101	4800	129	6400	173	8400	224	10,000	276
				35	2.4	4300	116	5400	145	7000	188	9300	249	12,000	310
	25 to 75	1.7 to 5.2	Green	35	2.4	3400	90.5	4500	120	6100	163	8200	221	10,000	278
				50	3.4	3600	97.4	4700	127	6400	172	8900	237	11,000	303
				75	5.2	4600	124	5700	153	7400	197	10,000	275	13,000	352
	70 to 140	4.8 to 9.7	Red	75	5.2	3900	104	5000	133	6600	176	9000	241	11,000	306
				100	6.9	4800	128	5900	158	7500	202	10,000	276	13,000	351
				125	8.6	5200	139	6300	169	8000	214	11,000	292	14,000	371
	130 to 200	9.0 to 13.8	Blue	150	10.3	6300	169	7300	196	8800	237	12,000	309	14,000	381
				175	12.1	7300	194	8300	223	9900	265	13,000	349	16,000	433
				200	13.8	8000	213	9100	244	11,000	289	14,000	370	17,000	450
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	7100	191	9500	253	13,000	348	17,000	461	21,000	574
				10	0.69	11,000	304	14,000	374	18,000	478	22,000	577	25,000	676
				15	1.0	12,000	330	15,000	395	18,000	493	23,000	624	28,000	754
				25	1.7	16,000	418	19,000	499	23,000	621	28,000	756	33,000	891
				35	2.4	18,000	479	21,000	570	26,000	705	32,000	869	39,000	1030
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	11,000	307	14,000	374	18,000	475	23,000	624	29,000	773
				35	2.4	13,000	357	17,000	452	22,000	595	28,000	760	35,000	925
				50	3.4	15,000	406	19,000	503	24,000	650	31,000	843	39,000	1040
				65	4.5	17,000	464	21,000	561	26,000	707	35,000	936	43,000	1170
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	11,000	297	14,000	372	18,000	484	25,000	670	32,000	855
				75	5.2	16,000	425	19,000	518	24,000	656	33,000	895	42,000	1130
				100	6.9	20,000	536	24,000	642	30,000	800	39,000	1040	48,000	1290
	75 to 170	5.2 to 11.7	Black	75	5.2	12,000	333	15,000	390	18,000	476	24,000	650	31,000	825
				100	6.9	17,000	451	20,000	532	24,000	655	32,000	857	39,000	1060
				125	8.6	19,000	522	23,000	628	29,000	786	38,000	1020	46,000	1250
				170	11.7	26,000	695	30,000	817	37,000	1000	47,000	1270	57,000	1540

- continued -

Air

Table 13. Air Relief Capacities in SCFH / Nm³/h, Types MR98H, MR98HD and MR98HDP with Metal Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						30 / 2.1		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar		psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1/4 NPT	15 to 35	1.0 to 2.4	Yellow	15	1.0	2700	71.5	3800	101	5100	137	6400	173
				25	1.7	3000	81.2	4200	113	5600	149	6900	185
				35	2.4	3400	90.5	4700	126	6000	162	7400	198
	25 to 75	1.7 to 5.2	Green	35	2.4	3200	84.6	4600	124	6000	160	7300	196
				50	3.4	3500	93.7	5200	140	6600	177	8000	215
				75	5.2	4000	108	6200	166	7700	205	9100	245
	70 to 140	4.8 to 9.7	Red	75	5.2	3500	93.6	5700	152	7300	196	8900	239
				100	6.9	4000	106	6400	172	8200	220	10,000	267
				125	8.6	4400	117	7000	188	9100	244	11,000	299
	130 to 200	9.0 to 13.8	Blue	150	10.3	5200	138	6900	184	9300	249	12,000	315
				175	12.1	5500	148	7300	196	10,000	268	13,000	340
				200	13.8	5800	156	7700	206	10,000	277	13,000	349
1/2 / 15	15 to 35	1.0 to 2.4	Yellow	15	1.0	6400	172	9000	240	12,000	324	15,000	409
				25	1.7	7400	199	10,000	269	13,000	354	16,000	439
				35	2.4	8300	223	11,000	299	14,000	385	18,000	471
	25 to 75	1.7 to 5.2	Green	35	2.4	6400	171	9200	248	12,000	323	15,000	398
				50	3.4	7300	196	11,000	288	14,000	363	16,000	437
				75	5.2	8200	219	12,000	334	15,000	414	18,000	494
	70 to 140	4.8 to 9.7	Red	75	5.2	7600	203	12,000	325	15,000	407	18,000	489
				100	6.9	8200	221	13,000	359	17,000	451	20,000	542
				125	8.6	8700	233	14,000	379	18,000	491	22,000	602
	130 to 200	9.0 to 13.8	Blue	150	10.3	8200	220	13,000	351	19,000	506	25,000	660
				175	12.1	8800	237	14,000	373	20,000	536	26,000	699
				200	13.8	9300	250	15,000	391	21,000	568	28,000	744
3/4 and 1 / 20 and 25	15 to 35	1.0 to 2.4	Yellow	15	1.0	11,000	303	16,000	432	22,000	583	27,000	734
				25	1.7	13,000	344	18,000	480	24,000	634	29,000	788
				35	2.4	14,000	384	20,000	530	26,000	689	32,000	847
	25 to 75	1.7 to 5.2	Green	35	2.4	13,000	358	19,000	517	25,000	684	32,000	850
				50	3.4	15,000	396	22,000	582	28,000	754	35,000	926
				75	5.2	17,000	465	26,000	690	33,000	873	39,000	1060
	70 to 140	4.8 to 9.7	Red	75	5.2	16,000	423	25,000	657	32,000	845	39,000	1030
				100	6.9	18,000	482	28,000	744	36,000	954	43,000	1160
				125	8.6	19,000	517	30,000	807	39,000	1050	48,000	1290
	130 to 200	9.0 to 13.8	Blue	150	10.3	20,000	530	31,000	827	43,000	1150	55,000	1470
				175	12.1	22,000	588	34,000	898	46,000	1230	58,000	1570
				200	13.8	23,000	617	35,000	950	49,000	1320	63,000	1680
1-1/2 and 2 / 40 and 50	5 to 35	0.34 to 2.4	Dark Gray	5	0.34	29,000	780	44,000	1190	62,000	1650	79,000	2110
				10	0.69	33,000	878	48,000	1280	65,000	1750	82,000	2210
				15	1.0	35,000	951	50,000	1350	68,000	1820	86,000	2290
				25	1.7	41,000	1090	56,000	1490	73,000	1960	90,000	2420
				35	2.4	46,000	1240	61,000	1650	79,000	2120	97,000	2600
	20 to 65	1.4 to 4.5	Black with Light Blue Stripe	25	1.7	36,000	978	52,000	1390	70,000	1870	87,000	2340
				35	2.4	43,000	1140	59,000	1570	76,000	2040	93,000	2510
				50	3.4	48,000	1280	65,000	1750	83,000	2220	100,000	2690
				65	4.5	53,000	1420	72,000	1930	91,000	2430	109,000	2930
	50 to 100	3.4 to 6.9	Light Gray	50	3.4	40,000	1070	56,000	1500	76,000	2040	96,500	2590
				75	5.2	53,000	1420	74,000	1980	93,000	2500	112,000	3010
				100	6.9	61,000	1630	86,000	2310	107,000	2880	128,000	3440
	75 to 170	5.2 to 11.7	Black	75	5.2	41,000	1090	60,000	1620	83,000	2240	106,000	2850
				100	6.9	53,000	1420	80,000	2150	102,000	2740	124,000	3330
				125	8.6	62,000	1660	92,000	2480	116,000	3100	139,000	3730
				170	11.7	77,000	2070	116,000	3120	142,000	3820	169,000	4520

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Table 14. Water Relief Capacities in GPM / l/min, Types MR98HH and MR98HHD with Elastomer Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
					5 / 0.34		10 / 0.69		15 / 1.0		20 / 1.4		25 / 1.7	
	psi	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	4.6	17.4	7.4	28	9.9	37.3	12.3	46.5	13.5	51.1
			175	12.1	5.1	19.3	8.2	31	10.7	40.3	13.1	49.6	14.4	54.5
			200	13.8	5.3	20	8.4	31.8	10.9	41.2	13.4	50.7	15.1	56.9
			250	17.2	5.8	21.9	9.1	34.4	12	45.4	14.9	56.4	16.5	62.4
			300	20.7	6.4	24.2	10	37.8	13.1	49.4	16.1	60.9	18	68.1
			375	25.9	7.3	27.6	11.1	42	14.6	55	18	68.1	20.2	76.4
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	8.8	33.3	13.3	50.3	17.3	65.4	21.3	80.6	24.6	92.9
			175	12.1	9.3	35.2	14.2	53.7	18.6	70.2	22.9	86.6	26.3	99.3
			200	13.8	9.9	37.5	15	56.7	19.6	74.1	24.2	91.5	27.9	105
			250	17.2	10.8	40.9	15.8	59.8	20.8	78.5	25.7	97.2	29.4	111
			300	20.7	11	41.6	16	60.5	22	83.2	28	106	33	125
			375	25.9	12	45.4	18	68.1	24	90.8	30	113	36.7	139
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	15.7	59.4	23.3	88.1	30.2	114	37.1	140	43	163
			175	12.1	15.8	59.8	23.4	88.5	30.8	117	38.2	145	45.3	171
			200	13.8	18	68.1	25.2	95.3	33.1	125	40.9	155	47.4	179
			250	17.2	19.6	74.1	26.8	101	35.3	134	43.8	166	51.5	195
			300	20.7	25	94.6	30	113	37.5	142	45	170	54.6	207
			375	25.9	28.6	108	33	125	41.4	157	49.9	189	60.8	230

- continued -

Table 14. Water Relief Capacities in GPM / l/min, Types MR98HH and MR98HHD with Elastomer Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar											
					30 / 2.1		35 / 2.4		40 / 2.8		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	14.7	55.6	15.5	58.4	16.2	61.3	17.7	67	19.2	72.6	20.7	78.3
			175	12.1	15.7	59.4	16.4	62.1	17.2	64.9	18.6	70.4	20.2	76.4	21.8	82.5
			200	13.8	16.7	63.2	17.5	66.2	18.3	69.2	19.9	75.3	21.4	80.8	22.8	86.3
			250	17.2	18.1	68.5	18.7	70.8	19.4	73.2	20.6	77.9	21.8	82.5	23	87
			300	20.7	19.9	75.3	20.5	77.6	21.1	79.8	22.3	84.4	23.4	88.3	24.4	92.3
			375	25.9												
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	27.8	105	30	114	32.3	122	36.7	139	42.7	161	48.6	184
			175	12.1	29.6	112	31.9	120	34.1	129	38.6	146	44.6	169	50.5	191
			200	13.8	31.5	119	33.7	127	35.9	136	40.3	152	46.4	176	52.5	199
			250	17.2	33	125	35.7	135	38.4	145	43.7	165	49.7	188	55.7	211
			300	20.7	38	144	40.3	152	42.5	161	47	178	53	200	59	223
			375	25.9												
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	48.9	185	53.6	203	58.3	221	67.7	256	79.3	300	90.9	344
			175	12.1	52.3	198	57	216	61.8	234	71.2	269	82.9	313	94.5	357
			200	13.8	53.9	204	59.1	223	64.3	243	74.6	282	86.6	328	98.6	373
			250	17.2	59.2	224	64.5	244	69.7	264	80.2	303	93	352	106	400
			300	20.7	64.2	243	69.9	264	75.6	286	87	329	110	417	133	504
			375	25.9												

- Shaded areas show where maximum inlet pressures are exceeded.

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Table 15. Water Relief Capacities in GPM / l/min, Types MR98HH and MR98HHD with Metal Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
					5 / 0.34		10 / 0.69		15 / 1.0		20 / 1.4		25 / 1.7	
	psi	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	3.2	12.1	4.8	18.2	6.2	23.3	7.5	28.4	8.7	32.7
			175	12.1	3.5	13.2	4.9	18.5	6.4	24	7.8	29.5	8.9	33.5
			200	13.8	3.6	13.6	5.2	19.7	6.5	24.6	7.8	29.5	8.9	33.7
			250	17.2	4.2	15.9	5.3	20	6.6	25	7.9	29.9	9.1	34.4
			300	20.7	4.6	17.4	5.6	21.2	6.8	25.7	8	30.3	9.3	35
			375	25.9	5.4	20.4	6	22.7	7.1	26.9	8.2	31	9.56	36.2
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	5.72	21.6	7.32	27.7	8.22	31.1	9.16	34.6	10.6	39.9
			175	12.1	6.05	22.9	7.81	29.5	8.81	33.3	9.85	37.3	11.3	42.7
			200	13.8	6.44	24.3	8.25	31.2	9.31	35.2	10.4	39.4	12	45.3
			250	17.2	6.7	25.3	8.69	32.9	9.86	37.3	11.1	41.8	12.6	47.7
			300	20.7	7	26.5	9	34	10.5	39.7	12	45.4	14	53
			375	25.9	8	30.3	9.5	35.9	11.5	43.5	13.5	51.1	15.8	59.7
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	12	45.4	17	64.3	20.3	76.6	23.5	88.9	26.8	101
			175	12.1	12.8	48.4	16.5	62.4	20.5	77.4	24.4	92.3	27.6	104
			200	13.8	13.1	49.6	17	64.3	20.8	78.5	24.5	92.7	27.9	106
			250	17.2	15.3	57.9	18.7	70.7	22.5	84.9	26.2	99.1	29.8	113
			300	20.7	14.9	56.4	19.2	72.6	23.2	87.8	27.2	103	31.4	119
			375	25.9	15.6	59	19.3	73	23.4	88.5	27.5	104	33.6	127

- continued -

Table 15. Water Relief Capacities in GPM / l/min, Types MR98HH and MR98HHD with Metal Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar											
					30 / 2.1		35 / 2.4		40 / 2.8		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar	psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	9.8	37.1	10.7	40.3	11.5	43.5	13.2	49.9	15.4	58.1	17.5	66.2
			175	12.1	9.9	37.5	10.9	41	11.8	44.6	13.7	51.8	16	60.3	18.2	68.9
			200	13.8	10	37.8	11	41.4	11.9	45	13.8	52.2	16.3	61.5	18.7	70.7
			250	17.2	10.3	39	11.3	42.6	12.2	46.2	14.1	53.3	17.1	64.5	20	75.7
			300	20.7	10.5	39.7	11.5	43.4	12.5	47.1	14.4	54.5	17.7	67	21	79.4
			375	25.9												
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	12	45.2	12.9	48.8	14.2	53.7	17.2	65.3	22.6	85.5	30.6	116
			175	12.1	12.7	48.2	13.7	51.8	15	56.8	18.1	68.6	23.6	89.3	31.3	118
			200	13.8	13.5	51.2	14.5	54.8	15.8	59.8	18.9	71.7	24.1	91.3	31.5	119
			250	17.2	14.2	53.7	15.3	58	16.9	63.8	20.5	77.7	25.8	97.8	32.3	122
			300	20.7	16	60.5	17.5	66.2	19	71.9	22	83.2	28	106	34	129
			375	25.9												
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	30	113	32.9	124	35.7	135	41.4	157	51.7	196	62	235
			175	12.1	30.7	116	33.8	128	36.9	140	43.1	163	53.7	203	64.2	243
			200	13.8	31.3	118	34.5	130	37.7	142	44	166	55.1	208	66.1	250
			250	17.2	33.3	126	36.5	138	39.6	150	45.9	174	57.6	218	69.3	262
			300	20.7	35.5	134	39.1	148	42.8	162	50	189	65.5	248	81	306
			375	25.9												

- Shaded areas show where maximum inlet pressures are exceeded.

Steam

Table 16. Steam Relief Capacities in lbs/h / kg/h, Types MR98HH and MR98HHD with Metal Diaphragm Only

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
					5 / 0.34		10 / 0.69		15 / 1.0		20 / 1.4		25 / 1.7	
	psi	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	53.2	24.2	75.2	34.2	96.7	43.9	118	53.7	139	63.4
			175	12.1	61.1	27.8	83.5	37.9	108	49	132	60.1	155	70.3
			200	13.8	67	30.4	92	41.8	116	52.6	140	63.4	165	74.9
			250	17.2	80.3	36.5	108	49	134	60.8	159	72.5	186	84.7
			300	20.7	92.6	42.1	120	54.6	148	67.3	176	80	205	93
			375	25.9	113	51.1	144	65.4	175	79.4	206	93.5	238	108
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	119	54.2	165	74.8	211	95.8	257	117	316	144
			175	12.1	148	67.3	197	89.7	248	113	298	135	351	160
			200	13.8	160	72.8	205	93.2	263	119	321	146	382	174
			250	17.2	189	85.7	243	111	301	137	360	163	422	192
			300	20.7	217	98.5	271	123	342	155	413	188	472	215
			375	25.9	268	122	336	153	410	186	483	220	550	250
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	245	111	329	149	419	191	510	232	604	274
			175	12.1	283	128	366	166	466	212	565	257	673	306
			200	13.8	316	144	411	187	513	233	615	279	719	327
			250	17.2	369	168	487	222	603	274	720	327	835	379
			300	20.7	435	198	549	249	675	307	802	364	921	419
			375	25.9	518	235	658	299	797	362	935	425	1090	494

- continued -

Table 16. Steam Relief Capacities in lbs/h / kg/h, Types MR98HH and MR98HHD with Metal Diaphragm Only (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar											
					30 / 2.1		35 / 2.4		40 / 2.8		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	161	73	181	82.3	201	91.5	242	110	310	141	377	171
			175	12.1	177	80.5	199	90.5	221	101	265	121	337	153	409	186
			200	13.8	190	86.4	213	96.8	236	107	282	128	362	164	442	201
			250	17.2	213	97	238	108	263	120	314	143	405	184	496	225
			300	20.7	233	106	260	118	287	131	342	155	449	204	557	253
			375	25.9												
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	375	170	430	195	484	220	594	270	854	388	1110	506
			175	12.1	405	184	465	211	525	239	645	293	943	428	1240	564
			200	13.8	444	202	504	229	565	257	686	312	982	446	1280	581
			250	17.2	484	220	552	251	620	282	756	343	1080	491	1410	639
			300	20.7	531	241	602	274	673	306	814	370	1150	521	1480	672
			375	25.9												
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	698	317	793	361	889	404	1080	491	1540	698	1990	905
			175	12.1	780	355	874	397	967	440	1150	525	1610	733	2070	940
			200	13.8	824	374	934	424	1040	474	1260	575	1740	793	2230	1010
			250	17.2	950	432	1060	480	1160	529	1380	625	1960	891	2540	1160
			300	20.7	1040	473	1170	530	1290	588	1550	703	2150	977	2750	1250
			375	25.9												

- Shaded areas show where maximum inlet pressures are exceeded.

Air

Table 17. Air Relief Capacities in SCFH / Nm³/h, Types MR98HH and MR98HHD with Elastomer Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
					5 / 0.34		10 / 0.69		15 / 1.0		20 / 1.4		25 / 1.7	
	psi	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	1450	38.8	2320	62.1	3640	97.5	4950	133	6780	182
			175	12.1	1910	51.1	2930	78.5	4400	118	5870	157	7630	205
			200	13.8	2370	63.4	3530	94.8	5160	138	6780	182	8470	227
			250	17.2	2800	75.2	4750	127	6680	179	8610	231	10,200	272
			300	20.7	3720	99.7	5970	160	8200	220	10,400	280	11,900	318
			375	25.9	5570	149	7800	209	10,500	281	13,200	353	14,400	386
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	3330	89.2	5220	140	7530	202	9840	264	12,100	325
			175	12.1	3870	104	6000	161	8210	220	10,400	280	12,900	346
			200	13.8	4150	111	6560	176	9070	243	11,600	310	14,300	382
			250	17.2	5100	137	7320	196	10,100	269	12,800	343	16,000	429
			300	20.7	5870	157	8470	227	11,900	319	15,400	412	19,000	509
			375	25.9	7210	193	9840	264	13,300	357	16,800	449	22,100	593
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	7510	201	10,800	290	14,600	390	18,300	491	22,400	599
			175	12.1	8300	222	12,100	324	16,400	440	20,800	556	25,400	680
			200	13.8	9380	252	13,900	373	18,500	496	23,100	619	27,600	739
			250	17.2	11,500	308	16,500	442	21,900	588	27,300	733	32,800	878
			300	20.7	13,300	357	20,100	538	26,500	711	33,000	884	39,300	1050
			375	25.9	18,200	487	26,300	706	34,500	924	42,600	1140	47,200	1270

- continued -

Table 17. Air Relief Capacities in SCFH / Nm³/h, Types MR98HH and MR98HHD with Elastomer Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar											
					30 / 2.1		35 / 2.4		40 / 2.8		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	8610	231	9130	245	9660	259	10,700	287	13,300	357	15,900	427
			175	12.1	9390	252	9870	265	10,300	277	11,300	303	13,700	368	16,100	432
			200	13.8	10,200	273	10,600	284	11,000	296	11,900	320	14,100	378	16,300	437
			250	17.2	11,700	314	12,200	328	12,800	342	13,800	371	15,400	412	16,900	453
			300	20.7	13,300	356	14,000	375	14,700	395	16,200	434	16,800	449	17,300	465
			375	25.9												
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	14,400	385	16,300	436	18,200	487	22,000	589	27,600	741	33,300	894
			175	12.1	15,400	413	17,600	472	19,800	531	24,200	650	30,200	811	36,300	972
			200	13.8	17,000	455	19,300	516	21,600	578	26,200	702	32,100	860	37,900	1020
			250	17.2	19,300	516	22,000	589	24,700	662	30,100	808	37,300	1000	44,500	1190
			300	20.7	22,600	607	25,800	691	29,000	776	35,300	946	43,200	1160	51,200	1370
			375	25.9												
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	26,400	708	30,200	809	34,000	910	41,500	1110	52,700	1410	63,900	1710
			175	12.1	30,000	804	34,200	918	38,500	1030	47,000	1260	58,200	1560	69,400	1860
			200	13.8	32,000	859	36,800	988	41,700	1120	51,300	1370	64,500	1730	77,800	2080
			250	17.2	38,200	1020	43,700	1170	49,200	1320	60,300	1620	74,900	2010	89,500	2400
			300	20.7	45,700	1220	51,900	1390	58,200	1560	70,800	1900	84,300	2260	97,800	2620
			375	25.9												

- Shaded areas show where maximum inlet pressures are exceeded.

FISHER

Air

Table 18. Air Relief Capacities in SCFH / Nm³/h, Types MR98HH and MR98HHD with Metal Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
					5 / 0.34		10 / 0.69		15 / 1.0		20 / 1.4		25 / 1.7	
	psi	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	1240	33.2	1750	46.9	2250	60.2	2740	73.6	3240	86.8
			175	12.1	1420	38.1	1940	52	2510	67.2	3070	82.3	3590	96.3
			200	13.8	1560	41.7	2140	57.3	2690	72.1	3240	87	3830	103
			250	17.2	1870	50	2510	67.2	3110	83.3	3710	99.4	4330	116
			300	20.7	2150	57.7	2790	74.8	3440	92.2	4090	110	4750	127
			375	25.9	2610	70.1	3340	89.7	4060	109	4780	128	5540	148
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	2770	74.3	3830	103	4900	131	5970	160	7340	197
			175	12.1	3440	92.2	4580	123	5760	154	6930	186	8170	219
			200	13.8	3720	99.8	4760	128	6110	164	7450	200	8880	238
			250	17.2	4380	117	5660	152	7010	188	8360	224	9800	263
			300	20.7	5040	135	6290	169	7950	213	9610	258	11,000	294
			375	25.9	6220	167	7810	209	9520	255	11,200	301	12,800	342
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	5690	153	7630	205	9740	261	11,800	318	14,000	376
			175	12.1	6560	176	8500	228	10,800	290	13,100	352	15,600	419
			200	13.8	7340	197	9560	256	11,900	320	14,300	383	16,700	448
			250	17.2	8590	230	11,300	304	14,000	376	16,700	448	19,400	520
			300	20.7	10,100	271	12,800	342	15,700	421	18,600	500	21,400	574
			375	25.9	12,000	323	15,300	410	18,500	497	21,700	583	25,300	677

- continued -

Table 18. Air Relief Capacities in SCFH / Nm³/h, Types MR98HH and MR98HHD with Metal Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar											
					30 / 2.1		35 / 2.4		40 / 2.8		50 / 3.4		75 / 5.2		100 / 6.9	
	psi	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
1/4 NPT	150 to 375	10.3 to 25.9	150	10.3	3730	100	4210	113	4680	125	5630	151	7190	193	8760	235
			175	12.1	4110	110	4630	124	5140	138	6170	165	7840	210	9510	255
			200	13.8	4410	118	4950	133	5480	147	6550	176	8410	225	10,300	275
			250	17.2	4960	133	5540	149	6120	164	7290	195	9400	252	11,500	309
			300	20.7	5420	145	6050	162	6680	179	7940	213	10,400	280	12,900	347
			375	25.9												
1/2 / 15	150 to 375	10.3 to 25.9	150	10.3	8710	234	9980	268	11,300	302	13,800	370	19,800	532	25,900	694
			175	12.1	9400	252	10,800	290	12,200	327	15,000	402	21,900	587	28,800	773
			200	13.8	10,300	276	11,700	314	13,100	352	15,900	427	22,800	612	29,700	797
			250	17.2	11,200	301	12,800	344	14,400	386	17,600	471	25,100	673	32,700	876
			300	20.7	12,300	331	14,000	375	15,600	419	18,900	507	26,600	714	34,300	921
			375	25.9												
3/4 and 1 / 20 and 25	150 to 375	10.3 to 25.9	150	10.3	16,200	434	18,400	494	20,700	554	25,100	673	35,700	957	46,300	1240
			175	12.1	18,100	486	20,300	544	22,500	603	26,800	720	37,500	1000	48,100	1290
			200	13.8	19,100	513	21,700	582	24,300	650	29,400	788	40,500	1090	51,700	1390
			250	17.2	22,100	592	24,500	658	27,000	724	32,000	857	45,500	1220	59,100	1580
			300	20.7	24,200	648	27,100	727	30,000	805	35,900	963	50,000	1340	64,000	1720
			375	25.9												

- Shaded areas show where maximum inlet pressures are exceeded.

EMERSON

MR98L Series

Backpressure/Relief Valve

Introduction

The MR98L Series are used for backpressure or relief applications in liquid, gas, air and steam service. The Type MR98L is a direct operated backpressure/relief valve used in applications including but not limited to pump recirculation, wash tanks, small heaters, fuel and oil lines, air supply system, test fixtures and sterilizers.

The Type MR98LD uses additional pressure loading to maintain relief differential pressures, backpressures or for remote setpoint adjustment. These constructions are used for differential control in steam applications such as steam atomization of fuel gas for a boiler. Other liquid applications include seal oil systems.

Available Configurations

See Table 1

Body Sizes and End Connection Styles

See Table 2

Construction Materials

See Table 3

Temperature Capabilities

See Table 4

Set Pressure Ranges

See Table 5

Orifice Sizes

1/4 NPT body: 0.284 in. / 7.22 mm
1/2 in. / DN 15 body: 0.416 in. / 10.56 mm
3/4 and 1 in. / DN 20 and 25 bodies: 0.631 in. / 16.02 mm

Maximum Cold Working Pressures of Body Size and Material

See Table 6

Maximum Inlet and Outlet Pressure Ratings

See Table 6
Maximum spring case loading pressure for Type MR98LD (spring setting plus loading pressure) are included in the table.(1)

Flow Coefficients

See Table 7

IEC Sizing Coefficients

See Table 8

Flow Capacities

See Tables 9 to 13

Shutoff Classification Per ANSI/FCI 70-3-2004

Metal Seats: Class IV
Polytetrafluoroethylene (PTFE): Class IV
Elastomer Seats: Class VI or better

Pressure Registration

Internal **(standard)** or External

Approximate Weights

1/4 NPT body: 7 lbs / 3.2 kg
1/2 in. / DN 15 body: 15 lbs / 6.8 kg
3/4 and 1 in. / DN 20 and 25 bodies: 35 lbs / 16 kg

Ordering Guide

To order this product, contact your local Sales Office.

Figure 1. *MR98L Series Backpressure/Relief Valve*

Features

- **Application Versatility**
- **Excellent Fluid Compatibility with Wide Selection of Materials**
- **Rugged and Field Proven Design**
- **Compact**
- **Differential Pressure Capability**
- **Options including Handwheel Adjustment, Control Line and Inlet Gauge Port**
- **Sour Gas Service Capability with NACE Constructions**
- **API 614 Constructions**

Applications

- **Air**
- **Liquid**
- **Process Gas**
- **Steam**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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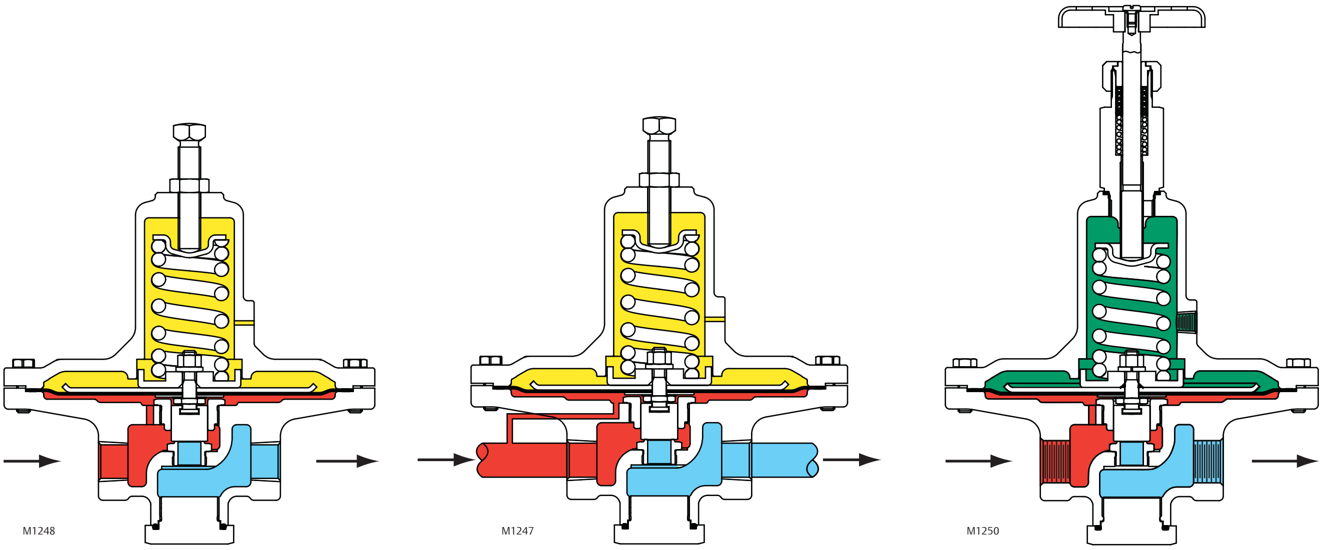
www.Emerson.com

Table 1. Available Configurations

TYPE	CONFIGURATION
MR98L	Backpressure regulator / relief valve for spring settings range from 2 to 38 psig / 0.14 to 2.6 bar. 1/4 in. to 1 in. body sizes only.
MR98LD	Differential pressure relief valve for differential set pressures range from 2 to 38 psi / 0.14 to 2.6 bar with maximum inlet / outlet pressure up to 150 psi / 10.3 bar. 1/4 in. to 1 in. body sizes only

1. Loading pressure plus spring setting should not exceed maximum inlet pressure.



TYPE MR98L WITH INTERNAL PRESSURE REGISTRATION

TYPE MR98L WITH EXTERNAL PRESSURE REGISTRATION

TYPE MR98LD WITH INTERNAL PRESSURE REGISTRATION

INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE
LOADING PRESSURE

Figure 2. *MR98L Series Operational Schematic*

Table 2. Body Sizes, End Connections[1] and Port Options

BODY SIZES	END CONNECTIONS	PORT OPTIONS
1/4 NPT 1/2 in. / DN 15 3/4 in. / DN 20 1 in. / DN 25	NPT SWE Welded CL150 RF Welded CL300 RF Welded PN 16/25/40 RF	Inlet Gauge and Control Line

1. Please refer to the Instruction Manual for end connections available for each size. This table displays all options which are not available to each body size.

Table 3. MR98L Series Construction Materials

MAIN VALVE MATERIALS		
Body	**Spring Case**	**Control Spring**
Gray cast iron, WCC/LCC steel, CF8M/CF3M Stainless steel, Monel®, Hastelloy® C	Gray cast iron, WCC/LCC steel, CF8M Stainless steel, Monel® or Hastelloy® C	Zinc-plated steel, Stainless steel, Powder-coated steel or Powder-coated stainless steel

- continued -

Table 3. MR98L Series Construction Materials (continued)

TRIM MATERIALS		
Part Name	**Standard**	**Optional**
Elastomer Seat		
Seat	Nitrile (NBR)	Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM)
Diaphragm	Neoprene (CR)	302 Stainless steel[1], Fluorocarbon (FKM)[2], Ethylenepropylene (EPDM)[2], Monel®[1], Hastelloy® C[1] or with PTFE protector[3]
Orifice, Valve Plug, Valve Plug Guide and Pusher Post	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Washer	302 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Metal Seat		
Seat, Orifice and Valve Plug	416 Stainless steel	316 Stainless steel, Stellite®[4], Monel®, Hastelloy® C or Alloy 6
Diaphragm	302 Stainless steel[1]	Monel®[1], Hastelloy® C[1], Fluorocarbon (FKM)[2], Ethylenepropylene (EPDM)[2], Neoperene (CR) or with PTFE protector[3]
Valve Plug Guide and Pusher Post	416 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C
Washer	302 Stainless steel	316 Stainless steel, Monel® or Hastelloy® C

1. Two diaphragms are required if metal diaphragm is to be used except for Types MR98L and MR98LD, 2 to 7 psi / 0.1 to 0.5 bar which use only one..
2. Two diaphragms are required if Fluorocarbon (FKM) or Ethylenepropylene (EPDM) diaphragm is to be used.
3. PTFE protector is only available for Fluorocarbon (FKM), Neoprene (CR) or 302 Stainless steel diaphragm.
4. Stellite® material is only availabe as Seat, Orifice and Valve Plug; Not available on the 1/4 in. size.

Table 4. Temperature Capabilities(1)(2)

MATERIAL	SEAT	DIAPHRAGM	O-RING	DIAPHRAGM PROTECTOR	TEMPERATURE	
					°F	°C
Nitrile (NBR)	✓		✓		-40 to 180	-40 to 82
Neoprene (CR)		✓			-40 to 180	-40 to 82
Fluorocarbon (FKM)(3)	✓	✓	✓		0 to 300, Limited to 200°F for hot water	-18 to 149,Limited to 93°C for hot water
Ethylenepropylene (EPDM)	✓	✓	✓		20 to 275	-7 to 135
Perfluoroelastomer (FFKM)	✓		✓		0 to 425	-18 to 218
PTFE				✓	-40 to 400	-40 to 204
Metal	✓	✓			-40 to 450	-40 to 232

BODY MATERIAL	TEMPERATURE	
	°F	°C
Gray cast iron	-20 to 406	-29 to 208
WCC Steel(4)	-20 to 450	-29 to 232
LCC Steel(4)	-40 to 450	-40 to 232
CF8M/CF3M Stainless steel(4), Monel® or Hastelloy® C	-40 to 450	-40 to 232

1. The pressure/temperature limits in this document and any applicable standard limitation should not be exceeded.
2. Pressure and/or the body end connection may decrease these maximum temperatures.
3. Not for use on steam service.
4. Meets API 614 requirements (with Stainless steel trim).

Table 5. MR98L Series Body Sizes, Pressure Ranges and Spring Information

TYPE	BODY SIZE		CONTROL PRESSURE RANGE(1)		SPRING WIRE DIAMETER		SPRING FREE LENGTH		SPRING MATERIAL	SPRING COLOR
	In.	DN	psig	bar	In.	mm	In.	mm		
MR98L and MR98LD	1/4	----	2 to 7	0.14 to 0.48	0.148	3.76	2.00	50.8	Zinc-plated steel	Yellow
			6 to 14	0.41 to 0.97	0.170	4.32	2.00	50.8	Zinc-plated steel	Green
			12 to 25	0.83 to 1.7	0.207	5.26	1.938	49.2	Powder-coated steel	Red
			20 to 38	1.4 to 2.6	0.225	5.72	2.086	53.0	Powder-coated steel	Blue
	1/2	15	2 to 7	0.14 to 0.48	0.207	5.26	2.50	63.5	Powder-coated steel	Yellow
			6 to 14	0.41 to 0.97	0.234	5.94	2.595	65.9	Powder-coated steel	Green
			12 to 25	0.83 to 1.7	0.283	7.19	2.44	62.0	Powder-coated steel	Red
			20 to 38	1.4 to 2.6	0.331	8.41	2.250	57.2	Powder-coated steel	Blue
	3/4 and 1	20 and 25	2 to 7	0.14 to 0.48	0.306	7.77	4.00	102	Powder-coated steel	Yellow
			6 to 14	0.41 to 0.97	0.343	8.71	4.00	102	Powder-coated steel	Green
			12 to 25	0.83 to 1.7	0.406	10.3	4.00	102	Powder-coated steel	Red
			20 to 38	1.4 to 2.6	0.468	11.9	3.75	95.3	Powder-coated steel	Blue
	3/4 and 1	20 and 25	2 to 7	0.14 to 0.48	0.306	7.77	4.00	102	Powder-coated Stainless steel	Yellow
			6 to 14	0.41 to 0.97	0.375	9.53	3.88	98.6	Stainless steel	Unpainted
			12 to 25	0.83 to 1.7	0.437	11.1	4.00	102	Stainless steel	Unpainted

1. All springs may be backed off to 0 psig / 0 bar. However, highest capacities and best performances are obtained by using these springs in their recommended ranges.

Table 6. Maximum Cold Working Pressures of Body Size and Materials(1)(2)								
BODY SIZE		BODY AND SPRING CASE MATERIAL	MAXIMUM INLET PRESSURE(3)		MAXIMUM OUTLET PRESSURE		MAXIMUM SPRING CASE PRESSURE	
In.	DN		psig	bar	psig	bar	psig	bar
1/4 1/2, 3/4, 1	- - - - 15, 20, 25	Gray cast iron	60	4.1	60	4.1	50	3.4
		Steel	150	10.3	150	10.3	125	8.6
		Stainless steel	150	10.3	150	10.3	125	8.6
1/2, 3/4, 1	15, 20, 25	Monel®	150	10.3	150	10.3	125	8.6
		Hastelloy® C	150	10.3	150	10.3	125	8.6

1. The pressure/temperature limits in this document and any applicable standard limitation should not be exceeded.
2. Temperature, trim material and/or the body end connection may decrease these maximum pressures.
3. Maximum inlet pressure equals set pressure plus build-up.

Table 7. Flow Coefficients				
BODY SIZE		C_V	C_G	C_1
In.	DN			
1/4 NPT	- - - -	1.4	48	34.3
1/2	15	3.4	120	35.3
3/4 and 1	20 and 25	6.5	250	38.5

Table 8. IEC Sizing Coefficients					
BODY SIZE		X_T	F_D	F_L	K_m
In.	DN				
1/4 NPT	- - - -	0.743	0.74	0.95	0.90
1/2	15	0.787	0.78	0.94	0.88
3/4 and 1	20 and 25	0.935	0.70	0.91	0.83

Process Gas

Relieving capacities at selected pressures and outlet pressure flows are given in SCFH (60°F and 14.7 psia) of air in Tables 12 and 13. To determine the equivalent capacities for other gases, multiply the table capacities by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in normal cubic meters per hour (Nm^3/h) at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

Liquid

Table 9. Water Relief Capacities in GPM / L/min, Types MR98L and MR98LD with Elastomer Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						2 / 0.14		4 / 0.28		6 / 0.41		8 / 0.55		10 / 0.69	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	2.4	9.08	3	11.3	3.6	13.6	4.1	15.3	4.5	17
				5	0.34	3.2	12.1	3.8	14.2	4.3	16.3	4.8	18	5.2	19.7
	6 to 14	0.41 to 0.97	Green	10	0.69	3.8	14.4	4.6	17.4	5.4	20.4	5.6	21.2	5.8	21.9
	12 to 25	0.83 to 1.7	Red	15	1.0	3.1	11.7	4.4	16.5	5.6	21.2	6	22.7	6.4	24.2
				20	1.4	3.3	12.5	4.6	17.4	5.9	22.3	6.6	24.8	7.2	27.2
				25	1.7	3.4	12.9	4.8	18.2	6.2	23.5	6.9	26.1	7.6	28.8
	20 to 38	1.4 to 2.6	Blue	25	1.7	3.3	12.5	4.7	17.8	6.1	23.1	6.8	25.7	7.5	28.4
				30	2.1	3.3	12.5	4.8	18.2	6.3	23.8	7.1	26.9	7.9	29.9
				35	2.4	3.6	13.6	5.1	19.3	6.6	25	7.4	28	8.2	31
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	6	22.7	7.4	27.8	8.7	32.9	9.9	37.3	11	41.6
				5	0.34	8.3	31.4	9.4	35.4	10	39.3	11	42.7	12	46.2
	6 to 14	0.41 to 0.97	Green	10	0.69	9.1	34.4	11	41.6	13	48.8	14	51.6	14	54.5
	12 to 25	0.83 to 1.7	Red	15	1.0	8.3	31.4	11	42.2	14	53	15	58.1	17	63.2
				20	1.4	9	34	12	46.7	16	59.4	17	63.9	18	68.5
				25	1.7	9.3	35.2	13	49.2	17	63.2	18	68.3	19	73.4
	20 to 38	1.4 to 2.6	Blue	25	1.7	5.5	20.8	8.9	33.5	12	46.2	14	53.7	16	61.3
				30	2.1	5.8	21.9	9.4	35.6	13	49.2	15	57.1	17	65.1
				35	2.4	6.6	25	10	38.6	14	52.2	16	60.1	18	68.1
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	11	41.6	14	52.6	17	63.6	19	70.9	21	78.3
				5	0.34	15	56.7	18	66.4	20	76	22	83	24	90
	6 to 14	0.41 to 0.97	Green	10	0.69	17	62.4	21	77.9	25	93.4	26	99.1	28	105
	12 to 25	0.83 to 1.7	Red	15	1.0	15	57.1	20	77.2	26	97.2	28	107	31	116
				20	1.4	17	64.3	23	85.5	28	107	31	117	34	127
				25	1.7	19	71.9	25	93.6	31	115	33	125	36	135
	20 to 38	1.4 to 2.6	Blue	25	1.7	14	52.6	20	76	26	99.5	30	112	33	125
				30	2.1	15	56.4	21	80.8	28	105	31	119	35	132
				35	2.4	16	60.9	23	86.3	30	112	33	126	37	140

- continued -

Table 9. Water Relief Capacities in GPM / L/min, Types MR98L and MR98LD with Elastomer Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						15 / 1.0		20 / 1.4		25 / 1.7		30 / 2.1	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	5.4	20.4	6.3	23.8	6.9	26.1	7.5	28.4
				5	0.34	5.9	22.3	6.6	25	7.3	27.4	7.9	29.9
	6 to 14	0.41 to 0.97	Green	10	0.69	6.6	25	7.4	28	8	30.1	8.5	32.2
	12 to 25	0.83 to 1.7	Red	15	1.0	7.2	27	7.9	29.9	8.5	32.2	9.1	34.4
				20	1.4	7.9	29.7	8.5	32.2	9.1	34.2	9.6	36.3
				25	1.7	8.4	31.6	9.1	34.4	9.6	36.1	10	37.8
	20 to 38	1.4 to 2.6	Blue	25	1.7	8.3	31.4	9.1	34.4	9.6	36.1	10	37.8
				30	2.1	8.7	32.9	9.5	35.9	10	38	11	40.1
				35	2.4	9.1	34.2	9.9	37.5	10	39.3	11	41.2
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	13	49	15	56.4	17	62.8	18	69.2
				5	0.34	14	53.5	16	60.9	18	67	19	73
	6 to 14	0.41 to 0.97	Green	10	0.69	16	61.3	18	68.1	19	73.2	21	78.3
	12 to 25	0.83 to 1.7	Red	15	1.0	18	68.1	19	73	21	77.7	22	82.5
				20	1.4	19	73.2	21	77.9	22	82.7	23	87.4
				25	1.7	21	78.1	22	82.8	23	87.2	24	91.5
	20 to 38	1.4 to 2.6	Blue	25	1.7	19	71.9	22	82.5	23	87.4	24	92.3
				30	2.1	20	75.3	23	85.5	24	90.8	25	96.1
				35	2.4	21	78.9	24	89.7	25	95	27	100
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	25	93.6	29	109	32	121	35	134
				5	0.34	27	104	31	117	34	128	37	140
	6 to 14	0.41 to 0.97	Green	10	0.69	31	117	34	130	37	140	40	150
	12 to 25	0.83 to 1.7	Red	15	1.0	34	128	37	140	40	150	42	160
				20	1.4	37	138	40	150	42	159	45	169
				25	1.7	39	147	42	160	45	168	47	177
	20 to 38	1.4 to 2.6	Blue	25	1.7	38	142	42	160	44	168	47	177
				30	2.1	40	150	44	168	47	176	49	185
				35	2.4	42	158	47	176	49	184	51	193

Liquid

Table 10. Water Relief Capacities in GPM / L/min, Types MR98L and MR98LD with Metal Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						2 / 0.14		4 / 0.28		6 / 0.41		8 / 0.55		10 / 0.69	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	1.5	5.67	2.2	8.13	2.8	10.6	3.4	12.9	4	15.1
				5	0.34	2.1	7.94	2.9	10.8	3.6	13.6	4	14.9	4.3	16.3
	6 to 14	0.41 to 0.97	Green	10	0.69	1.9	7.19	2.9	10.8	3.8	14.4	4.3	16.3	4.8	18.2
	12 to 25	0.83 to 1.7	Red	15	1.0	2.1	7.94	3.1	11.7	4.1	15.5	4.7	17.6	5.2	19.7
				20	1.4	2.3	8.7	3.4	12.9	4.5	17	5.1	19.1	5.6	21.2
				25	1.7	2.5	9.46	3.7	13.8	4.8	18.2	5.4	20.2	5.9	22.3
	20 to 38	1.4 to 2.6	Blue	25	1.7	2.2	8.32	3.3	12.5	4.4	16.6	5	18.7	5.5	20.8
				30	2.1	2.4	9.08	3.6	13.4	4.7	17.8	5.3	20	5.9	22.3
				35	2.4	2.2	8.32	3.5	13.2	4.8	18.2	5.5	20.8	6.2	23.5
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	4.9	18.5	6.5	24.6	8.1	30.6	9.3	35.2	11	39.7
				5	0.34	6.5	24.6	8	30.3	9.5	35.9	11	40.3	12	44.6
	6 to 14	0.41 to 0.97	Green	10	0.69	6.7	25.3	8.7	32.7	11	40.1	12	44.5	13	48.8
	12 to 25	0.83 to 1.7	Red	15	1.0	6.2	23.5	8.6	32.5	11	41.6	12	46.7	14	51.8
				20	1.4	7.1	26.9	9.7	36.5	12	46.2	14	51.1	15	56
				25	1.7	7.1	26.9	10	37.6	13	48.4	14	53.9	16	59.4
	20 to 38	1.4 to 2.6	Blue	25	1.7	4.5	17	7	26.3	9.4	35.6	11	42.4	13	49.2
				30	2.1	4.7	17.8	7.2	27.2	9.7	36.7	12	43.9	14	51.1
				35	2.4	4.9	18.5	7.4	28	9.9	37.5	12	44.8	14	52.2
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	8.9	33.7	12	44.5	15	55.2	17	63.9	19	72.6
				5	0.34	11	41.6	14	52.2	17	62.8	19	71.1	21	79.4
	6 to 14	0.41 to 0.97	Green	10	0.69	13	47.3	16	60	19	72.6	21	80.4	23	88.1
	12 to 25	0.83 to 1.7	Red	15	1.0	11	40.6	15	56.4	19	72.2	21	80.1	23	88
				20	1.4	11	43.5	16	60.2	20	76.9	23	85.5	25	94.2
				25	1.7	12	44.6	16	62.2	21	79.8	24	89.1	26	98.5
	20 to 38	1.4 to 2.6	Blue	25	1.7	10	39.3	15	57.3	20	75.3	23	85.9	26	96.5
				30	2.1	10	39	15	57.7	20	76.4	23	87.2	26	98
				35	2.4	11	40.1	16	59	21	77.9	24	89.3	27	101

- continued -

Table 10. Water Relief Capacities in GPM / L/min, Types MR98L and MR98LD with Metal Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						15 / 1.0		20 / 1.4		25 / 1.7		30 / 2.1	
	psi	bar		psig	bar	GPM	l/min	GPM	l/min	GPM	l/min	GPM	l/min
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	4.9	18.3	5.7	21.6	6.4	24.2	7.1	26.9
				5	0.34	5.2	19.7	6.1	23.1	6.7	25.3	7.3	27.6
	6 to 14	0.41 to 0.97	Green	10	0.69	5.7	21.6	6.6	25	7.2	27.2	7.8	29.5
	12 to 25	0.83 to 1.7	Red	15	1.0	6	22.7	6.8	25.7	7.4	28	8	30.3
				20	1.4	6.4	24.2	7.2	27.2	7.9	29.9	8.6	32.5
				25	1.7	6.7	25.3	7.5	28.4	8.1	30.6	8.7	32.9
	20 to 38	1.4 to 2.6	Blue	25	1.7	6.4	24	7.2	27.2	7.9	29.7	8.5	32.2
				30	2.1	6.7	25.3	7.5	28.4	8.2	30.8	8.8	33.3
				35	2.4	7.1	26.9	8	30.3	8.7	32.9	9.4	35.6
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	13	48.8	15	57.9	17	64.3	19	70.7
				5	0.34	14	52.8	16	60.9	18	67.3	20	73.8
	6 to 14	0.41 to 0.97	Green	10	0.69	15	56.7	17	64.7	19	70.7	20	76.8
	12 to 25	0.83 to 1.7	Red	15	1.0	16	59.8	18	67.7	19	73.4	21	79.1
				20	1.4	17	63.9	19	71.9	20	77.4	22	82.8
				25	1.7	18	67.1	20	74.9	21	80.4	23	85.9
	20 to 38	1.4 to 2.6	Blue	25	1.7	16	58.6	18	68.1	20	74.3	21	80.6
				30	2.1	16	61.1	19	71.1	20	77.4	22	83.6
				35	2.4	17	62.4	19	72.6	21	79.3	23	85.9
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	23	88.1	27	104	30	115	34	127
				5	0.34	25	95	29	110	32	122	35	133
	6 to 14	0.41 to 0.97	Green	10	0.69	27	104	32	119	34	130	37	141
	12 to 25	0.83 to 1.7	Red	15	1.0	27	103	31	118	34	130	37	142
				20	1.4	29	109	33	124	36	136	39	148
				25	1.7	30	114	34	129	37	141	40	152
	20 to 38	1.4 to 2.6	Blue	25	1.7	30	113	34	129	37	141	41	154
				30	2.1	31	116	35	133	39	146	42	158
				35	2.4	31	119	36	137	40	150	43	162

Steam

Table 11. Steam Relief Capacities in lbs/h / kg/h, Types MR98L and MR98LD with Metal Diaphragm Only

NOMINAL BODY SIZE, In. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						2 / 0.14		4 / 0.28		6 / 0.41		8 / 0.55		10 / 0.69	
	psi	bar		psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	13	5.85	22	10.1	31	14.3	39	17.6	46	20.9
				5	0.34	15	6.64	24	11	34	15.3	42	18.9	49	22.5
	6 to 14	0.41 to 0.97	Green	10	0.69	13	5.78	22	10.2	32	14.6	41	18.6	50	22.6
	12 to 25	0.83 to 1.7	Red	15	1.0	12	5.49	21	9.58	30	13.6	39	17.5	47	21.4
				20	1.4	14	6.52	25	11.2	35	15.9	44	20.1	53	24.2
				25	1.7	16	7.1	26	12	37	16.9	47	21.3	56	25.6
	20 to 38	1.4 to 2.6	Blue	25	1.7	15	6.76	24	10.7	32	14.7	41	18.6	50	22.6
				30	2.1	17	7.66	26	11.8	35	15.9	44	20	53	24.1
				35	2.4	18	8.21	28	12.6	37	17	47	21.2	56	25.3
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	66	29.9	83	37.9	100	45.8	110	52.1	130	58.3
				5	0.34	88	40	110	48.1	120	55.9	140	61.6	150	67
	6 to 14	0.41 to 0.97	Green	10	0.69	78	35.4	100	47	130	58.6	140	65.8	160	73
	12 to 25	0.83 to 1.7	Red	15	1.0	44	20.1	75	34.1	110	48	130	57.1	150	66.2
				20	1.4	64	29.2	100	46.2	140	63	160	71.9	180	80.7
				25	1.7	65	29.5	100	47.7	140	65.9	170	76.5	190	87.1
	20 to 38	1.4 to 2.6	Blue	25	1.7	54	24.7	100	45.4	150	66	180	83	220	100
				30	2.1	64	29.1	110	51.6	160	74.2	200	91.7	240	109
				35	2.4	71	32.1	120	55.9	180	79.7	220	99	260	118
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	88	40	130	57	160	73.9	190	87.2	220	100
				5	0.34	120	53.1	150	70.4	190	87.5	220	100	250	112
	6 to 14	0.41 to 0.97	Green	10	0.69	120	52.8	170	77.2	220	102	260	117	290	133
	12 to 25	0.83 to 1.7	Red	15	1.0	110	50	160	74.7	220	99.3	260	117	300	135
				20	1.4	110	49.5	170	77.2	230	105	280	125	320	145
				25	1.7	110	50.1	180	80.1	240	110	290	131	340	153
	20 to 38	1.4 to 2.6	Blue	25	1.7	91	41.3	150	67.5	210	93.7	250	113	290	133
				30	2.1	100	45.6	160	72.2	220	98.7	260	120	310	141
				35	2.4	110	49.1	170	75.3	220	102	270	124	320	146

- continued -

Table 11. Steam Relief Capacities in lbs/h / kg/h, Types MR98L and MR98LD with Metal Diaphragm Only (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						15 / 1.0		20 / 1.4		25 / 1.7		30 / 2.1	
	psi	bar		psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	59	26.8	72	32.6	82	37.3	93	42.1
				5	0.34	63	28.5	76	34.5	86	39.3	97	44.1
	6 to 14	0.41 to 0.97	Green	10	0.69	66	29.9	82	37.2	94	42.7	110	48.2
	12 to 25	0.83 to 1.7	Red	15	1.0	67	30.3	86	39.2	100	45.3	110	51.5
				20	1.4	73	33	92	41.8	110	48.2	120	54.5
				25	1.7	77	35.2	98	44.7	110	51.6	130	58.5
	20 to 38	1.4 to 2.6	Blue	25	1.7	70	32	91	41.5	110	48.8	120	56.2
				30	2.1	74	33.9	96	43.7	110	51.4	130	59
				35	2.4	78	35.4	100	45.5	120	53.6	140	61.7
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	160	72.2	190	84.9	210	97.1	240	109
				5	0.34	180	79.9	200	92.3	230	104	260	116
	6 to 14	0.41 to 0.97	Green	10	0.69	190	88.2	230	103	250	116	280	128
	12 to 25	0.83 to 1.7	Red	15	1.0	180	81.6	210	97	240	110	270	123
				20	1.4	210	94.6	240	108	270	121	290	133
				25	1.7	230	102	260	118	290	130	310	142
	20 to 38	1.4 to 2.6	Blue	25	1.7	260	120	310	140	330	151	360	163
				30	2.1	290	130	330	150	360	163	380	175
				35	2.4	310	140	360	162	380	175	410	187
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	280	128	340	156	410	187	480	219
				5	0.34	310	142	380	171	440	201	510	231
	6 to 14	0.41 to 0.97	Green	10	0.69	360	165	430	197	510	230	580	262
	12 to 25	0.83 to 1.7	Red	15	1.0	370	168	440	201	550	248	640	290
				20	1.4	400	181	480	216	600	271	690	315
				25	1.7	420	192	510	232	650	293	750	339
	20 to 38	1.4 to 2.6	Blue	25	1.7	380	174	470	216	630	285	750	339
				30	2.1	400	184	500	227	670	305	800	364
				35	2.4	420	191	520	236	710	324	850	389

Air

Table 12. Air Relief Capacities in SCFH / Nm³/h, Types MR98L and MR98LD with Elastomer Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						2 / 0.14		4 / 0.28		6 / 0.41		8 / 0.55		10 / 0.69	
	psi	bar		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	720	19.4	880	23.5	1000	27.5	1100	30.7	1300	34
				5	0.34	890	24	1000	27.9	1200	31.7	1300	34.9	1400	38.1
	6 to 14	0.41 to 0.97	Green	10	0.69	1100	29.9	1300	35.4	1500	40.8	1600	43.8	1700	46.8
	12 to 25	0.83 to 1.7	Red	15	1.0	810	21.6	1200	32.6	1600	43.5	1800	47.7	1900	51.9
				20	1.4	730	19.5	1300	33.8	1800	48.1	2000	53.1	2200	58
				25	1.7	790	21.3	1400	37	2000	52.8	2200	57.7	2300	62.6
	20 to 38	1.4 to 2.6	Blue	25	1.7	820	21.9	1300	36.1	1900	50.2	2100	56.3	2300	62.4
				30	2.1	890	23.8	1500	39	2000	54.3	2300	61.3	2500	68.3
				35	2.4	970	26	1600	42.5	2200	59.1	2500	66.4	2800	73.8
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	1500	39.2	1900	49.9	2300	60.6	2600	69.2	2900	77.7
				5	0.34	2000	52.9	2400	63.8	2800	74.7	3100	82.8	3400	90.9
	6 to 14	0.41 to 0.97	Green	10	0.69	2200	60.3	2900	77.1	3500	93.9	3800	102	4100	110
	12 to 25	0.83 to 1.7	Red	15	1.0	2000	54.7	3000	80.1	3900	106	4300	116	4700	126
				20	1.4	2400	63.2	3400	92.4	4500	122	5000	133	5400	144
				25	1.7	2300	62.2	3700	98	5000	134	5500	146	5900	159
	20 to 38	1.4 to 2.6	Blue	25	1.7	1200	33.5	2300	61.7	3400	89.8	4200	113	5100	137
				30	2.1	1500	39.6	2600	70.4	3800	101	4700	125	5600	149
				35	2.4	1600	43.8	2900	76.5	4100	109	5100	135	6000	162
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	2600	69.2	3400	92.2	4300	115	4900	132	5600	149
				5	0.34	3600	96.6	4500	120	5300	143	5900	159	6500	175
	6 to 14	0.41 to 0.97	Green	10	0.69	4000	106	5400	144	6800	181	7300	196	7900	211
	12 to 25	0.83 to 1.7	Red	15	1.0	3700	100	5500	148	7300	196	8200	221	9200	246
				20	1.4	4400	118	6500	173	8500	228	9500	255	11,000	282
				25	1.7	4600	123	6900	184	9200	246	10,000	278	12,000	311
	20 to 38	1.4 to 2.6	Blue	25	1.7	3200	86.2	5300	143	7400	199	9000	240	10,000	281
				30	2.1	3400	91.9	5900	158	8400	225	10,000	268	12,000	310
				35	2.4	4000	107	6500	175	9100	244	11,000	286	12,000	328

- continued -

Table 12. Air Relief Capacities in SCFH / Nm³/h, Types MR98L and MR98LD with Elastomer Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						15 / 1.0		20 / 1.4		25 / 1.7		30 / 2.1	
	psi	bar		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	1500	41.2	1800	48.4	2000	54	2200	59.7
				5	0.34	1700	44.8	1900	51.5	2100	57.6	2400	63.7
	6 to 14	0.41 to 0.97	Green	10	0.69	2000	53.2	2200	59.6	2400	64.9	2600	70.2
	12 to 25	0.83 to 1.7	Red	15	1.0	2200	58.9	2500	65.8	2600	70.7	2800	75.7
				20	1.4	2400	65	2700	72.1	2900	77.4	3100	82.8
				25	1.7	2600	69.9	2900	77.1	3100	83.2	3300	89.3
	20 to 38	1.4 to 2.6	Blue	25	1.7	2600	70.5	2900	78.6	3100	83.9	3300	89.2
				30	2.1	2800	76.3	3100	84.2	3400	90.3	3600	96.4
				35	2.4	3100	82.2	3400	90.6	3600	96.9	3800	103
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	3600	97	4300	116	5000	134	5600	151
				5	0.34	4100	109	4800	128	5400	144	6000	161
	6 to 14	0.41 to 0.97	Green	10	0.69	4800	128	5400	145	6000	161	6600	177
	12 to 25	0.83 to 1.7	Red	15	1.0	5400	144	6000	162	6600	178	7300	195
				20	1.4	6000	162	6700	180	7300	197	8000	213
				25	1.7	6600	177	7300	196	7900	212	8500	228
	20 to 38	1.4 to 2.6	Blue	25	1.7	6100	164	7100	191	7800	209	8500	228
				30	2.1	6600	178	7700	206	8400	225	9100	244
				35	2.4	7200	192	8300	222	8900	240	9600	258
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	6700	181	7900	212	9700	259	11,000	306
				5	0.34	7900	212	9300	249	11,000	288	12,000	327
	6 to 14	0.41 to 0.97	Green	10	0.69	9200	247	11,000	284	12,000	325	14,000	366
	12 to 25	0.83 to 1.7	Red	15	1.0	11,000	283	12,000	320	13,000	360	15,000	401
				20	1.4	12,000	318	13,000	353	15,000	391	16,000	429
				25	1.7	13,000	349	14,000	387	16,000	427	17,000	466
	20 to 38	1.4 to 2.6	Blue	25	1.7	12,000	334	14,000	386	17,000	447	19,000	508
				30	2.1	14,000	367	16,000	424	18,000	480	20,000	536
				35	2.4	15,000	390	17,000	451	19,000	507	21,000	562

Air

Table 13. Air Relief Capacities in SCFH / Nm³/h, Types MR98L and MR98LD with Metal Diaphragm

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar									
						2 / 0.14		4 / 0.28		6 / 0.41		8 / 0.55		10 / 0.69	
	psi	bar		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	290	7.68	500	13.3	710	18.9	870	23.4	1000	27.9
				5	0.34	330	8.77	550	14.6	760	20.5	940	25.3	1100	30.2
	6 to 14	0.41 to 0.97	Green	10	0.69	290	7.72	510	13.7	730	19.6	930	25.1	1100	30.5
	12 to 25	0.83 to 1.7	Red	15	1.0	280	7.39	480	12.9	690	18.5	890	23.8	1100	29.1
				20	1.4	330	8.83	570	15.3	810	21.7	1000	27.4	1200	33.1
				25	1.7	360	9.68	610	16.4	860	23.1	1100	29.1	1300	35.1
	20 to 38	1.4 to 2.6	Blue	25	1.7	340	9.21	550	14.6	750	20.1	950	25.5	1200	30.9
				30	2.1	390	10.5	600	16.1	810	21.8	1000	27.4	1200	33
				35	2.4	420	11.2	640	17.3	870	23.3	1100	29	1300	34.7
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	1500	39.2	1900	49.9	2300	60.6	2600	69.2	2900	77.7
				5	0.34	2000	52.9	2400	63.8	2800	74.7	3100	82.8	3400	90.9
	6 to 14	0.41 to 0.97	Green	10	0.69	1800	47.2	2300	62.9	2900	78.6	3300	88.5	3700	98.4
	12 to 25	0.83 to 1.7	Red	15	1.0	1000	27	1700	45.9	2400	64.8	2900	77.3	3300	89.7
				20	1.4	1500	39.5	2300	62.5	3200	85.5	3600	97.7	4100	110
				25	1.7	1500	40	2400	64.9	3300	89.7	3900	104	4400	119
	20 to 38	1.4 to 2.6	Blue	25	1.7	1200	33.5	2300	61.7	3400	89.8	4200	113	5100	137
				30	2.1	1500	39.6	2600	70.4	3800	101	4700	125	5600	149
				35	2.4	1600	43.8	2900	76.5	4100	109	5100	135	6000	162
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	2000	52.3	2800	74.9	3600	97.5	4300	115	5000	133
				5	0.34	2600	69.9	3500	92.9	4300	116	5000	133	5600	150
	6 to 14	0.41 to 0.97	Green	10	0.69	2600	70	3800	103	5000	135	5800	157	6600	178
	12 to 25	0.83 to 1.7	Red	15	1.0	2500	66.7	3700	99.7	5000	133	5900	157	6800	181
				20	1.4	2500	66.3	3900	104	5300	141	6300	168	7300	195
				25	1.7	2500	67.3	4000	108	5500	148	6600	177	7700	206
	20 to 38	1.4 to 2.6	Blue	25	1.7	2100	55.5	3400	90.8	4700	126	5700	153	6700	180
				30	2.1	2300	61.4	3600	97.4	5000	133	6000	162	7100	190
				35	2.4	2500	66.3	3800	102	5100	137	6200	167	7400	197

- continued -

Table 13. Air Relief Capacities in SCFH / Nm³/h, Types MR98L and MR98LD with Metal Diaphragm (continued)

NOMINAL BODY SIZE, IN. / DN	SPRING RELIEF PRESSURE RANGE		COLOR CODE	RELIEF PRESSURE SETTING		PRESSURE BUILD-UP OVER RELIEF SETTING, psig / bar							
						15 / 1.0		20 / 1.4		25 / 1.7		30 / 2.1	
	psi	bar		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1/4 NPT	2 to 7	0.14 to 0.48	Yellow	2	0.14	1300	36.1	1700	44.2	1900	50.9	2100	57.5
				5	0.34	1400	38.5	1700	46.9	2000	53.7	2300	60.4
	6 to 14	0.41 to 0.97	Green	10	0.69	1500	40.7	1900	50.8	2200	58.4	2500	66
	12 to 25	0.83 to 1.7	Red	15	1.0	1500	41.4	2000	53.6	2300	62.1	2600	70.6
				20	1.4	1700	45.2	2100	57.3	2500	66	2800	74.8
				25	1.7	1800	48.2	2300	61.3	2600	70.7	3000	80.2
	20 to 38	1.4 to 2.6	Blue	25	1.7	1600	43.9	2100	56.8	2500	66.9	2900	77
				30	2.1	1700	46.4	2200	59.8	2600	70.4	3000	80.9
				35	2.4	1800	48.6	2300	62.4	2700	73.5	3200	84.6
1/2 / 15	2 to 7	0.14 to 0.48	Yellow	2	0.14	3600	97	4300	116	5000	134	5600	151
				5	0.34	4100	109	4800	128	5400	144	6000	161
	6 to 14	0.41 to 0.97	Green	10	0.69	4500	120	5200	141	5900	158	6500	175
	12 to 25	0.83 to 1.7	Red	15	1.0	4100	111	4900	132	5600	150	6300	169
				20	1.4	4800	129	5500	148	6200	166	6800	183
				25	1.7	5200	140	6000	161	6600	178	7300	195
	20 to 38	1.4 to 2.6	Blue	25	1.7	6100	164	7100	191	7800	209	8500	228
				30	2.1	6600	178	7700	206	8400	225	9100	244
				35	2.4	7200	192	8300	222	8900	240	9600	258
3/4 and 1 / 20 and 25	2 to 7	0.14 to 0.48	Yellow	2	0.14	6400	171	7800	209	9400	252	11,000	295
				5	0.34	7100	189	8500	229	10,000	270	12,000	311
	6 to 14	0.41 to 0.97	Green	10	0.69	8300	221	9900	265	12,000	310	13,000	355
	12 to 25	0.83 to 1.7	Red	15	1.0	8400	226	10,000	271	13,000	335	15,000	400
				20	1.4	9100	244	11,000	293	14,000	367	16,000	441
				25	1.7	9700	260	12,000	315	15,000	398	18,000	482
	20 to 38	1.4 to 2.6	Blue	25	1.7	8800	236	11,000	292	14,000	387	18,000	482
				30	2.1	9300	249	11,000	308	15,000	415	19,000	522
				35	2.4	9700	259	12,000	320	16,000	442	21,000	563

Type MR105

Pressure Reducing Regulator

FISHER

Introduction

Type MR105 direct-operated pressure reducing regulator is a high capacity multi-purpose regulator designed to provide fast and economical pressure control for various applications and is suitable for different flow media such as liquid, air and gas. Type MR105 is ideal for applications where speed of response is critical, minimum differential pressure is a concern, or the process fluid is not free of impurities. Typical applications include lube oil, cooling water and pump bypass regulators.

The Type MR105 is available in linear and quick opening trim cages for gas and liquid applications, respectively. The cage-guided metal plug provides superior control and stability. The Type MR105 is offered in Low Pressure and High Pressure constructions (see Figures 1 and 2).

Body Sizes and End Connection Styles

See Table 1

Construction Materials

See Table 2

Maximum Differential Pressures

See Table 3

Outlet Pressure Ranges

5 to 300 psig / 0.34 to 20.7 bar; See Table 4

Maximum Inlet, Outlet and Emergency Casing Pressure

See Table 5

Wide-Open Flow and IEC Sizing Coefficients

See Table 6

Flow Capacities

See Tables 7 to 10

Shutoff Classification per ANSI/FCI 70-3-2004

Class VI (Soft Seat)

Temperature Capabilities

Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM)(1):
20 to 250°F / -7 to 121°C
Ethylene Propylene (EPDM)(2):
-20 to 225°F / -29 to 107°C

Pressure Registration

External

Downstream Control Line Connection Size

1/2 NPT

Maximum Pressure Over Setpoint to Avoid Internal Parts Damage

Low-Pressure Actuator: 20 psig / 1.4 bar
High-Pressure Actuator: 120 psig / 8.3 bar

Pressure-Loaded Spring Case Vent Connection

1/2 NPT

Approximate Weights

See Table 11

Options

Visual Travel Indicator, Drain Valve, Pressure-Loaded Actuator, Bleed Valve (for High-Pressure Actuator Only) and EPDM Elastomer Trim Parts

Ordering Guide

To order this product, contact your local Sales Office.

Features

- **Large Capacity Regulator with Minimal Offset from Setpoint and Fast Speed of Response**
- **Versatile Regulator for Liquid or Gas Service**
- **Bubble Tight Shutoff**
- **Designed for Superior Control Stability of Delivery Pressure**
- **Wide Range of Applications with Multiple Trim Materials**
- **NACE Constructions for Sour Gas Service Capability**
- **API 614 Compliant Constructions**
- **Visual Indication of Valve Movement with Optional Travel Indicator**
- **Drain Option for Ease of System Drainage leading to Cost and Space Savings**
- **Bleed Option for Performance Improvement**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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P1205

Figure 1. *Type MR105 Direct-Operated Regulator with Low-Pressure Actuator*

P1204

Figure 2. *Type MR105 Direct-Operated Regulator with High-Pressure Actuator*

Applications

- **Air**
- **Liquid**
- **Process Gas**

1. Fluorocarbon (FKM) is limited to 200°F / 93°C in hot water.
2. Ethylene Propylene (EPDM) is limited to 20 to 250°F / -7 to 121°C when used with Low Pressure Actuator.

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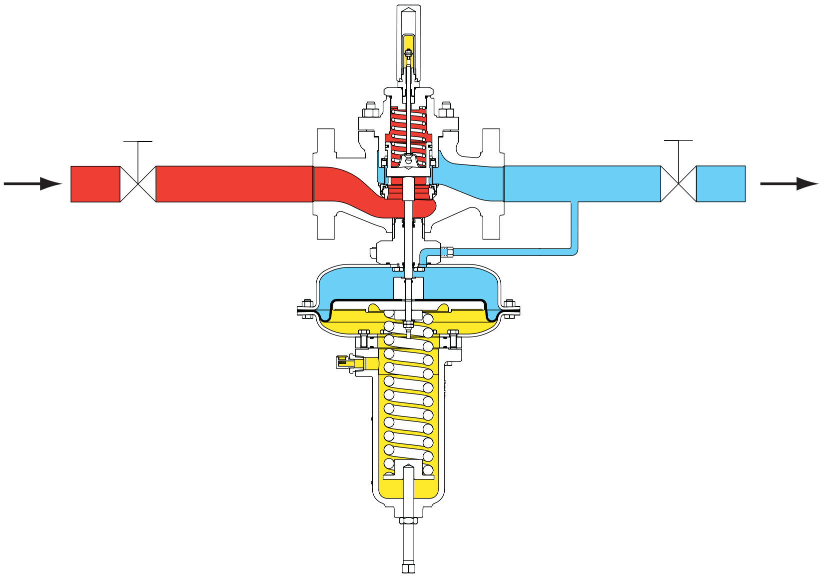

Figure 3. *Type MR105 Operational Schematic*

Table 1. Body Sizes and End Connection Styles

BODY MATERIAL	END CONNECTION STYLE	
	Body Size	
	NPS 1 and 2 / DN 25 and 50	NPS 3 and 4 / DN 80 and 100
Cast Iron	NPT, CL125 FF, CL250 RF	CL125 FF, CL250 RF
WCC steel(1)(2)	NPT, CL150 RF, CL300 RF, CL600 RF or PN 16/25/40 RF	CL150 RF, CL300 RF, CL600 RF or PN 16 RF
CF8M Stainless steel(1)(2)		
CF3M Stainless steel(1)(2)		

1. Optional NACE construction available.
2. Constructions meet API 614 requirements.

Table 2. Construction Materials

PART NAME	STANDARD	OPTIONAL
Body	WCC steel(1)	Cast Iron, CF8M, CF3M Stainless steel
Body Flange	WCC steel(1)	CF8M, CF3M Stainless steel
Actuator Casings - Low Pressure	AISI 1010 steel(1)	316/316L Stainless steel
Actuator Casings - High Pressure	WCC steel(1)	CF3M/CF8M Stainless steel
Internal Stiffener Plate	AISI 1010 steel(1)	316/316L Stainless steel
Spring Case	WCC steel	CF3M/CF8M Stainless steel
Spring Case Spacer	Zinc-Plated steel	Stainless steel
Cage	CF3M/CF8M (Quick Opening), CF8M (Linear) Stainless Steel	
Valve Plug and Seat Ring	416 Stainless steel	316, 316L, S20910 (Nitronic® 50) Stainless steel (NPS 1 / DN 25 body size only)
Closing Spring	Inconel® X750	
Stem	S17400 H1075 Stainless steel	S20910 (Nitronic® 50) Stainless steel
Lower Diaphragm Support	S17400 H1075 Stainless steel	
Diaphragm and Seals	Nitrile (NBR)	Fluorocarbon (FKM), Ethylene Propylene (EPDM)
Upper Diaphragm Plate	Cast Iron	
Control/Set Spring	Steel Alloy(1)	
Spring Seats	Zinc-Plated steel	
Bolting	SA194 Grade B7/NCF (Body to Bonnet), SAE Grade 5/NCF (Actuator)	Stainless steel
Adjusting Screw	Zinc-Plated steel	Stainless steel

1. Powder coated.

Table 3. Maximum Differential Pressures

ACTUATOR TYPE	BODY SIZE		MAXIMUM DIFFERENTIAL PRESSURE			
			Gas Service (Linear Cage)		Liquid Service (Quick Opening Cage)	
	NPS	DN	psid	bar d	psid	bar d
Low Pressure	1	25	400 or maximum inlet pressure, whichever is lower	27.6 or maximum inlet pressure, whichever is lower	200	13.6
	2	50			200	13.6
	3	80			225	15.5
	4	100			225	15.5
High Pressure	1	25	400 or maximum inlet pressure, whichever is lower	27.6 or maximum inlet pressure, whichever is lower	250	17.2
	2	50			200	13.6
	3	80			225	15.5
	4	100			250	17.2

Table 4. Outlet Pressure Ranges

ACTUATOR TYPE	BODY SIZE, SPRING RANGE				SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH		MAXIMUM PRESSURE OVER SETPOINT TO AVOID INTERNAL PARTS DAMAGE	
	NPS 1 AND 2 / DN 25 AND 50		NPS 3 AND 4 / DN 80 AND 100								
	psig	bar	psig	bar		In.	mm	In.	mm	psig	bar
Low Pressure	5 to 12	0.34 to 0.83	5 to 8	0.34 to 0.55	White	0.437	11.1	9.7	246	20	1.4
	10 to 24	0.69 to 1.6	8 to 20	0.55 to 1.4	Silver	0.500	12.7				
	14 to 32	0.96 to 2.2	12 to 30	0.83 to 2.1	Orange	0.562	14.3				
	18 to 43	1.2 to 3.0	18 to 39	1.2 to 2.7	Red	0.625	15.9				
High Pressure	25 to 60[1]	1.7 to 4.1[1]			Green	0.375	9.52			120	8.3
	43 to 100	3.0 to 6.9	39 to 72	2.7 to 5.0	White	0.437	11.1				
	75 to 175[2]	5.2 to 2.1[2]	71 to 175[2]	4.9 to 12.1[2]	Silver	0.500	12.7				
	110 to 300[2]	7.6 to 20.7[2]	110 to 250[2]	7.6 to 17.2[2]	Orange	0.562	14.3				

1. NPS 2 / DN 50 body size spring range is limited to 45 psig / 3.1 bar.
2. Maximum setpoint is limited to 150 psig / 10.3 bar for constructions with Fluorocarbon (FKM) diaphragm.

Table 5. Maximum Inlet, Outlet and Emergency Casing Pressures[1]

BODY MATERIAL	END CONNECTION	MAXIMUM INLET PRESSURE		MAXIMUM OUTLET PRESSURE				MAXIMUM EMERGENCY CASING			
				Low-Pressure Actuator		High-Pressure Actuator[2]		Low-Pressure Actuator		High-Pressure Actuator[2]	
		psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
Cast Iron	NPT	340	23.4	70	4.8	340	23.4	70	4.8	340	23.4
	CL125 FF	175	12.1			175	12.1			175	12.1
	CL250 RF	400	27.6			400	27.6			400	27.6
WCC steel	NPT	400	27.6	70	4.8	400	27.6	70	4.8	400	27.6
	CL150 RF	245	16.9			245	16.9			245	16.9
	CL300 RF	400	27.6			400	27.6			400	27.6
	CL600 RF										
	PN 16 RF	245	16.9			245	16.9			245	16.9
	PN 16/25/40 RF	400	27.6			400	27.6			400	27.6
CF8M Stainless steel	NPT	400	27.6	70	4.8	400	27.6	70	4.8	400	27.6
	CL150 RF	225	15.5			225	15.5			225	15.5
	CL300 RF	400	27.6			400	27.6			400	27.6
	CL600 RF										
	PN 16 RF	225	15.5			225	15.5			225	15.5
	PN 16/25/40 RF	400	27.6			400	27.6			400	27.6
CF3M Stainless steel	NPT	400	27.6	70	4.8	400	27.6	70	4.8	400	27.6
	CL150 RF	185	12.7			185	12.7			185	12.7
	CL300 RF	400	27.6			400	27.6			400	27.6
	CL600 RF										
	PN 16 RF	185	12.7			185	12.7			185	12.7
	PN 16/25/40 RF	400	27.6			400	27.6			400	27.6

1. Based on a maximum temperature of 250°F / 121°C.
2. Maximum outlet and emergency casing pressures for constructions with Fluorocarbon (FKM) diaphragm are limited to 230 psig / 15.8 bar or the body rating limit, whichever is lower.

Table 6. Wide-Open Flow and IEC Sizing Coefficients[1]

Body Size		Wide-Open Flow Coefficient		IEC Sizing Coefficient				
		Line Size Equals Body Size		C_1	K_m	F_L	X_T	F_d
NPS	DN	C_g	C_v					
LINEAR CAGE								
1	25	463	13.7	34.0	0.81	0.90	0.73	0.36
2	50	761	22.5	33.8	0.75	0.87	0.72	0.24
3	80	997	30.5	32.7	0.78	0.88	0.68	0.22
4	100	934	27.5	34.0	0.77	0.88	0.75	0.18
QUICK OPENING CAGE								
1	25	597	17.5	34.1	0.81	0.90	0.73	0.43
2	50	1740	48.2	36.1	0.81	0.90	0.82	0.34
3	80	3540	103.1	34.4	0.76	0.87	0.75	0.32
4	100	4300	135.9	31.6	0.72	0.85	0.65	0.30
REDUCED PORT QUICK OPENING CAGE								
2	50	1570	43.8	35.9	0.81	0.90	0.72	0.36

1. Refer to product bulletin for Regulating C_v's: Air C_v's with Linear Cage and Water C_v's with Quick Opening Cage.

Air

Table 7. Typical Air Capacities with Linear Cage - Setpoint Made at 10% Flow (for Type MR105 with Low-Pressure Actuator)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR											
					NPS 1 / DN 25 BODY						NPS 2 / DN 50 BODY					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 12 psig / 0.34 to 0.83 bar White	5	0.34	25	1.7	3300	89	4800	130	9800	260	3800	100	5800	160	11,800	320
			75	5.2	7700	210	12,200	330	25,800	690	10,600	280	13,600	360	27,300	730
			150	10.3	15,500	420	22,200	600	50,000	1300	18,000	480	27,600	740	57,100	1500
			250	17.2	18,400	490	29,100	780	76,400	2000	28,000	750	43,000	1200	93,800	2500
	10	0.69	25	1.7	3100	84	7500	200	17,300	460	5700	150	11,800	320	25,700	690
			75	5.2	12,000	320	23,400	630	41,600	1100	14,000	370	26,200	700	66,100	1800
			150	10.3	20,300	540	38,000	1000	79,700	2100	21,600	580	46,600	1200	121,000	3200
			250	17.2	34,500	930	76,000	2000	128,000	3400	38,800	1000	73,700	2000	182,000	4900
10 to 24 psig / 0.69 to 1.6 bar Silver	10	0.69	25	1.7	3100	84	6100	160	13,900	370	4600	120	8000	210	16,600	450
			75	5.2	8600	230	15,300	410	34,200	920	10,200	270	18,300	490	38,500	1000
			150	10.3	15,600	420	28,000	750	64,700	1700	19,700	530	34,200	920	79,300	2100
			250	17.2	29,200	780	46,000	1200	114,000	3100	30,900	830	57,800	1500	127,000	3400
	15	1.0	25	1.7	4000	110	8400	230	16,700	450	5100	140	11,400	310	26,200	700
			75	5.2	11,600	310	22,400	600	43,200	1200	15,200	410	28,200	760	66,600	1800
			150	10.3	21,900	590	43,400	1200	79,100	2100	28,500	760	54,600	1500	123,000	3300
			250	17.2	34,500	920	70,500	1900	128,000	3400	40,400	1100	87,800	2400	192,000	5200
	20	1.4	50	3.4	9800	260	21,900	590	30,600	820	12,500	330	26,000	700	48,200	1300
			75	5.2	13,500	360	29,200	780	42,500	1100	17,100	460	35,900	960	68,000	1800
			150	10.3	26,600	710	61,200	1600	79,400	2100	26,800	720	58,000	1600	125,000	3300
			250	17.2	44,000	1200	90,800	2400	127,000	3400	52,800	1400	121,000	3200	202,000	5400
14 to 32 psig / 0.96 to 2.2 bar Orange	15	1.0	25	1.7	3300	87	6400	170	14,700	390	4700	130	8400	230	20,100	540
			75	5.2	8500	230	16,800	450	36,800	990	11,100	300	19,600	520	46,400	1200
			150	10.3	16,000	430	28,900	780	65,100	1700	22,500	600	41,600	1100	90,900	2400
			250	17.2	27,000	720	51,800	1400	120,000	3200	34,500	920	63,200	1700	164,000	4400
	20	1.4	25	1.7	3500	94	7700	210	15,100	400	4300	120	10,400	280	22,700	610
			75	5.2	10,300	280	20,200	540	42,000	1100	13,500	360	26,400	710	66,000	1800
			150	10.3	19,700	530	39,000	1000	77,900	2100	28,600	770	53,700	1400	122,000	3300
			250	17.2	33,500	900	65,300	1700	127,000	3400	38,700	1000	79,800	2100	194,000	5200
	25	1.7	50	3.4	9500	250	18,900	510	29,900	800	10,300	280	22,900	610	47,200	1300
			75	5.2	11,200	300	25,500	680	43,000	1200	14,400	390	35,500	950	67,100	1800
			150	10.3	22,600	610	49,100	1300	79,100	2100	28,900	770	63,400	1700	125,000	3400
			250	17.2	36,400	980	87,500	2300	129,000	3400	42,700	1100	97,300	2600	202,000	5400
	30	2.1	50	3.4	10,000	270	22,000	590	29,700	800	11,100	300	27,300	730	46,400	1200
			75	5.2	14,700	390	33,200	890	42,300	1100	18,600	500	41,900	1100	67,800	1800
			150	10.3	26,700	720	62,100	1700	78,900	2100	34,600	930	80,700	2200	125,000	3300
			250	17.2	49,700	1300	114,000	3100	128,000	3400	47,200	1300	121,000	3300	202,000	5400
18 to 43 psig / 1.2 to 3.0 bar Red	20	1.4	50	3.4	5600	150	11,600	310	24,100	640	7800	210	15,700	420	33,200	890
			75	5.2	7800	210	15,500	420	33,600	900	14,000	370	19,900	530	46,300	1200
			150	10.3	16,900	450	30,000	800	66,400	1800	23,200	620	41,300	1100	90,100	2400
			250	17.2	25,400	680	45,200	1200	108,000	2900	36,300	970	62,500	1700	150,000	4000
	25	1.7	50	3.4	6400	170	13,400	360	27,700	740	10,000	270	18,100	490	43,200	1200
			75	5.2	11,000	290	20,700	560	41,600	1100	12,200	330	26,900	720	61,900	1700
			150	10.3	18,000	480	37,600	1000	76,600	2100	26,600	710	49,800	1300	117,000	3100
			250	17.2	31,100	830	59,800	1600	125,000	3300	41,000	1100	78,200	2100	181,000	4900
	30	2.1	50	3.4	8500	230	16,400	440	29,800	800	9100	240	21,600	580	44,900	1200
			75	5.2	12,300	330	24,500	660	42,600	1100	17,100	460	30,100	810	66,400	1800
			150	10.3	22,100	590	46,400	1200	79,200	2100	32,700	880	60,600	1600	122,000	3300
			250	17.2	34,000	910	70,900	1900	125,000	3300	45,000	1200	95,300	2600	198,000	5300
	35	2.4	50	3.4	8400	230	17,900	480	28,600	770	10,600	280	23,600	630	44,700	1200
			75	5.2	13,400	360	26,800	720	42,800	1100	17,800	480	38,300	1000	66,600	1800
			150	10.3	24,800	660	52,600	1400	78,700	2100	34,900	930	71,800	1900	124,000	3300
			250	17.2	39,700	1100	82,200	2200	124,000	3300	50,800	1400	112,000	3000	202,000	5400
	40	2.8	50	3.4	8600	230	19,600	530	27,600	740	10,200	270	26,900	720	43,100	1200
			75	5.2	12,800	340	30,300	810	42,500	1100	20,200	540	42,500	1100	65,500	1800
			150	10.3	25,200	680	61,600	1700	79,700	2100	30,700	820	67,400	1800	125,000	3300
			250	17.2	46,000	1200	99,300	2700	127,000	3400	56,200	1500	133,000	3600	204,000	5500

- continued -

Air

Table 7. Typical Air Capacities with Linear Cage - Setpoint Made at 10% Flow (for Type MR105 with Low-Pressure Actuator) (continued)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR											
					NPS 3 / DN 80 Body						NPS 4 / DN 100 Body					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 8 psig / 0.34 to 0.55 bar White	5	0.34	25	1.7	6300	170	8700	230	15,600	420	6200	160	8600	230	13,300	360
			75	5.2	13,600	360	19,400	520	35,900	960	13,800	370	18,500	500	32,800	880
			150	10.3	23,900	640	35,600	950	61,100	1600	24,000	640	34,300	920	61,000	1600
			250	17.2	34,400	920	50,400	1300	95,900	2600	40,000	1100	54,400	1500	97,000	2600
	8	0.55	25	1.7	8000	210	13,000	350	27,300	730	7000	190	11,000	300	22,800	610
			75	5.2	16,800	450	27,400	730	59,200	1600	16,100	430	25,400	680	51,700	1400
			150	10.3	28,200	750	47,600	1300	103,000	2800	30,100	810	51,400	1400	97,100	2600
			250	17.2	47,700	1300	78,500	2100	174,000	4700	41,500	1100	72,400	1900	156,000	4200
8 to 20 psig / 0.55 to 1.4 bar Silver	10	0.69	25	1.7	6600	180	11,200	300	22,000	590	5000	130	9600	260	19,300	520
			75	5.2	17,000	450	25,800	690	50,800	1400	14,600	390	22,500	600	46,600	1200
			150	10.3	28,500	760	43,500	1200	91,000	2400	25,900	690	39,300	1100	78,100	2100
			250	17.2	44,900	1200	72,300	1900	151,000	4000	37,700	1000	61,000	1600	127,000	3400
	15	1.0	25	1.7	7700	210	15,000	400	34,800	930	6400	170	12,700	340	29,400	790
			75	5.2	20,700	560	37,800	1000	85,400	2300	18,600	500	32,500	870	71,700	1900
			150	10.3	34,100	910	64,300	1700	151,000	4000	30,900	830	56,100	1500	130,000	3500
			250	17.2	57,900	1600	106,000	2900	240,000	6400	48,100	1300	88,700	2400	210,000	5600
	20	1.4	50	3.4	13,300	360	28,300	760	64,000	1700	15,200	410	29,200	780	55,100	1500
			75	5.2	25,000	670	49,300	1300	91,000	2400	23,600	630	42,700	1100	76,100	2000
			150	10.3	44,200	1200	90,300	2400	168,000	4500	38,000	1000	74,000	2000	154,000	4100
			250	17.2	72,900	2000	145,000	3900	271,000	7300	72,800	2000	121,000	3200	250,000	6700
12 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	25	1.7	6400	170	11,300	300	24,500	660	5300	140	9000	240	20,900	560
			75	5.2	16,700	450	27,000	720	58,400	1600	15,400	410	24,900	670	50,200	1300
			150	10.3	29,100	780	49,200	1300	105,000	2800	28,900	770	47,000	1300	97,000	2600
			250	17.2	47,800	1300	78,900	2100	173,000	4600	46,000	1200	75,400	2000	157,000	4200
	20	1.4	25	1.7	7200	190	14,100	380	31,700	850	4700	130	10,100	270	26,100	700
			75	5.2	19,600	520	35,300	940	81,300	2200	20,000	530	34,200	920	75,400	2000
			150	10.3	34,300	920	61,600	1700	149,000	4000	35,100	940	61,400	1600	138,000	3700
			250	17.2	49,600	1300	94,200	2500	234,000	6300	48,900	1300	87,200	2300	207,000	5600
	25	1.7	50	3.4	18,400	490	32,000	860	63,900	1700	13,800	370	26,600	710	54,300	1500
			75	5.2	21,400	570	42,600	1100	90,200	2400	19,900	530	40,500	1100	77,300	2100
			150	10.3	31,500	840	66,900	1800	166,000	4400	38,300	1000	73,600	2000	143,000	3800
			250	17.2	71,900	1900	138,000	3700	267,000	7200	57,400	1500	112,000	3000	232,000	6200
	30	2.1	50	3.4	18,900	510	33,800	910	64,600	1700	14,600	390	32,600	870	52,900	1400
			75	5.2	29,700	800	56,800	1500	89,800	2400	24,500	660	50,300	1300	76,800	2100
			150	10.3	45,600	1200	90,500	2400	167,000	4500	44,900	1200	91,200	2400	143,000	3800
			250	17.2	72,700	1900	158,000	4200	269,000	7200	71,700	1900	145,000	3900	231,000	6200
18 to 39 psig / 1.2 to 2.7 bar Red	20	1.4	50	3.4	12,000	320	20,100	540	42,600	1100	9800	260	17,000	460	36,300	970
			75	5.2	16,900	450	27,600	740	60,300	1600	15,100	400	26,100	700	51,600	1400
			150	10.3	29,500	790	48,800	1300	107,000	2900	28,300	760	46,700	1300	96,600	2600
			250	17.2	51,100	1400	83,200	2200	177,000	4700	48,300	1300	78,200	2100	164,000	4400
	25	1.7	50	3.4	14,400	390	25,700	690	55,100	1500	12,200	330	21,400	570	48,900	1300
			75	5.2	20,000	540	35,400	950	79,300	2100	18,300	490	31,600	850	68,800	1800
			150	10.3	28,400	760	51,700	1400	125,000	3300	34,100	910	58,300	1600	132,000	3500
			250	17.2	57,100	1500	100,000	2700	232,000	6200	51,600	1400	93,000	2500	214,000	5700
	30	2.1	50	3.4	12,400	330	25,500	680	62,800	1700	12,400	330	23,900	640	54,400	1500
			75	5.2	23,100	620	42,300	1100	88,300	2400	19,700	530	36,500	980	79,500	2100
			150	10.3	38,200	1000	73,500	2000	160,000	4300	36,700	980	68,900	1800	145,000	3900
			250	17.2	62,900	1700	117,000	3100	265,000	7100	62,600	1700	114,000	3100	244,000	6500
	35	2.4	50	3.4	18,700	500	32,700	880	63,000	1700	13,400	360	27,100	730	54,300	1500
			75	5.2	20,800	560	42,500	1100	90,300	2400	23,200	620	45,000	1200	79,900	2100
			150	10.3	38,000	1000	78,400	2100	167,000	4500	41,100	1100	81,000	2200	151,000	4000
			250	17.2	68,400	1800	139,000	3700	270,000	7200	66,000	1800	137,000	3700	244,000	6500

Air

Table 8. Typical Air Capacities with Linear Cage - Setpoint Made at 10% Flow (for Type MR105 with High-Pressure Actuator)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF AIR											
					NPS 1 / DN 25 Body						NPS 2 / DN 50 Body					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
25 to 60 psig / 1.7 to 4.1 bar Green	25	1.7	50	3.4	4100	110	5600	150	11,200	300						
			75	5.2	6300	170	9400	250	17,700	470						
			150	10.3	12,100	330	18,100	490	35,200	940						
			250	17.2	17,900	480	26,900	720	68,400	1800						
	30	2.1	50	3.4	4200	110	6900	190	13,800	370						
			75	5.2	8000	220	10,900	290	21,500	580						
			150	10.3	13,000	350	20,500	550	45,500	1200						
			250	17.2	20,500	550	33,500	900	91,000	2400						
	40	2.8	50	3.4	4000	110	7300	200	17,600	470						
			75	5.2	8000	210	13,400	360	29,000	780						
			150	10.3	14,000	370	24,200	650	59,000	1600						
			250	17.2	24,500	660	44,000	1200	122,000	3300						
	50	3.4	75	5.2	7300	190	14,000	380	33,800	910						
			150	10.3	16,700	450	30,900	830	76,000	2000						
			250	17.2	27,600	740	54,200	1500	129,000	3500						
	60	4.1	75	5.2	7200	190	14,400	390	38,900	1000						
			150	10.3	19,900	530	37,800	1000	80,400	2200						
			250	17.2	31,400	840	64,800	1700	129,000	3500						
25 to 45 psig / 1.7 to 3.1 bar Green	25	1.7	50	3.4							6400	170	8800	240	13,600	370
			75	5.2							8100	220	11,300	300	18,800	500
			150	10.3							17,700	470	22,300	600	37,800	1000
			250	17.2							26,300	700	34,700	930	59,200	1600
	30	2.1	50	3.4							5700	150	8200	220	15,300	410
			75	5.2							9900	260	13,200	350	24,000	640
			150	10.3							18,300	490	25,700	690	45,000	1200
			250	17.2							27,600	740	38,800	1000	69,100	1900
	40	2.8	50	3.4							5500	150	9500	260	19,400	520
			75	5.2							10,800	290	16,300	440	31,900	860
			150	10.3							19,100	510	29,500	790	58,400	1600
			250	17.2							32,100	860	48,700	1300	93,200	2500
	45	3.1	75	5.2							10,100	270	16,500	440	34,200	920
			150	10.3							20,300	540	31,200	840	62,700	1700
			250	17.2							35,000	940	53,600	1400	110,000	3000
43 to 100 psig / 3.0 to 6.9 bar White	50	3.4	75	5.2	6500	170	11,100	300	23,500	630	9000	240	13,800	370	27,600	740
			150	10.3	14,500	390	23,000	620	51,300	1400	18,500	500	27,600	740	51,800	1400
			250	17.2	22,400	600	36,600	980	97,300	2600	29,500	790	45,700	1200	86,600	2300
	60	4.1	75	5.2	6300	170	11,700	310	28,500	760	8600	230	15,000	400	32,600	870
			150	10.3	15,200	410	26,800	720	61,100	1600	20,300	540	31,600	850	62,400	1700
			250	17.2	24,700	660	45,000	1200	120,000	3200	32,900	880	51,800	1400	104,000	2800
	75	5.2	100	6.9	8600	230	17,700	470	45,000	1200	13,300	360	23,100	620	54,700	1500
			150	10.3	17,800	480	33,900	910	76,000	2000	22,600	610	39,500	1100	85,100	2300
			250	17.2	28,300	760	53,200	1400	129,000	3400	34,700	930	61,100	1600	132,000	3500
	100	6.9	150	10.3	18,000	480	38,800	1000	78,200	2100	20,500	550	42,400	1100	108,000	2900
			250	17.2	31,700	850	67,000	1800	130,000	3500	38,600	1000	77,600	2100	187,000	5000
75 to 175 psig / 5.2 to 12.1 bar Silver	75	5.2	100	6.9	8200	220	14,800	400	33,300	890	11,000	300	17,000	450	35,700	960
			250	17.2	23,300	620	37,400	1000	87,400	2300	33,500	900	50,200	1300	90,400	2400
	100	6.9	150	10.3	13,400	360	26,500	710	62,700	1700	17,800	480	31,500	840	71,200	1900
			250	17.2	26,600	710	48,700	1300	114,000	3100	36,800	990	59,700	1600	127,000	3400
	125	8.6	200	13.8	22,200	590	44,600	1200	99,700	2700	27,400	730	54,000	1400	126,000	3400
			300	20.7	36,900	990	70,400	1900	154,000	4100	46,600	1200	85,800	2300	196,000	5200
	150	10.3	200	13.8	23,900	640	51,400	1400	103,000	2700	29,600	790	59,500	1600	152,000	4100
			300	20.7	40,300	1100	84,500	2300	154,000	4100	51,200	1400	98,400	2600	231,000	6200
	175	12.1	200	13.8	21,000	560	52,300	1400	99,100	2700	27,600	740	64,600	1700	150,000	4000
			300	20.7	45,600	1200	101,000	2700	153,000	4100	56,900	1500	115,000	3100	241,000	6500
110 to 300 psig / 7.6 to 20.7 bar Orange	125	8.6	150	10.3	10,000	270	21,200	570	51,700	1400	14,700	400	27,400	730	64,500	1700
			250	17.2	25,500	680	44,600	1200	100,000	2700	33,400	890	57,500	1500	114,000	3100
	150	10.3	200	13.8	18,000	480	36,200	970	89,300	2400	24,800	660	46,100	1200	107,000	2900
			300	20.7	31,800	850	61,300	1600	145,000	3900	44,900	1200	76,500	2000	173,000	4600
	200	13.8	250	17.2	27,300	730	60,200	1600	126,000	3400	35,100	940	71,300	1900	182,000	4900
			300	20.7	40,400	1100	83,200	2200	151,000	4100	53,600	1400	105,000	2800	230,000	6200
	250	17.2	300	20.7	31,800	850	88,300	2400	150,000	4000	46,100	1200	103,000	2800	228,000	6100
			350	24.1	54,300	1500	115,000	3100	176,000	4700	72,200	1900	155,000	4200	275,000	7400
	300	20.7	350	24.1	46,800	1300	119,000	3200	171,000	4600	60,000	1600	146,000	3900	264,000	7100

- Spring range is not available for the body size.

- continued -

Air

Table 8. Typical Air Capacities with Linear Cage - Setpoint Made at 10% Flow (for Type MR105 with High-Pressure Actuator) (continued)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF AIR											
					NPS 3 / DN 80 Body						NPS 4 / DN 100 Body					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
39 to 72 psig / 2.7 to 5.0 bar White	40	2.8	75	5.2	9900	270	13,900	370	23,100	620	11,200	300	14,500	390	23,200	620
			150	10.3	21,600	580	29,400	790	47,800	1300	20,200	540	26,300	710	43,000	1200
			250	17.2	33,500	900	45,300	1200	73,600	2000	33,600	900	44,000	1200	69,900	1900
	50	3.4	75	5.2	10,300	280	14,700	390	28,400	760	9600	260	13,700	370	26,000	700
			150	10.3	21,100	560	29,600	790	54,100	1500	22,300	600	31,300	840	53,100	1400
			250	17.2	33,700	900	47,700	1300	84,500	2300	35,700	960	48,400	1300	83,600	2200
	60	4.1	75	5.2	9900	270	16,800	450	34,300	920	9600	260	15,400	410	30,900	830
			150	10.3	21,200	570	32,600	870	63,800	1700	22,400	600	33,600	900	60,900	1600
			250	17.2	39,400	1100	56,500	1500	107,000	2900	37,900	1000	53,800	1400	100,000	2700
	70	4.8	100	6.9	13,900	370	23,500	630	51,300	1400	14,300	380	22,700	610	47,500	1300
			150	10.3	23,900	640	38,000	1000	75,600	2000	24,800	660	36,500	980	70,900	1900
			250	17.2	39,100	1000	59,800	1600	122,000	3300	40,000	1100	60,700	1600	119,000	3200
71 to 175 psig / 4.9 to 12.1 bar Silver	75	5.2	100	6.9	13,200	350	20,800	560	41,100	1100	12,600	340	18,900	510	36,600	980
			150	10.3	23,700	640	34,800	930	63,700	1700	23,000	620	31,300	840	58,400	1600
			250	17.2	37,300	1000	53,900	1400	95,400	2600	37,300	1000	50,900	1400	93,000	2500
	100	6.9	150	10.3	17,300	460	31,700	850	71,200	1900	22,500	600	35,200	940	71,200	1900
			250	17.2	41,000	1100	64,200	1700	126,000	3400	40,000	1100	60,900	1600	116,000	3100
	125	8.6	200	13.8	35,900	960	61,200	1600	136,000	3600	32,100	860	54,500	1500	119,000	3200
			300	20.7	54,900	1500	90,300	2400	192,000	5200	49,800	1300	84,700	2300	179,000	4800
	150	10.3	200	13.8	34,800	930	65,900	1800	161,000	4300	32,200	860	61,100	1600	145,000	3900
			300	20.7	59,600	1600	105,000	2800	234,000	6300	61,100	1600	102,000	2700	225,000	6000
	175	12.1	200	13.8	25,000	670	57,700	1500	175,000	4700	29,700	800	63,400	1700	165,000	4400
			300	20.7	67,400	1800	124,000	3300	292,000	7800	60,500	1600	113,000	3000	258,000	6900
110 to 250 psig / 7.6 to 17.2 bar Orange	125	8.6	150	10.3	18,300	490	32,500	870	73,600	2000	11,900	320	15,100	400	52,300	1400
			250	17.2	38,600	1000	58,400	1600	117,000	3100	31,600	850	39,700	1100	113,000	3000
	150	10.3	200	13.8	30,400	820	52,800	1400	119,000	3200	26,600	710	43,700	1200	97,000	2600
			300	20.7	42,000	1100	72,100	1900	157,000	4200	50,900	1400	80,100	2100	164,000	4400
	200	13.8	250	17.2	45,300	1200	85,000	2300	205,000	5500	36,500	980	69,200	1900	170,000	4600
			300	20.7	64,400	1700	112,000	3000	257,000	6900	57,800	1500	102,000	2700	227,000	6100
	250	17.2	300	20.7	61,300	1600	121,000	3200	293,000	7900	51,200	1400	108,000	2900	264,000	7100
			350	24.1	88,900	2400	168,000	4500	347,000	9300	80,600	2200	155,000	4200	319,000	8500

Process Gas

Regulating capacities at selected pressures and outlet pressure flows in Tables 7 to 8 are given in- SCFH (60°F and 14.7 psia) of air. To determine the equivalent capacities for other gases, multiply the table capacities in Tables 7 to 8 by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm^3/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

Liquid

Table 9. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (for Type MR105 with Low-Pressure Actuator)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN GPM / LPM OF WATER																	
					NPS 1 / DN 25 Body						NPS 2 / DN 50 - Reduced Port						NPS 2 / DN 50 Body					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 12 psig / 0.34 to 0.83 bar White	5	0.34	25	1.7	24	91	44	170	72	270	37	140	58	220	100	380	54	200	92	350	160	610
			75	5.2	42	160	79	300	130	500	74	280	110	410	160	620	92	350	160	610	250	950
			150	10.3	52	200	110	400	180	690	99	370	140	510	190	720	130	500	210	780	350	1310
	10	0.69	25	1.7	35	130	61	230	84	320	50	190	83	310	160	600	73	280	130	510	220	840
			75	5.2	74	280	130	490	160	590	99	370	150	570	260	990	150	550	230	870	390	1460
			150	10.3	110	410	180	680	210	790	140	520	180	690	320	1210	200	740	290	1080	470	1790
10 to 24 psig / 0.69 to 1.6 bar Silver	10	0.69	25	1.7	29	110	52	200	80	300	40	150	67	250	120	460	61	230	110	400	180	700
			75	5.2	53	200	100	390	150	560	84	320	130	480	210	790	120	450	190	710	310	1150
			150	10.3	77	290	160	590	200	770	110	420	160	600	260	980	170	640	260	970	390	1470
	15	1.0	25	1.7	37	140	65	250	89	340	46	170	86	330	160	590	71	270	130	500	210	790
			75	5.2	65	250	110	430	150	550	110	420	190	710	300	1150	140	540	240	900	380	1430
			150	10.3	96	360	180	670	210	780	140	530	210	800	360	1360	200	760	320	1230	580	2200
	20	1.4	50	3.4	56	210	95	360	110	430	84	320	150	580	260	1000	130	500	230	850	350	1310
			75	5.2	81	310	130	500	150	560	120	450	200	750	330	1260	170	640	290	1090	430	1630
			150	10.3	130	500	200	740	210	790	160	590	270	1000	450	1700	220	850	390	1480	700	2660
14 to 32 psig / 0.96 to 2.2 bar Orange	15	1.0	25	1.7	24	91	46	170	74	280	36	140	61	230	120	450	53	200	100	380	180	690
			75	5.2	60	230	110	400	150	560	88	330	140	510	240	890	120	470	200	770	340	1290
			150	10.3	82	310	150	580	200	770	120	470	180	670	300	1120	170	650	280	1070	490	1860
	20	1.4	25	1.7	24	91	45	170	64	240	37	140	73	280	140	520	53	200	110	420	190	710
			75	5.2	75	280	120	440	140	530	110	410	180	700	300	1130	150	570	270	1030	410	1560
			150	10.3	110	410	180	670	210	790	140	530	220	820	380	1430	220	840	400	1500	610	2310
	25	1.7	50	3.4	50	190	83	310	110	400	87	330	160	590	240	920	130	480	220	840	320	1200
			75	5.2	90	340	120	450	140	530	120	450	210	800	320	1200	160	610	270	1040	420	1570
			150	10.3	110	420	190	700	210	790	160	600	260	980	450	1700	230	870	410	1530	620	2350
	30	2.1	50	3.4	56	210	90	340	110	410	80	300	150	560	240	920	120	450	210	810	330	1260
			75	5.2	82	310	130	480	140	530	120	460	210	800	330	1230	160	620	290	1110	440	1650
			150	10.3	130	500	200	750	210	790	170	650	290	1110	480	1830	240	920	410	1540	700	2660
18 to 43 psig / 1.2 to 3.0 bar Red	20	1.4	50	3.4	39	150	73	280	110	420	61	230	100	390	180	700	90	340	150	570	270	1010
			75	5.2	57	220	100	380	140	540	85	320	130	500	240	890	120	450	200	750	330	1260
			150	10.3	79	300	150	560	200	760	130	480	190	710	310	1160	180	680	290	1100	470	1770
	25	1.7	50	3.4	46	170	77	290	110	400	67	250	120	460	220	830	100	380	190	700	300	1130
			75	5.2	60	230	110	410	150	580	98	370	160	600	280	1050	140	520	230	880	390	1470
			150	10.3	100	380	170	650	210	790	140	510	200	750	340	1290	210	780	330	1250	550	2060
	30	2.1	50	3.4	47	180	76	290	100	380	69	260	130	490	230	850	110	410	200	760	300	1150
			75	5.2	66	250	110	420	150	580	100	390	170	650	290	1100	140	540	240	920	380	1450
			150	10.3	120	440	180	690	210	790	140	540	230	850	400	1510	220	810	380	1450	580	2200
	35	2.4	50	3.4	44	170	74	280	95	360	73	280	130	500	230	850	110	410	200	770	290	1100
			75	5.2	68	260	110	420	140	550	110	420	190	710	300	1140	160	590	270	1020	400	1500
			150	10.3	130	470	190	710	210	790	150	580	260	970	450	1690	240	900	400	1500	610	2300
	40	2.8	50	3.4	40	150	71	270	96	360	65	250	130	490	220	830	94	360	170	660	290	1110
			75	5.2	70	260	110	430	140	510	120	450	200	750	310	1160	160	600	280	1040	420	1570
			150	10.3	130	490	190	720	210	780	170	630	290	1090	480	1810	260	980	430	1610	630	2370

- continued -

Liquid

Table 9. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (for Type MR105 with Low-Pressure Actuator) (continued)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN GPM / LPM OF WATER											
					NPS 3 / DN 80 Body						NPS 4 / DN 100 Body					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 8 psig / 0.34 to 0.55 bar White	5	0.34	25	1.7	87	330	130	480	220	830	110	420	170	640	290	1100
			75	5.2	140	540	200	770	320	1190	190	720	270	1030	440	1650
			150	10.3	190	730	240	900	390	1480	260	1000	360	1350	510	1920
	8	0.55	25	1.7	99	370	170	640	300	1140	120	460	230	880	410	1550
			75	5.2	180	670	260	1000	450	1680	240	900	360	1380	610	2310
			150	10.3	220	840	300	1150	520	1980	300	1120	460	1720	720	2740
8 to 20 psig / 0.55 to 1.4 bar Silver	10	0.69	25	1.7	90	340	150	560	270	1010	120	450	190	730	350	1320
			75	5.2	170	640	250	950	450	1680	230	880	350	1320	590	2220
			150	10.3	230	860	330	1230	540	2040	300	1150	440	1660	730	2750
	15	1.0	25	1.7	100	380	180	690	340	1300	130	470	230	890	460	1740
			75	5.2	220	820	350	1320	590	2220	260	1000	470	1790	830	3150
			150	10.3	260	980	420	1570	740	2790	380	1440	580	2210	1000	3770
	20	1.4	50	3.4	190	700	340	1280	590	2210	230	870	440	1680	780	2960
			75	5.2	230	870	420	1600	710	2680	300	1150	560	2100	970	3660
			150	10.3	320	1190	520	1950	920	3470	420	1580	680	2590	1250	4740
12 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	25	1.7	86	330	150	560	280	1070	100	390	180	700	360	1370
			75	5.2	190	700	290	1090	500	1900	220	840	370	1390	640	2410
			150	10.3	240	910	370	1390	630	2400	320	1210	510	1920	830	3140
	20	1.4	25	1.7	81	310	160	600	320	1220	100	390	200	760	420	1570
			75	5.2	210	800	360	1360	630	2370	260	990	440	1650	810	3070
			150	10.3	270	1000	440	1650	780	2960	390	1460	610	2310	1020	3850
	25	1.7	50	3.4	170	650	310	1160	560	2110	230	850	400	1510	750	2840
			75	5.2	240	890	420	1570	720	2730	290	1090	510	1930	920	3490
			150	10.3	320	1220	540	2040	920	3460	430	1620	710	2680	1220	4630
			250	17.2	380	1450	610	2320	1050	3960	500	1880	790	2970	1380	5210
	30	2.1	50	3.4	180	690	340	1280	580	2200	230	860	430	1640	720	2730
			75	5.2	270	1010	460	1750	750	2840	320	1220	580	2180	960	3630
			150	10.3	360	1360	620	2340	1020	3850	480	1810	810	3070	1330	5050
			250	17.2	420	1580	680	2590	1100	4170	560	2130	930	3520	1590	6000
18 to 39 psig / 1.2 to 2.7 bar Red	20	1.4	50	3.4	140	530	230	860	410	1540	170	650	280	1040	520	1970
			75	5.2	180	690	290	1090	510	1950	220	850	370	1380	650	2460
			150	10.3	240	920	380	1440	650	2480	320	1200	490	1850	860	3240
	25	1.7	50	3.4	150	560	260	970	490	1850	190	720	310	1180	590	2230
			75	5.2	210	810	340	1290	610	2290	240	900	420	1590	760	2870
			150	10.3	270	1010	450	1690	780	2960	360	1370	590	2220	1010	3800
			250	17.2	340	1280	520	1980	870	3300	440	1670	690	2610	1170	4440
	30	2.1	50	3.4	150	580	270	1030	520	1960	190	700	340	1280	660	2510
			75	5.2	230	850	390	1460	680	2570	260	980	460	1760	860	3240
			150	10.3	310	1150	530	2000	910	3430	390	1480	670	2530	1150	4350
			250	17.2	360	1370	590	2230	1030	3910	480	1810	770	2930	1360	5140
	35	2.4	50	3.4	160	590	290	1090	550	2090	180	700	360	1370	690	2620
			75	5.2	240	920	430	1620	730	2750	270	1030	500	1880	920	3470
			150	10.3	340	1280	590	2210	1000	3770	420	1590	740	2810	1280	4860
			250	17.2	410	1540	670	2550	1150	4340	550	2070	900	3390	1540	5840

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Table 10. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (for Type MR105 with High-Pressure Actuator)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN GPM / LPM OF WATER																	
					NPS 1 / DN 25 BODY						NPS 2 / DN 50 - REDUCED PORT						NPS 2 / DN 50 BODY					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
25 to 60 psig / 1.7 to 4.1 bar Green	25	1.7	50	3.4	23	87	41	160	76	290												
			75	5.2	35	130	61	230	110	410												
			150	10.3	55	210	120	450	190	700												
			250	17.2	60	230	250	930	260	970												
	30	2.1	50	3.4	23	87	43	160	79	300												
			75	5.2	37	140	67	250	110	420												
			150	10.3	62	230	140	530	190	710												
			250	17.2	78	300	240	920	250	950												
	40	2.8	50	3.4	22	83	44	170	79	300												
			75	5.2	44	170	77	290	120	440												
			150	10.3	82	310	160	610	190	720												
			250	17.2	140	520	240	890	240	920												
	50	3.4	75	5.2	40	150	75	280	110	420												
			150	10.3	94	360	160	610	190	700												
			250	17.2	230	860	240	910	250	950												
	60	4.1	75	5.2	37	140	70	260	110	410												
			150	10.3	110	400	160	610	190	700												
			250	17.2	220	840	240	890	250	930												
25 to 45 psig / 1.7 to 3.1 bar Green	25	1.7	50	3.4							38	140	57	220	96	360	51	190	76	290	140	540
			75	5.2							59	220	83	310	130	490	81	310	120	440	190	700
			150	10.3							83	310	120	440	180	670	120	440	160	610	250	960
	30	2.1	50	3.4							35	130	57	220	110	400	49	190	81	310	150	580
			75	5.2							60	230	88	330	150	560	85	320	130	480	210	790
			150	10.3							83	310	120	470	210	780	120	460	180	690	300	1130
	40	2.8	50	3.4							33	120	59	220	120	460	50	190	92	350	180	700
			75	5.2							68	260	100	390	180	690	96	360	150	570	270	1010
			150	10.3							93	350	150	550	250	960	150	560	220	840	390	1470
	45	3.1	75	5.2							51	190	89	340	180	660	77	290	130	510	260	990
			150	10.3							97	370	150	570	280	1070	130	500	230	880	410	1560
43 to 100 psig / 3.0 to 6.9 bar White	50	3.4	75	5.2	33	120	61	230	110	400	46	170	78	300	150	580	65	250	120	440	230	860
			150	10.3	69	260	130	480	180	680	90	340	140	530	250	940	130	510	220	820	390	1480
			250	17.2	120	440	230	860	250	940	120	460	180	680	300	1150	170	650	260	1000	490	1840
	60	4.1	75	5.2	31	120	59	220	100	380	44	170	78	300	160	620	62	230	120	440	240	910
			150	10.3	76	290	140	520	180	670	96	360	150	570	280	1060	150	570	250	930	460	1730
			250	17.2	120	440	230	860	240	920	130	470	200	740	340	1290	200	740	320	1230	600	2260
	75	5.2	100	6.9	45	170	83	310	120	470	56	210	110	400	220	850	87	330	170	630	330	1260
			250	17.2	170	640	230	860	240	910	140	520	220	830	400	1530	210	790	360	1370	670	2550
	100	6.9	150	10.3	78	300	130	490	160	600	92	350	170	650	350	1310	130	500	270	1020	490	1850
			250	17.2	160	620	210	810	230	890	170	620	270	1010	510	1910	240	920	460	1720	690	2590
75 to 175 psig / 5.2 to 12.1 bar Silver	75	5.2	100	6.9	33	120	64	240	110	430	46	170	81	310	170	640	68	260	130	470	260	970
			250	17.2	84	320	170	640	240	890	120	470	190	720	330	1230	170	640	270	1020	520	1950
	100	6.9	150	10.3	56	210	110	400	160	600	72	270	130	490	270	1020	110	430	210	780	410	1540
			250	17.2	110	410	190	720	230	880	140	530	220	840	400	1510	200	750	320	1210	620	2340
	125	8.6	200	13.8	81	310	150	550	190	710	100	390	190	710	370	1390	160	590	290	1080	550	2090
			300	20.7	150	560	230	860	250	950	170	630	270	1030	500	1910	230	870	440	1650	700	2630
	150	10.3	200	13.8	80	300	140	510	180	680	100	390	190	730	400	1510	150	580	290	1110	550	2070
			300	20.7	150	580	220	830	240	920	190	700	300	1140	580	2180	280	1060	500	1890	700	2630
	175	12.1	200	13.8	69	260	120	470	170	620	94	360	200	740	420	1590	140	520	280	1070	540	2050
			300	20.7	150	560	210	780	240	890	190	710	320	1210	600	2280	290	1110	520	1970	700	2630
110 to 300 psig / 7.6 to 20.7 bar Orange	125	8.6	150	10.3	40	150	81	310	140	540	58	220	110	410	240	890	83	310	160	620	360	1360
			250	17.2	90	340	160	600	220	830	130	490	200	770	370	1390	190	720	320	1200	580	2180
	150	10.3	200	13.8	60	230	110	430	170	650	83	310	160	590	330	1250	120	460	240	920	490	1850
			300	20.7	120	470	200	760	240	920	160	590	250	940	470	1760	230	860	410	1530	690	2600
	200	13.8	250	17.2	79	300	140	540	190	720	110	400	210	780	430	1640	160	600	320	1200	600	2270
			300	20.7	130	480	190	710	230	860	170	650	290	1100	550	2070	260	980	460	1730	690	2620
	250	17.2	300	20.7	97	370	160	600	210	780	120	470	250	950	530	1990	200	750	400	1510	650	2480
			350	24.1	160	600	200	770	220	830	210	780	360	1350	580	2200	320	1200	530	2020	630	2380
	300	20.7	350	24.1	120	440	170	660	190	730	150	570	310	1170	540	2040	230	860	480	1830	630	2390

- Spring range is not available for the body size.

- continued -

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Table 10. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (for Type MR105 with High-Pressure Actuator) (continued)

SPRING RANGE AND COLOR	SET PRESSURE		INLET PRESSURE		CAPACITIES IN GPM / LPM OF WATER											
					NPS 3 / DN 80 Body						NPS 4 / DN 100 Body					
					10% Droop		20% Droop		40% Droop		10% Droop		20% Droop		40% Droop	
	psig	bar	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
39 to 72 psig / 2.7 to 5.0 bar White	40	2.8	75	5.2	100	380	140	550	240	910	120	460	180	660	300	1120
			150	10.3	180	670	230	860	340	1290	230	880	300	1150	440	1670
			250	17.2	220	820	270	1010	380	1440	290	1080	350	1330	480	1810
	50	3.4	75	5.2	95	360	150	560	260	1000	130	480	200	750	350	1330
			150	10.3	190	720	250	960	390	1490	250	950	340	1290	510	1920
			250	17.2	230	860	290	1100	440	1660	300	1140	380	1450	550	2080
	60	4.1	75	5.2	86	330	150	560	290	1090	120	450	190	730	380	1450
			150	10.3	200	760	280	1060	440	1680	260	990	360	1370	560	2120
			250	17.2	240	890	320	1210	490	1850	310	1180	410	1560	620	2330
	70	4.8	100	6.9	120	470	210	780	390	1470	160	610	270	1000	490	1870
			150	10.3	210	800	310	1150	500	1890	280	1070	400	1520	640	2430
			250	17.2	250	950	350	1330	550	2080	330	1260	460	1720	690	2620
71 to 175 psig / 4.9 to 12.1 bar Silver	75	5.2	100	6.9	110	400	170	650	330	1250	140	530	220	840	410	1560
			150	10.3	200	750	280	1050	460	1730	260	1000	370	1400	580	2190
			250	17.2	240	900	330	1250	510	1940	320	1220	440	1660	650	2470
	100	6.9	150	10.3	160	610	250	960	490	1850	210	780	340	1270	610	2320
			250	17.2	270	1010	390	1460	630	2380	360	1350	500	1900	790	2990
	125	8.6	200	13.8	210	790	340	1280	640	2400	270	1000	440	1650	780	2960
			300	20.7	310	1180	460	1720	810	3050	420	1570	590	2240	970	3680
	150	10.3	200	13.8	200	770	360	1360	720	2720	260	1000	470	1780	900	3400
			300	20.7	340	1280	510	1930	890	3370	460	1730	680	2590	1070	4040
	175	12.1	200	13.8	190	730	360	1380	770	2900	240	920	460	1740	960	3620
			300	20.7	360	1360	570	2170	990	3750	480	1810	730	2760	1230	4660
110 to 250 psig / 7.6 to 17.2 bar Orange	125	8.6	150	10.3	130	490	220	840	450	1720	160	610	290	1080	570	2160
			250	17.2	260	1000	390	1460	640	2420	360	1350	500	1870	840	3170
	150	10.3	200	13.8	190	720	310	1180	610	2310	230	870	390	1460	750	2830
			300	20.7	310	1180	460	1750	760	2870	400	1530	580	2200	1020	3860
	200	13.8	250	17.2	220	840	400	1510	790	2970	270	1030	490	1870	990	3760
			300	20.7	350	1340	550	2090	970	3690	430	1620	680	2590	1200	4540
	250	17.2	300	20.7	250	950	480	1830	960	3640	310	1180	600	2270	1250	4720
			350	24.1	410	1560	660	2500	1170	4410	540	2020	880	3320	1650	6240

Table 11. Approximate Weights

BODY SIZE		FOR TYPE MR105 WITH LOW-PRESSURE ACTUATOR		FOR TYPE MR105 WITH HIGH-PRESSURE ACTUATOR	
NPS	DN	LBS	kg	LBS	kg
1	25	86	39	76	34
2	50	116	53	105	48
3	80	165	75	155	70
4	100	174	79	164	74

Type MR108
Backpressure Regulator

Introduction

The Type MR108 backpressure regulators are direct-operated, high-capacity, multi-purpose regulators. They are designed to handle pressures up to 400 psig / 27.6 bar and temperatures up to 250°F / 121°C. This product provides a fast, simple, reliable and economical backpressure control in multi-purpose applications suitable for different flow media including liquid, air and gas. Applications include lube oil systems and any application where speed of response is critical, minimum differential pressure is a concern or fluid is not free of impurities.

The Type MR108 is available in three different cage options depending on application: linear cage for accurate control at low flow conditions, high capacity linear cage for medium flow application with high-turndown requirements and quick-opening cage for high flow applications. The Type MR108 is offered in Low Pressure and High Pressure constructions (see Figures 1 and 2).

Body Sizes and End Connection Styles
See Table 1

Construction Materials
See Table 2

Approximate Weights
See Table 3

Backpressure Control Ranges
5 to 300 psig / 0.34 to 20.7 bar; See Table 4

Maximum Differential Pressures
Low-Pressure Actuator: 70 psig / 4.8 bar
High-Pressure Actuator: 400 psig / 27.6 bar or maximum inlet pressure, whichever is lower

Wide Open Flow and IEC Sizing Coefficients
See Tables 6

Typical C_v Coefficients
See Tables 7 to 12

Flow Capacities
See Tables 13 to 20

Shutoff Classification per ANSI/FCI 70-3-2004
Class VI (Soft Seat)

Temperature Capabilities
Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM)[(1)]:
20 to 250°F / -7 to 121°C
Ethylene Propylene (EPDM)[(2)]:
-20 to 225°F / -29 to 107°C

Pressure Registration
External

Upstream Control Line Connection Size
1/2 NPT

Maximum Pressure Over Setpoint to Avoid Internal Parts Damage
Low-Pressure Actuator: 20 psig / 1.4 bar
High-Pressure Actuator: 120 psig / 8.3 bar

Pressure-Loaded Spring Case Vent Connection
1/2 NPT

Options
Inlet Pressure Gauge Tap, Drain Valve, Pressure-Loaded Actuator, Bleed Valve (for High-Pressure Actuator Only) and EPDM Elastomer Trim Parts

Ordering Guide
To order this product, contact your local Sales Office.

Features

- **Large Capacity Regulator with Minimal Build-up from Setpoint and Fast Speed of Response**
- **Bubble Tight Shutoff**
- **Versatile Regulator for Liquid or Gas Service**
- **Wide Range of Applications with Multiple Trim Materials and Cage Options**
- **NACE Constructions for Sour Gas Service Capability**
- **API 614 Compliant Constructions**
- **Drain Option for Ease of System Drainage leading to Cost and Space Savings**
- **Bleed Option for Performance Improvement**
- **Inlet Gauge Port Option for Easier Troubleshooting**

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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P1202

Figure 1. Type MR108 with Low-Pressure Actuator


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Figure 2. Type MR108 with High-Pressure Actuator

Applications
- Air
- Liquid
- Process Gas

1. Fluorocarbon (FKM) is limited to 200°F / 93°C in hot water.
2. Ethylene Propylene (EPDM) is limited to 20 to 250°F / -7 to 121°C when used with Low Pressure Actuator.

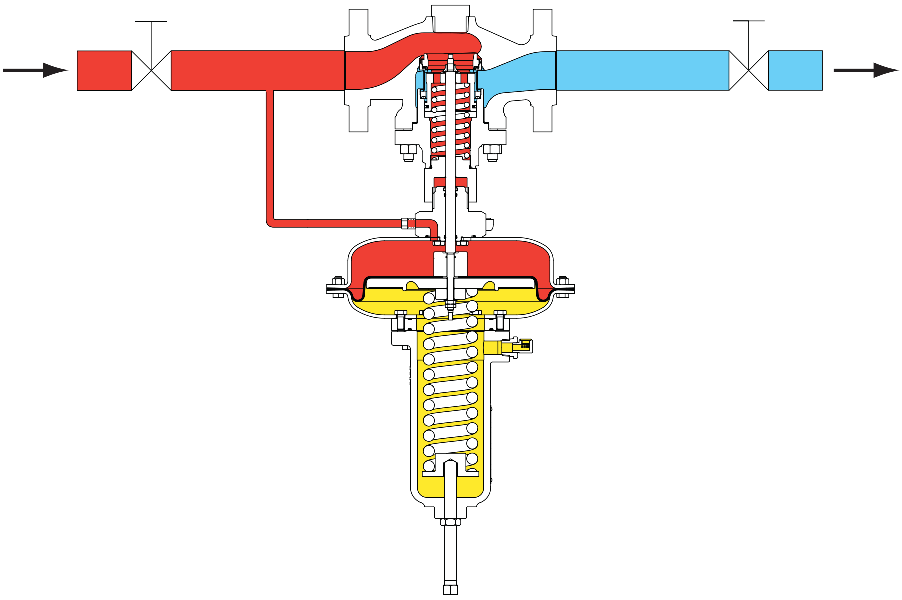

Figure 3. *Type MR108 Operational Schematic*

Table 1. Body Sizes and End Connection Styles

BODY MATERIAL	END CONNECTION STYLE	
	NPS 1 and 2 / DN 25 and 50 Body Sizes	NPS 3 and 4 / DN 80 and 100 Body Sizes
Cast Iron	NPT, CL125 FF or CL250 RF	CL125 FF or CL250 RF
WCC Steel(1)(2)	NPT, CL150 RF, CL300 RF, CL600 RF or PN 16/25/40 RF	CL150 RF, CL300 RF, CL600 RF or PN 16 RF
CF8M Stainless steel(1)(2)		
CF3M Stainless steel(1)(2)		

1. Optional NACE construction available.
2. Constructions meet API 614 requirements.

Table 2. Construction Materials

PART	STANDARD	OPTIONAL
Body	WCC Steel(1)	Cast Iron, CF8M, CF3M Stainless steel
Body Flange	WCC Steel(1)	CF8M, CF3M Stainless steel
Actuator Casing - Low Pressure	AISI 1010 Steel(1)	316/316L Stainless steel
Actuator Casing - High Pressure	WCC Steel(1)	CF3M/CF8M Stainless steel
Internal Stiffener Plate	AISI 1010 Steel(1)	316/316L Stainless steel
Spring Case	WCC Steel	CF3M/CF8M Stainless steel
Spring Case Spacer	Zinc-plated Steel	Stainless steel
Cage	CF3M/CF8M (Quick Opening), CF8M (Linear) Stainless steel	
Valve Plug and Seat Ring	416 Stainless steel	316, 316L, S20910 (Nitronic® 50) Stainless steel (NPS 1 / DN 25 only)
Closing Spring	Inconel® X750	
Stem	S17400 H1075 Stainless steel	S20910 (Nitronic® 50) Stainless steel
Lower Diaphragm Support	S17400 H1075 Stainless steel	
Diaphragm and Seals	Nitrile (NBR)	Fluorocarbon (FKM), Ethylene Propylene (EPDM)
Upper Diaphragm Plate	Cast Iron	
Control/Set Spring	Steel Alloy(1)	
Spring Seats	Zinc-plated Steel	
Bolting	SA194 Grade B7/NCF (Body to Bonnet) SAE Grade 5/NCF (Actuator)	Stainless steel
Adjusting Screw	Zinc-plated Steel	Stainless steel

1. Powder coated.

Table 3. Approximate Weights

BODY SIZE		FOR TYPE MR108 WITH LOW-PRESSURE ACTUATOR		FOR TYPE MR108 WITH HIGH-PRESSURE ACTUATOR	
NPS	DN	LBS	kg	LBS	kg
1	25	88	40	78	35
2	50	118	54	107	49
3	80	167	76	156	71
4	100	176	80	166	75

Table 4. Backpressure Control Ranges

ACTUATOR TYPE	SPRING RANGE		SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH		MAXIMUM PRESSURE OVER SETPOINT TO AVOID INTERNAL PARTS DAMAGE	
	psig	bar		In.	mm	In.	mm	psig	bar
Low Pressure	5 to 14	0.34 to 0.97	White	0.44	11.2	9.70	246	20	1.4
	8 to 24	0.55 to 1.7	Silver	0.50	12.7				
	12 to 30	0.83 to 2.1	Orange	0.56	14.2				
	15 to 35	1.0 to 2.4	Red	0.63	16.0				
High Pressure	25 to 40	1.7 to 2.8	Blue	0.33	8.38			120	8.3
	35 to 70	2.4 to 4.8	Green	0.38	9.65				
	55 to 120	3.8 to 8.3	White	0.44	11.2				
	90 to 200(1)	6.2 to 13.8(2)	Silver	0.50	12.7				
	175 to 300(1)	12.1 to 20.7(2)	Red	0.63	16.0				

1. Maximum setpoint is limited to 150 psig / 10.3 bar for constructions with Fluorocarbon (FKM) diaphragm.
2. Not applicable for constructions with Fluorocarbon (FKM) diaphragm.

Table 5. Maximum Inlet, Outlet and Emergency Casing Pressures(1)

BODY MATERIAL	END CONNECTION	MAXIMUM INLET PRESSURE				MAXIMUM OUTLET PRESSURE				MAXIMUM EMERGENCY CASING PRESSURE			
		Low-Pressure Actuator		High-Pressure Actuator(2)		Low-Pressure Actuator		High-Pressure Actuator(2)		Low-Pressure Actuator		High-Pressure Actuator(2)	
		psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
Cast Iron	NPT	70	4.8	340	23.4	70	4.8	340	23.4	70	4.8	340	23.4
	CL125 FF			175	12.1			175	12.1			175	12.1
	CL250 RF			400	27.6			400	27.6			400	27.6
WCC Steel	NPT	70	4.8	400	27.6	70	4.8	400	27.6	70	4.8	400	27.6
	CL150 RF			245	16.9			245	16.9			245	16.9
	CL300 RF			400	27.6			400	27.6			400	27.6
	CL600 RF												
	PN 16 RF			245	16.9			245	16.9			245	16.9
	PN 16/25/40 RF			400	27.6			400	27.6			400	27.6
CF8M Stainless steel	NPT	70	4.8	400	27.6	70	4.8	400	27.6	70	4.8	400	27.6
	CL150 RF			225	15.5			225	15.5			225	15.5
	CL300 RF			400	27.6			400	27.6			400	27.6
	CL600 RF												
	PN 16 RF			225	15.5			225	15.5			225	15.5
	PN 16/25/40 RF			400	27.6			400	27.6			400	27.6
CF3M Stainless steel	NPT	70	4.8	400	27.6	70	4.8	400	27.6	70	4.8	400	27.6
	CL150 RF			185	12.7			185	12.7			185	12.7
	CL300 RF			400	27.6			400	27.6			400	27.6
	CL600 RF												
	PN 16 RF			185	12.7			185	12.7			185	12.7
	PN 16/25/40 RF			400	27.6			400	27.6			400	27.6

1. Pressure ratings are based on a maximum operating temperature of 250°F / 121°C.
2. Maximum inlet, outlet and emergency pressures for constructions with Fluorocarbon (FKM) diaphragm are limited to 230 psig / 15.8 bar or the body rating limit, whichever is lower.

Table 6. Wide Open Flow and Sizing Coefficients

BODY SIZE		WIDE OPEN COEFFICIENT		IEC SIZING COEFFICIENT				
		Line Size Equals Body Size		C_1	K_m	F_l	X_t	F_d
NPS	DN	C_g	C_v					
LINEAR CAGE								
1	25	463	13.7	34	0.81	0.9	0.73	0.36
2	50	761	22.5	33.8	0.75	0.87	0.72	0.24
3	80	997	30.5	32.7	0.78	0.88	0.68	0.22
4	100	934	27.5	34	0.77	0.88	0.75	0.18
HIGH-CAPACITY LINEAR CAGE(1)								
2	50		43.6		0.8	0.89		
3	80		69.3		0.73	0.85		
4	100		71.5		0.71	0.84		
QUICK OPENING CAGE								
1	25	597	17.5	34.1	0.81	0.9	0.73	0.43
2	50	1740	48.2	36.1	0.81	0.9	0.82	0.34
3	80	3540	103.1	34.4	0.76	0.87	0.75	0.32
4	100	4300	135.9	31.6	0.72	0.85	0.65	0.3

- Shaded areas represents that for High-Capacity Linear Cage, only C_v, K_m, F_L are available.
1. Recommend for use in liquid applications only.

Table 7. Typical C_v Coefficient With Linear Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		% Pressure Buildup Over Relief Setting															
			NPS 1 / DN 25 Body				NPS 2 / DN 50 Body				NPS 3 / DN 80 Body				NPS 4 / DN 100 Body			
			10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
	psig	bar	C_v				C_v				C_v				C_v			
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34	1.7	1.7	4.3	5.3	4.3	8.2	11.0	15.5	5.3	8.7	12.0	16.4	5.1	8.2	12.9	16.6
	10	0.69	1.8	3.2	10.8	11.2	8.1	15.0	22.5	22.5	8.3	15.6	23.3	30.5	8.7	16.5	25.0	27.5
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	1.8	2.3	11.4	11.8	5.1	7.2	13.6	19.0	5.8	10.0	14.6	19.9	5.7	10.7	15.3	20.8
	20	1.4	6.4	10.0	13.1	13.2	7.0	17.1	22.5	22.5	9.5	17.7	27.5	30.5	10.0	19.4	27.5	27.5
13 to 30 psig / 0.89 to 2.1 bar Orange	15	1.0	6.4	8.5	9.5	10.0	4.7	8.5	13.1	18.8	6.0	10.3	15.6	21.1	5.9	10.6	15.6	21.6
	25	1.7	5.9	8.0	10.5	13.2	6.9	14.6	22.5	22.5	8.5	15.7	24.0	30.5	8.4	16.6	25.3	27.5
	30	2.1	5.9	10.8	13.1	13.1	8.2	18.0	22.5	22.5	9.6	17.7	28.4	30.5	9.7	19.2	27.5	27.5
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	2.0	6.8	7.9	8.7	3.9	7.5	10.4	14.2	5.0	7.9	11.3	15.1	4.7	7.8	11.3	14.8
	25	1.7	5.5	6.4	9.8	13.5	5.5	10.6	16.8	22.5	6.4	11.8	17.3	24.0	6.3	12.2	18.2	24.7
	35	2.4	4.2	10.6	13.3	12.9	7.1	14.5	22.5	22.5	7.8	15.3	23.7	30.5	8.1	15.9	23.9	27.5

Table 8. Typical C_v Coefficient With Linear Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		% PRESSURE BUILDUP OVER RELIEF SETTING															
			NPS 1 / DN 25 Body				NPS 2 / DN 50 Body				NPS 3 / DN 80 Body				NPS 4 / DN 100 Body			
			10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
	psig	bar	C_v				C_v				C_v				C_v			
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	3.1	5.3	8.2	11.3	5.0	8.0	12.3	16.2	5.1	8.8	12.7	17.9	4.4	6.9	9.8	13.4
	35	2.4	4.0	8.2	11.3	12.7	5.3	9.9	14.7	19.7	6.6	11.1	17.8	24.1	5.3	9.1	13.3	19.4
	40	2.8	4.5	8.5	11.4	12.4	5.6	10.7	16.1	21.9	7.2	12.6	19.9	27.4	5.6	9.8	15.7	21.2
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	3.1	5.2	7.7	10.0	4.4	6.9	10.2	13.7	5.2	8.0	11.6	15.9	4.4	6.6	9.5	12.6
	50	3.4	3.9	6.6	10.3	12.3	4.6	8.5	12.8	17.8	6.1	10.8	16.6	22.7	5.0	8.6	14.0	19.0
	70	4.8	4.4	9.1	12.7	12.7	5.9	11.0	17.2	22.5	7.5	14.2	21.6	29.5	6.3	12.8	18.7	24.5
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	3.1	5.2	7.6	10.4	4.2	7.0	10.1	13.6	5.2	8.3	11.9	16.5	4.2	6.6	9.2	13.7
	75	5.2	3.5	6.5	10.5	10.5	5.0	8.7	13.1	17.7	6.0	10.1	15.6	21.4	5.1	8.5	14.2	18.2
	120	8.3	4.8	10.1	12.1	12.1	6.4	12.3	19.0	22.5	7.9	15.1	23.3	29.8	6.2	13.7	20.6	27.2
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	3.2	5.5	8.6	11.6	4.5	7.8	11.3	15.0	5.5	8.9	13.2	18.0	5.1	7.5	12.0	15.4
	150	10.3	4.1	8.3	9.9	9.9	5.8	10.4	15.5	21.2	6.3	11.9	18.3	26.0	5.3	10.1	16.0	22.7
	200	13.8	5.3	10.2	9.8	9.8	6.7	12.6	19.4	22.5	7.9	15.3	23.8	29.8	6.5	13.9	21.9	27.2
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	3.1	5.3	7.8	10.2	4.2	6.8	9.8	13.1	5.0	7.7	11.3	15.3	4.8	7.0	9.8	13.5
	250	17.2	4.0	7.5	11.5	11.5	4.7	8.0	11.9	16.5	5.9	10.4	15.8	21.9	5.4	9.8	15.0	20.3
	300	20.7	4.4	8.7	11.9		5.2	9.1	12.4		6.6	12.3	18.8		6.0	11.1	17.3	

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

EMERSON

Table 9. Typical C_v Coefficient With High Capacity Linear Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		% PRESSURE BUILDUP OVER RELIEF SETTING															
			NPS 1 / DN 25 Body				NPS 2 / DN 50 Body				NPS 3 / DN 80 Body				NPS 4 / DN 100 Body			
			10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
	psig	bar	C_v				C_v				C_v				C_v			
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34					9.8	18.3	26.8	35.2	13.6	23.3	35.3	45.4	14.1	25.3	36.9	50.3
	10	0.69					17.0	33.9	41.6	42.5	23.5	44.5	64.6	68.7	25.9	47.6	66.8	69.2
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69					12.2	21.9	29.6	38.8	16.3	28.0	41.6	54.3	17.5	32.0	45.2	58.8
	20	1.4					19.5	36.5	42.5	42.7	26.2	47.4	66.5	67.3	30.7	54.9	68.4	68.4
13 to 30 psig / 0.89 to 2.1 bar Orange	15	1.0					12.6	23.2	33.3	42.3	16.2	28.3	42.3	55.2	18.5	32.8	47.1	61.3
	25	1.7					17.4	34.3	42.7	42.5	23.8	43.1	62.8	65.9	26.3	47.7	66.3	67.1
	30	2.1					19.1	39.0	42.3	42.2	26.1	48.2	65.7	65.7	28.9	53.2	66.6	66.2
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0					9.7	16.6	24.6	32.0	13.3	21.7	31.3	41.2	14.5	24.0	34.4	45.4
	25	1.7					14.4	25.8	37.9	42.5	17.5	31.6	47.2	60.5	19.5	35.2	51.6	66.1
	35	2.4					16.9	34.2	41.8	41.6	22.6	41.4	59.6	65.1	25.6	46.3	65.2	65.6

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

Table 10. Typical C_v Coefficient With High-Capacity Linear Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		% PRESSURE BUILDUP OVER RELIEF SETTING															
			NPS 1 / DN 25 Body				NPS 2 / DN 50 Body				NPS 3 / DN 80 Body				NPS 4 / DN 100 Body			
			10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
	psig	bar	C_v				C_v				C_v				C_v			
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7					11.2	19.2	27.1	35.5	13.5	22.1	30.9	41.1	15.3	22.8	31.2	42.8
	35	2.4					12.1	22.3	32.0	41.2	15.5	26.8	38.4	49.7	17.4	29.5	42.7	53.1
	40	2.8					14.2	25.3	37.2	41.9	16.6	28.4	40.2	52.0	18.5	30.6	44.0	54.8
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4					9.8	16.9	24.0	32.2	13.1	20.8	28.9	37.1	14.8	22.8	31.3	39.4
	50	3.4					11.3	20.5	29.9	38.7	15.4	25.6	36.2	45.4	17.4	28.0	38.8	48.9
	70	4.8					13.5	25.6	37.1	40.6	17.7	30.8	42.4	53.5	21.1	33.5	45.5	57.9
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8					9.4	16.0	22.9	30.9	13.1	20.3	28.3	36.5	14.0	21.9	31.3	39.2
	75	5.2					11.4	19.8	29.2	32.0	15.0	24.7	34.9	44.4	16.0	28.0	38.5	49.2
	120	8.3					13.7	26.5	39.9	40.3	18.5	31.9	44.8	58.0	21.3	35.9	50.0	61.4
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9					9.5	16.0	23.2	31.5	13.7	21.8	30.4	39.0	14.0	23.1	32.3	41.3
	150	10.3					12.1	21.8	32.9	39.7	16.6	28.0	39.7	51.0	18.6	29.8	42.2	54.3
	200	13.8					13.6	26.5	38.6	39.7	19.2	33.2	46.8	59.0	20.2	34.5	49.9	60.8
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1					9.1	15.2	22.0	29.1	12.7	19.8	27.6	35.5	13.8	21.1	29.4	37.4
	250	17.2					11.0	19.7	29.6	37.0	15.2	25.0	35.6	45.8	15.5	25.6	36.4	47.5
	300	20.7					12.5	23.6	35.0		16.7	28.5	40.5		16.9	28.7	41.4	

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

Table 11. Typical C_v Coefficient With Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		C_v AT % BUILDUP															
			NPS 1 / DN 25 Body				NPS 2 / DN 50 Body				NPS 3 / DN 80 Body				NPS 4 / DN 100 Body			
	psig	bar	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34	5.76	10.7	13.8	16	12.3	24.6	33.9	41.8	26.5	41.5	59.4	74.0	23.2	32.9	44.4	54.1
	10	0.69	11.2	15.8	16.9	17.2	23.2	40.7	48.2	48.2	40.3	71.1	94.0	103	34.1	54.8	79.2	96.9
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	7.28	13.0	15.2	16.4	16.6	29.2	40.8	47.6	29.9	50.0	69.6	85.0	28.6	44.4	60.0	75.5
	20	1.4	11.7	15.6	16.7	16.9	28.0	47.1	48.2	48.2	47.7	76.8	97.1	103	44.2	73.5	98.1	124
12 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	6.57	12.3	15.5	16.8	16.7	29.1	41.9	48.2	30.1	51.3	68.6	81.6	30.9	48.8	66.7	83.3
	25	1.7	12.1	15.7	17.3	17.5	25.0	43.1	48.2	48.2	42.3	67.0	87.6	101	43.1	72.9	98.6	124
	30	2.1	12.8	16.1	17.0	17.0	27.1	45.5	48.2	48.2	46.4	73.4	95.8	103	46.1	80.4	113	132
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	6.45	10.6	13.9	15.2	13.0	22.2	31.0	39.5	24.9	40.1	56.8	69.3	26.5	41.4	54.7	68.8
	25	1.7	9.05	13.6	15.7	16.3	19.0	33.6	43.6	48.2	30.9	53.8	73.2	89.4	36.2	59.7	82.1	102
	35	2.4	10.7	15.5	16.4	16.8	24.3	42.0	48.2	48.2	41.9	65.9	89.1	102	45.0	74.1	103	127

Table 12. Typical C_v Coefficient With Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		C_v AT % BUILDUP															
			NPS 1 / DN 25 Body				NPS 2 / DN 50 Body				NPS 3 / DN 80 Body				NPS 4 / DN 100 Body			
	psig	bar	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%	10%	20%	30%	40%
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	5.56	9.38	12.7	14.7	12.9	24.2	36.3	42.4	21.9	34.3	47.3	57.5	27.2	45.7	57.7	70.4
	35	2.4	8.16	13.7	15.7	17.0	18.8	34.3	43.8	48.2	26.1	41.2	55.1	71.2	34.6	50.3	68.5	84.6
	40	2.8	7.59	14.5	16.9	17.5	19.0	38.0	45.9	48.2	28.0	43.3	59.6	79.4	39.0	55.8	74.0	95.0
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	5.54	10.4	14.5	15.5	13.6	23.0	33.1	41.2	21.7	34.2	43.7	53.2	29.1	44.3	57.4	68.1
	50	3.4	8.02	13.5	15.8	17.0	16.1	32.4	42.7	47.4	25.6	38.2	52.3	68.2	33.1	49.1	66.3	84.4
	70	4.8	10.3	15.8	17.1	17.5	24.4	41.1	48.2	48.2	27.9	46.8	69.3	87.8	35.5	57.6	83.5	109
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	6.01	11.7	14.7	16.1	14.0	24.6	36.0	42.9	23.7	33.8	44.6	57.4	29.7	42.2	56.4	71.0
	75	5.2	7.58	14.2	16.2	17.0	16.7	31.4	42.9	48.2	25.2	38.3	55.7	71.4	31.3	48.6	67.2	87.3
	120	8.3	13.2	16.6	17.5	17.5	28.7	43.9	48.2	48.2	30.0	54.1	77.6	96.8	37.3	65.6	92.4	117
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	7.92	13.8	16.0	16.9	16.4	29.8	40.5	48.0	22.8	35.3	50.0	64.1	28.8	44.2	60.8	75.6
	150	10.3	12.7	16.0	16.9	17.1	21.5	39.1	46.8	48.2	26.4	47.7	68.1	87.7	34.5	58.8	82.5	106
	200	14.8	14.7	16.8	17.3	17.3	27.4	43.9	48.2	48.2	32.9	58.6	80.6	97.9	40.6	72.3	104	130
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	7.90	13.5	15.7	16.6	14.4	26.3	35.6	42.0	20.6	33.7	48.1	62.5	27.2	43.7	59.7	76.2
	250	17.2	11.3	15.5	16.8	17.0	19.5	34.2	43.5	47.1	26.4	45.5	65.9	82	33.4	55.2	77.4	97.5
	300	20.7	12.9	16.7	17.1		22.8	39.5	48.2		30.2	52.9	71.1		34.8	58.9	84.8	

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

Air

Table 13. Typical Air Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN SCFH / Nm³/h OF AIR															
			% Pressure Buildup Over Relief Setting															
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34	3100	84	6100	160	8200	220	9900	270	6800	180	14,300	380	20,600	550	26,500	710
	10	0.69	9000	240	13,300	360	14,900	400	15,800	420	19,000	510	35,300	940	46,100	1240	54,000	1450
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	5800	160	10,900	290	13,400	360	15,100	400	13,600	370	25,300	680	37,100	990	45,300	1210
	20	1.4	14,300	380	20,200	540	22,800	610	24,200	650	35,600	950	63,600	1700	79,100	2120	86,300	2310
12 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	6700	180	13,300	360	17,500	470	20,000	530	17,600	470	32,500	870	49,200	1320	61,000	1640
	25	1.7	17,200	460	23,700	640	27,600	740	29,500	790	37,100	990	68,000	1820	87,200	2340	99,900	2680
	30	2.1	20,600	550	27,600	740	30,800	820	32,600	870	45,900	1230	82,000	2200	102,000	2740	112,000	3000
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	6600	180	11,300	300	15,800	420	18,000	480	13,700	370	24,800	660	36,400	980	48,800	1310
	25	1.7	12,800	340	20,400	550	25,100	670	27,300	730	28,300	760	53,000	1420	73,000	1960	89,800	2410
	35	2.4	19,200	520	29,800	800	33,500	900	36,200	970	46,100	1230	85,000	2280	109,000	2920	124,000	3330

- continued -

Table 13. Typical Air Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN SCFH / Nm³/h OF AIR															
			% Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34	14,500	390	23,800	640	35,600	950	46,200	1240	12,500	330	18,400	490	26,000	700	32,900	880
	10	0.69	32,400	870	60,200	1610	83,500	2240	99,800	2670	26,400	710	44,600	1200	67,400	1810	86,100	2310
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	24,100	640	42,300	1130	61,800	1660	78,900	2120	22,200	590	36,200	970	51,100	1370	67,100	1800
	20	1.4	58,900	1580	100,000	2690	134,000	3590	154,000	4130	51,400	1380	90,400	2420	127,000	3410	169,000	4530
12 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	30,900	830	55,600	1490	78,300	2100	97,700	2620	30,200	810	50,200	1350	72,100	1930	94,300	2530
	25	1.7	60,600	1630	102,000	2730	141,000	3780	172,000	4600	57,900	1550	104,000	2780	148,000	3970	197,000	5270
	30	2.1	75,600	2030	127,000	3410	176,000	4720	201,000	5400	70,100	1880	130,000	3480	194,000	5200	239,000	6410
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	25,600	690	43,500	1170	64,800	1740	82,900	2220	25,900	690	42,700	1140	59,100	1580	77,900	2090
	25	1.7	44,300	1190	81,900	2190	118,000	3160	152,000	4070	48,700	1300	85,000	2280	123,000	3310	162,000	4340
	35	2.4	76,300	2050	128,000	3430	184,000	4930	223,000	5970	76,400	2050	134,000	3590	198,000	5310	259,000	6930

Process Gas

Regulating capacities at selected pressures and outlet pressure flows in Tables 13 to 14 are given in SCFH (60°F and 14.7 psia) of air. To determine the equivalent capacities for other gases, multiply the table capacities in Tables 13 to 14 by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane, 0.707 for butane or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm³/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

Air

Table 14. Typical Air Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN SCFH / Nm³/h OF AIR																
			% Pressure Buildup Over Relief Setting																
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body								
			10%		20%		30%		40%		10%		20%		30%		40%		
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	7900	210	14,100	380	20,200	540	24,700	660	19,200	510	38,200	1000	60,600	1600	74,800	2000	
	35	2.4	14,700	390	26,300	700	32,000	860	36,700	980	35,700	960	69,300	1900	94,200	2500	111,000	3000	
	40	2.8	15,100	400	30,900	830	38,000	1000	43,000	1200	39,800	1100	85,300	2300	110,000	2900	127,000	3400	
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	9900	270	19,900	530	29,500	790	33,500	900	25,700	690	46,500	1200	71,200	1900	93,900	2500	
	50	3.4	18,900	510	34,200	920	42,600	1100	48,700	1300	40,300	1100	86,800	2300	122,000	3300	144,000	3900	
	70	4.8	31,900	860	52,900	1400	61,300	1600	68,600	1800	80,400	2200	146,000	3900	189,000	5100	211,000	5700	
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	15,300	410	31,900	850	42,800	1100	50,000	1300	37,700	1000	71,300	1900	111,000	3000	141,000	3800	
	75	5.2	25,000	670	50,600	1400	61,400	1600	69,100	1900	58,500	1600	118,000	3200	173,000	4600	211,000	5700	
	120	8.3	65,700	1800	89,500	2400	102,000	2700	109,000	2900	152,000	4100	251,000	6700	302,000	8100	325,000	8700	
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	33,500	900	63,000	1700	78,700	2100	88,600	2400	73,600	2000	144,000	3900	211,000	5600	267,000	7200	
	150	10.3	77,400	2100	106,000	2800	120,000	3200	130,000	3500	139,000	3700	274,000	7300	353,000	9500	404,000	10,800	
	200	14.8	117,000	3100	145,000	3900	162,000	4300	173,000	4600	231,000	6200	402,000	10,800	477,000	12,800	513,000	13,800	
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	55,600	1500	103,000	2800	129,000	3400	146,000	3900	107,000	2900	212,000	5700	311,000	8300	392,000	10,500	
	250	17.2	111,000	3000	166,000	4400	193,000	5200	211,000	5700	203,000	5500	387,000	10,400	532,000	14,300	618,000	16,600	
	300	20.7	151,000	4000	212,000	5700	235,000	6300			283,000	7600	532,000	14,300	704,000	18,900			

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

- continued -

Table 14. Typical Air Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN SCFH / Nm³/h OF AIR															
			% Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	NM³/H
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	31,400	840	52,200	1400	76,100	2000	97,700	2600	36,600	980	65,100	1700	86,800	2300	112,000	3000
	35	2.4	47,500	1300	80,100	2100	114,000	3000	156,000	4200	58,700	1600	90,900	2400	132,000	3500	172,000	4600
	40	2.8	56,400	1500	93,200	2500	136,000	3700	192,000	5200	73,000	2000	112,000	3000	158,000	4200	214,000	5700
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	39,600	1100	66,400	1800	90,300	2400	116,000	3100	49,400	1300	80,100	2100	110,000	3000	138,000	3700
	50	3.4	61,200	1600	98,000	2600	143,000	3800	198,000	5300	73,700	2000	117,000	3100	169,000	4500	228,000	6100
	70	4.8	87,700	2400	159,000	4300	252,000	6700	340,000	9100	104,000	2800	182,000	4900	282,000	7600	393,000	10,500
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	61,100	1600	93,700	2500	132,000	3500	181,000	4800	71,400	1900	109,000	2900	155,000	4200	208,000	5600
	75	5.2	84,200	2300	138,000	3700	215,000	5800	294,000	7900	97,400	2600	163,000	4400	241,000	6500	334,000	9000
	120	8.3	151,000	4100	295,000	7900	455,000	12,200	608,000	16,300	175,000	4700	333,000	8900	505,000	13,500	687,000	18,400
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	97,500	2600	163,000	4400	249,000	6700	341,000	9100	115,000	3100	191,000	5100	282,000	7500	374,000	10,000
	150	10.3	163,000	4400	319,000	8600	491,000	13,200	678,000	18,200	199,000	5300	366,000	9800	554,000	14,900	762,000	20,400
	200	14.8	265,000	7100	513,000	13,800	762,000	20,400	993,000	26,600	305,000	8200	590,000	15,800	914,000	24,500	1,224,000	32,800
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	147,000	3900	260,000	7000	401,000	10,800	559,000	15,000	180,000	4800	314,000	8400	463,000	12,400	634,000	17,000
	250	17.2	263,000	7000	492,000	13,200	770,000	20,600	1,030,000	27,600	310,000	8300	557,000	14,900	843,000	22,600	1,140,000	30,600
	300	20.7	359,000	9600	682,000	18,300	990,000	26,500			384,000	10,300	707,000	18,900	1,100,000	29,500		

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

Liquid

Table 15. Typical Water Capacities with Linear Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER															
			% Pressure Buildup Over Relief Setting															
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34	4	15	4	15	11	42	14	53	10	38	20	76	28	106	41	155
	10	0.69	6	23	11	42	39	148	42	159	27	102	52	197	87	329	93	352
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	6	23	8	30	41	155	44	167	17	64	25	95	49	185	71	269
	20	1.4	30	114	49	185	67	254	70	265	33	125	84	318	124	469	129	488
13 to 30 psig / 0.90 to 2.1 bar Orange	15	1.0	26	98	36	136	42	159	46	174	19	72	36	136	58	220	86	326
	25	1.7	31	117	44	167	60	227	78	295	36	136	80	303	134	507	144	545
	30	2.1	34	129	65	246	82	310	85	322	47	178	108	409	151	572	157	594
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	8	30	29	110	35	132	40	151	16	61	32	121	46	174	65	246
	25	1.7	29	110	35	132	56	212	80	303	29	110	58	220	96	363	136	515
	35	2.4	26	98	69	261	90	341	90	341	44	167	94	356	154	583	169	640

- continued -

Table 15. Typical Water Capacities with Linear Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER															
			% Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34	12	47	21	81	31	116	43	164	12	45	20	76	33	125	44	167
	10	0.69	28	104	54	204	84	318	117	443	29	110	57	216	90	341	109	413
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	19	73	35	132	53	199	75	282	19	72	37	140	55	208	78	295
	20	1.4	45	169	87	327	140	531	171	646	47	178	95	360	147	556	153	579
13 to 30 psig / 0.90 to 2.1 bar Orange	15	1.0	24	92	44	165	69	260	97	366	24	91	45	170	69	261	99	375
	25	1.7	44	168	86	325	137	519	185	700	44	167	91	344	144	545	169	640
	30	2.1	55	208	106	403	178	672	206	780	56	212	115	435	176	666	183	693
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	20	76	34	128	50	190	69	262	19	72	33	125	50	189	68	257
	25	1.7	34	128	64	244	99	374	142	537	33	125	67	254	104	394	146	553
	35	2.4	48	182	99	375	160	605	220	832	50	189	103	390	161	609	197	746

Liquid

Table 16. Typical Water Capacities with Linear Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER, % Pressure Buildup Over Relief Setting															
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	16	61	29	110	47	178	67	254	26	98	44	167	70	265	96	363
	35	2.4	25	95	53	201	76	288	89	337	33	125	64	242	99	375	138	522
	40	2.8	30	114	59	223	82	310	93	352	37	140	74	280	116	439	164	621
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	19	72	34	129	52	197	70	265	27	102	45	170	69	261	96	363
	50	3.4	29	110	51	193	83	314	103	390	34	129	66	250	103	390	149	564
	70	4.8	39	148	83	314	121	458	121	458	52	197	101	382	164	621	224	848
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	24	91	42	159	64	242	91	344	33	125	57	216	85	322	119	450
	75	5.2	32	121	62	235	104	394	104	394	45	170	83	314	129	488	181	685
	120	8.3	55	208	121	458	151	572	151	572	74	280	147	556	237	897	298	1128
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	34	129	60	227	98	371	137	519	47	178	85	322	129	488	177	670
	150	10.3	53	201	112	424	138	522	138	522	75	284	139	526	216	818	307	1162
	200	13.8	78	295	158	598	158	598	158	598	99	375	195	738	313	1185	378	1431
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	43	163	77	291	118	447	160	606	58	220	99	375	148	560	205	776
	250	17.2	66	250	130	492	208	787	208	787	78	295	139	526	215	814	308	1166
	300	20.7	80	303	166	628	235	889	245	927	94	356	173	655	245	927		

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

- continued -

Table 16. Typical Water Capacities with Linear Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER, % Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	27	100	48	183	73	275	106	400	23	87	38	144	56	212	79	299
	35	2.4	41	155	72	273	120	453	169	640	33	125	59	223	90	341	136	515
	40	2.8	48	180	87	331	143	542	205	777	37	140	68	257	113	428	159	602
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	32	121	52	196	78	295	111	421	27	102	43	163	64	242	88	333
	50	3.4	45	171	83	316	134	508	190	720	37	140	67	254	113	428	159	602
	70	4.8	66	249	130	493	206	781	292	1104	55	208	117	443	178	674	243	920
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	41	154	68	255	101	380	145	547	33	125	54	204	78	295	120	454
	75	5.2	55	206	96	364	154	583	219	830	46	174	81	307	140	530	186	704
	120	8.3	91	345	181	685	291	1100	387	1464	71	269	164	621	257	973	352	1332
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	58	220	97	367	151	570	213	808	54	204	82	310	137	519	182	689
	150	10.3	82	308	160	604	255	966	377	1427	68	257	136	515	223	844	329	1245
	200	13.8	117	444	238	900	384	1454	499	1890	96	363	216	818	353	1336	455	1722
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	69	260	112	423	170	643	239	906	67	254	101	382	148	560	212	802
	250	17.2	98	370	180	682	286	1081	409	1547	89	337	170	643	270	1022	379	1435
	300	20.7	120	453	233	882	372	1408			109	413	211	799	342	1294		

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

Liquid

Table 17. Typical Water Capacities with High Capacity Linear Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER															
			% PRESSURE BUILDUP OVER RELIEF SETTING															
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34									23	87	45	170	68	259	93	352
	10	0.69									56	213	118	445	150	568	159	603
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69									40	153	76	287	107	403	145	550
	20	1.4									92	347	179	677	217	819	226	856
13 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0									51	194	98	372	147	557	194	733
	25	1.7									91	346	188	711	243	921	252	953
	30	2.1									110	416	234	885	264	1000	273	1034
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0									39	149	71	267	109	411	147	555
	25	1.7									76	287	141	534	216	818	252	952
	35	2.4									105	397	222	840	282	1067	291	1103

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

- continued -

Table 17. Typical Water Capacities with High Capacity Linear Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM/LPM OF WATER															
			% Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 14 psig / 0.34 to 0.97 bar White	5	0.34	32	121	57	216	90	341	120	454	33	125	62	235	94	356	133	503
	10	0.69	78	295	154	583	233	882	257	973	86	326	165	625	241	912	259	980
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	54	204	97	367	150	568	203	768	58	220	111	420	163	617	220	833
	20	1.4	123	466	232	878	339	1283	356	1347	144	545	269	1018	349	1321	362	1370
13 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	66	250	120	454	187	708	253	958	75	284	139	526	208	787	281	1064
	25	1.7	125	473	236	893	358	1355	390	1476	138	522	261	988	378	1431	397	1503
	30	2.1	150	568	289	1094	410	1552	426	1612	166	628	319	1207	416	1575	429	1624
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	54	204	92	348	138	522	189	715	59	223	102	386	152	575	208	787
	25	1.7	92	348	173	655	269	1018	358	1355	102	386	193	731	294	1113	391	1480
	35	2.4	140	530	268	1014	402	1522	456	1726	159	602	300	1136	440	1665	459	1737

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Table 18. Typical Water Capacities with High Capacity Linear Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER															
			% Pressure Buildup Over Relief Setting															
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7									59	223	105	398	155	585	210	796
	35	2.4									75	283	145	548	216	816	288	1091
	40	2.8									95	358	175	663	268	1014	313	1185
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4									61	231	109	414	162	612	225	853
	50	3.4									84	316	159	602	241	913	324	1226
	70	4.8									119	450	234	886	354	1340	402	1521
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8									73	276	130	492	193	732	272	1028
	75	5.2									103	391	188	712	288	1090	328	1243
	120	8.3									158	598	318	1205	498	1885	523	1978
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9									99	376	176	665	265	1003	373	1411
	150	10.3									156	589	292	1105	460	1739	575	2178
	200	13.8									201	762	410	1551	622	2355	664	2511
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1									126	475	221	835	332	1258	456	1726
	250	17.2									182	688	342	1294	533	2019	692	2617
	300	20.7									227	858	448	1695	690	2613		

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

- continued -

Table 18. Typical Water Capacities with High Capacity Linear Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER															
			% Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	71	269	121	458	176	666	243	920	80	303	125	473	178	674	253	958
	35	2.4	96	363	174	659	259	980	348	1317	108	409	191	723	288	1090	372	1408
	40	2.8	110	416	197	746	290	1098	389	1472	123	466	212	802	317	1200	410	1552
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	81	307	135	511	195	738	260	984	92	348	148	560	211	799	276	1045
	50	3.4	114	431	198	749	292	1105	380	1438	129	488	217	821	313	1185	409	1548
	70	4.8	155	587	282	1067	404	1529	530	2006	185	700	307	1162	434	1643	573	2169
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	102	386	165	625	239	905	320	1211	109	413	178	674	265	1003	344	1302
	75	5.2	136	515	234	886	345	1306	455	1722	145	549	266	1007	380	1438	504	1908
	120	8.3	212	802	383	1450	560	2120	752	2846	245	927	431	1631	624	2362	796	3013
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	144	545	239	905	347	1313	461	1745	147	556	253	958	368	1393	489	1851
	150	10.3	213	806	375	1419	554	2097	739	2797	239	905	400	1514	589	2229	787	2979
	200	13.8	285	1079	514	1945	755	2858	987	3736	299	1132	534	2021	804	3043	1017	3849
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	176	666	287	1086	416	1575	556	2104	192	727	306	1158	443	1677	586	2218
	250	17.2	252	954	433	1639	642	2430	857	3244	257	973	444	1681	656	2483	889	3365
	300	20.7	304	1151	541	2048	800	3028	1069	4046	307	1162	545	2063	818	3096		

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

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Table 19. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER															
			% Pressure Buildup Over Relief Setting															
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 14 psig / 0.35 to 0.97 bar White	5	0.34	15	57	27	100	36	140	40	150	27	100	50	190	75	280	96	360
	10	0.69	32	120	52	200	61	230	66	250	84	320	140	510	180	670	210	790
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	29	110	44	170	56	210	62	230	58	220	100	380	140	510	160	610
	20	1.4	60	230	81	310	89	340	92	350	130	470	210	810	270	1000	300	1100
12 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	31	120	51	190	65	250	74	280	76	290	130	500	180	680	220	840
	25	1.7	50	190	79	300	97	370	100	390	130	500	230	860	280	1100	330	1200
	30	2.1	61	230	95	360	110	410	120	440	160	600	270	1000	330	1200	360	1400
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	34	130	49	190	64	240	72	270	57	220	99	370	140	530	180	660
	25	1.7	46	170	73	280	88	330	99	370	100	390	180	670	240	920	300	1100
	35	2.4	64	240	100	380	120	440	120	470	160	590	270	1000	340	1300	390	1500

- continued -

Table 19. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 Low-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER															
			% Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
5 to 14 psig / 0.35 to 0.97 bar White	5	0.34	51	190	92	350	130	480	160	620	69	260	120	440	170	620	210	800
	10	0.69	120	470	210	790	280	1100	370	1400	150	560	270	1000	370	1400	460	1700
8 to 24 psig / 0.55 to 1.7 bar Silver	10	0.69	90	340	150	570	210	790	270	1000	110	410	190	720	270	1000	350	1300
	20	1.4	190	720	330	1200	450	1700	520	2000	250	940	430	1600	570	2200	680	2600
12 to 30 psig / 0.83 to 2.1 bar Orange	15	1.0	110	410	190	710	260	970	330	1200	140	530	240	900	340	1300	440	1600
	25	1.7	200	750	320	1200	460	1700	560	2100	250	950	430	1600	590	2200	740	2800
	30	2.1	240	910	390	1500	540	2000	630	2400	300	1100	520	2000	710	2700	820	3100
15 to 35 psig / 1.0 to 2.4 bar Red	15	1.0	91	340	150	580	210	810	270	1000	120	470	200	740	280	1000	360	1400
	25	1.7	160	590	270	1000	380	1400	480	1800	200	750	350	1300	490	1900	630	2400
	35	2.4	220	840	390	1500	540	2000	650	2500	280	1100	490	1900	700	2600	890	3400

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Table 20. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER, % Pressure Buildup Over Relief Setting															
			NPS 1 / DN 25 Body								NPS 2 / DN 50 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	30	110	63	240	84	320	97	370	68	260	120	440	170	650	230	870
	35	2.4	46	170	94	360	110	420	120	450	90	340	190	730	240	920	310	1170
	40	2.8	69	260	100	390	120	450	130	480	110	400	190	730	280	1050	350	1310
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	37	140	74	280	95	360	110	410	82	310	150	570	200	760	260	990
	50	3.4	59	220	100	390	130	470	140	510	130	500	220	840	310	1180	380	1430
	70	4.8	92	350	140	510	150	580	160	610	160	590	280	1070	400	1510	480	1830
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	52	200	99	370	120	470	140	520	110	400	180	700	260	980	330	1230
	75	5.2	96	360	140	530	160	610	170	640	150	560	250	940	340	1290	440	1670
	120	8.3	150	580	190	730	210	780	220	810	220	820	390	1470	550	2080	650	2460
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	90	340	140	540	170	640	190	700	140	540	260	970	380	1420	480	1820
	150	10.3	140	540	200	740	220	840	230	880	210	780	390	1480	550	2080	690	2610
	200	14.8	190	730	240	920	260	970	270	1020	290	1110	510	1930	730	2760	810	3070
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	100	390	170	660	210	800	240	900	170	660	310	1160	440	1650	570	2150
	250	17.2	160	620	240	890	270	1020	290	1100	250	950	430	1640	650	2460	770	2900
	300	20.7	200	750	270	1020	300	1130			290	1090	540	2040	750	2820		

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

- continued -

Table 20. Typical Water Capacities with Quick Opening Cage - Setpoint Made at 10% Flow (For Type MR108 High-Pressure Actuator) (continued)

SPRING RANGE AND COLOR CODE	RELIEF PRESSURE SETTING		CAPACITIES IN GPM / LPM OF WATER, % Pressure Buildup Over Relief Setting															
			NPS 3 / DN 80 Body								NPS 4 / DN 100 Body							
			10%		20%		30%		40%		10%		20%		30%		40%	
	psig	bar	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM	GPM	LPM
25 to 40 psig / 1.7 to 2.8 bar Blue	25	1.7	110	430	170	650	230	870	280	1060	140	530	210	810	290	1090	360	1370
	35	2.4	150	570	240	890	330	1260	410	1550	170	640	270	1000	360	1370	470	1780
	40	2.8	170	640	270	1000	350	1340	450	1680	200	750	310	1190	420	1570	530	2000
35 to 70 psig / 2.4 to 4.8 bar Green	35	2.4	120	470	190	730	260	990	320	1220	150	580	230	860	310	1170	390	1480
	50	3.4	180	670	270	1020	370	1400	470	1770	210	780	320	1230	430	1640	550	2060
	70	4.8	220	830	370	1390	500	1900	620	2340	270	1020	430	1630	590	2240	750	2850
55 to 120 psig / 3.8 to 8.3 bar White	55	3.8	160	590	250	950	330	1260	430	1610	200	750	300	1140	410	1540	510	1930
	75	5.2	200	750	320	1220	450	1720	560	2130	250	940	390	1480	530	2010	670	2530
	120	8.3	310	1170	500	1880	670	2550	850	3210	380	1450	590	2240	820	3080	1070	4030
90 to 200 psig / 6.2 to 13.8 bar Silver	100	6.9	220	840	360	1350	480	1810	590	2240	280	1070	430	1630	580	2200	740	2820
	150	10.3	310	1170	510	1920	700	2650	880	3320	390	1460	610	2310	820	3110	1090	4140
	200	14.8	410	1540	640	2440	910	3450	1190	4490	480	1820	780	2940	1140	4300	1460	5530
175 to 300 psig / 12.1 to 20.7 bar Red	175	12.1	280	1070	450	1690	590	2250	750	2850	360	1370	540	2020	720	2720	930	3500
	250	17.2	390	1490	620	2330	850	3200	1090	4130	480	1810	760	2870	1070	4050	1400	5300
	300	20.7	450	1700	730	2770	1030	3880			540	2060	900	3390	1310	4940		

- Shaded areas indicate where pressure conditions exceed the pressure limit of the actuator.

Type R622

Pressure Reducing Regulator

Introduction

Type R622 direct-operated, spring-loaded regulators provide economical pressure reducing control in a variety of residential, commercial and industrial applications. These regulators can be used with natural, manufactured or liquefied petroleum gases (LPG) and have the same inlet and outlet pressure capabilities.

In addition, Type R622 regulators have internal relief across the diaphragm to help minimize overpressure in the regulator's outlet casing. Any outlet pressure above the start-to-discharge point of the non-adjustable relief valve spring moves the diaphragm off of the relief valve seat, allowing excess pressure to bleed out through the screened spring case vent.

The Type R622 in this Application Guide does not include UL® Listed Constructions for Propane residential applications.

Body Size and End Connection Style

1/2 NPT

Maximum Allowable Inlet Pressure

Operating: 125 psig / 8.6 bar
Emergency: 125 psig / 8.6 bar except 1.8 to 2.2 in. w.c. / 4 to 5 mbar spring range which has operating and emergency pressures of 60 psig / 4.1 bar

Maximum Allowable Outlet (Casing) Pressure

Operating to Avoid Internal Part Damage: 3 psid / 0.21 bar d above outlet pressure setting
Emergency: 20 psi / 1.4 bar

Outlet Pressure Ranges

See Table 2

Orifice Size

1/8 in / 3.2 mm orifice

Flow Coefficients

Wide-Open C_g for Relief Sizing: 12.5
Wide-Open C_v for Relief Sizing: 0.36
C_1: 35

IEC Sizing Coefficients

X_T: 0.78
F_D: 0.82
F_L: 0.89

Flow Capacities

See Table 3

Pressure Registration

Internal

Internal Relief Performance

See Figure 3

Figure 1. Type R622 Pressure Reducing Regulator

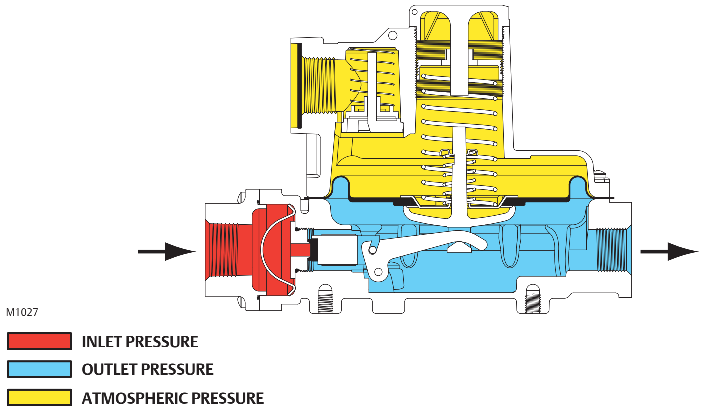

Figure 2. Type R622 Operational Schematic

Internal Relief Start-to-Discharge

8 to 22 in. w.c. / 20 to 55 mbar for setpoints from 1.8 to 20 in. w.c. / 4 to 50 mbar.
140 to 200% over setpoints from 20 in. w.c. to 2.2 psig / 50 to 152 mbar

Spring Case Vent Connections

3/4 NPT with removable screen

Temperature Capabilities

-20 to 160°F / -29 to 71°C

Ordering Guide

To order this product, contact your local Sales Office.

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Features

- Compact and Rugged Design
- Large Diaphragm Area - Highly Accurate
- Protective Inlet Screen
- Superior Internal Relief Capacity
- Inlet and Outlet Pressure Gauge Taps
- Ease of Installation with Accessible Wrench Flats
- Designed with Corrosion Resistant Materials
- Fabric Reinforced Molded Diaphragm for Longer Service Life

Applications

- Fuel Gas

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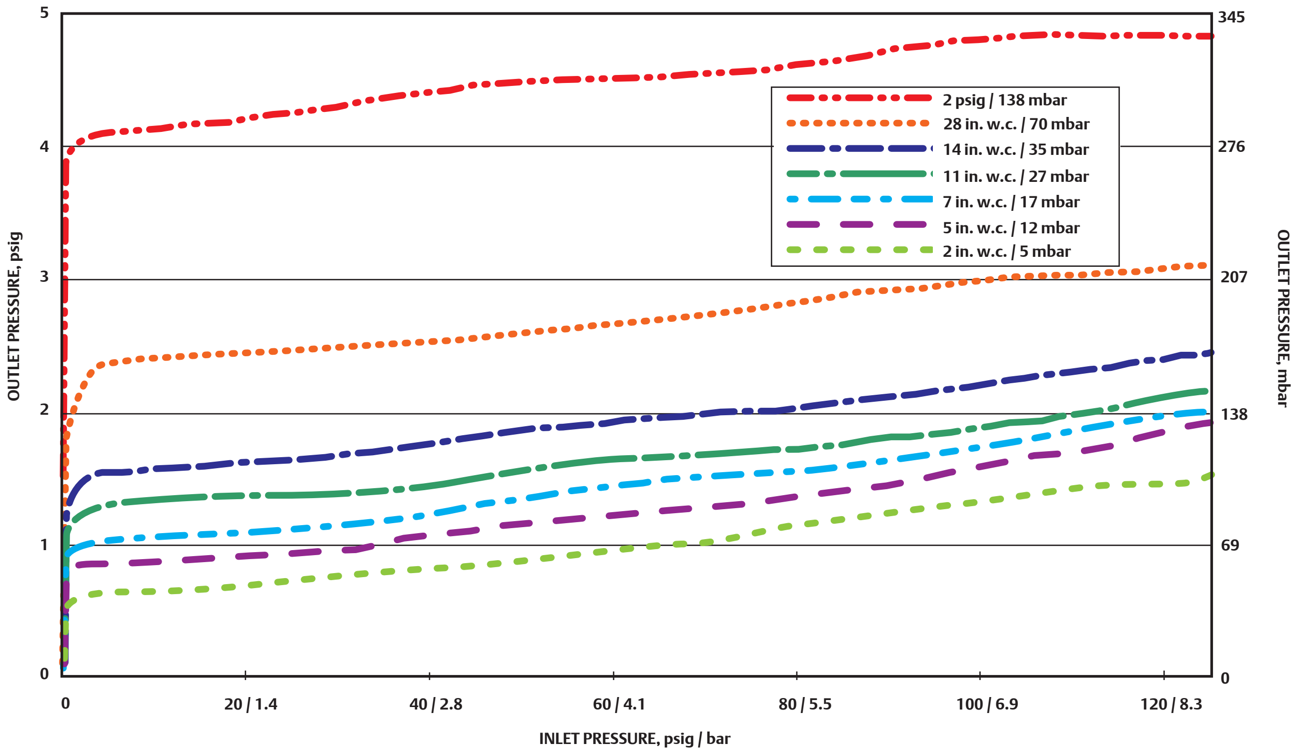

NOTE: TESTED UNDER THE FOLLOWING CONDITIONS: 10 psig / 0.69 bar INLET PRESSURE, 7 In. w.c. / 17 mbar OUTLET PRESSURE SETTING AND 50 SCFH / 1.34 Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS

Figure 3. *Industrial Relief Performance*

Table 1. Construction Materials

PART NAME	MATERIAL
Body, Spring Case, Diaphragm Plate and Orifice	Aluminum
Diaphragm, Disk and O-ring	Nitrile (NBR)
Adjusting Screw and Pushpost	Thermoplastic, Delrin®
Closing Cap	ASA Thermoplastic (UV-Ray Resistant)
Control Spring	Zinc Plated steel
Machine Screw, Spring Seat and Lever	Zinc Plated steel
Valve Stem	Zinc
Relief Valve Spring, Relief Spring Retainer, Lever Pin and Vent Screen	Stainless steel

Table 2. Outlet Pressure Ranges

OUTLET PRESSURE RANGE		CONTROL SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
In. w.c.	mbar		In.	mm	In.	mm
1.8 to 2.2	4 to 5	Purple	0.051	1.30	3.40	86.4
5 to 7	12 to 17	Orange	0.062	1.58	3.40	86.4
6.5 to 9	16 to 22	Yellow	0.067	1.70	3.61	91.7
9 to 13	22 to 32	Silver	0.072	1.83	4.10	104
13 to 20	32 to 50	Gray	0.080	2.03	3.60	91.4
16 to 35	40 to 87	Pink	0.093	2.36	3.52	89.4
1 to 2.2 psig	69 to 152	Light Blue	0.105	2.67	3.66	93.0

Table 3. Typical Regulating Capacities in SCFH / Nm³/h of 0.6 Specific Gravity Natural Gas for Type R622 Regulator

OUTLET PRESSURE SETTING, CONTROL SPRING RANGE, COLOR CODE AND DROOP	INLET PRESSURE		1/2 NPT INLET AND OUTLET	
	psig	bar	SCFH	Nm³/h
Setting: 2 in. w.c. / 5 mbar Range: 1.8 to 2.2 in. w.c. / 4 to 5 mbar Purple Droop: 1 in. w.c. / 2 mbar	5	0.35	287	7.7
	10	0.69	380	10.2
	25	1.7	451	12.1
	50	3.4	493	13.2
	60	4.1	506	13.6
Setting: 5 in. w.c. / 12 mbar Ranges: 5 to 7 in. w.c. / 12 to 17 mbar Orange Droop: 1 in. w.c. / 2 mbar	5	0.35	271	7.3
	10	0.69	367	9.8
	25	1.7	468	12.5
	50	3.4	484	13.0
	60	4.1	428	11.5
	75	5.2	444	11.9
	100	6.9	536	14.4
	125	8.6	536	14.4
Setting: 7 in. w.c. / 17 mbar Range: 6.5 to 9 in. w.c. / 16 to 22 mbar Yellow Droop: 1 in. w.c. / 2 mbar	5	0.35	246	6.6
	10	0.69	347	9.3
	25	1.7	451	12.1
	50	3.4	469	12.6
	60	4.1	477	12.8
	75	5.2	445	11.9
	100	6.9	507	13.6
	125	8.6	511	13.7
Setting: 11 in. w.c. / 27 mbar Range: 9 to 13 in. w.c. / 22 to 32 mbar Silver Droop: 2 in. w.c. / 5 mbar	5	0.35	274	7.3
	10	0.69	401	10.8
	25	1.7	623	16.7
	50	3.4	708	19.0
	60	4.1	735	19.7
	75	5.2	676	18.1
	100	6.9	721	19.3
	125	8.6	738	19.8
Setting: 14 in. w.c. / 35 mbar Range: 13 to 20 in. w.c. / 32 to 50 mbar Grey Droop: 2 in. w.c. / 5 mbar	5	0.35	246	6.6
	10	0.69	364	9.8
	25	1.7	551	14.8
	50	3.4	641	17.2
	60	4.1	661	17.7
	75	5.2	614	16.5
	100	6.9	677	18.1
	125	8.6	727	19.5
Setting: 1 psig / 69 mbar Range: 16 to 35 in. w.c. / 40 to 87 mbar Pink Droop: 10%	5	0.35	174	4.7
	10	0.69	337	9.0
	25	1.7	533	14.3
	50	3.4	679	18.2
	60	4.1	708	19.0
	75	5.2	756	20.3
	100	6.9	762	20.4
	125	8.6	796	21.3
Setting: 2 psig / 0.14 bar Range: 1.2 to 2.2 psi / 83 to 152 mbar Light Blue Droop: 10%	5	0.35	222	5.9
	10	0.69	381	10.2
	25	1.7	630	16.9
	50	3.4	923	24.7
	60	4.1	976	26.2
	75	5.2	1007	27.0
	100	6.9	1285	34.4
	125	8.6	1028	27.6

Type SR5
Pressure Reducing Regulator

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Introduction

The Type SR5 is a compact, large capacity, direct-operated pressure reducing regulator, designed for sanitary applications. The sanitary design meets pharmaceutical, biotechnology, and food and beverage industries needs. Units are available with end connections that match with Tri-Clamp® sanitary fittings. The Type SR5 is suitable for use in steam, liquid or gas service.

Body Size, Inlet and Outlet Connection
1/2, 3/4, 1, 1-1/2, 1-1/2 x 1, 2 and 3 in. / 15, 20, 25 ,40, 40 x 25, 50 and 80 mm

Construction Materials
See Table 1

Service Media
1/2, 3/4, 1 and 1-1/2 x 1 in. / 15, 20, 25 and 40 x 25 mm: Steam, Gas and Liquid
1-1/2 in. / 40 mm full port: Steam and Gas only, Liquid not recommended
2 and 3 in. / 50 and 80 mm: Steam, Gas and Liquid

End Connection
Tri-Clamp® Sanitary connections(1)

Regulator Temperature Capabilities
See Table 2

Body Pressure/Temperature Ratings
See Table 3

Outlet Pressure Ranges
See Table 4

Maximum Differential Pressures
See Table 5

Pressure Registration
Internal

Pressure Loaded Spring Case Option
Maximum Loading Pressure
1/2 to 1 in. / 15 to 25 mm body size:
135 psig / 9.31 bar
1-1/2 in. / 40 mm body size:
100 psig / 6.90 bar
2 and 3 in. / 50 and 80 mm body size:
75 psig / 5.17 bar
1/4 NPT tapped vent connection

Vacuum Protection Option
Maximum vacuum pressure
14 psig / 0.96 bar vacuum

Certifications Available upon Request
FDA approved elastomers/plastics
Material and Functional Test Certificates
USP Class VI approved elastomers/plastics

Spring Case Construction
Drilled untapped vent hole **(standard)**
1/4 NPT for Pressure Load Connection (optional)

Pressure Setting Adjustment
Adjusting screw with Electropolished Cover **(standard)**
T-Handle adjusting screw (optional)

Shutoff Classification per ANSI / FCI 70-3-2003
Metal Seat: ANSI Class III
PTFE Soft Seat: ANSI Class VI
PEEK Soft Seat: ANSI Class VI (150 to 400°F / 65 to 204°C)(2)

Flow Coefficients
See Tables 6 and 7

Flow Capacity
See Table 8

Approximate Weight
1/2 and 3/4 in. / 15 and 20 mm: 9 lbs / 4 kg
1 and 1-1/2 in. / 25 and 40 mm: 18 lbs / 8 kg
2 and 3 in. / 50 and 80 mm: 60 lbs / 27 kg

Ordering Guide
To order this product, contact your local Sales Office.

Application
Sanitary

Features
- Polished 316L Stainless Steel for High Purity Processing
- Meets AMSE BPE and European Hygienic Standards
- Self-draining and Tri-Clamp® design for easy maintenance
- Optional spring case pressure loading for remote setpoint


W8966

Figure 1. *Type SR5 Sanitary Pressure Regulator*

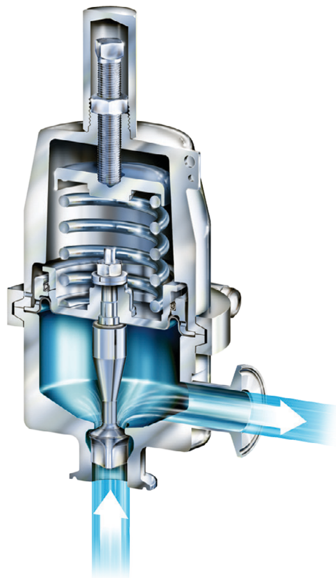
E0967

Figure 2. *Type SR5 Sectional View*

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.
11/15
www.Emerson.com

1. End connection clamps and gaskets to be supplied by the user.
2. PEEK Seat meets ANSI Class IV or better below 150°F / 65°C.

EMERSON

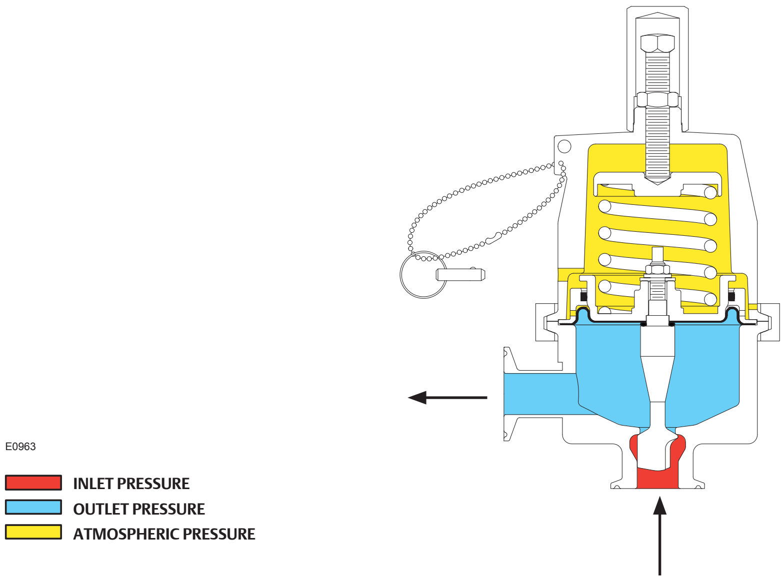

Figure 3. *Type SR5 Operational Schematic*

Table 1. Construction Materials

PART	MATERIAL
Body	316L Stainless steel, 20 µin / 0.5 µm Ra with Electropolish
Spring Case	316 Stainless steel with Electropolish
Plug and Diaphragm Plate	316L Stainless steel 20 µin / 0.5 µm Ra with Electropolish
Soft Seat	Virgin PTFE or PEEK
Diaphragm	EPDM (FDA), Virgin PTFE coated Fluorocarbon (FKM), or 316L Stainless steel
Control Springs	Inconel or 302 Stainless steel
Guide Ring and Upper and Lower Spring Seats	300 Series Stainless steel
Adjusting Screw and Lock Nut	300 Series Stainless steel
Closing Cap	300 Series Stainless steel with Electropolish or Plastic
T-handle and Locking Lever	300 Series Stainless steel
O-rings	EPDM (FDA), Virgin PTFE encapsulated Fluorocarbon (FKM), or Virgin PTFE
Piston Ring	PTFE with 302 Stainless steel
Gaskets (Stainless steel diaphragm only)	Expanded Virgin PTFE
Bolted Clamp	304 Stainless steel with Brass or Stainless steel Nuts
Bead Chain and Ring Grip	300 Series Stainless steel

Table 2. Temperature Capabilities

SEAT TYPE	DIAPHRAGM MATERIAL	O-RING MATERIAL	TEMPERATURE RANGE	
			°F	°C
Metal (316L)	EPDM	EPDM	-20 to 275	-28 to 135
	316L Stainless steel	PTFE/FKM[1]	20 to 400	-6 to 204
	PTFE/FKM	PTFE/FKM	20 to 400	-6 to 204
Soft (PTFE/316L)	EPDM	EPDM	-20 to 150	-28 to 65
	316L Stainless steel	PTFE/FKM[1]	20 to 150	-6 to 65
	PTFE/FKM	PTFE/FKM	20 to 150	-6 to 65
Soft (PEEK/316L)	EPDM	EPDM	-20 to 275	-28 to 135
	316L Stainless steel	PTFE/FKM[1]	20 to 400	-6 to 204
	PTFE/FKM	PTFE/FKM	20 to 400	-6 to 204

1. O-ring material is PTFE for the 1/2 and 3/4 In. / 15 and 20 mm sizes. Temperature range is the same.

Table 3. Body Pressure and Temperature Ratings[1]

BODY SIZE		MAXIMUM TEMPERATURE		MAXIMUM INLET PRESSURE		MAXIMUM OUTLET PRESSURE	
In.	mm	°F	°C	psig	bar	psig	bar
1/2 to 1-1/2	15 to 40	150	65	210	14.5	210	14.5
		275	135	180	12.4	180	12.4
		400	204	160	11	160	11
2 and 3	50 and 80	150	65	210	14.5	150	10.3
		275	135	180	12.4	125	8.62
		400	204	160	11	110	7.58

1. Maximum pressure to prevent damage to internal parts and leakage to atmosphere.

Table 4. Outlet Pressure Ranges

BODY SIZE		OUTLET PRESSURE RANGES		COLOR	WIRE DIAMETER		FREE LENGTH	
In.	mm	psig	bar		In.	mm	In.	mm
1/2 3/4	15 20	2 to 8[1]	0.2 to 0.5[1]	Blue	0.138	3.51	2.75	69.9
		5 to 25	0.4 to 1.7	Silver	0.177	4.50	2.75	69.9
		10 to 50	0.7 to 3.4	Green	0.192	4.88	2.75	69.9
		25 to 90	1.7 to 6.2	Red	0.225	5.72	2.75	69.9
		35 to 135	2.4 to 9.3	Red/ Yellow	0.225 0.148	5.72 3.76	2.75 2.75	69.9 69.9
1 1-1/2 x 1	25 40 x 25	2 to 8[1]	0.2 to 0.5[1]	Blue	0.225	5.72	3.25	82.6
		5 to 25	0.4 to 1.7	Silver	0.282	7.16	3.25	82.6
		10 to 50	0.7 to 3.4	Green	0.331	8.41	3.25	82.6
		25 to 90	1.7 to 6.2	Red	0.362	9.19	3.25	82.6
		35 to 135	2.4 to 9.3	Red/ Yellow	0.362 0.250	9.19 6.35	3.25 3.25	82.6 82.6
1-1/2 full port	40 full port	5 to 25	0.4 to 1.7	Silver	0.282	7.16	3.25	82.6
		10 to 50	0.7 to 3.4	Green	0.331	8.41	3.25	82.6
		25 to 75	1.7 to 5.2	Red	0.362	9.19	3.25	82.6
		35 to 100	2.4 to 6.9	Green/ Yellow	0.331 0.250	8.41 6.35	3.25 3.25	82.6 82.6
2 3	50 80	10 to 25	0.7 to 1.7	Silver	0.562	14.3	6.00	152.4
		15 to 50	1.0 to 3.4	Green	0.625	15.9	6.00	152.4
		25 to 75	1.7 to 5.2	Red	0.625	15.9	6.00	152.4

1. The 2 to 8 psig / 0.2 to 0.5 bar spring is not available with the metal diaphragm.

Table 5. Maximum Differential Pressures

BODY SIZE		OUTLET PRESSURE RANGES		COLOR	MAXIMUM DIFFERENTIAL PRESSURE	
In.	mm	psig	bar		psid	bar d
1/2, 3/4, 1 and 1-1/2 x 1	15, 20, 25 and 40 x 25	2 to 8	0.2 to 0.5	Blue	50	3.4
		5 to 25	0.4 to 1.7	Silver	75	5.2
		10 to 50	0.7 to 3.4	Green	100	6.9
		25 to 90	1.7 to 6.2	Red	125	8.6
		35 to 135	2.4 to 9.3	Red/Yellow	125	8.6
1-1/2 full port	40 full port	5 to 25	0.4 to 1.7	Silver	75	5.2
		10 to 50	0.7 to 3.4	Green	100	6.9
		25 to 75	1.7 to 5.2	Red	125	8.6
		35 to 100	2.4 to 6.9	Green/Yellow	125	8.6
2 3	50 80	10 to 25	0.7 to 1.7	Silver	60	4.1
		15 to 50	1.0 to 3.4	Green	120	8.3
		25 to 75	1.7 to 5.2	Red	130	9.0

Table 6. Flow Coefficients

BODY SIZE		WIDE OPEN COEFFICIENTS (FOR RELIEF VALVE SIZING)			C_1	K_m	F_L	X_T	F_d
In.	mm	C_g	C_v	C_s					
1/2	15	39	1.3	1.9	29.8	0.73	0.85	0.56	0.47
3/4	20	82	2.7	4.1	31.1	0.87	0.93	0.61	0.36
1	25	223	6.4	11.2	34.9	0.87	0.93	0.77	0.43
1-1/2 x 1	40 x 25	231	6.9	11.6	33.5	0.87	0.93	0.71	0.43
1-1/2 full port	40 full port	457	12.4	22.9	36.9	0.87	0.93	0.86	0.34
2	50	929	29.5	46	31.5	0.78	0.88	0.63	0.32
3	80	1108	34.2	55	32.4	0.69	0.83	0.66	0.36

Table 7. C_v Coefficients for 1/2 and 3/4 In. / 15 and 20 mm Body Sizes																	
SPRING RANGE		SET PRESSURE		INLET PRESSURE		C_V AT % DROOP											
						1/2 In. / 15 mm Body Size						3/4 In. / 20 mm Body Size					
						Elastomer Diaphragm			Metal Diaphragm			Elastomer Diaphragm			Metal Diaphragm		
psig	bar	psig	bar	psig	bar	10%	20%	30%	10%	20%	30%	10%	20%	30%	10%	20%	30%
2 to 8	0.2 to 0.5	2	0.2	10	0.7	0.22	0.31	0.40				0.50	0.58	0.66			
				25	1.7	0.20	0.27	0.30				0.34	0.39	0.45			
				50	3.4	0.13	0.18	0.20				0.28	0.30	0.35			
		5	0.4	10	0.7	0.39	0.57	0.71				0.83	1.04	1.41			
				25	1.7	0.24	0.34	0.43		- - - -		0.48	0.67	0.89		- - - -	
				50	3.4	0.19	0.25	0.31				0.35	0.55	0.70			
		8	0.5	10	0.7	0.59	0.83	1.09				1.24	1.89	2.25			
				25	1.7	0.29	0.43	0.57				0.55	0.90	1.22			
				50	3.4	0.24	0.33	0.40				0.40	0.63	0.91			
5 to 25	0.4 to 1.7	5	0.4	25	1.7	0.25	0.34	0.43	0.21	0.27	0.33	0.50	0.69	0.89	0.43	0.56	0.70
				50	3.4	0.19	0.24	0.29	0.16	0.21	0.25	0.46	0.59	0.72	0.39	0.48	0.56
				75	5.2	0.16	0.20	0.23	0.14	0.18	0.21	0.45	0.54	0.65	0.37	0.45	0.50
		15	1.1	25	1.7	0.51	0.76	0.90	0.31	0.48	0.63	0.94	1.49	2.11	0.66	0.92	1.19
				50	3.4	0.34	0.47	0.58	0.24	0.36	0.45	0.66	1.01	1.39	0.51	0.71	0.90
				75	5.2	0.29	0.38	0.45	0.23	0.32	0.38	0.58	0.86	1.14	0.47	0.65	0.81
		25	1.7	35	2.4	0.67	0.90	1.07	0.37	0.60	0.80	1.37	2.22	2.70	0.59	0.92	1.23
				50	3.4	0.48	0.66	0.81	0.30	0.47	0.62	0.95	1.62	2.05	0.53	0.81	1.10
				75	5.2	0.38	0.51	0.62	0.27	0.40	0.50	0.71	1.24	1.58	0.54	0.77	1.04
10 to 50	0.7 to 3.4	10	0.7	25	1.7	0.34	0.51	0.62	0.25	0.35	0.47	0.49	0.72	1.18	0.45	0.67	1.09
				50	3.4	0.25	0.35	0.42	0.19	0.26	0.33	0.39	0.52	0.75	0.36	0.48	0.69
				100	6.9	0.19	0.25	0.28	0.16	0.21	0.25	0.34	0.39	0.47	0.31	0.37	0.44
		25	1.7	50	3.4	0.48	0.68	0.80	0.28	0.46	0.59	0.73	1.30	1.93	0.67	1.14	1.56
				75	5.2	0.37	0.50	0.60	0.25	0.38	0.47	0.57	1.05	1.49	0.53	1.00	1.30
				100	6.9	0.31	0.41	0.49	0.24	0.34	0.40	0.50	0.93	1.26	0.46	0.94	1.17
		50	3.4	75	5.2	0.61	0.90	1.03	0.40	0.59	0.77	1.47	2.29	2.70	1.11	1.45	1.86
				100	6.9	0.48	0.69	0.81	0.34	0.49	0.63	1.16	1.81	2.23	0.83	1.19	1.56
				125	8.6	0.41	0.58	0.68	0.31	0.44	0.55	1.02	1.56	1.92	0.69	1.06	1.41
25 to 90	1.7 to 6.2	25	1.7	50	3.4	0.40	0.61	0.72	0.31	0.45	0.55	0.91	1.33	1.77	0.45	0.90	0.97
				100	6.9	0.28	0.39	0.45	0.24	0.31	0.37	0.68	0.95	1.22	0.46	0.73	0.88
				125	8.6	0.25	0.34	0.39	0.22	0.28	0.33	0.64	0.87	1.10	0.46	0.70	0.86
		50	3.4	75	5.2	0.58	0.81	0.98	0.40	0.57	0.72	1.27	1.87	2.47	0.79	1.24	1.71
				100	6.9	0.45	0.64	0.77	0.33	0.47	0.58	1.03	1.53	2.03	0.73	1.12	1.50
				125	8.6	0.39	0.55	0.65	0.30	0.42	0.50	0.92	1.36	1.79	0.72	1.07	1.39
				150	10	0.35	0.49	0.57	0.28	0.38	0.45	0.86	1.25	1.62	0.72	1.04	1.32
		75	5.2	100	6.9	0.66	0.91	1.09	0.41	0.63	0.80	1.64	2.47	2.70	0.98	1.45	1.93
				125	8.6	0.53	0.74	0.90	0.36	0.54	0.68	1.33	2.00	2.37	0.86	1.30	1.73
				150	10	0.47	0.64	0.78	0.34	0.49	0.61	1.17	1.74	2.07	0.82	1.23	1.62
				175	12	0.43	0.58	0.70	0.33	0.46	0.56	1.08	1.58	1.92	0.80	1.20	1.55
		90	6.2	100	6.9	0.84	1.08	1.12	0.52	0.76	0.96	2.16	2.70	2.70	1.42	2.00	2.57
				125	8.6	0.59	0.83	0.93	0.39	0.60	0.78	1.54	2.14	2.49	1.06	1.61	2.12
				150	10	0.50	0.71	0.83	0.36	0.53	0.68	1.31	1.88	2.30	0.94	1.45	1.89
				175	12	0.46	0.64	0.77	0.34	0.49	0.62	1.19	1.92	2.52	0.88	1.35	1.75
35 to 135	2.4 to 9.3	35	2.4	50	3.4	0.48	0.73	0.87	0.35	0.53	0.66	1.21	1.70	2.05	0.69	0.88	1.29
				75	5.2	0.37	0.54	0.65	0.27	0.40	0.50	0.89	1.31	1.62	0.64	0.86	1.18
				100	6.9	0.33	0.46	0.55	0.24	0.35	0.43	0.78	1.16	1.43	0.65	0.88	1.15
				125	8.6	0.30	0.41	0.48	0.23	0.32	0.38	0.72	1.07	1.31	0.66	0.90	1.14
		50	3.4	75	5.2	0.57	0.78	0.92	0.36	0.55	0.69	1.34	1.79	2.41	0.97	1.32	1.75
				100	6.9	0.45	0.62	0.73	0.31	0.46	0.57	1.04	1.45	1.94	0.80	1.13	1.49
				125	8.6	0.39	0.54	0.63	0.29	0.41	0.49	0.89	1.27	1.68	0.72	1.03	1.36
				150	10	0.36	0.48	0.55	0.28	0.38	0.44	0.80	1.16	1.49	0.68	0.97	1.26
		75	5.2	100	6.9	0.63	0.94	1.07	0.46	0.64	0.81	1.47	2.15	2.70	1.08	1.56	1.99
				125	8.6	0.50	0.76	0.89	0.37	0.54	0.68	1.16	1.78	2.32	0.91	1.35	1.75
				150	10	0.44	0.65	0.78	0.32	0.49	0.60	1.02	1.59	2.08	0.83	1.24	1.61
				175	12	0.40	0.59	0.70	0.30	0.45	0.54	0.92	1.46	1.92	0.78	1.17	1.53
		100	6.9	125	8.6	0.73	1.05	1.14	0.49	0.72	0.88	1.66	2.50	2.70	1.14	1.75	2.22
				150	10	0.60	0.88	0.99	0.42	0.61	0.76	1.37	2.08	2.49	0.95	1.51	1.98
				175	12	0.54	0.78	0.89	0.38	0.56	0.69	1.22	1.85	2.30	0.85	1.37	1.84
				200	14	0.50	0.72		0.36	0.52		1.13	1.69		0.80	1.29	
		135	9.3	150	10	0.87	1.12	1.15	0.60	0.83	1.01	2.27	2.70	2.70	1.33	2.05	2.61
				175	12	0.74	0.99	1.09	0.49	0.74	0.90	1.68	2.44	2.70	1.12	1.73	2.26
				200	14	0.69	0.94	1.06	0.45	0.69	0.83	1.39	2.28	2.67	1.03	1.56	2.04

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 7. C_v Coefficients for 1 and 1-1/2 x 1 In. / 25 and 40 x 25 mm Body Sizes (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		C_v AT % DROOP											
						1 In. / 25 mm Body Size						1-1/2 x 1 In. / 40 x 25 mm Body Size					
						Elastomer Diaphragm			Metal Diaphragm			Elastomer Diaphragm			Metal Diaphragm		
psig	bar	psig	bar	psig	bar	10%	20%	30%	10%	20%	30%	10%	20%	30%	10%	20%	30%
2 to 8	0.2 to 0.5	2	0.2	10	0.7	0.85	0.86	0.89				0.95	0.96	0.99			
				25	1.7	0.77	0.93	0.95				0.88	1.06	1.08			
				50	3.4	0.78	1.03	1.03				0.89	1.17	1.18			
		5	0.4	10	0.7	1.00	1.03	2.11				1.11	1.14	2.35			
				25	1.7	0.69	0.87	1.43		- - - -		0.78	0.99	1.61		- - - -	
				50	3.4	0.62	0.88	1.21				0.70	1.01	1.38			
		8	0.5	10	0.7	3.00	3.54	3.52				3.31	3.92	3.90			
				25	1.7	1.57	1.78	1.83				1.76	2.00	2.07			
				50	3.4	1.33	1.34	1.34				1.52	1.53	1.53			
5 to 25	0.4 to 1.7	5	0.4	25	1.7	0.76	0.93	1.42	0.69	0.84	1.28	0.86	1.05	1.61	0.78	0.96	1.46
				50	3.4	0.70	0.87	1.15	0.63	0.78	1.04	0.80	1.00	1.32	0.73	0.90	1.20
				75	5.2	0.69	0.86	1.05	0.62	0.77	0.95	0.79	0.98	1.21	0.72	0.89	1.10
		15	1.1	25	1.7	2.07	2.10	3.98	0.99	1.24	1.66	2.30	2.35	4.45	1.11	1.38	1.85
				50	3.4	1.23	1.59	2.50	0.87	1.11	1.41	1.39	1.81	2.83	0.98	1.26	1.60
				75	5.2	0.99	1.47	2.01	0.87	1.11	1.36	1.13	1.68	2.30	0.99	1.26	1.55
		25	1.7	35	2.4	3.11	4.40	5.67	1.06	1.49	2.33	3.46	4.91	6.33	1.18	1.66	2.61
				50	3.4	2.27	3.24	4.23	0.98	1.34	2.00	2.55	3.64	4.76	1.10	1.51	2.25
				75	5.2	1.82	2.51	3.24	0.99	1.29	1.81	2.06	2.85	3.69	1.12	1.47	2.05
10 to 50	0.7 to 3.4	10	0.7	25	1.7	1.30	1.92	2.91	0.93	0.98	1.21	1.45	2.15	3.27	1.04	1.10	1.36
				50	3.4	1.07	1.50	2.06	0.86	0.96	1.15	1.21	1.71	2.34	0.97	1.10	1.31
				100	6.9	0.98	1.30	1.59	0.85	1.00	1.15	1.12	1.49	1.82	0.98	1.14	1.31
		25	1.7	50	3.4	2.13	3.52	4.60	1.03	1.26	1.81	2.39	3.96	5.18	1.15	1.41	2.04
				75	5.2	1.79	2.76	3.58	1.00	1.24	1.68	2.02	3.14	4.07	1.13	1.41	1.91
				100	6.9	1.64	2.41	3.08	1.00	1.25	1.63	1.87	2.75	3.52	1.14	1.43	1.86
		50	3.4	75	5.2	3.64	5.53	6.40	1.52	2.28	3.31	4.06	6.19	6.90	1.69	2.56	3.72
				100	6.9	2.95	4.38	5.16	1.25	1.88	2.70	3.32	4.95	5.83	1.40	2.12	3.06
				125	8.6	2.64	3.80	4.65	1.13	1.68	2.38	2.98	4.32	5.28	1.28	1.90	2.70
25 to 90	1.7 to 6.2	25	1.7	50	3.4	1.22	2.39	3.85	1.22	1.76	2.44	1.37	2.69	4.34	1.37	1.98	2.75
				100	6.9	1.36	1.95	2.75	1.07	1.44	1.99	1.55	2.23	3.14	1.22	1.64	2.28
				125	8.6	1.41	1.88	2.53	1.05	1.39	1.91	1.61	2.15	2.90	1.21	1.59	2.19
		50	3.4	75	5.2	3.18	4.70	6.09	1.69	2.83	4.52	3.55	5.26	6.84	1.89	3.17	5.08
				100	6.9	2.54	3.79	4.91	1.37	2.33	3.59	2.85	4.27	5.55	1.54	2.62	4.06
				125	8.6	2.24	3.33	4.27	1.23	2.08	3.07	2.54	3.78	4.86	1.39	2.36	3.50
				150	10	2.06	3.05	3.86	1.15	1.92	2.74	2.35	3.47	4.41	1.30	2.19	3.13
		75	5.2	100	6.9	3.75	5.47	6.31	1.96	3.18	4.72	4.17	6.10	6.90	2.19	3.55	5.29
				125	8.6	3.06	4.61	5.49	1.73	2.77	4.04	3.43	5.18	6.19	1.94	3.11	4.55
				150	10	2.74	4.17	5.03	1.64	2.56	3.65	3.08	4.71	5.70	1.85	2.89	4.14
				175	12	2.55	3.89	4.74	1.60	2.44	3.40	2.88	4.41	5.39	1.81	2.77	3.87
		90	6.2	100	6.9	4.96	6.17	6.40	2.60	3.98	5.51	5.49	6.85	6.90	2.88	4.42	6.15
				125	8.6	3.66	5.06	5.75	1.92	3.19	4.52	4.08	5.66	6.45	2.14	3.57	5.08
				150	10	3.22	4.61	5.39	1.69	2.85	4.02	3.61	5.18	6.08	1.89	3.21	4.54
				175	12	2.99	4.37	5.19	1.57	2.66	3.71	3.37	4.93	5.88	1.77	3.01	4.20
35 to 135	2.4 to 9.3	35	2.4	50	3.4	2.07	3.14	4.37	1.86	2.88	3.70	2.31	3.51	4.89	2.10	3.21	4.14
				75	5.2	1.71	2.57	3.49	1.56	2.20	2.92	1.93	2.90	3.95	1.75	2.48	3.30
				100	6.9	1.62	2.37	3.13	1.38	1.93	2.60	1.83	2.69	3.56	1.56	2.19	2.96
				125	8.6	1.58	2.27	2.92	1.28	1.79	2.41	1.80	2.59	3.34	1.46	2.04	2.76
		50	3.4	75	5.2	3.03	4.08	5.01	1.76	2.63	3.63	3.38	4.57	5.63	1.97	2.94	4.08
				100	6.9	2.30	3.33	4.17	1.54	2.27	3.08	2.59	3.75	4.71	1.74	2.56	3.48
				125	8.6	1.96	2.95	3.72	1.46	2.10	2.79	2.21	3.35	4.23	1.65	2.38	3.17
				150	10	1.74	2.72	3.44	1.42	2.01	2.61	1.98	3.10	3.93	1.61	2.28	2.98
		75	5.2	100	6.9	3.44	5.26	6.30	1.61	2.64	4.07	3.82	5.88	6.90	1.80	2.95	4.56
				125	8.6	2.85	4.37	5.44	1.59	2.51	3.71	3.20	4.91	6.14	1.78	2.82	4.19
				150	10	2.59	3.90	4.96	1.62	2.48	3.53	2.92	4.40	5.62	1.83	2.80	4.00
				175	12	2.44	3.60	4.65	1.66	2.48	3.43	2.76	4.08	5.29	1.88	2.81	3.90
		100	6.9	125	8.6	3.85	5.92	6.40	2.25	3.45	4.62	4.28	6.60	6.90	2.50	3.84	5.17
				150	10	3.15	5.02	6.18	1.94	3.08	4.19	3.52	5.63	6.90	2.17	3.45	4.71
				175	12	2.81	4.53	5.75	1.80	2.90	3.94	3.15	5.10	6.50	2.02	3.26	4.46
				200	14	2.60	4.21		1.73	2.79		2.93	4.76		1.95	3.15	
		135	9.3	150	10	2.65	6.40	6.40	2.38	4.38	5.69	2.93	6.90	6.90	2.67	4.87	6.36
				175	12	3.40	6.08	6.40	2.43	3.86	5.27	3.78	6.79	6.90	2.70	4.32	5.91
				200	14	3.96	5.84	6.40	2.20	3.61	5.05	4.43	6.55	6.90	2.46	4.05	5.68

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 7. C_v Coefficients for 1-1/2 In. / 40 mm Body Size (continued)											
SPRING RANGE		SET PRESSURE		INLET PRESSURE		C_v AT % DROOP					
						1-1/2 In. / 40 mm Body Size with Full Port					
						Elastomer Diaphragm			Metal Diaphragm		
psig	bar	psig	bar	psig	bar	10%	20%	30%	10%	20%	30%
5 to 25	0.4 to 1.7	5	0.4	25	1.7	0.59	1.02	1.24	1.36	1.38	1.40
				50	3.4	1.98	2.37	2.77	1.45	1.61	1.89
				75	5.2	1.86	2.10	2.39	1.51	1.72	2.12
		15	1.0	25	1.7	2.02	4.37	6.40	1.94	2.33	3.27
				50	3.4	2.23	3.42	4.60	1.76	2.21	2.97
				75	5.2	2.39	3.20	4.07	1.77	2.25	2.95
		25	1.7	25	1.7	3.48	6.14	7.55	1.80	2.47	4.08
				50	3.4	3.21	5.12	6.52	1.72	2.38	3.67
				75	5.2	3.21	4.60	5.94	1.77	2.44	3.48
10 to 50	0.7 to 3.4	10	0.7	25	1.7	1.50	2.14	3.22	1.52	2.16	3.27
				50	3.4	1.53	2.02	2.63	1.57	2.07	2.71
				100	6.9	1.57	2.01	2.45	1.63	2.08	2.54
		25	1.7	50	3.4	2.32	4.24	6.05	2.14	3.36	4.74
				75	5.2	2.35	3.65	4.94	1.94	2.91	4.07
				100	6.9	2.40	3.40	4.42	1.88	2.72	3.77
		50	3.4	75	5.2	6.00	9.26	11.53	3.35	5.09	6.76
				100	6.9	4.53	7.23	8.86	3.17	4.73	6.02
				125	8.6	3.84	6.21	7.41	3.15	4.60	5.65
25 to 75	1.7 to 5.2	25	1.7	50	3.4	3.78	4.97	6.67	2.47	4.43	5.47
				100	6.9	3.33	4.60	5.46	2.11	2.95	3.77
				125	8.6	3.28	4.57	5.25	2.06	2.67	3.43
		50	3.4	75	5.2	4.90	7.21	9.10	3.31	5.16	6.33
				100	6.9	3.88	6.03	7.45	2.40	4.12	5.24
				125	8.6	3.41	5.46	6.58	1.96	3.59	4.66
				150	10	3.13	5.12	6.03	1.68	3.27	4.30
		75	5.2	100	6.9	5.24	7.06	9.84	4.33	5.65	7.52
				125	8.6	4.83	6.52	8.70	3.58	5.00	6.62
				150	10	4.72	6.30	8.09	3.23	4.69	6.12
				175	12	4.68	6.19	7.70	3.03	4.51	5.80
35 to 100	2.4 to 6.9	35	2.4	50	3.4	3.51	5.27	7.12	3.53	4.57	6.02
				75	5.2	2.74	4.14	5.57	2.79	3.53	4.67
				100	6.9	2.50	3.72	4.92	2.56	3.13	4.11
				125	8.6	2.38	3.49	4.56	2.45	2.91	3.78
		50	3.4	75	5.2	4.88	6.88	8.31	2.90	3.97	5.58
				100	6.9	3.70	5.45	6.74	2.26	3.27	4.61
				125	8.6	3.14	4.74	5.91	1.97	2.92	4.10
				150	10	2.80	4.29	5.38	1.79	2.71	3.78
		75	5.2	100	6.9	5.88	8.19	10.19	3.09	4.76	6.70
				125	8.6	4.56	6.46	8.37	2.72	4.38	6.01
				150	10	3.91	5.52	7.33	2.58	4.23	5.65
				175	12	3.52	4.91	6.64	2.50	4.15	5.43
		100	6.9	125	8.6	4.56	7.66	10.59	4.41	6.37	8.21
				150	10	4.89	6.96	9.55	3.82	5.63	7.28
				175	12	5.20	6.62	8.96	3.57	5.25	6.74
				200	14	5.46	6.42		3.43	5.03	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 7. C_v Coefficients for 2 In. / 50 mm Body Size (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		C_V AT % DROOP					
						2 In. / 50 mm Body Size					
						Elastomer Diaphragm			Metal Diaphragm		
psig	bar	psig	bar	psig	bar	10%	20%	30%	10%	20%	30%
10 to 25	0.7 to 1.7	10	0.7	25	1.7	7.97	11.12	15.04	6.71	9.41	11.05
				50	3.4	7.27	8.67	12.17	5.41	7.28	8.75
		15	1.0	25	1.7	10.97	15.05	20.61	7.51	10.76	14.75
				50	3.4	7.30	11.44	15.60	6.17	8.15	11.08
		25	1.7	50	3.4	10.15	17.09	22.48	7.64	10.47	15.10
				75	5.2	8.58	13.70	17.79	6.06	9.29	12.55
15 to 50	1.0 to 3.4	15	1.0	25	1.7	9.90	12.94	17.79	7.42	10.20	12.55
				50	3.4	7.12	9.44	13.05	5.80	7.57	9.75
				75	5.2	6.15	8.18	10.62	5.36	6.66	8.65
				100	6.9	5.47	7.31	9.10	5.02	6.03	7.85
				125	8.6	4.95	6.63	8.24	4.72	5.55	7.22
		25	1.7	50	3.4	7.70	14.67	18.37	7.12	9.86	13.81
				75	5.2	7.15	12.16	15.52	6.06	8.91	12.00
				100	6.9	6.69	10.71	13.65	5.37	8.19	10.56
				125	8.6	6.15	9.59	12.14	4.81	7.54	9.37
		50	3.4	75	5.2	12.15	19.35	24.67	8.06	13.57	19.05
				100	6.9	11.40	17.07	21.17	7.85	12.84	16.94
				125	8.6	10.41	15.11	18.78	7.36	11.79	15.27
				150	10	9.45	13.45	16.90	6.86	10.72	13.87
25 to 75	1.7 to 5.2	25	1.7	50	3.4	8.87	13.48	16.78	6.70	8.94	12.52
				75	5.2	7.06	11.43	14.81	6.19	8.32	11.08
				100	6.9	6.88	10.37	12.95	5.52	7.91	10.15
				125	8.6	6.51	9.53	11.31	4.88	7.41	9.33
				150	10	5.78	8.75	10.03	4.40	6.87	8.59
		50	3.4	75	5.2	11.63	18.55	23.38	7.80	13.00	18.36
				100	6.9	9.07	15.54	19.89	7.39	11.79	16.15
				125	8.6	8.64	14.03	18.04	7.08	10.94	14.62
				150	10	8.60	12.95	16.63	6.77	10.22	13.41
				175	12	8.38	12.01	15.26	6.46	9.60	12.49
		75	5.2	100	6.9	14.25	20.63	24.79	10.23	17.45	23.33
				125	8.6	11.53	18.18	22.23	8.94	14.73	20.52
				150	10	10.35	16.27	20.45	8.11	13.66	18.94
				175	12	9.74	14.90	18.89	7.69	12.90	17.53

- continued -

Table 7. C_v Coefficients for 3 In. / 80 mm Body Size (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		C_v AT % DROOP					
						3 In. / 80 mm Body Size					
						Elastomer Diaphragm			Metal Diaphragm		
psig	bar	psig	bar	psig	bar	10%	20%	30%	10%	20%	30%
10 to 25	0.7 to 1.7	10	0.7	25	1.7	8.43	12.71	17.90	6.27	8.80	10.95
				50	3.4	6.93	10.49	14.69	4.68	7.09	8.36
		15	1.0	25	1.7	10.67	16.78	24.05	7.28	10.12	14.69
				50	3.4	9.26	14.70	19.36	5.90	7.72	11.36
		25	1.7	50	3.4	13.92	21.21	25.93	7.51	10.34	15.45
				75	5.2	9.70	17.12	21.37	6.06	9.99	14.30
15 to 50	1.0 to 3.4	15	1.0	25	1.7	10.53	14.23	18.72	6.48	9.43	12.40
				50	3.4	7.14	10.68	15.02	5.73	7.79	10.59
				75	5.2	6.68	10.00	12.99	5.49	7.29	9.87
				100	6.9	6.61	9.75	11.63	5.19	6.86	9.23
				125	8.6	6.53	9.49	10.84	4.88	6.46	8.64
		25	1.7	50	3.4	9.50	16.34	21.67	7.70	9.87	13.71
				75	5.2	8.80	14.00	18.77	6.30	9.15	13.30
				100	6.9	7.82	12.62	16.66	5.66	8.88	12.49
				125	8.6	7.02	11.24	14.95	5.31	8.64	11.59
		50	3.4	75	5.2	15.49	22.85	28.52	7.82	13.73	19.79
				100	6.9	12.66	20.10	25.01	7.68	12.79	18.92
				125	8.6	11.51	18.19	23.26	7.28	12.06	17.63
				150	10	10.81	16.67	21.45	6.87	11.46	16.30
25 to 75	1.7 to 5.2	25	1.7	50	3.4	8.93	15.32	21.23	7.25	10.80	14.66
				75	5.2	7.29	12.62	17.15	5.96	9.48	13.02
				100	6.9	7.12	11.51	15.13	5.34	8.80	11.95
				125	8.6	7.33	10.85	13.83	5.07	8.32	11.08
				150	10	7.28	10.31	12.86	4.97	7.96	10.37
		50	3.4	75	5.2	13.39	20.76	26.00	7.72	13.23	18.78
				100	6.9	11.10	18.55	24.11	7.71	11.82	17.60
				125	8.6	10.99	17.03	22.02	7.21	11.43	16.56
				150	10	10.38	15.91	20.19	6.69	11.26	15.57
				175	12	9.69	15.17	18.93	6.40	11.02	14.75
		75	5.2	100	6.9	14.97	21.94	28.10	8.91	15.33	22.96
				125	8.6	12.68	21.25	26.29	8.42	14.21	21.98
				150	10	11.63	20.26	24.93	7.85	13.33	20.53
				175	12	11.00	18.91	23.64	7.99	12.88	18.61

Table 8. Steam Capacities for 1/2 In. / 15 mm Body Size

SPRING RANGE		SET PRESSURE		INLET PRESSURE		CAPACITIES IN POUNDS PER HOUR / kg/h OF SATURATED STEAM AT % DROOP — 1/2 In. / 15 mm Body Size — Elastomer Diaphragm — 10%		Elastomer Diaphragm — 20%		Elastomer Diaphragm — 30%		Metal Diaphragm — 10%		Metal Diaphragm — 20%		Metal Diaphragm — 30%	
psig	bar	psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
2 to 8	0.2 to 0.5	2	0.2	10	0.7	7	3.2	10	4.5	12	5.4						
				25	1.7	10	4.5	14	6.4	15	6.8						
				50	3.4	11	5.0	15	6.8	17	7.7						
		5	0.4	10	0.7	11	5.0	16	7.3	21	9.5						
				25	1.7	13	5.9	18	8.2	22	10	- - - -					
				50	3.4	16	7.3	21	9.5	26	12						
		8	0.5	10	0.7	13	5.9	19	8.6	28	13						
				25	1.7	15	6.8	22	10	30	14						
				50	3.4	20	9.1	28	13	34	15						
5 to 25	0.4 to 1.7	5	0.4	25	1.7	13	5.9	18	8.2	22	10	11	5.0	14	6.4	17	7.7
				50	3.4	16	7.3	20	9.1	25	11	14	6.4	17	7.7	21	9.5
				75	5.2	19	8.6	23	10	27	12	17	7.7	21	9.5	25	11
		15	1.1	25	1.7	24	11	37	17	45	20	15	6.8	24	11	32	15
				50	3.4	29	13	40	18	49	22	21	9.5	30	14	38	17
				75	5.2	35	16	44	20	53	24	27	12	37	17	45	20
		25	1.7	35	2.4	39	18	55	25	67	30	21	9.5	36	16	50	23
				50	3.4	40	18	56	25	69	31	25	11	40	18	53	24
				75	5.2	44	20	60	27	73	33	32	15	47	21	59	27
10 to 50	0.7 to 3.4	10	0.7	25	1.7	17	7.7	26	12	32	15	13	5.9	18	8.2	24	11
				50	3.4	21	9.5	30	14	35	16	16	7.3	22	10	28	13
				100	6.9	29	13	38	17	42	19	24	11	31	14	37	17
		25	1.7	50	3.4	40	18	57	26	68	31	23	10	39	18	50	23
				75	5.2	44	20	59	27	71	32	30	14	45	20	55	25
				100	6.9	47	21	62	28	74	34	36	16	51	23	60	27
		50	3.4	75	5.2	68	31	104	47	121	55	45	20	69	31	90	41
				100	6.9	72	33	105	48	122	55	51	23	75	34	94	43
				125	8.6	76	34	107	49	125	57	56	25	81	37	100	45
25 to 90	1.7 to 6.2	25	1.7	50	3.4	34	15	51	23	61	28	26	12	38	17	47	21
				100	6.9	42	19	58	26	68	31	35	16	46	21	55	25
				125	8.6	46	21	62	28	72	33	40	18	51	23	60	27
		50	3.4	75	5.2	65	29	94	43	114	52	45	20	66	30	84	38
				100	6.9	68	31	97	44	116	53	50	23	71	32	88	40
				125	8.6	71	32	101	46	119	54	55	25	77	35	92	42
				150	10	76	34	105	48	123	56	61	28	83	38	97	44
		75	5.2	100	6.9	91	41	132	60	162	74	57	26	91	41	119	54
				125	8.6	97	44	135	61	165	75	65	30	98	44	125	57
				150	10	102	46	139	63	169	77	73	33	106	48	132	60
				175	12	108	49	144	65	174	79	82	37	115	52	139	63
		90	6.2	100	6.9	97	44	142	64	159	72	60	27	101	46	136	62
				125	8.6	103	47	148	67	169	77	68	31	108	49	142	64
				150	10	108	49	154	70	179	81	76	35	116	53	147	67
				175	12	114	52	160	73	191	87	84	38	123	56	154	70
35 to 135	2.4 to 9.3	35	2.4	50	3.4	37	17	59	27	72	33	27	12	43	20	55	25
				75	5.2	43	20	64	29	77	35	32	15	47	21	59	27
				100	6.9	49	22	70	32	82	37	37	17	52	24	65	30
				125	8.6	56	25	76	34	88	40	41	19	58	26	70	32
		50	3.4	75	5.2	64	29	90	41	108	49	41	19	63	29	81	37
				100	6.9	67	30	94	43	111	50	47	21	69	31	85	39
				125	8.6	72	33	98	44	115	52	53	24	75	34	91	41
				150	10	77	35	103	47	119	54	60	27	82	37	96	44
		75	5.2	100	6.9	87	39	136	62	160	73	64	29	93	42	121	55
				125	8.6	91	41	138	63	163	74	67	30	99	45	125	57
				150	10	96	44	142	64	168	76	70	32	105	48	130	59
				175	12	101	46	146	66	174	79	74	34	112	51	136	62
		100	6.9	125	8.6	119	54	182	83	205	93	80	36	125	57	158	72
				150	10	127	58	189	86	213	97	88	40	132	60	165	75
				175	12	134	61	196	89	222	101	95	43	139	63	173	79
				200	14	142	64	204	93			102	46	146	66		
		135	9.3	150	10	148	67	215	98	238	108	102	46	160	73	209	95
				175	12	169	77	239	108	270	123	112	51	177	80	221	100
				200	14	190	86	263	119	300	136	122	55	193	88	234	106

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 8. Steam Capacities for 3/4 In. / 20 mm Body Size (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		CAPACITIES IN POUNDS PER HOUR / KG/H OF SATURATED STEAM AT % DROOP											
						3/4 In. / 20 mm Body Size											
						Elastomer Diaphragm						Metal Diaphragm					
						10%		20%		30%		10%		20%		30%	
psig	bar	psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
2 to 8	0.2 to 0.5	2	0.2	10	0.7	15	6.8	18	8.2	21	9.5	- - - -					
				25	1.7	19	8.6	21	9.5	24	11						
				50	3.4	24	11	27	12	31	14						
		5	0.4	10	0.7	23	10	30	14	41	19						
				25	1.7	26	12	36	16	48	22						
				50	3.4	31	14	49	22	62	28						
		8	0.5	10	0.7	26	12	45	20	58	26						
				25	1.7	30	14	48	22	66	30						
				50	3.4	35	16	55	25	81	37						
5 to 25	0.4 to 1.7	5	0.4	25	1.7	27	12	37	17	48	22	23	10	30	14	38	17
				50	3.4	41	19	52	24	64	29	35	16	43	20	50	23
				75	5.2	55	25	66	30	80	36	46	21	55	25	62	28
		15	1.1	25	1.7	46	21	75	34	110	50	32	15	47	21	61	28
				50	3.4	58	26	89	40	120	54	45	20	63	29	79	36
				75	5.2	71	32	110	50	140	64	58	26	80	36	99	45
		25	1.7	35	2.4	80	36	140	64	170	77	34	15	57	26	79	36
				50	3.4	83	38	140	64	180	82	46	21	71	32	97	44
				75	5.2	87	39	150	68	190	86	66	30	95	43	130	59
10 to 50	0.7 to 3.4	10	0.7	25	1.7	26	12	38	17	63	29	24	11	35	16	58	26
				50	3.4	35	16	46	21	66	30	32	15	42	19	61	28
				100	6.9	53	24	62	28	74	34	49	22	57	26	70	32
		25	1.7	50	3.4	63	29	110	50	170	77	58	26	100	45	140	64
				75	5.2	70	32	130	59	180	82	65	29	120	54	160	73
				100	6.9	79	36	150	68	200	91	70	32	150	68	180	82
		50	3.4	75	5.2	170	77	270	123	330	150	130	59	170	77	230	104
				100	6.9	180	82	280	127	350	159	130	59	190	86	250	114
				125	8.6	200	91	300	136	370	168	130	59	200	91	270	123
25 to 90	1.7 to 6.2	25	1.7	50	3.4	79	36	120	54	160	73	39	18	79	36	86	39
				100	6.9	110	50	150	68	190	86	72	33	120	54	140	64
				125	8.6	120	54	170	77	210	95	89	40	130	59	160	73
		50	3.4	75	5.2	150	68	220	100	300	136	91	41	150	68	210	95
				100	6.9	160	73	240	109	320	145	110	50	180	82	240	109
				125	8.6	180	82	260	118	340	154	140	64	210	95	270	123
				150	10	190	86	280	127	370	168	160	73	240	109	300	136
		75	5.2	100	6.9	230	104	370	168	410	186	140	64	210	95	300	136
				125	8.6	250	114	380	173	450	204	160	73	250	114	330	150
				150	10	260	118	390	177	470	213	190	86	280	127	370	168
				175	12	280	127	410	186	500	227	210	95	310	141	400	182
		90	6.2	100	6.9	250	114	360	163	390	177	170	77	270	123	370	168
				125	8.6	270	123	390	177	470	213	190	86	300	136	400	182
				150	10	290	132	420	191	520	236	210	95	320	145	430	195
				175	12	310	141	500	227	660	300	230	104	350	159	460	209
35 to 135	2.4 to 9.3	35	2.4	50	3.4	96	44	140	64	180	82	54	25	73	33	110	50
				75	5.2	110	50	160	73	200	91	78	35	110	50	140	64
				100	6.9	120	54	180	82	220	100	100	45	140	64	180	82
				125	8.6	140	64	200	91	250	114	130	59	170	77	220	100
		50	3.4	75	5.2	150	68	210	95	290	132	110	50	160	73	210	95
				100	6.9	160	73	230	104	300	136	120	54	180	82	230	104
				125	8.6	170	77	240	109	320	145	140	64	200	91	260	118
				150	10	180	82	260	118	340	154	150	68	220	100	290	132
		75	5.2	100	6.9	210	95	320	145	410	186	150	68	230	104	310	141
				125	8.6	220	100	340	154	440	200	170	77	260	118	330	150
				150	10	230	104	360	163	470	213	190	86	280	127	360	163
				175	12	240	109	380	173	500	227	200	91	300	136	400	182
		100	6.9	125	8.6	270	123	440	200	500	227	190	86	310	141	410	186
				150	10	290	132	460	209	560	254	200	91	330	150	450	204
				175	12	310	141	480	218	600	272	220	100	360	163	480	218
				200	14	330	150	500	227			230	104	380	173		
		135	9.3	150	10	390	177	530	241	570	259	230	104	400	182	550	250
				175	12	390	177	600	272	690	313	260	118	430	195	580	263
				200	14	390	177	660	300	780	354	290	132	450	204	600	272

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 8. Steam Capacities for 1 In. / 25 mm Body Size (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		CAPACITIES IN POUNDS PER HOUR / KG/H OF SATURATED STEAM AT % DROOP											
						1 In. / 25 mm Body Size											
						Elastomer Diaphragm						Metal Diaphragm					
						10%		20%		30%		10%		20%		30%	
psig	bar	psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
2 to 8	0.2 to 0.5	2	0.2	10	0.7	28	13	28	13	30	14	- - - -					
				25	1.7	47	21	56	25	57	26						
				50	3.4	78	35	102	46	103	47						
		5	0.4	10	0.7	29	13	30	14	65	30						
				25	1.7	41	19	52	24	85	39						
				50	3.4	61	28	87	39	120	54						
		8	0.5	10	0.7	65	30	86	39	93	42						
				25	1.7	90	41	100	45	110	50						
				50	3.4	132	60	134	61	133	60						
5 to 25	0.4 to 1.7	5	0.4	25	1.7	45	20	56	25	85	39	41	19	50	23	76	34
				50	3.4	70	32	87	39	110	50	63	29	78	35	100	45
				75	5.2	95	43	120	54	150	68	90	41	110	50	130	59
		15	1.1	25	1.7	110	50	110	50	220	100	51	23	66	30	91	41
				50	3.4	120	54	160	73	250	114	85	39	110	50	140	64
				75	5.2	140	64	200	91	280	127	120	54	150	68	190	86
		25	1.7	35	2.4	190	86	290	132	380	173	65	30	97	44	160	73
				50	3.4	210	95	310	141	410	186	91	41	130	59	190	86
				75	5.2	250	114	350	159	450	204	130	59	180	82	250	114
10 to 50	0.7 to 3.4	10	0.7	25	1.7	73	33	110	50	168	76	52	24	56	25	70	32
				50	3.4	110	50	150	68	204	93	85	39	96	44	110	50
				100	6.9	170	77	230	104	281	128	151	69	180	82	200	91
		25	1.7	50	3.4	200	91	330	150	440	200	96	44	120	54	170	77
				75	5.2	240	109	380	173	490	222	136	62	170	77	230	104
				100	6.9	290	132	430	195	540	245	180	82	220	100	290	132
		50	3.4	75	5.2	440	200	700	318	840	381	180	82	290	132	430	195
				100	6.9	500	227	760	345	900	409	210	95	320	145	470	213
				125	8.6	560	254	810	368	1000	454	240	109	360	163	510	232
25 to 90	1.7 to 6.2	25	1.7	50	3.4	110	50	230	104	370	168	113	51	170	77	240	109
				100	6.9	240	109	340	154	490	222	189	86	250	114	350	159
				125	8.6	300	136	400	182	550	250	227	103	300	136	410	186
		50	3.4	75	5.2	390	177	590	268	800	363	205	93	360	163	590	268
				100	6.9	430	195	650	295	860	390	230	104	400	182	630	286
				125	8.6	480	218	710	322	920	418	260	118	440	200	660	300
				150	10	520	236	770	350	980	445	290	132	490	222	700	318
		75	5.2	100	6.9	550	250	860	390	1040	472	290	132	500	227	780	354
				125	8.6	610	277	950	431	1150	522	350	159	570	259	850	386
				150	10	670	304	1040	472	1270	577	400	182	640	291	920	418
				175	12	740	336	1130	513	1380	627	460	209	710	322	990	449
		90	6.2	100	6.9	590	268	860	390	980	445	310	141	550	250	840	381
				125	8.6	680	309	990	449	1170	531	360	163	620	281	920	418
				150	10	760	345	1120	508	1340	608	400	182	690	313	1000	454
				175	12	850	386	1250	568	1510	686	440	200	760	345	1080	490
35 to 135	2.4 to 9.3	35	2.4	50	3.4	170	77	280	127	400	182	150	68	250	114	340	154
				75	5.2	230	104	350	159	480	218	210	95	300	136	400	182
				100	6.9	280	127	420	191	550	250	240	109	340	154	460	209
				125	8.6	340	154	490	222	630	286	280	127	380	173	520	236
		50	3.4	75	5.2	370	168	520	236	660	300	210	95	330	150	470	213
				100	6.9	390	177	570	259	730	331	260	118	390	177	540	245
				125	8.6	420	191	630	286	800	363	310	141	450	204	600	272
				150	10	440	200	690	313	870	395	360	163	510	232	660	300
		75	5.2	100	6.9	500	227	830	377	1030	468	240	109	410	186	670	304
				125	8.6	570	259	900	409	1140	518	320	145	520	236	780	354
				150	10	640	291	970	440	1250	568	400	182	620	281	890	404
				175	12	700	318	1050	477	1360	617	480	218	720	327	1000	454
		100	6.9	125	8.6	660	300	1100	499	1270	577	390	177	640	291	910	413
				150	10	720	327	1190	540	1510	686	440	200	730	331	1020	463
				175	12	780	354	1280	581	1660	754	500	227	820	372	1140	518
				200	14	840	381	1370	622			560	254	910	413		
		135	9.3	150	10	460	209	1300	590	1430	649	420	191	890	404	1270	577
				175	12	820	372	1580	717	1750	795	590	268	1010	459	1440	654
				200	14	1180	536	1810	822	2050	931	660	300	1120	508	1610	731

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 8. Steam Capacities for 1-1/2 x 1 In. / 40 x 25 mm Body Size (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		CAPACITIES IN POUNDS PER HOUR / KG/H OF SATURATED STEAM AT % DROOP											
						1-1/2 x 1 In. / 40 x 25 mm Body Size											
						Elastomer Diaphragm						Metal Diaphragm					
						10%		20%		30%		10%		20%		30%	
psig	bar	psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
2 to 8	0.2 to 0.5	2	0.2	10	0.7	31	14	31	14	33	15						
				25	1.7	51	23	61	28	63	29						
				50	3.4	85	39	112	51	113	51						
		5	0.4	10	0.7	31	14	33	15	71	32						
				25	1.7	45	20	57	26	93	42			- - - -			
				50	3.4	67	30	96	44	131	59						
		8	0.5	10	0.7	72	33	94	43	102	46						
				25	1.7	99	45	110	50	120	54						
				50	3.4	145	66	146	66	146	66						
5 to 25	0.4 to 1.7	5	0.4	25	1.7	50	23	61	28	93	42	45	20	55	25	84	38
				50	3.4	77	35	95	43	130	59	70	32	86	39	110	50
				75	5.2	105	48	130	59	160	73	100	45	120	54	150	68
		15	1.1	25	1.7	120	54	120	54	240	109	56	25	72	33	99	45
				50	3.4	130	59	170	77	270	123	93	42	120	54	150	68
				75	5.2	150	68	220	100	300	136	130	59	170	77	210	95
		25	1.7	35	2.4	210	95	310	141	420	191	71	32	106	48	170	77
				50	3.4	230	104	340	154	450	204	100	45	140	64	210	95
				75	5.2	270	123	380	173	490	222	150	68	190	86	270	123
10 to 50	0.7 to 3.4	10	0.7	25	1.7	80	36	120	54	184	84	57	26	61	28	77	35
				50	3.4	120	54	160	73	224	102	93	42	105	48	120	54
				100	6.9	190	86	250	114	309	140	166	75	190	86	220	100
		25	1.7	50	3.4	220	100	370	168	490	222	105	48	130	59	190	86
				75	5.2	270	123	420	191	540	245	149	68	190	86	250	114
				100	6.9	320	145	470	213	600	272	190	86	240	109	320	145
		50	3.4	75	5.2	480	218	770	350	880	400	200	91	320	145	470	213
				100	6.9	550	250	830	377	980	445	230	104	350	159	520	236
				125	8.6	610	277	890	404	1090	495	260	118	390	177	560	254
25 to 90	1.7 to 6.2	25	1.7	50	3.4	120	54	250	114	410	186	124	56	180	82	260	118
				100	6.9	260	118	380	173	530	241	207	94	280	127	390	177
				125	8.6	330	150	440	200	600	272	249	113	330	150	450	204
		50	3.4	75	5.2	420	191	650	295	870	395	225	102	390	177	650	295
				100	6.9	470	213	720	327	940	427	260	118	440	200	680	309
				125	8.6	520	236	780	354	1000	454	290	132	490	222	720	327
				150	10	570	259	850	386	1080	490	320	145	530	241	760	345
		75	5.2	100	6.9	600	272	940	427	1110	504	320	145	550	250	850	386
				125	8.6	670	304	1040	472	1260	572	380	173	620	281	930	422
				150	10	740	336	1140	518	1390	631	440	200	700	318	1010	459
				175	12	810	368	1240	563	1510	686	500	227	780	354	1090	495
		90	6.2	100	6.9	650	295	940	427	1040	472	340	154	610	277	930	422
				125	8.6	740	336	1090	495	1280	581	390	177	680	309	1010	459
				150	10	840	381	1230	558	1470	667	440	200	760	345	1090	495
				175	12	930	422	1370	622	1650	749	490	222	840	381	1180	536
35 to 135	2.4 to 9.3	35	2.4	50	3.4	190	86	300	136	440	200	170	77	280	127	370	168
				75	5.2	250	114	380	173	520	236	230	104	320	145	440	200
				100	6.9	310	141	460	209	600	272	260	118	370	168	500	227
				125	8.6	370	168	540	245	690	313	300	136	420	191	570	259
		50	3.4	75	5.2	400	182	570	259	720	327	230	104	360	163	520	236
				100	6.9	430	195	630	286	800	363	290	132	430	195	590	268
				125	8.6	460	209	690	313	870	395	340	154	490	222	660	300
				150	10	480	218	760	345	960	436	390	177	560	254	730	331
		75	5.2	100	6.9	550	250	910	413	1110	504	260	118	450	204	730	331
				125	8.6	630	286	990	449	1250	568	350	159	570	259	850	386
				150	10	700	318	1070	486	1370	622	440	200	680	309	970	440
				175	12	770	350	1150	522	1490	676	530	241	790	359	1090	495
		100	6.9	125	8.6	720	327	1210	549	1340	608	420	191	710	322	1000	454
				150	10	790	359	1310	595	1640	745	490	222	800	363	1120	508
				175	12	850	386	1410	640	1810	822	550	250	900	409	1240	563
				200	14	920	418	1500	681			610	277	1000	454		
		135	9.3	150	10	510	232	1390	631	1510	686	460	209	980	445	1390	631
				175	12	910	413	1740	790	1850	840	650	295	1100	499	1580	717
				200	14	1300	590	1990	903	2150	976	720	327	1230	558	1770	804

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 8. Steam Capacities for 1-1/2 In. / 40 mm Body Size with Full Port (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		CAPACITIES IN POUNDS PER HOUR / KG/H OF SATURATED STEAM AT % DROOP											
						1-1/2 In. / 40 mm Body Size											
						Elastomer Diaphragm						Metal Diaphragm					
						10%		20%		30%		10%		20%		30%	
psig	bar	psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
5 to 25	0.4 to 1.7	5	0.4	25	1.7	110	50	200	91	240	109	84	38	80	36	90	41
				50	3.4	220	100	260	118	300	136	150	68	170	77	200	91
				75	5.2	290	132	320	145	370	168	220	100	250	114	310	141
		15	1.0	25	1.7	110	50	240	109	370	168	100	45	130	59	180	82
				50	3.4	240	109	360	163	490	222	180	82	230	104	310	141
				75	5.2	360	163	490	222	620	281	260	118	330	150	430	195
		25	1.7	25	1.7	220	100	410	186	530	241	110	50	160	73	280	127
				50	3.4	310	141	510	232	670	304	160	73	230	104	370	168
				75	5.2	470	213	680	309	890	404	250	114	350	159	500	227
10 to 50	0.7 to 3.4	10	0.7	25	1.7	89	40	130	59	200	91	90	41	130	59	190	86
				50	3.4	160	73	220	100	290	132	160	73	220	100	280	127
				100	6.9	240	109	310	141	380	173	240	109	300	136	370	168
		25	1.7	50	3.4	230	104	430	195	620	281	200	91	330	150	470	213
				75	5.2	350	159	540	245	740	336	280	127	420	191	590	268
				100	6.9	470	213	660	300	860	390	350	159	510	232	700	318
		50	3.4	75	5.2	750	341	1230	558	1590	722	410	186	660	300	910	413
				100	6.9	820	372	1330	604	1660	754	560	254	840	381	1090	495
				125	8.6	880	400	1440	654	1740	790	700	318	1030	468	1270	577
25 to 75	1.7 to 5.2	25	1.7	50	3.4	370	168	500	227	680	309	240	109	430	195	550	250
				100	6.9	640	291	890	404	1070	486	390	177	550	250	700	318
				125	8.6	780	354	1090	495	1260	572	470	213	610	277	780	354
		50	3.4	75	5.2	620	281	950	431	1260	572	410	186	670	304	850	386
				100	6.9	700	318	1110	504	1400	636	420	191	740	336	950	431
				125	8.6	780	354	1270	577	1540	699	430	195	800	363	1050	477
				150	10	860	390	1420	645	1690	767	450	204	870	395	1150	522
		75	5.2	100	6.9	790	359	1150	522	1700	772	650	295	910	413	1270	577
				125	8.6	1010	459	1420	645	1950	885	730	331	1060	481	1440	654
				150	10	1230	558	1680	763	2200	999	820	372	1210	549	1610	731
				175	12	1450	658	1950	885	2450	1112	910	413	1370	622	1780	808
35 to 100	2.4 to 6.9	35	2.4	50	3.4	300	136	480	218	680	309	300	136	410	186	560	254
				75	5.2	390	177	600	272	810	368	380	172	490	222	660	300
				100	6.9	470	213	710	322	950	431	470	213	580	263	760	345
				125	8.6	560	254	830	377	1080	490	550	249	660	300	860	390
		50	3.4	75	5.2	610	277	910	413	1150	522	360	163	520	236	750	341
				100	6.9	670	304	1000	454	1260	572	400	182	580	263	840	381
				125	8.6	720	327	1100	499	1380	627	440	200	650	295	920	418
				150	10	770	350	1190	540	1500	681	480	218	720	327	1010	459
		75	5.2	100	6.9	890	404	1340	608	1760	799	460	209	760	345	1130	513
				125	8.6	960	436	1400	636	1870	849	560	254	930	422	1310	595
				150	10	1020	463	1480	672	1990	903	650	295	1090	495	1480	672
				175	12	1090	495	1550	704	2110	958	750	341	1260	572	1660	754
		100	6.9	125	8.6	800	363	1480	672	2190	994	770	350	1210	549	1660	754
				150	10	1160	527	1740	790	2480	1126	890	404	1380	627	1840	835
				175	12	1520	690	2000	908	2770	1258	1020	463	1540	699	2020	917
				200	14	1880	854	2250	1022			1140	518	1700	772		

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

- continued -

Table 8. Steam Capacities for 2 In. / 50 mm Body Size (continued)

SPRING RANGE		SET PRESSURE		INLET PRESSURE		CAPACITIES IN POUNDS PER HOUR / KG/H OF SATURATED STEAM AT % DROOP											
						2 In. / 50 mm Body Size											
						Elastomer Diaphragm						Metal Diaphragm					
						10%		20%		30%		10%		20%		30%	
psig	bar	psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
10 to 25	0.7 to 1.7	10	0.7	25	1.7	420	191	590	268	810	368	360	163	510	232	600	272
				50	3.4	650	295	770	350	1090	495	490	222	650	295	790	359
		15	1.0	25	1.7	540	245	760	345	1070	486	370	168	550	250	770	350
				50	3.4	650	295	1020	463	1390	631	550	250	730	331	1000	454
		25	1.7	50	3.4	890	404	1510	686	2000	908	670	304	930	422	1350	613
				75	5.2	1060	481	1700	772	2200	999	760	345	1160	527	1570	713
15 to 50	1.0 to 3.4	15	1.0	25	1.7	480	218	650	295	920	418	360	163	520	236	650	295
				50	3.4	630	286	840	381	1160	527	520	236	680	309	880	400
				75	5.2	760	345	1010	459	1310	595	670	304	830	377	1080	490
				100	6.9	870	395	1160	527	1440	654	800	363	960	436	1250	568
				125	8.6	960	436	1280	581	1590	722	920	418	1080	490	1410	640
		25	1.7	50	3.4	670	304	1290	586	1630	740	620	281	870	395	1240	563
				75	5.2	890	404	1500	681	1920	872	760	345	1110	504	1500	681
				100	6.9	1060	481	1700	772	2160	981	860	390	1310	595	1690	767
				125	8.6	1190	540	1850	840	2340	1062	940	427	1470	667	1820	826
		50	3.4	75	5.2	1400	636	2310	1049	3010	1367	930	422	1630	740	2340	1062
				100	6.9	1790	813	2700	1226	3350	1521	1240	563	2050	931	2710	1230
				125	8.6	2010	913	2920	1326	3630	1648	1430	649	2300	1044	2970	1348
				150	10	2150	976	3060	1389	3850	1748	1580	717	2460	1117	3180	1444
25 to 75	1.7 to 5.2	25	1.7	50	3.4	770	350	1190	540	1490	676	590	268	790	359	1120	508
				75	5.2	870	395	1420	645	1830	831	770	350	1040	472	1380	627
				100	6.9	1090	495	1640	745	2050	931	880	400	1260	572	1620	735
				125	8.6	1260	572	1840	835	2180	990	950	431	1440	654	1820	826
				150	10	1320	599	1990	903	2280	1035	1010	459	1580	717	1970	894
		50	3.4	75	5.2	1340	608	2210	1003	2850	1294	900	409	1560	708	2250	1022
				100	6.9	1430	649	2460	1117	3150	1430	1170	531	1880	854	2580	1171
				125	8.6	1670	758	2710	1230	3480	1580	1380	627	2130	967	2850	1294
				150	10	1960	890	2950	1339	3790	1721	1550	704	2350	1067	3080	1398
				175	12	2200	999	3150	1430	4010	1821	1710	776	2540	1153	3300	1498
		75	5.2	100	6.9	2010	913	3080	1398	3830	1739	1450	658	2610	1185	3620	1643
				125	8.6	2170	985	3470	1575	4290	1948	1690	767	2830	1285	3980	1807
				150	10	2350	1067	3700	1680	4660	2116	1850	840	3130	1421	4350	1975
				175	12	2560	1162	3910	1775	4960	2252	2040	926	3410	1548	4640	2107

- continued -

Table 8. Steam Capacities for 3 In. / 80 mm Body Size (continued)																	
SPRING RANGE		SET PRESSURE		INLET PRESSURE		CAPACITIES IN POUNDS PER HOUR / KG/H OF SATURATED STEAM AT % DROOP											
						3 In. / 80 mm Body Size											
						Elastomer Diaphragm						Metal Diaphragm					
						10%		20%		30%		10%		20%		30%	
psig	bar	psig	bar	psig	bar	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h	lbs/h	kg/h
10 to 25	0.7 to 1.7	10	0.7	25	1.7	470	213	720	327	1030	468	330	150	470	213	590	268
				50	3.4	680	309	1030	468	1440	654	420	191	640	291	750	341
		15	1.0	25	1.7	540	245	890	404	1310	595	360	163	510	232	770	350
				50	3.4	900	409	1430	649	1890	858	530	241	690	313	1020	463
		25	1.7	50	3.4	1290	586	2000	908	2480	1126	660	300	920	418	1380	627
				75	5.2	1310	595	2320	1053	2910	1321	760	345	1250	568	1780	808
15 to 50	1.0 to 3.4	15	1.0	25	1.7	530	241	750	341	1020	463	320	145	480	218	650	295
				50	3.4	690	313	1040	472	1470	667	510	232	700	318	950	431
				75	5.2	910	413	1360	617	1770	804	680	309	910	413	1230	558
				100	6.9	1150	522	1700	772	2030	922	830	377	1100	499	1470	667
				125	8.6	1390	631	2010	913	2300	1044	950	431	1260	572	1680	763
		25	1.7	50	3.4	880	400	1540	699	2070	940	670	304	880	400	1230	558
				75	5.2	1190	540	1900	863	2550	1158	790	359	1140	518	1660	754
				100	6.9	1360	617	2200	999	2900	1317	900	409	1420	645	2000	908
				125	8.6	1490	676	2390	1085	3180	1444	1030	468	1680	763	2260	1026
		50	3.4	75	5.2	1860	844	2870	1303	3700	1680	910	413	1650	749	2430	1103
				100	6.9	2130	967	3440	1562	4320	1961	1220	554	2040	926	3020	1371
				125	8.6	2420	1099	3850	1748	4940	2243	1420	645	2350	1067	3430	1557
				150	10	2700	1226	4180	1898	5370	2438	1580	717	2630	1194	3740	1698
25 to 75	1.7 to 5.2	25	1.7	50	3.4	830	377	1440	654	2030	922	640	291	960	436	1310	595
				75	5.2	990	449	1710	776	2330	1058	740	336	1180	536	1620	735
				100	6.9	1240	563	2010	913	2640	1199	850	386	1410	640	1910	867
				125	8.6	1560	708	2300	1044	2940	1335	990	449	1620	735	2160	981
				150	10	1820	826	2580	1171	3220	1462	1140	518	1830	831	2380	1081
		50	3.4	75	5.2	1610	731	2610	1185	3370	1530	890	404	1590	722	2300	1044
				100	6.9	1870	849	3170	1439	4160	1889	1220	554	1880	854	2810	1276
				125	8.6	2310	1049	3600	1634	4670	2120	1400	636	2230	1012	3220	1462
				150	10	2600	1180	3990	1811	5060	2297	1540	699	2580	1171	3580	1625
				175	12	2800	1271	4380	1989	5460	2479	1690	767	2910	1321	3900	1771
		75	5.2	100	6.9	2190	994	3420	1553	4590	2084	1260	572	2300	1044	3560	1616
				125	8.6	2520	1144	4340	1970	5470	2483	1590	722	2730	1239	4270	1939
				150	10	2840	1289	5000	2270	6210	2819	1790	813	3060	1389	4710	2138
				175	12	3140	1426	5440	2470	6820	3096	2110	958	3410	1548	4920	2234

Introduction

The Type SR8 is a self-draining, compact, direct-operated backpressure regulator, designed for sanitary applications. The sanitary design meets pharmaceutical, biotechnology, and food and beverage industries needs. The unit is available in 1/2 through 3 in. / 15 through 80 mm sizes with end connections that will match up to Tri-Clamp® sanitary fittings. The Type SR8 is suitable for use in steam, liquid or gas service. The unit is available in 1/2 through 3 in. / 15 through 80 mm sizes with end connections that will match up to Tri-Clamp® sanitary fittings. The Type SR8 is suitable for use in steam, liquid or gas service.

Body Size, Inlet and Outlet Connection

1/2, 3/4, 1, 1-1/2, 1-1/2 x 1, 2 and 3 In. / 15, 20, 25, 40, 40 x 25, 50 and 80 mm

Construction Materials

See Table 1

Service Media

Steam, Gas and Liquid

End Connection

Tri-Clamp® Sanitary connections[1]

Temperature Capabilities

See Table 2

Maximum Operating Pressure

See Table 3

Temperature Ratings

See Table 3

Set Pressure Ranges

See Table 4

Maximum Differential Pressures

See Table 4

Pressure Registration

Internal

Certifications Available Upon Request

316L Stainless steel diaphragms only
FDA approved elastomers/plastics
Material and Functional Test Certificates
USP Class VI approved elastomers/plastics[2]

Shutoff Classification per ANSI FCI 70-3-2003

Metal Seat: ANSI Class III
Polytetrafluoroethylene (PTFE) Soft Seat: ANSI Class VI
Polyetheretherketone (PEEK) Soft Seat: ANSI Class VI (150 to 400°F / 65 to 204°C)[3]

Flow Coefficients

See Tables 5 and 6

Flow Capacity

See Table 7 for Steam
See Product Bulletin for Air and Liquid

Approximate Weight

1/2 and 3/4 in. / 15 and 20 mm: 9 lbs / 4 kg
1 and 1-1/2 in. / 25 and 40 mm: 18 lbs / 8 kg
2 and 3 in. / 50 and 80 mm: 60 lbs / 27 kg

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Sanitary

Features

- **Polished 316L Stainless Steel for High Purity Processing**
- **Meets ASME BPE and European Hygienic Standards**
- **Self-draining and Tri-Clamp® design for easy maintenance**
- **Optional spring case pressure loading for remote setpoint**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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www.Emerson.com

Figure 1. *Type SR8 Sanitary Backpressure Regulator*

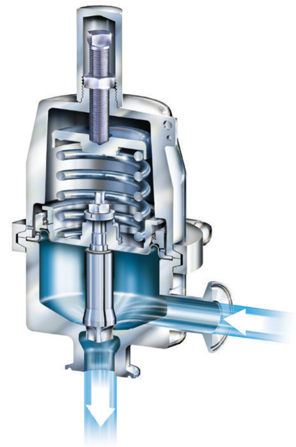

Figure 2. *Type SR8 Sectional View*

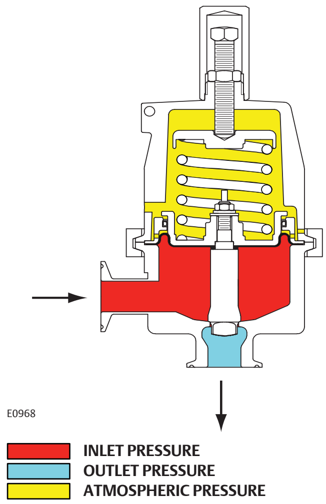

Figure 3. *Type SR8 Operational Schematic*

1. End connection clamps and gaskets to be supplied by the user.
2. Contact your Local Sales Office for details on available constructions.
3. Polyetheretherketone (PEEK) Seat meets ANSI Class IV or better below 150°F / 66°C.

Table 1. Construction Materials

PART	MATERIAL
Body	316L Stainless steel, 20 µin / 0.5 µm Ra with Electropolish
Spring Case	316 Stainless steel with Electropolish
Plug and Diaphragm Plate	316L Stainless steel, 20 µin / 0.5 µm Ra with Electropolish
Soft Seat	Virgin PTFE or Polyetheretherketone (PEEK)
Diaphragm	Ethylenepropylene (EPDM)(FDA), Virgin PTFE coated Fluorocarbon (FKM) or 316L Stainless steel
Control Springs	Inconel® or 302 Stainless steel
Guide Ring and Upper and lower spring seats	300 Series Stainless steel
Adjusting Screw and locknut	300 Series Stainless steel
Closing Cap	300 Series Stainless steel with Electropolish or Plastic
T-handle and Locking Lever	300 Series Stainless steel
O-rings	Ethylenepropylene (EPDM) (FDA), Virgin PTFE encapsulated Fluorocarbon (FKM) or Virgin PTFE
Piston Ring	Expanded PTFE with 302 Stainless steel
Gaskets (Stainelss steel diaphragm only)	Virgin PTFE
Bolted Clamp	304 Stainless steel with Brass or Stainless steel Nuts
Bead Chain and Ring Grip	300 Series Stainless steel

Table 2. Temperature Capabilities

SEAT TYPE	DIAPHRAGM MATERIAL	O-RING MATERIAL	TEMPERATURE RANGE	
			°F	°C
Metal (316L)	Ethylenepropylene (EPDM)	Ethylenepropylene (EPDM)	-20 to 275	-28 to 135
	316L Stainless steel	PTFE/Fluorocarbon (FKM)(1)	20 to 400	-6 to 204
	PTFE/Fluorocarbon (FKM)	PTFE/Fluorocarbon (FKM)	20 to 400	-6 to 204
Soft (PTFE/316L)	Ethylenepropylene (EPDM)	Ethylenepropylene (EPDM)	-20 to 150	-28 to 65
	316L Stainless steel	PTFE/Fluorocarbon (FKM)(1)	20 to 150	-6 to 65
	PTFE/Fluorocarbon (FKM)	PTFE/Fluorocarbon (FKM)	20 to 150	-6 to 65
Soft (Polyetheretherketone (PEEK)/316L)	Ethylenepropylene (EPDM)	Ethylenepropylene (EPDM)	-20 to 275	-28 to 135
	316L Stainless steel	PTFE/Fluorocarbon (FKM)(1)	20 to 400	-6 to 204
	PTFE/Fluorocarbon (FKM)	PTFE/Fluorocarbon (FKM)	20 to 400	-6 to 204

1. O-ring material is Polytetrafluoroethylene (PTFE) for the 1/2 and 3/4 In. / 15 and 20 mm sizes. Temperature range is the same.

Table 3. Maximum Operating Pressure and Temperature Ratings(1)(2)

BODY SIZE		MAXIMUM TEMPERATURE		MAXIMUM INLET PRESSURE		MAXIMUM OUTLET PRESSURE	
In.	mm	°F	°C	psig	bar	psig	bar
1/2 through 1-1/2	15 through 40	150	65	210	14.5	210	14.5
		275	135	180	12.4	180	12.4
		400	204	160	11.0	160	11.0
2 and 3	50 and 80	150	65	150	10.3	150	10.3
		275	135	125	8.6	125	8.6
		400	204	110	7.6	110	7.6

1. Maximum pressure to prevent damage to internal parts and leakage to atmosphere.
2. The pressure/temperature limits in this document and any applicable standard or code limitation should not be exceeded.

Table 4. Set Pressure Ranges, Control Spring Data and Maximum Differential Pressures

BODY SIZE		SET PRESSURE RANGES		MAXIMUM DIFFERENTIAL PRESSURE		COLOR CODE	WIRE DIAMETER		FREE LENGTH	
In.	mm	psig	bar	psid	bar d		In.	mm	In.	mm
1/2 and 3/4	15 and 20	2 to 8(1)	0.14 to 0.55(1)	15	1.0	Blue	0.138	3.51	2.75	69.9
		5 to 25	0.34 to 1.7	40	2.7	Silver	0.177	4.50	2.75	69.9
		10 to 50	0.69 to 3.4	100	6.9	Green	0.192	4.88	2.75	69.9
		35 to 100	2.4 to 6.9	140	9.6	Red	0.225	5.72	2.75	69.9
		75 to 125	5.2 to 8.6	160	11.0	Red/ Yellow	0.225/ 0.148	5.72/ 3.76	2.75/ 2.75	69.9/ 69.9
1 and 1-1/2 full port 1-1/2 x 1	25 and 40 full port 40 x 25	2 to 8(1)	0.2 to 0.5(1)	15	1.0	Blue	0.225	5.72	3.25	82.6
		5 to 25	0.4 to 1.7	40	2.7	Silver	0.282	7.16	3.25	82.6
		15 to 70	1.0 to 4.8	100	6.9	Green	0.331	8.41	3.25	82.6
		25 to 90	1.7 to 6.2	125	8.6	Red	0.362	9.19	3.25	82.6
		35 to 100	2.4 to 6.9	140	9.6	Green/ Yellow	0.331/ 0.250	8.41/ 6.35	3.25 3.25	82.6/ 82.6
		75 to 125	5.2 to 8.6	160	11.0	Red/ Yellow	0.362/ 0.250	9.19/ 6.35	3.25/ 3.25	82.6/ 82.6
2 and 3	50 and 80	10 to 25	0.7 to 1.7	50	3.4	Silver	0.562	14.3	6.00	152
		15 to 50	1.0 to 3.4	75	5.2	Green	0.625	15.9	6.00	152
		25 to 60	1.7 to 4.1	75	5.2	Red	0.625	15.9	6.00	152

1. The 2 to 8 psig / 0.14 to 0.55 bar spring is not available with the metal diaphragm.

Table 5. Flow Coefficients

BODY SIZE		WIDE OPEN COEFFECIENTS			C_1	K_m	F_L	X_T	F_d
In.	mm	C_g	C_v	C_s					
1/2	15	27	1.4	1.3	19.1	0.54	0.73	0.23	0.40
3/4	20	70	3.1	3.5	22.8	0.61	0.78	0.33	0.41
1	25	202	7.2	10.1	28.1	0.63	0.79	0.50	0.42
1-1/2 x 1	40 x 25	216	7.6	10.8	28.4	0.60	0.77	0.51	0.42
1-1/2 (full port)	40 (full port)	309	10.9	15.5	28.4	0.68	0.82	0.51	0.40
2	50	962	34.4	48	28.0	0.60	0.78	0.49	0.32
3	80	1114	40.3	56	27.6	0.44	0.67	0.48	0.36

Table 6. C_V Coefficients for 1/2 In. / 15 mm

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	C_V AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	0.45	0.55	0.65	0.75	Not Available			
	5 / 0.34	0.45	0.67	0.84	0.99				
	8 / 0.55	0.50	0.80	1.03	1.22				
5 to 25 / 0.34 to 1.7	5 / 0.34	0.35	0.49	0.62	0.80	0.32	0.36	0.40	0.47
	15 / 1.0	0.59	0.94	1.13	1.26	0.40	0.55	0.67	0.81
	25 / 1.7	0.71	1.15	1.36	1.40	0.44	0.64	0.78	0.96
10 to 50 / 0.69 to 3.4	10 / 0.69	0.40	0.65	0.87	1.10	0.35	0.42	0.50	0.57
	15 / 1.0	0.54	0.87	1.04	1.21	0.38	0.49	0.62	0.74
	30 / 2.1	0.76	1.22	1.30	1.37	0.43	0.59	0.82	0.98
	45 / 3.1	0.86	1.39	1.40	1.40	0.45	0.64	0.91	1.09
	50 / 3.4	0.89	1.40	1.40	1.40	0.45	0.66	0.93	1.12
35 to 100 / 2.4 to 6.9	35 / 2.4	0.60	0.95	1.24	1.40	0.42	0.60	0.75	0.94
	50 / 3.4	0.69	1.10	1.35	1.40	0.46	0.69	0.89	1.11
	75 / 5.2	0.77	1.23	1.40	1.40	0.50	0.77	1.02	1.27
	100 / 6.9	0.82	1.30	1.40	1.40	0.53	0.82	1.09	1.36
75 to 125 / 5.2 to 8.6	75 / 5.2	1.16	1.40	1.40	1.40	1.12	1.40	1.40	1.40
	100 / 6.9	1.13	1.40	1.40	1.40	1.10	1.40	1.40	1.40
	125 / 8.6	1.23	1.36	1.39		1.02	1.40	1.40	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 6. C_V Coefficients for 3/4 In. / 20 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	C_V AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	0.58	0.67	0.90	1.07	Not Available			
	5 / 0.34	0.82	1.38	2.08	2.27				
	8 / 0.55	1.04	1.94	2.96	3.10				
5 to 25 / 0.34 to 1.7	5 / 0.34	0.60	0.87	1.16	1.44	0.51	0.56	0.64	0.75
	15 / 1.0	1.04	2.10	2.69	2.82	0.56	0.70	0.86	1.03
	25 / 1.7	1.26	2.67	3.10	3.10	0.59	0.76	0.95	1.15
10 to 50 / 0.69 to 3.4	10 / 0.69	0.62	0.92	1.28	1.70	0.47	0.55	0.62	0.73
	15 / 1.0	0.80	1.35	1.70	2.11	0.51	0.65	0.78	0.93
	30 / 2.1	1.09	2.02	2.34	2.72	0.59	0.80	1.02	1.23
	45 / 3.1	1.23	2.34	2.64	3.00	0.62	0.87	1.13	1.37
	50 / 3.4	1.26	2.41	2.70	3.06	0.63	0.88	1.16	1.40
35 to 100 / 2.4 to 6.9	35 / 2.4	0.91	1.83	2.71	3.10	0.56	0.73	0.89	1.06
	50 / 3.4	1.34	2.36	3.00	3.10	0.62	0.83	1.09	1.35
	75 / 5.2	1.72	2.83	3.10	3.10	0.67	0.93	1.27	1.59
	100 / 6.9	1.94	3.10	3.10	3.10	0.70	0.98	1.36	1.73
75 to 125 / 5.2 to 8.6	75 / 5.2	1.66	2.80	3.04	3.10	1.01	1.58	1.92	2.10
	100 / 6.9	1.96	3.10	3.10	3.10	1.01	1.33	1.85	2.21
	125 / 8.6	2.21	3.10	3.10		1.01	1.47	1.96	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 6. C_V Coefficients for 1 In. / 25 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	C_V AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	1.79	2.48	3.02	4.13	Not Available			
	5 / 0.34	1.82	3.14	4.37	5.75				
	8 / 0.55	2.18	3.70	5.29	6.57				
5 to 25 / 0.34 to 1.7	5 / 0.34	1.37	1.79	2.28	2.91	1.03	1.25	1.53	1.76
	15 / 1.0	1.70	3.03	4.49	5.46	1.11	1.52	2.12	2.74
	25 / 1.7	2.13	4.01	6.00	7.20	1.19	1.69	2.43	3.21
15 to 70 / 1.0 to 4.8	15 / 1.0	1.19	2.19	3.34	4.26	1.04	1.32	1.68	2.11
	30 / 2.1	2.06	4.07	5.20	5.99	1.60	2.35	3.25	4.12
	45 / 3.1	2.48	4.96	6.06	6.78	1.87	2.84	3.98	5.03
	50 / 3.4	2.58	5.16	6.25	6.96	1.93	2.95	4.14	5.23
	60 / 4.1	2.73	5.47	6.56	7.20	2.03	3.12	4.40	5.55
	70 / 4.8	2.84	5.71	6.79	7.20	2.10	3.25	4.59	5.79
25 to 90 / 1.7 to 6.2	35 / 2.4	1.08	1.70	2.44	3.31	1.01	1.39	1.90	2.47
	50 / 3.4	1.76	3.24	4.58	5.27	1.39	2.20	3.10	3.98
	75 / 5.2	2.38	4.61	6.48	7.00	1.73	2.93	4.16	5.32
	90 / 6.2	2.60	5.12	7.18	7.20	1.85	3.20	4.55	5.80
35 to 100 / 2.4 to 6.9	35 / 2.4	1.55	2.46	3.57	4.66	1.11	1.52	2.02	2.58
	50 / 3.4	1.98	3.45	5.02	5.87	1.41	2.19	3.05	3.86
	75 / 5.2	2.38	4.33	6.31	6.95	1.68	2.79	3.96	4.98
	100 / 6.9	2.60	4.82	7.02	7.20	1.83	3.12	4.46	5.60
75 to 125 / 5.2 to 8.6	75 / 5.2	5.21	7.07	7.20	7.20	3.45	4.94	5.81	5.66
	100 / 6.9	5.88	7.20	7.20	7.20	3.30	4.93	5.28	6.00
	125 / 8.6	5.84	7.20	7.20		3.51	5.17	5.79	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 6. C_V Coefficients for 1-1/2 In. / 40 mm Reduced Port (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	C_V AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	1.97	2.72	3.31	4.54	Not Available			
	5 / 0.34	2.00	3.44	4.78	6.29				
	8 / 0.55	2.38	4.05	5.78	7.16				
5 to 25 / 0.34 to 1.7	5 / 0.34	1.50	1.96	2.49	3.18	1.12	1.37	1.67	1.92
	15 / 1.0	1.85	3.30	4.89	5.95	1.21	1.65	2.31	2.99
	25 / 1.7	2.32	4.37	6.54	7.60	1.30	1.84	2.65	3.50
15 to 70 / 1.0 to 4.8	15 / 1.0	1.29	2.39	3.64	4.64	1.13	1.44	1.83	2.30
	30 / 2.1	2.24	4.43	5.66	6.52	1.74	2.56	3.54	4.48
	45 / 3.1	2.70	5.40	6.60	7.38	2.04	3.09	4.33	5.48
	50 / 3.4	2.80	5.62	6.81	7.58	2.10	3.21	4.51	5.70
	60 / 4.1	2.97	5.96	7.14	7.60	2.21	3.40	4.79	6.05
	70 / 4.8	3.10	6.22	7.39	7.60	2.29	3.55	5.00	6.31
25 to 90 / 1.7 to 6.2	35 / 2.4	1.17	1.86	2.65	3.61	1.10	1.51	2.07	2.69
	50 / 3.4	1.91	3.52	4.98	5.74	1.51	2.40	3.37	4.34
	75 / 5.2	2.59	5.03	7.06	7.60	1.88	3.19	4.53	5.80
	90 / 6.2	2.84	5.57	7.60	7.60	2.02	3.48	4.95	6.32
35 to 100 / 2.4 to 6.9	35 / 2.4	1.69	2.68	3.89	5.08	1.21	1.65	2.20	2.81
	50 / 3.4	2.16	3.75	5.47	6.40	1.53	2.38	3.32	4.20
	75 / 5.2	2.59	4.71	6.87	7.57	1.83	3.04	4.31	5.43
	100 / 6.9	2.83	5.25	7.60	7.60	1.99	3.40	4.86	6.10
75 to 125 / 5.2 to 8.6	75 / 5.2	5.49	6.87	7.45	7.60	3.38	5.05	6.01	6.05
	100 / 6.9	5.44	7.52	7.60	7.60	3.58	5.25	5.87	6.92
	125 / 8.6	6.42	7.60	7.60		3.64	4.91	6.63	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 6. C_V Coefficients for 1-1/2 In. / 40 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	C_V AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	1.95	2.54	2.81	3.31	Not Available			
	5 / 0.34	1.55	2.73	4.87	6.66				
	8 / 0.55	1.47	3.05	6.32	8.91				
5 to 25 / 0.34 to 1.7	5 / 0.34	1.37	1.64	2.54	2.94	1.37	1.51	1.81	2.06
	15 / 1.0	1.87	4.12	7.34	8.17	1.31	1.68	2.40	3.08
	25 / 1.7	2.16	5.32	9.55	10.50	1.35	1.81	2.71	3.57
15 to 70 / 1.0 to 4.8	15 / 1.0	1.87	2.94	4.14	5.83	1.37	1.62	2.16	2.79
	30 / 2.1	4.83	7.28	7.83	8.70	1.66	2.59	3.66	4.76
	45 / 3.1	6.25	9.33	9.54	10.01	1.81	3.05	4.36	5.66
	50 / 3.4	6.57	9.79	9.92	10.30	1.84	3.16	4.52	5.86
	60 / 4.1	7.09	10.52	10.52	10.76	1.89	3.32	4.77	6.18
	70 / 4.8	7.48	10.90	10.90	10.90	1.93	3.44	4.95	6.42
25 to 90 / 1.7 to 6.2	35 / 2.4	1.85	3.13	4.40	5.66	1.07	1.41	1.75	2.25
	50 / 3.4	3.61	6.48	7.44	8.17	1.46	2.29	3.11	4.05
	75 / 5.2	5.20	9.49	10.15	10.39	1.82	3.08	4.31	5.65
	90 / 6.2	5.79	10.59	10.90	10.90	1.96	3.37	4.75	6.22
35 to 100 / 2.4 to 6.9	35 / 2.4	2.93	3.99	5.59	8.06	1.47	2.00	2.59	3.28
	50 / 3.4	4.13	6.41	7.91	9.36	1.64	2.47	3.57	4.75
	75 / 5.2	5.22	8.60	9.97	10.51	1.80	2.90	4.45	6.04
	100 / 6.9	5.83	9.80	10.90	10.90	1.88	3.13	4.93	6.75
75 to 125 / 5.2 to 8.6	75 / 5.2	5.85	9.55	10.56	10.51	3.62	5.21	6.22	6.38
	100 / 6.9	6.05	10.50	10.74	10.41	3.89	5.08	6.70	7.87
	125 / 8.6	7.46	10.68	10.81		3.96	5.52	7.34	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 6. C_V Coefficients for 2 In. / 50 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	C_V AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
10 to 25 / 0.69 to 1.7	10 / 0.69	9.54	12.90	20.16	25.94	6.97	9.73	12.00	14.51
	15 / 1.0	13.77	25.30	30.19	30.19	9.10	11.66	14.20	17.37
	25 / 1.7	19.87	30.19	30.19	30.19	9.39	12.66	16.48	19.66
15 to 50 / 1.0 to 3.4	15 / 1.0	12.16	17.45	24.11	28.98	6.97	9.67	11.54	12.29
	25 / 1.7	14.20	24.03	29.03	30.08	8.32	11.20	14.90	17.73
	50 / 3.4	22.24	28.76	29.98	29.90	9.57	15.28	20.12	23.86
25 to 60 / 1.7 to 4.1	25 / 1.7	12.93	21.88	30.01	30.19	8.26	11.29	15.06	18.15
	50 / 3.4	18.16	29.95	30.19	30.19	9.12	14.28	19.11	22.97
	60 / 4.1	22.06	30.19	30.19		10.75	17.53	22.96	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 6. C_V Coefficients for 3 In. / 80 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	C_V AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
10 to 25 / 0.69 to 1.7	10 / 0.69	12.81	17.24	24.09	28.28	8.76	14.51	19.01	22.35
	15 / 1.0	13.42	21.30	28.37	35.03	11.58	17.34	21.63	25.08
	25 / 1.7	17.78	28.44	37.90	39.21	13.03	19.27	23.95	28.24
15 to 50 / 1.0 to 3.4	15 / 1.0	10.11	15.34	22.43	28.58	11.25	16.30	20.36	23.58
	25 / 1.7	12.15	23.16	33.49	39.21	10.85	18.05	22.17	26.93
	50 / 3.4	12.51	26.03	38.44	39.08	14.70	23.64	28.97	33.40
25 to 60 / 1.7 to 4.1	25 / 1.7	11.29	20.42	28.43	35.61	10.73	17.26	22.36	26.33
	50 / 3.4	13.31	25.82	37.56	39.11	13.57	21.54	27.47	31.76
	60 / 4.1	24.47	34.81	39.21		15.57	23.99	30.03	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 7. Steam Capacities for 1/2 In. / 15 mm

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	CAPACITIES IN POUNDS PER HOUR / kg/h SATURATED STEAM AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	6.4 / 2.9	8.3 / 3.8	10 / 4.5	12 / 5.4	Not Available			
	5 / 0.34	9.2 / 4.2	14 / 6.4	18 / 8.2	22 / 10				
	8 / 0.55	12 / 5.4	20 / 9.1	27 / 12	32 / 15				
5 to 25 / 0.34 to 1.7	5 / 0.34	7.2 / 3.3	10 / 4.5	13 / 5.9	18 / 8.2	5.3 / 2.4	6.2 / 2.8	7.1 / 3.2	8.4 / 3.8
	15 / 1.0	19 / 8.6	32 / 15	40 / 18	46 / 21	10 / 4.5	15 / 6.8	19 / 8.6	24 / 11
	25 / 1.7	31 / 14	53 / 24	66 / 30	72 / 33	15 / 6.8	24 / 11	31 / 14	40 / 18
10 to 50 / 0.69 to 3.4	10 / 0.69	11 / 5.0	18 / 8.2	25 / 11	32 / 15	7.5 / 3.4	9.3 / 4.2	12 / 5.4	14 / 6.4
	15 / 1.0	17 / 7.7	29 / 13	37 / 17	44 / 20	10 / 4.5	13 / 5.9	18 / 8.2	22 / 10
	30 / 2.1	37 / 17	64 / 29	72 / 33	80 / 36	17 / 7.7	25 / 11	37 / 17	47 / 21
	45 / 3.1	57 / 26	99 / 45	110 / 50	110 / 50	24 / 11	37 / 17	56 / 25	71 / 32
	50 / 3.4	64 / 29	110 / 50	120 / 54	120 / 54	27 / 12	41 / 19	62 / 28	80 / 36
35 to 100 / 2.4 to 6.9	35 / 2.4	33 / 15	56 / 25	77 / 35	92 / 42	19 / 8.6	28 / 13	38 / 17	50 / 23
	50 / 3.4	50 / 23	85 / 39	110 / 50	120 / 54	27 / 12	43 / 20	60 / 27	79 / 36
	75 / 5.2	78 / 35	130 / 59	160 / 73	170 / 77	41 / 19	68 / 31	96 / 44	130 / 59
	100 / 6.9	110 / 50	180 / 82	210 / 95	220 / 100	55 / 25	93 / 42	130 / 59	180 / 82
75 to 125 / 5.2 to 8.6	75 / 5.2	120 / 54	150 / 68	160 / 73	170 / 77	91 / 41	120 / 54	130 / 59	140 / 64
	100 / 6.9	150 / 68	200 / 91	210 / 95	220 / 100	120 / 54	160 / 73	170 / 77	180 / 82
	125 / 8.6	190 / 86	230 / 104	260 / 118		130 / 59	190 / 86	210 / 95	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 7. Steam Capacities for 3/4 In. / 20 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	CAPACITIES IN POUNDS PER HOUR / kg/h SATURATED STEAM AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	8.3 / 3.8	9.9 / 4.5	14 / 6.4	17 / 7.7	Not Available			
	5 / 0.34	16 / 7.3	28 / 13	44 / 20	49 / 22				
	8 / 0.55	24 / 11	47 / 21	74 / 34	80 / 36				
5 to 25 / 0.34 to 1.7	5 / 0.34	12 / 5.4	18 / 8.2	24 / 11	31 / 14	10 / 4.5	12 / 5.4	14 / 6.4	16 / 7.3
	15 / 1.0	33 / 15	69 / 31	92 / 42	100 / 45	17 / 7.7	23 / 10	29 / 13	37 / 17
	25 / 1.7	53 / 24	120 / 54	150 / 68	150 / 68	25 / 11	34 / 15	45 / 20	58 / 26
10 to 50 / 0.69 to 3.4	10 / 0.7	16 / 7.3	24 / 11	35 / 16	49 / 22	12 / 5.4	15 / 6.8	17 / 7.7	21 / 9.5
	15 / 1.0	25 / 11	44 / 20	58 / 26	75 / 34	16 / 7.3	21 / 9.5	27 / 12	33 / 15
	30 / 2.1	52 / 24	100 / 45	130 / 59	150 / 68	28 / 13	40 / 18	55 / 25	70 / 32
	45 / 3.1	79 / 36	160 / 73	190 / 86	230 / 104	40 / 18	60 / 27	83 / 38	110 / 50
	50 / 3.4	89 / 40	180 / 82	220 / 100	260 / 118	44 / 20	66 / 30	93 / 42	120 / 54
35 to 100 / 2.4 to 6.9	35 / 2.4	49 / 22	100 / 45	160 / 73	200 / 91	30 / 14	42 / 19	54 / 25	68 / 31
	50 / 3.4	94 / 43	180 / 82	240 / 109	260 / 118	44 / 20	63 / 29	87 / 39	110 / 50
	75 / 5.2	170 / 77	300 / 136	350 / 159	370 / 168	66 / 30	98 / 44	140 / 64	190 / 86
	100 / 6.9	240 / 109	420 / 191	450 / 204	480 / 218	89 / 40	130 / 59	200 / 91	270 / 123
75 to 125 / 5.2 to 8.6	75 / 5.2	160 / 73	300 / 136	340 / 154	370 / 168	99 / 45	170 / 77	220 / 100	250 / 114
	100 / 6.9	250 / 114	420 / 191	450 / 204	480 / 218	130 / 59	180 / 82	270 / 123	350 / 159
	125 / 8.6	340 / 154	520 / 236	550 / 250		160 / 73	240 / 109	350 / 159	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 7. Steam Capacities for 1 In. / 25 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	CAPACITIES IN POUNDS PER HOUR / kg/h SATURATED STEAM AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	27 / 12	39 / 18	49 / 22	70 / 32	Not Available			
	5 / 0.34	42 / 19	75 / 34	110 / 50	150 / 68				
	8 / 0.55	62 / 28	110 / 50	160 / 73	210 / 95				
5 to 25 / 0.34 to 1.7	5 / 0.34	32 / 15	43 / 20	57 / 26	75 / 34	24 / 11	30 / 14	38 / 17	45 / 20
	15 / 1.0	65 / 30	120 / 54	190 / 86	240 / 109	42 / 19	61 / 28	89 / 40	120 / 54
	25 / 1.7	110 / 50	220 / 100	350 / 159	440 / 200	62 / 28	93 / 42	140 / 64	200 / 91
15 to 70 / 1.0 to 4.8	15 / 1.0	46 / 21	88 / 40	140 / 64	190 / 86	40 / 18	53 / 24	71 / 32	93 / 42
	30 / 2.1	120 / 54	250 / 114	340 / 154	420 / 191	94 / 43	150 / 68	220 / 100	290 / 132
	45 / 3.1	200 / 91	420 / 191	550 / 250	650 / 295	150 / 68	240 / 109	360 / 163	480 / 218
	50 / 3.4	220 / 100	480 / 218	620 / 281	730 / 331	170 / 77	270 / 123	410 / 186	550 / 250
	60 / 4.1	270 / 123	590 / 268	750 / 341	880 / 400	200 / 91	340 / 154	510 / 232	680 / 309
	70 / 4.8	320 / 145	700 / 318	890 / 404	1010 / 459	240 / 109	400 / 182	600 / 272	810 / 368
25 to 90 / 1.7 to 6.2	35 / 2.4	71 / 32	120 / 54	180 / 82	260 / 118	66 / 30	97 / 44	140 / 64	190 / 86
	50 / 3.4	150 / 68	300 / 136	450 / 204	550 / 250	120 / 54	200 / 91	310 / 141	420 / 191
	75 / 5.2	290 / 132	600 / 272	900 / 409	1040 / 472	210 / 95	380 / 173	580 / 263	790 / 359
	90 / 6.2	370 / 168	780 / 354	1170 / 531	1260 / 572	260 / 118	490 / 222	740 / 336	1010 / 459
35 to 100 / 2.4 to 6.9	35 / 2.4	100 / 45	170 / 77	270 / 123	370 / 168	73 / 33	110 / 50	150 / 68	200 / 91
	50 / 3.4	170 / 77	320 / 145	500 / 227	620 / 281	120 / 54	200 / 91	300 / 136	400 / 182
	75 / 5.2	290 / 132	560 / 254	880 / 400	1030 / 468	200 / 91	360 / 163	550 / 250	740 / 336
	100 / 6.9	400 / 182	810 / 368	1260 / 572	1380 / 627	280 / 127	520 / 236	800 / 363	1080 / 490
75 to 125 / 5.2 to 8.6	75 / 5.2	630 / 286	920 / 418	1000 / 454	1070 / 486	420 / 191	640 / 291	810 / 368	840 / 381
	100 / 6.9	910 / 413	1200 / 545	1290 / 586	1380 / 627	510 / 232	830 / 377	950 / 431	1150 / 522
	125 / 8.6	1100 / 499	1470 / 667	1580 / 717		660 / 300	1060 / 481	1270 / 577	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 7. Steam Capacities for 1-1/2 In. / 40 mm Reduced Port (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	CAPACITIES IN POUNDS PER HOUR / kg/h SATURATED STEAM AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	30 / 14	43 / 20	54 / 24	77 / 35	Not Available			
	5 / 0.34	46 / 21	83 / 38	120 / 54	160 / 73				
	8 / 0.55	68 / 31	120 / 54	180 / 82	230 / 104				
5 to 25 / 0.34 to 1.7	5 / 0.34	35 / 16	47 / 21	62 / 28	82 / 37	26 / 12	33 / 15	42 / 19	50 / 23
	15 / 1.0	72 / 33	130 / 59	210 / 95	260 / 118	47 / 21	67 / 30	98 / 44	130 / 59
	25 / 1.7	120 / 54	240 / 109	380 / 173	470 / 213	68 / 31	100 / 45	160 / 73	220 / 100
15 to 70 / 1.0 to 4.8	15 / 1.0	50 / 23	97 / 44	150 / 68	210 / 95	44 / 20	58 / 26	78 / 35	100 / 45
	30 / 2.1	130 / 59	280 / 127	380 / 173	460 / 209	100 / 45	160 / 73	240 / 109	320 / 145
	45 / 3.1	220 / 100	460 / 209	600 / 272	720 / 327	160 / 73	270 / 123	400 / 182	530 / 241
	50 / 3.4	240 / 109	520 / 236	680 / 309	800 / 363	180 / 82	300 / 136	450 / 204	600 / 272
	60 / 4.1	300 / 136	650 / 295	830 / 377	940 / 427	220 / 100	370 / 168	560 / 254	750 / 341
	70 / 4.8	360 / 163	770 / 350	980 / 445	1070 / 486	260 / 118	440 / 200	660 / 300	890 / 404
25 to 90 / 1.7 to 6.2	35 / 2.4	78 / 35	130 / 59	200 / 91	290 / 132	73 / 33	110 / 50	160 / 73	210 / 95
	50 / 3.4	170 / 77	330 / 150	500 / 227	610 / 277	130 / 59	220 / 100	340 / 154	460 / 209
	75 / 5.2	320 / 145	660 / 300	990 / 449	1140 / 518	230 / 104	420 / 191	640 / 291	870 / 395
	90 / 6.2	400 / 182	860 / 390	1250 / 568	1340 / 608	290 / 132	540 / 245	820 / 372	1110 / 504
35 to 100 / 2.4 to 6.9	35 / 2.4	110 / 50	190 / 86	290 / 132	400 / 182	80 / 36	120 / 54	170 / 77	220 / 100
	50 / 3.4	190 / 86	350 / 159	540 / 245	680 / 309	130 / 59	220 / 100	330 / 150	450 / 204
	75 / 5.2	320 / 145	620 / 281	970 / 440	1140 / 518	220 / 100	400 / 182	610 / 277	810 / 368
	100 / 6.9	440 / 200	890 / 404	1380 / 627	1470 / 667	310 / 141	570 / 259	880 / 400	1180 / 536
75 to 125 / 5.2 to 8.6	75 / 5.2	670 / 304	900 / 409	1050 / 477	1140 / 518	410 / 186	660 / 300	840 / 381	910 / 413
	100 / 6.9	850 / 386	1270 / 577	1380 / 627	1470 / 667	560 / 254	890 / 404	1060 / 481	1340 / 608
	125 / 8.6	1230 / 558	1570 / 713	1690 / 767		690 / 313	1010 / 459	1470 / 667	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 7. Steam Capacities for 1-1/2 In. / 40 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	CAPACITIES IN POUNDS PER HOUR / kg/h SATURATED STEAM AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
2 to 8 / 0.14 to 0.55	2 / 0.14	30 / 14	40 / 18	46 / 21	56 / 25	Not Available			
	5 / 0.34	36 / 16	66 / 30	120 / 54	170 / 77				
	8 / 0.55	42 / 19	91 / 41	200 / 91	290 / 132				
5 to 25 / 0.34 to 1.7	5 / 0.34	32 / 15	40 / 18	64 / 29	76 / 35	32 / 15	36 / 16	45 / 20	53 / 24
	15 / 1.0	72 / 33	170 / 77	310 / 141	360 / 163	51 / 23	68 / 31	102 / 46	140 / 64
	25 / 1.7	110 / 50	300 / 136	560 / 254	650 / 295	71 / 32	100 / 45	160 / 73	220 / 100
15 to 70 / 1.0 to 4.8	15 / 1.0	73 / 33	120 / 54	180 / 82	260 / 118	53 / 24	66 / 30	92 / 42	120 / 54
	30 / 2.1	290 / 132	460 / 209	520 / 236	620 / 281	100 / 45	160 / 73	250 / 114	340 / 154
	45 / 3.1	500 / 227	800 / 363	870 / 395	970 / 440	140 / 64	260 / 118	400 / 182	550 / 250
	50 / 3.4	570 / 259	910 / 413	990 / 449	1090 / 495	160 / 73	290 / 132	450 / 204	620 / 281
	60 / 4.1	720 / 327	1140 / 518	1220 / 554	1330 / 604	190 / 86	360 / 163	550 / 250	760 / 345
	70 / 4.8	860 / 390	1350 / 613	1440 / 654	1540 / 699	220 / 100	430 / 195	660 / 300	910 / 413
25 to 90 / 1.7 to 6.2	35 / 2.4	123 / 56	220 / 100	330 / 150	450 / 204	71 / 32	100 / 45	130 / 59	180 / 82
	50 / 3.4	310 / 141	610 / 277	740 / 336	870 / 395	130 / 59	210 / 95	310 / 141	430 / 195
	75 / 5.2	630 / 286	1240 / 563	1430 / 649	1560 / 708	220 / 100	400 / 182	610 / 277	850 / 386
	90 / 6.2	820 / 372	1630 / 740	1800 / 817	1920 / 872	280 / 127	520 / 236	780 / 354	1100 / 499
35 to 100 / 2.4 to 6.9	35 / 2.4	190 / 86	280 / 127	420 / 191	640 / 291	97 / 44	140 / 64	190 / 86	260 / 118
	50 / 3.4	360 / 163	600 / 272	790 / 359	990 / 449	140 / 64	230 / 104	360 / 163	500 / 227
	75 / 5.2	640 / 291	1130 / 513	1400 / 636	1580 / 717	220 / 100	380 / 173	630 / 286	910 / 413
	100 / 6.9	910 / 413	1660 / 754	1980 / 899	2110 / 958	290 / 132	530 / 241	900 / 409	1310 / 595
75 to 125 / 5.2 to 8.6	75 / 5.2	710 / 322	1250 / 568	1480 / 672	1580 / 717	440 / 200	680 / 309	870 / 395	960 / 436
	100 / 6.9	950 / 431	1770 / 804	1950 / 885	2020 / 917	610 / 277	860 / 390	1220 / 554	1530 / 695
	125 / 8.6	1420 / 645	2210 / 1003	2400 / 1090		760 / 345	1140 / 518	1630 / 740	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 7. Steam Capacities for 2 In. / 50 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	CAPACITIES IN POUNDS PER HOUR / kg/h SATURATED STEAM AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
10 to 25 / 0.69 to 1.7	10 / 0.69	280 / 127	400 / 182	640 / 291	860 / 390	210 / 95	300 / 136	390 / 177	490 / 222
	15 / 1.0	500 / 227	950 / 431	1190 / 540	1240 / 563	330 / 150	440 / 200	570 / 259	720 / 327
	25 / 1.7	970 / 440	1560 / 708	1650 / 749	1740 / 790	460 / 209	660 / 300	910 / 413	1140 / 518
15 to 50 / 1.0 to 3.4	15 / 1.0	440 / 200	660 / 300	950 / 431	1190 / 540	250 / 114	370 / 168	460 / 209	510 / 232
	25 / 1.7	690 / 313	1240 / 563	1590 / 722	1730 / 785	410 / 186	590 / 268	820 / 372	1030 / 468
	50 / 3.4	1800 / 817	2500 / 1135	2780 / 1262	2940 / 1335	780 / 354	1340 / 608	1880 / 854	2380 / 1081
25 to 60 / 1.7 to 4.1	25 / 1.7	630 / 286	1130 / 513	1640 / 745	1740 / 790	410 / 186	590 / 268	830 / 377	1060 / 481
	50 / 3.4	1470 / 667	2600 / 1180	2800 / 1271	2970 / 1348	750 / 341	1250 / 568	1790 / 813	2290 / 1040
	60 / 4.1	2490 / 1130	3680 / 1671	3940 / 1789		1230 / 558	2160 / 981	3030 / 1376	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Table 7. Steam Capacities for 3 In. / 80 mm (continued)

SPRING RANGE, psig / bar	SET PRESSURE, psig / bar	CAPACITIES IN POUNDS PER HOUR / kg/h SATURATED STEAM AT % BUILD-UP							
		Elastomer Diaphragm				Metal Diaphragm			
		10%	20%	30%	40%	10%	20%	30%	40%
10 to 25 / 0.69 to 1.7	10 / 0.69	400 / 182	560 / 254	820 / 372	1000 / 454	270 / 123	470 / 213	630 / 286	770 / 350
	15 / 1.0	510 / 232	860 / 390	1190 / 540	1540 / 699	440 / 200	680 / 309	890 / 404	1080 / 490
	25 / 1.7	930 / 422	1570 / 713	2210 / 1003	2410 / 1094	660 / 300	1040 / 472	1370 / 622	1700 / 772
15 to 50 / 1.0 to 3.4	15 / 1.0	390 / 177	620 / 281	940 / 427	1260 / 572	420 / 191	640 / 291	840 / 381	1020 / 463
	25 / 1.7	630 / 286	1280 / 581	1950 / 885	2410 / 1094	550 / 250	980 / 445	1270 / 577	1620 / 735
	50 / 3.4	1080 / 490	2410 / 1094	3800 / 1725	4100 / 1861	1240 / 563	2140 / 972	2800 / 1271	3430 / 1557
25 to 60 / 1.7 to 4.1	25 / 1.7	590 / 268	1130 / 513	1660 / 754	2190 / 994	550 / 250	930 / 422	1280 / 581	1580 / 717
	50 / 3.4	1150 / 522	2390 / 1085	3710 / 1684	4100 / 1861	1150 / 522	1950 / 885	2660 / 1208	3270 / 1485
	60 / 4.1	2950 / 1339	4520 / 2052	5460 / 2479		1840 / 835	3050 / 1385	4090 / 1857	

– Shaded areas indicate conditions where maximum differential pressure for the spring range is exceeded.

Introduction

T205 Series tank blanketing regulator is a direct-operated and spring-loaded regulator. The regulator prevents a stored liquid from vaporizing into the atmosphere, reduces liquid combustibility and prevents oxidation or contamination of the product by reducing its exposure to air. T205 Series maintains a slightly positive pressure and thereby reduces the possibility of tank wall collapse during pump out operation.

Product Configurations
See Table 1

Body Sizes and End Connection Styles
See Table 2

Maximum Allowable Inlet Pressure
See Table 2

Maximum Operating Inlet Pressure
See Table 8

Maximum Outlet (Casing) Pressure
Types T205 and T205M
Gray cast iron: 35 psig / 2.4 bar
WCC Carbon steel or CF8M/CF3M Stainless steel: 75 psig / 5.2 bar
Types T205H and T205HM
WCC Carbon steel or CF8M/CF3M Stainless steel: 150 psig / 10.3 bar

Outlet (Control) Pressure Range
See Table 3

Operating Outlet Pressure
See Table 6

Orifice Size and Flow Coefficients
See Table 4

Flow Capacities
See Table 9 to 12

Shutoff Classification per ANSI/FCI 70-3-2004
Class VI (Soft Seat)

Body and Casing Materials
Gray cast iron, WCC Carbon steel and CF8M/CF3M Stainless steel[1]

Trim Materials
See Table 6

Material Temperature Capabilities[2]
See Table 7

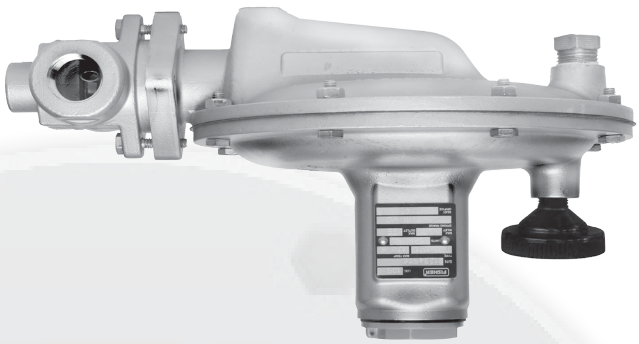

Figure 1. *Type T205 Tank Blanketing Regulator*

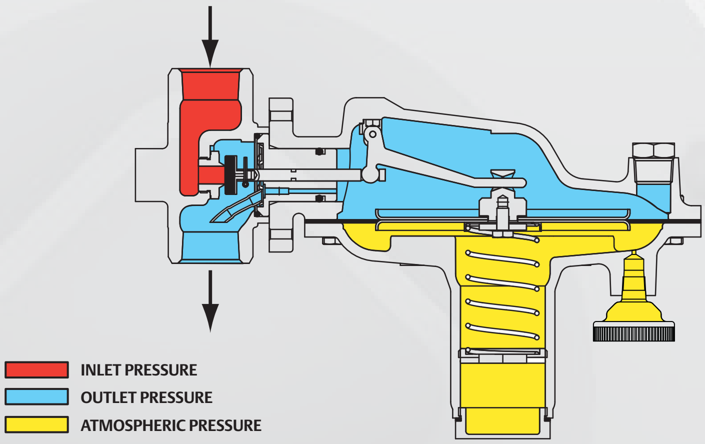

Figure 2. *Type T205 with Internal Pressure Registration Operational Schematics*

Pressure Registration
Types T205 and T205H: Internal
Types T205M and T205HM: External

Spring Case Vent Connection
1/4 NPT

Diaphragm Case Control Line Connection (Types T205M and T205HM)
1/2 NPT

Approximate Weight
17.7 lbs / 8 kg

Ordering Guide
To order this product, contact your local Sales Office.

Applications

- Process Gas
- Tank Blanketing

Features

- **Low-Pressure Setting and Fast Speed of Response**
- **Accurate Control and Small Lockup Pressure**
- **Multiple Applications**
- **Corrosion Resistance**
- **Easy Conversion Between Constructions**
- **Sour Gas Service Capability**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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1. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.
2. See Table 6 for operating temperature ranges for available trim combinations.

Table 1. Product Configurations

TYPE	CONFIGURATION
T205	Tank blanketing regulator with outlet pressure range of 1 in. w.c. to 7 psig / 2.5 mbar to 0.48 bar in seven different spring ranges and has internal pressure registration requiring no downstream control line
T205M	Similar to Type T205 but has a blocked throat and a downstream control line connection for external pressure registration
T205H	Similar to Type T205, except with inlet pressure equals outlet (casing) pressure (both 150 psig / 10.3 bar) and low temperature to -20°F / -29°C
T205HM	Similar to Type T205M, except with inlet pressure equals outlet (casing) pressure (both 150 psig / 10.3 bar) and low temperature to -20°F / -29°C

Table 2. Body Sizes, End Connection Styles and Maximum Allowable Inlet Pressures

BODY SIZE		BODY MATERIAL	END CONNECTION STYLE(1)	MAXIMUM ALLOWABLE INLET PRESSURE	
In.	DN			psig	bar
3/4 or 1	20 or 25	Gray cast iron	NPT	150	10.3
		WCC Carbon steel	NPT, CL150 RF, CL300 RF or PN 16/25/40 RF	200(3)	13.8(3)
		CF8M/CF3M Stainless steel(2)			

1. All flanges are welded. Weld-on flange dimension is 14 in. / 356 mm face-to-face.
2. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.
3. Inlet pressure is limited to 150 psig / 10.3 bar for Types T205H and T205HM.

Table 3. Outlet (Control) Pressure Ranges and Spring Information

OUTLET (CONTROL) PRESSURE RANGE		SPRING COLOR	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
In. w.c.	mbar		In.	mm	In.	mm
1 to 2.5(1)(2)	2.5 to 6.2(1)(2)	Orange	0.072	1.8	3.25	82.6
2.5 to 7(1)	6.2 to 17(1)	Red	0.085	2.2	3.63	92.2
7 to 16	17 to 40	Unpainted	0.105	2.7	3.75	95.2
0.5 to 1.2 psig	34 to 83	Yellow	0.114	2.9	4.31	109
1.2 to 2.5 psig	83 to 172	Green	0.156	4.0	4.06	103
2.5 to 4.5 psig	0.17 to 0.31 bar	Light blue	0.187	4.8	3.94	100
4.5 to 7 psig	0.31 to 0.48 bar	Black	0.218	5.5	3.98	101

1. To achieve the published control pressure range the spring case must be installed pointing down.
2. Do not use Fluorocarbon (FKM) diaphragm with this spring at diaphragm temperatures lower than 60°F / 16°C.

Table 4. Flow Coefficients

TYPE	ORIFICE SIZE		FLOW COEFFICIENTS (WIDE-OPEN)		C_1
	In.	mm	C_g	C_v	
T205, T205H, T205M and T205HM	1/8	3.2	12	0.36	33.3
	1/4	6.4	47	1.40	33.1
	3/8	9.5	101	2.96	34.1
	1/2	13	174	5.20	33.4
	9/16	14	205	6.20	33.1

Table 5. Correction Factors (For converting Air Flow Rates to Other Gas Flow Rates)(1)

BLANKET GAS	SPECIFIC GRAVITY	CORRECTION FACTOR
Natural Gas	0.60	1.291
Nitrogen	0.97	1.015
Dry CO_2	1.52	0.811

1. For gases of other specific gravities, use equation below.

$$\text{Correction Factor} = \frac{1.00}{\sqrt{SG}}$$

Table 6. Trim Materials

BODY AND SPRING CASE	DIAPHRAGM HEAD	LEVER ASSEMBLY	GUIDE INSERT	TRIM OPTION CODE	DIAPHRAGM MATERIAL(1)	DISK AND O-RING MATERIAL	OPERATING OUTLET PRESSURE	OPERATING TEMPERATURE RANGE(2)
Gray cast iron, WCC Carbon steel or CF8M CF3M Stainless steel	304 Stainless steel	302 Stainless steel	316 Stainless steel	Standard	Nitrile (NBR)	Nitrile (NBR)	35 psi / 2.4 bar	-40 to 180°F / -40 to 82°C
				VV	Fluorocarbon (FKM)	Fluorocarbon (FKM)		40 to 300°F / 4 to 149°C
				TN	Fluorinated Ethylene Propylene (FEP)	Nitrile (NBR)	10 psi / 0.7 bar	-20 to 180°F / -29 to 82°C
				TV	Fluorinated Ethylene Propylene (FEP)	Fluorocarbon (FKM)		40 to 180°F / 4 to 82°C
				TK	Fluorinated Ethylene Propylene (FEP)	Perfluoroelastomer (FFKM)		0 to 180°F / -18 to 82°C
				TE	Fluorinated Ethylene Propylene (FEP)	Ethylenepropylene (EPDM)		-20 to 180°F / -29 to 82°C

1. Types T205H and T205HM are available with Nitrile (NBR) diaphragm only and operating temperature range of -20 to 180°F / -29 to 82°C.
2. Gray cast iron and Carbon steel bodies are limited to -20 to 300°F / -29 to 149°C.

Table 7. Material Temperature Capabilities

MATERIALS	TEMPERATURE RANGE
Elastomer Parts	
Nitrile (NBR)	T205 and T205M: -40 to 180°F / -40 to 82°C
	T205H and T205HM: -20 to 180°F / -29 to 82°C
Fluorinated Ethylene Propylene (FEP)(1)	-20 to 180°F / -29 to 82°C
Fluorocarbon (FKM)(1)	40 to 300°F / 4 to 149°C
Ethylene Propylene Diene (EPDM)(1)	-20 to 225°F / -29 to 107°C
Perfluoroelastomer (FFKM)(1)	0 to 300°F / -18 to 149°C
Body Materials	
Gray cast iron(1)	-20 to 300°F / -29 to 149°C
WCC Carbon steel	
CF8M/CF3M Stainless steel	-40 to 300°F / -40 to 149°C

1. Not available for Types T205H and T205HM.

Table 8. T205 Series Maximum Operating Inlet Pressure[1]															
ORIFICE SIZE		MAXIMUM OPERATING INLET PRESSURE													
		1 to 2.5 In. w.c. / 2.5 to 6.2 mbar Outlet (Control) Pressure Setting		2.5 to 7 In. w.c. / 6.2 to 17 mbar Outlet (Control) Pressure Setting		7 to 16 In. w.c. / 17 to 40 mbar Outlet (Control) Pressure Setting		0.5 to 1.2 psig / 34 to 83 mbar Outlet (Control) Pressure Setting		1.2 to 2.5 psig / 83 to 172 mbar Outlet (Control) Pressure Setting		2.5 to 4.5 psig / 0.17 to 0.31 bar Outlet (Control) Pressure Setting		4.5 to 7 psig / 0.31 to 0.48 bar Outlet (Control) Pressure Setting	
In.	mm	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
3/4 In. / DN 20 Body Size															
1/8	3.2	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
1/4	6.4	125	8.62	175[2]	12.1[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
3/8	9.5	60	4.14	80	5.52	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
1/2	13	30	2.07	40	2.76	125	8.62	150	10.3	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
9/16	14	20	1.38	30	2.07	100	6.89	125	8.62	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
1 In. / DN 25 Body Size															
1/8	3.2	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
1/4	6.4	100	6.89	150	10.3	150	10.3	150	10.3	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
3/8	9.5	40	2.76	80	5.52	150	10.3	150	10.3	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
1/2	13	30	2.07	40	2.76	125	8.62	150	10.3	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]
9/16	14	20	1.38	15	1.03	100	6.89	125	8.62	200[2]	13.8[2]	200[2]	13.8[2]	200[2]	13.8[2]

1. At maximum inlet pressure, minimum achievable setpoints may vary based on process conditions.
2. Inlet pressure is limited to 150 psig / 10.3 bar for Gray cast iron bodies or for Types T205H and T205HM.

Table 9. Flow Capacities of Types T205 and T205H with 3/4 in. / DN 20 Body Size														
SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR									
					Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 2.5 in. w.c. / 2.5 to 6.2 mbar Orange	1 in. w.c. / 2.5 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	74	1.98	215	5.76	315	8.44	584	15.7	565	15.1
			5	0.34	196	5.25	604	16.2	767	20.6	973	26.1	1041	27.9
			15	1.0	346	9.27	1019	27.3	1222	32.7	1531	41.0	1146	30.7
			30	2.1	533	14.3	1487	39.9	1575	42.2	1518	40.7		
			60	4.1	877	23.5	1904	51.0	1190	31.9				
			100	6.9	1352	36.2	1618	43.4						
			150	10.3	1936	51.9								
			200	13.8	1452	38.9								
	2 in. w.c. / 5.0 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	70	1.88	212	5.68	279	7.48	442	11.8	466	12.5
			5	0.34	188	5.04	567	15.2	720	19.3	885	23.7	977	26.2
			15	1.0	353	9.46	971	26.0	1108	29.7	1502	40.3	1145	30.7
			30	2.1	540	14.5	1503	40.3	1529	41.0	1204	32.3		
			60	4.1	875	23.4	1885	50.5	2346	62.9				
			100	6.9	1367	36.6	1568	42.0						
			150	10.3	1857	49.8								
			200	13.8	1472	39.4								
2.5 to 7 in. w.c. / 6.2 to 17 mbar Red	2.5 in. w.c. / 6.2 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	69	1.85	124	3.32	236	6.32	318	8.52	332	8.90
			5	0.34	150	4.02	321	8.60	531	14.2	730	19.6	777	20.8
			15	1.0	347	9.30	611	16.4	953	25.5	1272	34.1	1116	29.9
			30	2.1	532	14.3	1764	47.3	1411	37.8	1019	27.3	1131	30.3
			60	4.1	831	22.3	1768	47.4	2170	58.2				
			100	6.9	1265	33.9	2644	70.9						
			150	10.3	1567	42.0	1509	40.4						
			200	13.8	1431	38.4								
	4 in. w.c. / 10 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	66	1.77	115	3.08	161	4.31	266	7.13	264	7.08
			5	0.34	149	3.99	366	9.81	488	13.1	620	16.6	698	18.7
			15	1.0	287	7.69	694	18.6	908	24.3	1209	32.4	931	25.0
			30	2.1	504	13.5	1655	44.4	1380	37.0	1794	48.1	1035	27.7
			60	4.1	861	23.1	1713	45.9	1434	38.4				
			100	6.9	1249	33.5	2673	71.6						
			150	10.3	1433	38.4	1563	41.9						
			200	13.8	1545	41.4								
	7 in. w.c. / 17.4 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	71	1.90	137	3.67	253	6.78	332	8.90	333	8.92
			5	0.34	179	4.80	500	13.4	647	17.3	916	24.5	957	25.6
			15	1.0	351	9.41	894	24.0	1147	30.7	1569	42.0	1422	38.1
			30	2.1	539	14.4	1545	41.4	1483	39.7	2100	56.3	1482	39.7
			60	4.1	882	23.6	1855	49.7	2241	60.1				
			100	6.9	1372	36.8	2745	73.6						
			150	10.3	1926	51.6	1619	43.4						
			200	13.8	1598	42.8								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	8 in. w.c. / 20 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	62	1.66	146	3.91	192	5.15	233	6.24	314	8.42
			5	0.34	164	4.40	428	11.5	555	14.9	831	22.3	861	23.1
			20	1.4	390	10.5	980	26.3	1241	33.3	1647	44.1	1550	41.5
			60	4.1	850	22.8	1698	45.5	2227	59.7	2629	70.5	3264	87.5
			100	6.9	1318	35.3	2699	72.3	2077	55.7	2277	61.0	2872	77.0

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

- continued -

Table 9. Flow Capacities of Types T205 and T205H with 3/4 in. / DN 20 Body Size (continued)

SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR, Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	8 in. w.c. / 20 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	150	10.3	1862	49.9	1645	44.1	1600	42.9				
			200	13.8	1462	39.2	1806	48.4	1160	31.1				
	12 in. w.c. / 30 mbar	20% Gauge	1	0.07	83	2.22	105	2.81	213	5.71	246	6.59	223	5.98
			5	0.34	173	4.64	433	11.6	573	15.4	796	21.3	859	23.0
			20	1.4	387	10.4	979	26.2	1228	32.9	1727	46.3	1545	41.4
			60	4.1	872	23.4	1783	47.8	2294	61.5	2538	68.0	3339	89.5
			100	6.9	1288	34.5	2645	70.9	2123	56.9	2387	64.0	2779	74.5
			150	10.3	1833	49.1	1900	50.9	1851	49.6				
			200	13.8	2498	66.9	2010	53.9	1387	37.2				
	16 in. w.c. / 40 mbar	20% Gauge	1	0.07			110	2.95	197	5.28	222	5.95	236	6.32
			5	0.34	178	4.77	467	12.5	629	16.9	912	24.4	926	24.8
			20	1.4	377	10.1	1050	28.1	1315	35.2	1653	44.3	1752	47.0
			60	4.1	849	22.8	1953	52.3	2320	62.2	2983	79.9	3404	91.2
			100	6.9	1322	35.4	2620	70.2	2139	57.3	2816	75.5	2967	79.5
			150	10.3	1890	50.7	2117	56.7	3365	90.2				
			200	13.8	2459	65.9	2496	66.9	3469	93.0				
0.5 to 1.2 psig / 34 to 83 mbar Yellow	0.58 psig / 40 mbar	20% Gauge	2	0.14	115	3.08	216	5.79	357	9.57	459	12.3	476	12.8
			10	0.69	235	6.30	623	16.7	851	22.8	1246	33.4	1373	36.8
			45	3.1	666	17.8	1957	52.4	1571	42.1	2117	56.7	2885	77.3
			80	5.5	1087	29.1	2719	72.9	2253	60.4	2517	67.5	2910	78.0
			125	8.6	1590	42.6	1925	51.6	2685	72.0	2155	57.8	3075	82.4
			175	12.1	1909	51.2	1918	51.4	3022	81.0				
			200	13.8	2517	67.5	1982	53.1	2586	69.3				
	1 psi / 69 mbar	20% Gauge	2	0.14	108	2.89	265	7.10	401	10.7	521	14.0	528	14.2
			10	0.69	259	6.94	761	20.4	991	26.6	1419	38.0	1672	44.8
			60	4.1	898	24.1	2241	60.1	2438	65.3	2675	71.7	3592	96.3
			100	6.9	1383	37.1	2908	77.9	2279	61.1	3155	84.6	3273	87.7
			150	10.3	1976	53.0	3339	89.5	3608	96.7	2912	78.0		
			200	13.8	2562	68.7	2634	70.6	3748	100				
1.2 to 2.5 psig / 83 to 172 mbar Green	1.2 psi / 83 mbar	20% Gauge	4	0.28	120	3.22	264	7.08	406	10.9	572	15.3	578	15.5
			12	0.83	212	5.68	552	14.8	754	20.2	1134	30.4	1146	30.7
			60	4.1	765	20.5	1815	48.6	2373	63.6	3199	85.7	3221	86.3
			100	6.9	1235	33.1	2788	74.7	2271	60.9	2644	70.9	3088	82.8
			150	10.3	1627	43.6	3452	92.5	3295	88.3	2729	73.1	3401	91.1
			200	13.8	2501	67.0	3873	104	3538	94.8	2782	74.6	3445	92.3
	2.5 psi / 172 mbar	20% Gauge	6	0.41	159	4.26	465	12.5	677	18.1	943	25.3	1015	27.2
			30	2.1	497	13.3	1441	38.6	2073	55.6	2607	69.9	1943	52.1
			80	5.5	1143	30.6	3008	80.6	3224	86.4	3821	102	4444	119
			125	8.6	1646	44.1	3517	94.3	3539	94.8	3893	104	4118	110
			175	12.1	2235	59.9	4555	122	3974	107	3884	104	4449	119
			200	13.8	2528	67.8	4627	124	4158	111	3511	94.1	4515	121
2.5 to 4.5 psig / 0.17 to 0.31 bar Light blue	2.5 psi / 0.17 bar	20% Gauge	4	0.28	128	3.43	209	5.60	335	8.98	466	12.5	487	13.1
			12	0.83	277	7.42	539	14.4	749	20.1	1080	28.9	1167	31.3
			60	4.1	897	24.0	1804	48.3	2474	66.3	2776	74.4	3488	93.5
			100	6.9	1364	36.6	2763	74.0	2907	77.9	3837	103	3626	97.2
			150	10.3	1951	52.3	3504	93.9	3765	101	3898	104	3933	105
			200	13.8	2493	66.8	3965	106	4060	109	3520	94.3	4138	111
	4.5 psi / 0.31 bar	20% Gauge	8	0.55	194	5.20	416	11.1	714	19.1	992	26.6	1005	26.9
			30	2.1	520	13.9	1290	34.6	1830	49.0	2593	69.5	2610	69.9
			80	5.5	1143	30.6	2727	73.1	3470	93.0	3865	104	4886	131
			125	8.6	1673	44.8	3690	98.9	3862	104	5056	136	5623	151
			175	12.1	2032	54.5	4462	120	4569	122	5313	142	5459	146
			200	13.8	2174	58.3	5005	134	4757	127	4826	129	5587	150
4.5 to 7 psig / 0.31 to 0.48 bar Black	4.5 psi / 0.31 bar	20% Gauge	9	0.62	188	5.04	407	10.9	566	15.2	791	21.2	885	23.7
			30	2.1	438	11.7	1012	27.1	1570	42.1	1891	50.7	2136	57.2
			80	5.5	930	24.9	2161	57.9	2974	79.7	3727	99.9	4195	112
			125	8.6	1390	37.3	3168	84.9	3546	95.0	4202	113	4695	126
			175	12.1	1871	50.1	3988	107	4236	114	5155	138	5185	139
			200	13.8	2254	60.4	4232	113	4570	122	4663	125	5029	135
	7 psi / 0.48 bar	20% Gauge	9	0.62	173	4.64	402	10.8	618	16.6	843	22.6	563	15.1
			30	2.1	490	13.1	1239	33.2	2040	54.7	2328	62.4	1830	49.0
			80	5.5	1065	28.5	2658	71.2	3680	98.6	4649	125	5197	139
			125	8.6	1582	42.4	3836	103	4290	115	5945	159	6199	166
			175	12.1	2180	58.4	4688	126	5117	137	5788	155	6358	170
			200	13.8	2473	66.3	5153	138	5382	144	6439	173	6514	175

- Black areas indicate where desired flow capacity is not obtainable for a given inlet pressure.
- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

Table 10. Flow Capacities of Types T205 and T205H with 1 in. / DN 25 Body Size

SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR, Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 2.5 in. w.c. / 2.5 to 6.2 mbar Orange	1 in. w.c. / 2.5 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	88	2.36	334	8.95	611	16.4	950	25.5	1101	29.5
			5	0.34	211	5.65	756	20.3	1314	35.2	2067	55.4	2385	63.9
			15	1.0	349	9.35	1318	35.3	2475	66.3	2486	66.6	1934	51.8
			30	2.1	538	14.4	2057	55.1	2104	56.4	1919	51.4		
			60	4.1	912	24.4	1923	51.5						
			100	6.9	1373	36.8	1759	47.1						
			150	10.3	1941	52.0								
			200	13.8	2552	68.4								
	2 in. w.c. / 5.0 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	95	2.55	332	8.90	599	16.1	890	23.9	1065	28.5
			5	0.34	204	5.47	688	18.4	1314	35.2	2094	56.1	2400	64.3
			15	1.0	368	9.86	1319	35.3	2659	71.3	2136	57.2	1931	51.8
			30	2.1	538	14.4	2013	53.9	2060	55.2	1801	48.3		
			60	4.1	906	24.3	1696	45.5						
			100	6.9	1383	37.1	1631	43.7						
			150	10.3	1977	53.0								
			200	13.8	2544	68.2								
2.5 to 7 in. w.c. / 6.2 to 17 mbar Red	2.5 in. w.c. / 6.2 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	96	2.57	207	5.55	385	10.3	521	14.0	512	13.7
			5	0.34	181	4.85	555	14.9	1246	33.4	1988	53.3	2370	63.5
			15	1.0	352	9.43	1308	35.1	2435	65.3	2190	58.7	2028	54.4
			30	2.1	539	14.4	2016	54.0	2277	61.0	1842	49.4		
			60	4.1	896	24.0	1857	49.8	3013	80.7				
			100	6.9	1237	33.2	1637	43.9						
			150	10.3	1875	50.2	1460	39.1						
			200	13.8	2563	68.7								
	4 in. w.c. / 10 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	101	2.71	222	5.95	308	8.25	368	9.86	422	11.3
			5	0.34	204	5.47	441	11.8	1024	27.4	1940	52.0	2348	62.9
			15	1.0	353	9.46	1233	33.0	2453	65.7	3468	92.9	2597	69.6
			30	2.1	534	14.3	2002	53.7	3923	105	1986	53.2		
			60	4.1	854	22.9	1973	52.9	3933	105				
			100	6.9	1371	36.7	1576	42.2						
			150	10.3	1930	51.7	1444	38.7						
			200	13.8	2438	65.3								
	7 in. w.c. / 17.4 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	77	2.06	252	6.75	384	10.3	571	15.3	693	18.6
			5	0.34	197	5.28	601	16.1	1183	31.7	1971	52.8	2319	62.1
			15	1.0	349	9.35	1235	33.1	2403	64.4	2656	71.2	3881	104
			30	2.1	549	14.7	1994	53.4	2935	78.7	2039	54.6		
			60	4.1	896	24.0	1978	53.0	2778	74.5				
			100	6.9	1335	35.8	1682	45.1						
			150	10.3	1902	51.0	1648	44.2						
			200	13.8	2337	62.6								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	8 in. w.c. / 20 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	67	1.80	245	6.57	253	6.78	497	13.3	510	13.7
			5	0.34	189	5.07	547	14.7	906	24.3	1474	39.5	2215	59.4
			20	1.4	337	9.03	1318	35.3	2674	71.7	2462	66.0	2171	58.2
			60	4.1	885	23.7	2043	54.8	3769	101	2319	62.1	1409	37.8
			100	6.9	1370	36.7	1640	44.0	1961	52.6	1863	49.9	1044	28.0
			150	10.3	1958	52.5	1560	41.8	1215	32.6				
			200	13.8	2349	63.0								
	12 in. w.c. / 30 mbar	20% Gauge	1	0.07	81	2.17	242	6.49	204	5.47	421	11.3	465	12.5
			5	0.34	183	4.90	493	13.2	766	20.5	1249	33.5	1422	38.1
			20	1.4	395	10.6	1453	38.9	2381	63.8	2412	64.6	2362	63.3
			60	4.1	895	24.0	2226	59.7	2986	80.0	1983	53.1	1533	41.1
			100	6.9	1375	36.8	1802	48.3	2041	54.7	1550	41.5	1179	31.6
			150	10.3	1965	52.7	1717	46.0	1303	34.9				
			200	13.8	2534	67.9								
	16 in. w.c. / 40 mbar	20% Gauge	1	0.07	73	1.96	230	6.16	240	6.43	423	11.3	411	11.0
			5	0.34	173	4.64	533	14.3	877	23.5	1280	34.3	1541	41.3
			20	1.4	400	10.7	1317	35.3	2679	71.8	5362	144	5845	157
			60	4.1	869	23.3	2484	66.6	6906	185	2434	65.2	1892	50.7
			100	6.9	1363	36.5	2004	53.7	1785	47.8	1760	47.2	1737	46.6
			150	10.3	1871	50.1	2210	59.2	1707	45.7				
			200	13.8	2418	64.8								

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

- continued -

Table 10. Flow Capacities of Types T205 and T205H with 1 in. / DN 25 Body Size (continued)

SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR, Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
0.5 to 1.2 psig / 34 to 83 mbar Yellow	0.58 psig / 40 mbar	20% Gauge	2	0.14	104	2.79	302	8.09	417	11.2	589	15.8	656	17.6
			10	0.69	253	6.78	737	19.8	1213	32.5	2380	63.8	3554	95.2
			45	3.1	736	19.7	2397	64.2	3961	106	2790	74.8	2279	61.1
			80	5.5	1114	29.9	3413	91.5	2499	67.0	1947	52.2	1749	46.9
			125	8.6	1588	42.6	2831	75.9	1235	33.1	1646	44.1	1737	46.6
			175	12.1	2056	55.1								
			200	13.8	2197	58.9								
	1 psi / 69 mbar	20% Gauge	2	0.14	108	2.89	272	7.29	393	10.5	631	16.9	739	19.8
			10	0.69	270	7.24	869	23.3	1396	37.4	2430	65.1	3189	85.5
			60	4.1	875	23.4	3318	88.9	3784	101	3392	90.9	2583	69.2
			100	6.9	1338	35.9	3765	101	3388	90.8	3061	82.0	2823	75.7
			150	10.3	1678	45.0	3187	85.4			2500	67.0		
			200	13.8	2187	58.6								
1.2 to 2.5 psig / 83 to 172 mbar Green	1.2 psi / 83 mbar	20% Gauge	4	0.28	138	3.70	310	8.31	414	11.1	507	13.6	709	19.0
			12	0.83	253	6.78	662	17.7	864	23.2	1364	36.6	1706	45.7
			60	4.1	808	21.7	2973	79.7	7021	188	3964	106	3821	102
			100	6.9	1289	34.5	5113	137	4053	109	3738	100	3542	94.9
			150	10.3	1804	48.3	4882	131	4791	128	3318	88.9	3381	90.6
			200	13.8	2135	57.2	2367	63.4	2799	75.0	2729	73.1	4006	107
	2.5 psi / 172 mbar	20% Gauge	6	0.41	187	5.0	494	13.2	786	21.1	1112	29.8	1195	32.0
			30	2.1	523	14.0	1414	37.9	2875	77.1	5879	157.6	7620	204.2
			80	5.5	1158	31.0	4195	112.4	8711	186.9	5277	141	5169	139
			125	8.6	1590	42.6	6389	171.2	4874	130.6	4545	122	4978	133
			175	12.1	2175	58.3	6297	168.8	6634	178	4194	112	4257	114
			200	13.8	2386	63.9	6854	183.7	6117	164	4321	116	4459	120
2.5 to 4.5 psig / 0.17 to 0.31 bar Light blue	2.5 psi / 0.17 bar	20% Gauge	4	0.28	108	2.89	269	7.21	334	8.95	535	14.3	550	14.7
			12	0.83	244	6.54	514	13.8	784	21.0	1260	33.8	1421	38.1
			60	4.1	782	21.0	2046	54.8	3578	95.9	11,836	317	12,955	347
			100	6.9	1205	32.3	4667	125	7249	194	5219	140	5078	136
			150	10.3	1819	48.7	7511	201	7377	198	5340	143	5291	142
			200	13.8	2198	58.9	7118	191	6708	180	5094	137	4415	118
	4.5 psi / 0.31 bar	20% Gauge	8	0.55	174	4.7	472	12.6	721	19.3	1142	30.6	1174	31.5
			30	2.1	507	13.6	1309	35.1	2070	55.5	3345	89.6	4494	120
			80	5.5	1048	28.1	3573	95.8	8714	234	15,292	410	17,613	472
			125	8.6	1558	41.8	6177	165.5	12,919	346	7482	201	7714	207
			175	12.1	2096	56.2	8569	229.6	86,460	2317	7401	198	7341	197
			200	13.8	2380	63.8	9791	262.4	8496	228	6937	186	7374	198
4.5 to 7 psig / 0.31 to 0.48 bar Black	4.5 psi / 0.31 bar	20% Gauge	9	0.62	178	4.8	383	10.3	595	15.9	874	23.4	988	26.5
			30	2.1	433	11.6	963	25.8	1518	40.7	2234	59.9	2712	72.7
			80	5.5	835	22.4	2506	67.2	7112	190.6	14,046	376	16,558	444
			125	8.6	1486	39.8	4809	128.9	12,529	335.8	8487	227	8479	227
			175	12.1	2069	55.4	8494	227.6	9717	260	8031	215	8225	220
			200	13.8	2182	58.5	9751	261.3	9382	251	7948	213	8603	231
	7 psi / 0.48 bar	20% Gauge	9	0.62	150	4.0	412	11.0	644	17.3	896	24.0	1049	28.1
			30	2.1	410	11.0	1274	34.1	1896	50.8	2853	76.5	3469	93.0
			80	5.5	992	26.6	3150	84.4	6662	178.5	14,248	382	16,431	440
			125	8.6	1590	42.6	5404	144.8	12,573	337.0	21,735	582	24,399	654
			175	12.1	1939	52.0	8098	217.0	18,033	483	11,618	311	11,410	306
			200	13.8	2394	64.2	9331	250.1	13,239	355	11,601	311	9264	248

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

Table 11. Flow Capacities of Types T205M and T205HM with 3/4 in. / DN 20 Body Size

SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR, Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 2.5 in. w.c. / 2.5 to 6.2 mbar Orange	1 in. w.c. / 2.5 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	76	2.04	283	7.58	462	12.4	641	17.2	723	19.4
			5	0.34	201	5.39	739	19.8	1113	29.8	1899	50.9	1940	52.0
			15	1.0	349	9.35	1380	37.0	2042	54.7	2736	73.3	4808	129
			30	2.1	538	14.4	2647	70.9	4078	109	6541	175		
			60	4.1	895	24.0	4083	109	7557	203				
			100	6.9	1403	37.6	5344	143						
			150	10.3	2018	54.1								
			200	13.8	2640	70.8								
	2 in. w.c. / 5.0 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	64	1.72	256	6.86	437	11.7	529	14.2	710	19.0
			5	0.34	198	5.31	705	18.9	1018	27.3	1452	38.9	1436	38.5
			15	1.0	352	9.43	1332	35.7	1645	44.1	2501	67.0	3728	99.9
			30	2.1	534	14.3	2038	54.6	3560	95.4	3558	95.4		
			60	4.1	894	24.0	3367	90.2	4921	132				
			100	6.9	1396	37.4	5027	135						
			150	10.3	2012	53.9								
			200	13.8	2625	70.4								
2.5 to 7 in. w.c. / 6.2 to 17 mbar Red	2.5 in. w.c. / 6.2 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	67	1.80	178	4.77	257	6.89	534	14.3	416	11.1
			5	0.34	184	4.93	246	6.59	599	16.1	793	21.3	909	24.4
			15	1.0	337	9.03	821	22.0	1062	28.5	1095	29.3	2216	59.4
			30	2.1	490	13.1	1287	34.5	1645	44.1	3249	87.1	1456	39.0
			60	4.1	836	22.4	1534	41.1	2705	72.5				
			100	6.9	1247	33.4	2419	64.8						
			150	10.3	1548	41.5	6672	179						
			200	13.8	2121	56.8								
	4 in. w.c. / 10 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	81	2.17	160	4.29	265	7.10	289	7.75	302	8.09
			5	0.34	170	4.56	190	5.09	444	11.9	674	18.1	741	19.9
			15	1.0	311	8.33	698	18.7	928	24.9	1222	32.7	1286	34.5
			30	2.1	455	12.2	1138	30.5	1424	38.2	1992	53.4	1428	38.3
			60	4.1	748	20.0	1516	40.6	1489	39.9				
			100	6.9	1048	28.1	1613	43.2						
			150	10.3	1402	37.6	3764	101						
			200	13.8	2191	58.7								
	7 in. w.c. / 17.4 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	69	1.85	182	4.88	308	8.25	358	9.59	507	13.6
			5	0.34	189	5.07	390	10.5	681	18.3	1091	29.2	1143	30.6
			15	1.0	338	9.06	1054	28.2	1462	39.2	1823	48.9	2337	62.6
			30	2.1	516	13.8	1663	44.6	2603	69.8	4708	126	3955	106
			60	4.1	903	24.2	2514	67.4	4409	118				
			100	6.9	1376	36.9	3813	102						
			150	10.3	1967	52.7	6810	183						
			200	13.8	2565	68.7								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	8 in. w.c. / 20 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	60	1.61	188	5.04	230	6.16	314	8.42	295	7.91
			5	0.34	177	4.74	309	8.28	554	14.8	874	23.4	942	25.2
			20	1.4	239	6.41	1002	26.9	1327	35.6	1746	46.8	1861	49.9
			60	4.1	854	22.9	1974	52.9	2333	62.5	4429	119	4359	117
			100	6.9	1311	35.1	2644	70.9	5222	140	6067	163	5169	139
			150	10.3	1754	47.0	3923	105	3915	105				
			200	13.8	2330	62.4	6821	183	5039	135				
	12 in. w.c. / 30 mbar	20% Gauge	1	0.07			147	3.94	193	5.17	261	6.99	268	7.18
			5	0.34	172	4.61	275	7.37	553	14.8	894	24.0	950	25.5
			20	1.4	241	6.46	1073	28.8	1438	38.5	1793	48.1	1897	50.8
			60	4.1	837	22.4	2038	54.6	2701	72.4	4702	126	5023	135
			100	6.9	1307	35.0	2847	76.3	4232	113	5979	160	5617	151
			150	10.3	1744	46.7	4283	115	6321	169				
			200	13.8	2312	62.0	6668	179	6028	162				
	16 in. w.c. / 40 mbar	20% Gauge	1	0.07			146	3.91	199	5.33	272	7.29	325	8.71
			5	0.34	175	4.69	370	9.92	622	16.7	984	26.4	1074	28.8
			20	1.4	300	8.04	1060	28.4	1607	43.1	2180	58.4	2380	63.8
			60	4.1	867	23.2	2396	64.2	3082	82.6	5909	158	3732	100
			100	6.9	1362	36.5	3347	89.7	5824	156	7573	203	6407	172
			150	10.3	1778	47.7	5135	138	5567	149				
			200	13.8	2360	63.2	7865	211	8286	222				

- Black areas indicate where desired flow capacity is not obtainable for a given inlet pressure.
- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

- continued -

Table 11. Flow Capacities of Types T205M and T205HM with 3/4 in. / DN 20 Body Size (continued)

SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR									
					Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
0.5 to 1.2 psig / 34 to 83 mbar Yellow	0.58 psig / 40 mbar	20% Gauge	2	0.14	103	2.76	257	6.89	325	8.71	343	9.19	2517	67.5
			10	0.69	256	6.86	650	17.4	851	22.8	1272	34.1	1462	39.2
			45	3.1	611	16.4	1722	46.1	2448	65.6	3071	82.3	3940	106
			80	5.5	1055	28.3	2505	67.1	4702	126	5246	141	5879	158
			125	8.6	1530	41.0	3693	99.0	4440	119	6976	187	6172	165
			175	12.1	2088	56.0	5526	148	7147	192				
			200	13.8	2304	61.7	6208	166	6515	175				
	1 psi / 69 mbar	20% Gauge	2	0.14	80	2.14	254	6.81	377	10.1	558	15.0	397	10.6
			10	0.69	287	7.69	798	21.4	1051	28.2	1545	41.4	1713	45.9
			60	4.1	871	23.3	2674	71.7	3489	93.5	6426	172	6832	183
			100	6.9	1361	36.5	3981	107	5293	142	8009	215	8880	238
			150	10.3	1916	51.3	6298	169	8902	239	10,291	276		
			200	13.8	2421	64.9	7463	200	10,523	282				
1.2 to 2.5 psig / 83 to 172 mbar Green	1.2 psi / 83 mbar	20% Gauge	4	0.28	144	3.86	292	7.83	354	9.49	558	15.0	551	14.8
			12	0.83	259	6.94	583	15.6	757	20.3	1109	29.7	1237	33.2
			60	4.1	734	19.7	1710	45.8	2321	62.2	3859	103	4083	109
			100	6.9	1122	30.1	2546	68.2	3402	91.2	5445	146	5992	161
			150	10.3	1537	41.2	3584	96.1	5313	142	7493	201	6600	177
			200	13.8	2011	53.9	4539	122	5542	149	8020	215	7371	198
	2.5 psi / 172 mbar	20% Gauge	6	0.41	179	4.80	481	12.9	604	16.2	984	26.4	1041	27.9
			30	2.1	399	10.7	1486	39.8	2191	58.7	2859	76.6	3197	85.7
			80	5.5	1102	29.5	3269	87.6	4494	120	6285	168	6838	183
			125	8.6	1611	43.2	4687	126	6442	173	9048	242	10,720	287
			175	12.1	2175	58.3	6267	168	9827	263	12,419	333	12,612	338
			200	13.8	2499	67.0	6876	184	10,250	275	13,775	369	12,236	328
2.5 to 4.5 psig / 0.17 to 0.31 bar Light blue	2.5 psi / 0.17 bar	20% Gauge	4	0.28	106	2.84	266	7.13	318	8.52	366	9.81	438	11.7
			12	0.83	232	6.22	548	14.7	651	17.4	1050	28.1	1213	32.5
			60	4.1	738	19.8	1691	45.3	2424	65.0	3337	89.4	4945	133
			100	6.9	1133	30.4	2549	68.3	3422	91.7	5956	160	6061	162
			150	10.3	1639	43.9	3641	97.6	5498	147	7866	211	8703	233
			200	13.8	2109	56.5	4579	123	6288	169	8974	241	9551	256
	4.5 psi / 0.31 bar	20% Gauge	8	0.55	194	5.20	500	13.4	658	17.6	959	25.7	1064	28.5
			30	2.1	369	9.89	1363	36.5	1916	51.3	2686	72.0	2862	76.7
			80	5.5	1095	29.3	2942	78.8	4153	111	6219	167	7130	191
			125	8.6	1571	42.1	4272	114	6156	165	9286	249	10,573	283
			175	12.1	2097	56.2	5709	153	8504	228	12,480	334	11,930	320
			200	13.8	2341	62.7	6371	171	10,001	268	13,286	356	12,709	341
4.5 to 7 psig / 0.31 to 0.48 bar Black	4.5 psi / 0.31 bar	20% Gauge	9	0.62	181	4.85	253	6.78	765	20.5	816	21.9	828	22.2
			30	2.1	201	5.39	961	25.8	2022	54.2	2046	54.8	2070	55.5
			80	5.5	919	24.6	2142	57.4	4274	115	4056	109	3865	104
			125	8.6	1372	36.8	3001	80.4	6367	171	6258	168	6777	182
			175	12.1	1845	49.4	3970	106	6034	162	7338	197	9084	243
			200	13.8	2034	54.5	4813	129	6852	184	9275	249	9521	255
	7 psi / 0.48 bar	20% Gauge	9	0.62	167	4.48	433	11.6	812	21.8	902	24.2	909	24.4
			30	2.1	290	7.77	1216	32.6	2427	65.0	2358	63.2	2723	73.0
			80	5.5	1022	27.4	2681	71.9	5239	140	5636	151	6119	164
			125	8.6	1564	41.9	3884	104	7509	201	8007	215	8976	241
			175	12.1	2069	55.4	5029	135	8297	222	11,126	298	11,850	318
			200	13.8	2401	64.3	5686	152	9206	247	12,386	332	13,032	349

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

Table 12. Flow Capacities of Types T205M and T205HM with 1 in. / DN 25 Body Size														
SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR									
					Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 2.5 in. w.c. / 2.5 to 6.2 mbar Orange	1 in. w.c. / 2.5 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	94	2.52	342	9.17	602	16.1	890	23.9	929	24.9
			5	0.34	208	5.57	768	20.6	1293	34.7	2143	57.4	2377	63.7
			15	1.0	358	9.59	1350	36.2	2470	66.2	4107	110	4936	132
			30	2.1	539	14.4	2022	54.2	4017	108	6933	186		
			60	4.1	878	23.5	3414	91.5						
			100	6.9	1236	33.1	5332	143						
			150	10.3	1696	45.5								
			200	13.8	2219	59.5								
	2 in. w.c. / 5.0 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	81	2.17	325	8.71	507	13.6	828	22.2	952	25.5
			5	0.34	204	5.47	740	19.8	1150	30.8	1996	53.5	2310	61.9
			15	1.0	361	9.67	1279	34.3	1883	50.5	2553	68.4	3218	86.2
			30	2.1	545	14.6	2004	53.7	2846	76.3	5646	151		
			60	4.1	882	23.6	3347	89.7						
			100	6.9	1217	32.6	5192	139						
			150	10.3	1708	45.8								
			200	13.8	2184	58.5								
2.5 to 7 in. w.c. / 6.2 to 17 mbar Red	2.5 in. w.c. / 6.2 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	91	2.44	256	6.86	268	7.18	424	11.4	383	10.3
			5	0.34	184	4.93	404	10.8	664	17.8	1084	29.1	1266	33.9
			15	1.0	341	9.14	938	25.1	1081	29.0	1886	50.5	1210	32.4
			30	2.1	524	14.0	1462	39.2	1747	46.8	2492	66.8		
			60	4.1	772	20.7	1840	49.3	2599	69.7				
			100	6.9	1166	31.2	2026	54.3						
			150	10.3	1628	43.6	7363	197						
			200	13.8	2210	59.2								
	4 in. w.c. / 10 mbar	-1 to 2 in. w.c. / -2.5 to 5.0 mbar	1	0.07	77	2.06	221	5.92	264	7.08	321	8.60	347	9.30
			5	0.34	184	4.93	298	7.99	533	14.3	776	20.8	916	24.5
			15	1.0	313	8.39	696	18.7	875	23.4	1205	32.3	1281	34.3
			30	2.1	447	12.0	918	24.6	1319	35.3	2009	53.8		
			60	4.1	734	19.7	1458	39.1	1434	38.4				
			100	6.9	1090	29.2	1592	42.7						
			150	10.3	1419	38.0	3413	91.5						
			200	13.8	2001	53.6								
	7 in. w.c. / 17.4 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	83	2.22	284	7.61	410	11.0	607	16.3	596	16.0
			5	0.34	191	5.12	578	15.5	895	24.0	1362	36.5	1521	40.8
			15	1.0	325	8.71	1037	27.8	1653	44.3	2467	66.1	1863	49.9
			30	2.1	562	15.1	1579	42.3	2310	61.9	3372	90.4		
			60	4.1	782	21.0	2672	71.6	4681	125				
			100	6.9	1162	31.1	2649	71.0						
			150	10.3	1718	46.0	6567	176						
			200	13.8	2218	59.4								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	8 in. w.c. / 20 mbar	-2 to 2 in. w.c. / -5.0 to 5.0 mbar	1	0.07	77	2.06	198	5.31	295	7.91	385	10.3	444	11.9
			5	0.34	191	5.12	413	11.1	702	18.8	947	25.4	1100	29.5
			20	1.4	369	9.89	992	26.6	1545	41.4	2163	58.0	2157	57.8
			60	4.1	873	23.4	1979	53.0	2369	63.5	3249	87.1	3741	100
			100	6.9	1123	30.1	2572	68.9	3761	101	4879	131	2851	76.4
			150	10.3	1681	45.1	5794	155	6001	161				
			200	13.8	2208	59.2								
	12 in. w.c. / 30 mbar	20% Gauge	1	0.07	66	1.77	174	4.66	283	7.58	395	10.6	462	12.4
			5	0.34	182	4.88	400	10.7	720	19.3	926	24.8	1108	29.7
			20	1.4	343	9.19	1026	27.5	1498	40.1	2439	65.4	2208	59.2
			60	4.1	836	22.4	2142	57.4	2578	69.1	3610	96.7	4418	118
			100	6.9	1125	30.2	2452	65.7	3572	95.7	5630	151	4909	132
			150	10.3	1787	47.9	5560	149	6769	181				
			200	13.8	2251	60.3								
	16 in. w.c. / 40 mbar	20% Gauge	1	0.07	75	2.01	175	4.69	273	7.32	392	10.5	496	13.3
			5	0.34	191	5.12	433	11.6	831	22.3	1096	29.4	1248	33.4
			20	1.4	375	10.0	1198	32.1	1834	49.2	2856	76.5	2740	73.4
			60	4.1	861	23.1	2338	62.7	3593	96.3	4725	127	5559	149
			100	6.9	1123	30.1	3187	85.4	5772	155	5722	153	4661	125
			150	10.3	1817	48.7	6426	172	7714	207				
			200	13.8	2203	59.0								

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

- continued -

Table 12. Flow Capacities of Types T205M and T205HM with 1 in. / DN 25 Body Size (continued)

SPRING RANGE AND COLOR	OUTLET PRESSURE SETTING	OFFSET FROM SETPOINT	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF AIR									
					Orifice Size, In. / mm									
					1/8 / 3.2		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
0.5 to 1.2 psig / 34 to 83 mbar Yellow	0.58 psig / 40 mbar	20% Gauge	2	0.14	115	3.08	297	7.96	435	11.7	541	14.5	545	14.6
			10	0.69	284	7.61	661	17.7	988	26.5	1294	34.7	1568	42.0
			45	3.1	680	18.2	1772	47.5	2248	60.2	3529	94.6	3109	83.3
			80	5.5	1101	29.5	2511	67.3	3605	96.6	5625	151	4918	132
			125	8.6	1552	41.6	4531	121	6034	162	5451	146	6951	186
			175	12.1	1890	50.7								
			200	13.8	2085	55.9								
	1 psi / 69 mbar	20% Gauge	2	0.14	100	2.68	293	7.85	525	14.1	648	17.4	596	16.0
			10	0.69	277	7.42	765	20.5	1371	36.7	1775	47.6	1971	52.8
			60	4.1	870	23.3	2727	73.1	4256	114	5175	139	3674	98.5
			100	6.9	1026	27.5	4586	123	7935	213	9443	253	7744	208
			150	10.3	1626	43.6	6099	163	9407	252	10,410	279		
			200	13.8	2221	59.5								
1.2 to 2.5 psig / 83 to 172 mbar Green	1.2 psi / 83 mbar	20% Gauge	4	0.28	136	3.64	349	9.35	348	9.33	585	15.7	634	17.0
			12	0.83	267	7.16	579	15.5	798	21.4	1120	30.0	1275	34.2
			60	4.1	731	19.6	1732	46.4	2258	60.5	3141	84.2	1895	50.8
			100	6.9	1139	30.5	2544	68.2	3170	85.0	4876	131	5197	139
			150	10.3	1590	42.6	3539	94.8	6305	169	7062	189	4813	129
			200	13.8	1846	49.5	4449	119	6213	167	7189	193	4890	131
	2.5 psi / 172 mbar	20% Gauge	6	0.41	191	5.12	521	14.0	765	20.5	1005	26.9	1167	31.3
			30	2.1	498	13.3	1382	37.0	2263	60.6	2783	74.6	3555	95.3
			80	5.5	1074	28.8	2879	77.2	4586	123	7109	191	7606	204
			125	8.6	1565	41.9	4270	114	6512	175	10,046	269	10,446	280
			175	12.1	2019	54.1	5841	157	9454	253	12,684	340	13,557	363
			200	13.8	2232	59.8	6593	177	11,421	306	13,394	359	12,786	343
2.5 to 4.5 psig / 0.17 to 0.31 bar Light blue	2.5 psi / 0.17 bar	20% Gauge	4	0.28	115	3.08	273	7.32	345	9.25	494	13.2	510	13.7
			12	0.83	249	6.67	521	14.0	743	19.9	1074	28.8	1183	31.7
			60	4.1	776	20.8	1581	42.4	2262	60.6	2710	72.6	3174	85.1
			100	6.9	1129	30.3	2615	70.1	3156	84.6	4379	117	5528	148
			150	10.3	1634	43.8	3778	101	5735	154	5956	160	7722	207
			200	13.8	1997	53.5	4421	118	7327	196	9291	249	9609	258
	4.5 psi / 0.31 bar	20% Gauge	8	0.55	206	5.52	415	11.1	708	19.0	1012	27.1	1070	28.7
			30	2.1	512	13.7	1334	35.8	2008	53.8	2720	72.9	2998	80.3
			80	5.5	1127	30.2	2826	75.7	4302	115	5804	156	6241	167
			125	8.6	1662	44.5	4177	112	6565	176	8183	219	9844	264
			175	12.1	1981	53.1	5486	147	9965	267	11,236	301	11,864	318
			200	13.8	2277	61.0	6487	174	10,233	274	12,388	332	14,093	378
4.5 to 7 psig / 0.31 to 0.48 bar Black	4.5 psi / 0.31 bar	20% Gauge	9	0.62	192	5.15	251	6.73	600	16.1	772	20.7	823	22.1
			30	2.1	441	11.8	1023	27.4	1404	37.6	1925	51.6	2185	58.6
			80	5.5	977	26.2	2094	56.1	3023	81.0	3832	103	4177	112
			125	8.6	1336	35.8	3247	87.0	3852	103	5686	152	6346	170
			175	12.1	1729	46.3	4222	113	6197	166	7609	204	8573	230
			200	13.8	2036	54.6	4518	121	6915	185	8098	217	8150	218
	7 psi / 0.48 bar	20% Gauge	9	0.62	184	4.93	455	12.2	575	15.4	900	24.1	936	25.1
			30	2.1	414	11.1	1269	34.0	1800	48.2	2647	70.9	2772	74.3
			80	5.5	1005	26.9	2772	74.3	3965	106	5636	151	5824	156
			125	8.6	1593	42.7	3952	106	5454	146	7249	194	8606	231
			175	12.1	1925	51.6	5309	142	8473	227	10,620	285	11,872	318
			200	13.8	2257	60.5	5791	155	9592	257	11,706	314	12,938	347

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

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Introduction

The T205VB Series vacuum breakers are used for precise control of small capacity, low-pressure service applications where an increase in vacuum must be limited.

Available Configurations

Type T205VB: Direct-operated vacuum breaker with internal registration.
Type T205VBM: Direct-operated vacuum breaker equipped with a blocked throat and control line connection for external pressure registration.

Body Sizes

See Table 1

End Connection Styles

See Table 1

Maximum Allowable Inlet Pressure

See Table 1

Maximum Operating Inlet Pressure

150 psig / 10.3 bar

Maximum Outlet (Casing) Pressure

Gray Cast Iron: 35 psig / 2.41 bar
WCC Carbon Steel or CF8M/CF3M Stainless Steel: 75 psig / 5.2 bar

Maximum Allowable Vacuum Pressure

See Product Bulletin

Maximum Emergency Outlet Pressure to Avoid Internal Parts Damage

See Product Bulletin

Vacuum Control Pressure Ranges

0 to 5 psig / 0 to 0.34 bar

Flow Capacities

See Product Bulletin

Construction Materials

See Table 2

Material Temperature Capabilities

See Table 2

Spring Case Connection

1/4 NPT

Flow Coefficients

See Table 3

Figure 1. Typical T205VB Series Vacuum Breaker

Pressure Registration

Type T205VB: Internal
Type T205VBM: External

Orifice Size

1/4 in. / 6.4 mm, 1/2 in. / 13 mm

Pressure Setting Adjustment

Adjusting Nut

Diaphragm Case Connection

1/2 NPT

Approximate Weight

18.7 lbs / 8.5 kg

Ordering Guide

To order this product, contact your local Sales Office.

Application

Process Gas

Features

- **Common Spare Parts**
- **Tamper-Resistant Adjustment**
- **Easy Conversion**
- **Precision Control of Low-Pressure Settings**
- **Corrosion Resistance**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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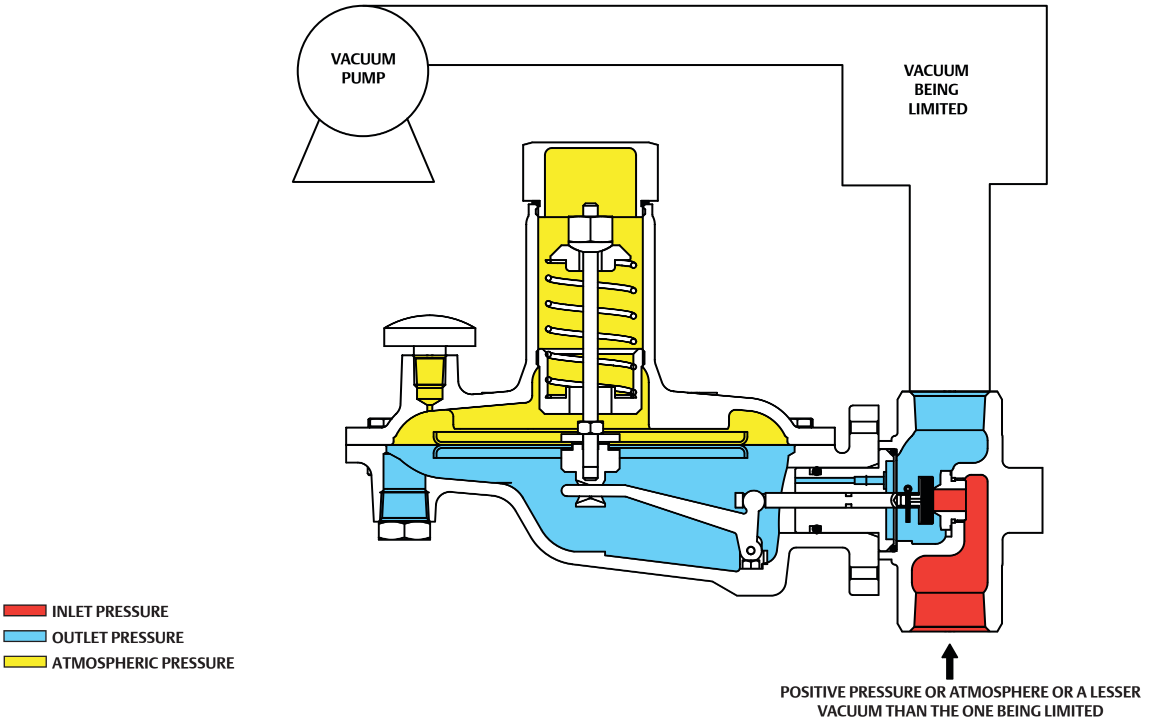

Figure 2. *T205VB Series Operational Schematic*

Table 1. Body Sizes, End Connection Styles and Allowable Inlet Pressures

BODY SIZE		BODY MATERIAL	END CONNECTION STYLE[1]	MAXIMUM ALLOWABLE INLET PRESSURE	
In.	DN			psig	bar
3/4 or 1	20 or 25	Gray cast iron	NPT	150	10.3
		WCC Carbon steel	NPT or CL150 RF	200	13.8
		CF8M/CF3M Stainless steel[2]			

1. All flanges are welded. Weld-on flange dimension is 14 in. / 356 mm face-to-face.
2. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.

Table 2. Trim Materials

BODY AND SPRING CASE	DIAPHRAGM HEAD	LEVER ASSEMBLY	GUIDE INSERT	TRIM OPTION CODE	DIAPHRAGM MATERIAL	DISK AND O-RING MATERIAL	OPERATING TEMPERATURE RANGE[1]
Gray cast iron, WCC Carbon steel or CF8M/CF3M Stainless steel	304 Stainless steel	302 Stainless steel	316 Stainless steel	Standard	Nitrile (NBR)	Nitrile (NBR)	-40 to 180°F / -40 to 82°C
				VV	Fluorocarbon (FKM)	Fluorocarbon (FKM)	40 to 300°F / 4 to 149°C
				TN	Flourinated Ethylene Propylene (FEP)	Nitrile (NBR)	-20 to 180°F / -29 to 82°C
				TV	Flourinated Ethylene Propylene (FEP)	Fluorocarbon (FKM)	40 to 180°F / 4 to 82°C
				TK	Flourinated Ethylene Propylene (FEP)	Perflouroelastomer (FFKM)	0 to 180°F / -18 to 82°C
				TE	Flourinated Ethylene Propylene (FEP)	Ethylenepropylene (EPDM)	-20 to 180°F / -29 to 82°C

1. Gray cast iron and Carbon steel bodies are limited to -20 to 300°F / -29 to 149°C.

Table 3. Flow Coefficients

ORIFICE SIZE		FLOW COEFFICIENT					
		Regulating			Wide Open		
In.	mm	C_g	C_v	C_1	C_g	C_v	C_1
1/4	6.4	44	1.47	29.7	45	1.52	29.7
1/2	13	173	4.74	36.4	178	4.89	36.4

Introduction

The T208 Series are direct-operated tank blanketing vapor recovery regulators. These regulators are used to sense an increase in vessel pressure and vent excessive internal tank pressure to an appropriate vapor recovery disposal or reclamation system. T208 Series may also be used as backpressure regulators or relief valves.

Available Configurations

See Table 1

Body Sizes and End Connection Styles

See Table 2

Available Construction Materials

See Table 3

Maximum Allowable Inlet (Casing) Pressure

See Table 2

Maximum Outlet Pressure

35 psig / 2.4 bar

Maximum Emergency Inlet Pressure to Avoid Internal Parts Damage

With Nitrile (NBR) or Fluorocarbon (FKM) diaphragm: 35 psig / 2.4 bar
With Fluorinated Ethylene Propylene (FEP) diaphragm: 10 psig / 0.69 bar

Material Temperature Capabilities

Elastomer Parts
Nitrile (NBR): -40 to 180°F / -40 to 82°C
Fluorinated Ethylene Propylene (FEP): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM): 40 to 300°F / 4 to 149°C
Ethylene Propylene Diene (EPDM): -20 to 225°F /-29 to 107°C
Perfluoroelastomer (FFKM): 0 to 300°F / -18 to 149°C
Body Materials
Gray Cast Iron: -20 to 300°F / -29 to 149°C
WCC Carbon Steel: -20 to 300°F / -29 to 149°C
CF8M/CF3M Stainless Steel: -40 to 300°F / -40 to 149°C

Control Pressure Ranges

See Table 4

Flow and Sizing Coefficients

See Table 5

C_v Coefficients and Flow Capacities

See Table 6

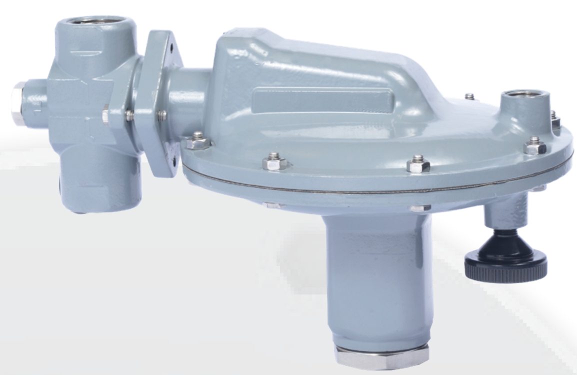

Figure 1. *Type T208 Tank Blanketing Vapor Recovery Regulator*

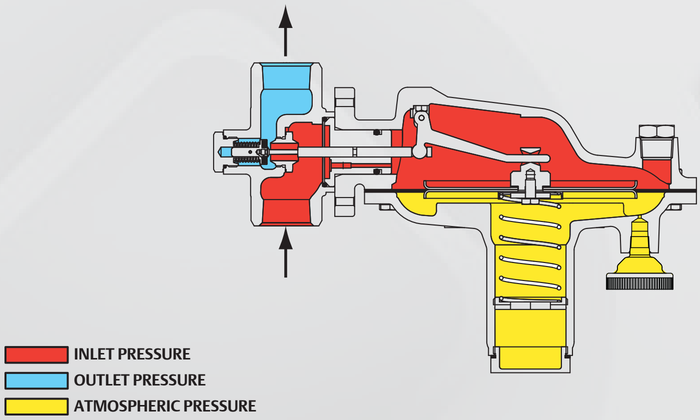

Figure 2. *Type T208 with Internal Pressure Registration Operational Schematics*

Orifice Size

7/16 in. / 11 mm

Spring Case Vent Connection

1/4 NPT

Diaphragm Case Control Line Connection (Type T208M)

1/2 NPT

Approximate Weight

17.7 lbs / 8 kg

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Process Gas
- Vapor Recovery

Features

- Accurate Control
- Easy Conversion
- Rugged Construction
- Simplicity
- Sour Gas Service Capability

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Available Configurations

TYPE	CONFIGURATION
T208	Tank Blanketing Vapor Recovery regulator with control pressure range of 2 in.w.c. to 7 psig / 5 mbar to 0.48 bar in six different spring ranges and has internal pressure registration requiring no control line
T208M	Similar to Type T208 but has a blocked throat and a control line connection for external pressure registration.

Table 2. Body Sizes, End Connection Styles and Maximum Allowable Inlet (Casing) Pressures

BODY SIZE		BODY MATERIAL	END CONNECTION STYLE[1]	MAXIMUM ALLOWABLE INLET (CASING) PRESSURE	
In.	DN			psig	bar
3/4 or 1	20 or 25	Gray cast iron	NPT	35	2.4
		WCC Carbon steel	NPT, CL150 RF, CL300 RF or PN 16/25/40 RF	75	5.2
		CF8M/CF3M Stainless steel[2]			

1. All flanges are welded. Weld-on flange dimension is 14 in. / 356 mm face-to-face.
2. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.

Table 3. Available Construction and Trim Materials

AVAILABLE CONSTRUCTION MATERIAL				AVAILABLE TRIM OPTION			
Body and Casing	Guide Insert, Stem and Pusher Post	Diaphragm Head	Lever Assembly	Trim Option Code	Diaphragm Material	Disk and O-ring Material	Operating Temperature Range
Gray cast iron, WCC Carbon steel or CF8M/CF3M Stainless steel[1]	316 Stainless Steel	304 Stainless Steel	302 Stainless Steel	Standard	Nitrile (NBR)	Nitrile (NBR)	-40 to 180°F / -40 to 82°C
				VV	Fluorocarbon (FKM)	Fluorocarbon (FKM)	40 to 300°F / 4 to 149°C
				TV	Fluorinated Ethylene Propylene (FEP)	Fluorocarbon (FKM)	40 to 180°F / 4 to 82°C
				TN	Fluorinated Ethylene Propylene (FEP)	Nitrile (NBR)	-20 to 180°F / -29 to 82°C
				TK	Fluorinated Ethylene Propylene (FEP)	Perfluoroelastomer (FFKM)	0 to 180°F / -18 to 82°C
				TE	Fluorinated Ethylene Propylene (FEP)	Ethylene Propylene Diene (EPDM)	-20 to 180°F / -29 to 82°C

1. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.

Table 4. Control Pressure Ranges and Spring Information

CONTROL PRESSURE RANGE		SPRING COLOR	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
In. w.c.	mbar		In.	mm	In.	mm
2.0 to 7.0[1][2]	5 to 17[1][2]	Red	0.085	2.2	3.63	92.2
3.0 to 13.0[1][2]	7 to 32[1][2]	Unpainted	0.105	2.7	3.75	95.3
10.0 to 26.0	25 to 65	Yellow	0.114	2.9	4.31	109
0.9 to 2.5 psig	62 to 172	Green	0.156	4.0	4.06	103
1.3 to 4.5 psig	90 to 310	Light Blue	0.187	4.8	3.94	100
3.8 to 7.0 psig	0.26 to 0.48 bar	Black	0.218	5.5	3.98	101

1. To achieve the published control pressure range the spring case must be installed pointing down.
2. Do not use Fluorocarbon (FKM) diaphragm with these springs at diaphragm temperatures lower than 60°F / 16°C.

Table 5. Flow and Sizing Coefficients

ORIFICE SIZE		REGULATING			WIDE-OPEN		
In.	mm	C_g	C_v	C_1	C_g	C_v	C_1
7/16	11	94	2.7	35.0	97	2.8	35.0

Table 6. T208 Series C_v Coefficient and Flow Capacity

CONTROL PRESSURE RANGE AND SPRING COLOR	SET PRESSURE		MINIMUM BUILDUP TO WIDE-OPEN		VACUUM OUTLET PRESSURE		C_v COEFFICIENT	CAPACITIES OF AIR	
	In. w.c.	mbar	In. w.c.	mbar	psig	barg		SCFH	Nm³/h
2.0 to 7.0 in. w.c. / 5 to 17 mbar Red	2.0	5.0	4.02	10	0	0	3.1	192	5.1
					2.5	0.17	3.5	1161	31.1
					5	0.34	3.5	1488	39.9
	4.0	10.0	3.62	9	0	0	2.6	226	6.1
					2.5	0.17	3.5	1178	31.6
					5	0.34	3.5	1500	40.2
3.0 to 13.0 in. w.c. / 7 to 32 mbar Unpainted	10.0	25	5.99	15	0	0	2.0	268	7.2
					2.5	0.17	3.5	1232	33.0
					5	0.34	3.5	1539	41.2
10.0 to 26.0 in. w.c. / 25 to 65 mbar Yellow	15	37	8.89	22.1	0	0	2.0	331	8.9
					2.5	0.17	3.5	1279	34.3
					5	0.34	3.5	1574	42.2
0.9 to 2.5 psig / 62 to 172 mbar Green	1 psig	70	0.78 psig	54	0	0	2.2	499	13.4
					2.5	0.17	3.6	1426	38.2
					5	0.34	3.6	1687	45.2
1.3 to 4.5 psig / 90 to 310 mbar Light Blue	2 psig	140	1.49 psig	103	0	0	2.3	752	20.2
					2.5	0.17	3.8	1694	45.4
					5	0.34	3.7	1904	51.0
3.8 to 7.0 psig / 0.26 to 0.48 bar Black	5 psig	340	2.79 psig	192	0	0	2.2	1139	30.5
					2.5	0.17	3.8	2286	61.3
					5	0.34	3.8	2242	60.1

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T208VR Series
Vacuum Regulator

Introduction

The T208VR Series direct-operated vacuum regulators are used where a decrease in vacuum must be limited, such as between a tank and vacuum source to control vacuum in tank.

Available Configurations

Type T208VR: Direct-operated vacuum regulator with internal pressure registration
Type T208VRM: Direct-operated vacuum regulator with blocked throat and control line connection for external pressure registration

Body Sizes and End Connection Styles

See Table 1

Construction Materials

See Table 2

Maximum (Casing) Pressure

See Table 1

Maximum Emergency Vacuum Pressure

Full Vacuum

Maximum Operating Vacuum Pressure

See Product Bulletin

Change in Control Pressure to Wide-Open

See Product Bulletin

Pressure Registration

Type T208VR: Internal
Type T208VRM: External

Flow Coefficients

Regulating: C_g: 95; C_v: 3.01; C_1: 31.4
Wide Open: C_g: 97; C_v: 3.11; C_1: 31.4

Material Temperature Capabilities

See Table 2

Orifice Size

7/16 in. / 11 mm

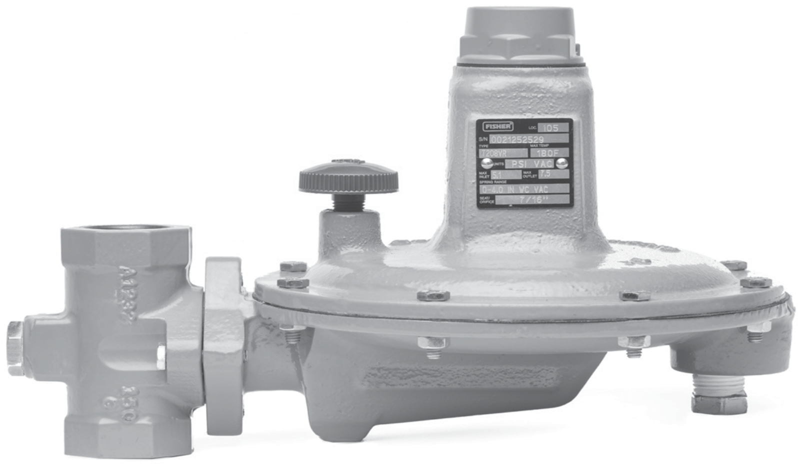

Figure 1. *T208VR Series Vacuum Regulator*

Vacuum Control Pressure Range

0 to 12.8 psig / 0 to 0.88 bar

Spring Case Connection

1/4 NPT

Diaphragm Case Connection

1/2 NPT

Pressure Setting Adjustment

Adjusting nut

Additional Options

Umbrella vent assembly for spring case connection

Approximate Weight

19 lbs / 8.6 kg

Ordering Guide

To order this product, contact your local Sales Office.

Application

- Process Gas

Features

- Tamper Resistant Adjustment
- Precision Control of Low Pressure Settings
- Easy Conversion
- Common Spare Parts
- Corrosion Resistance

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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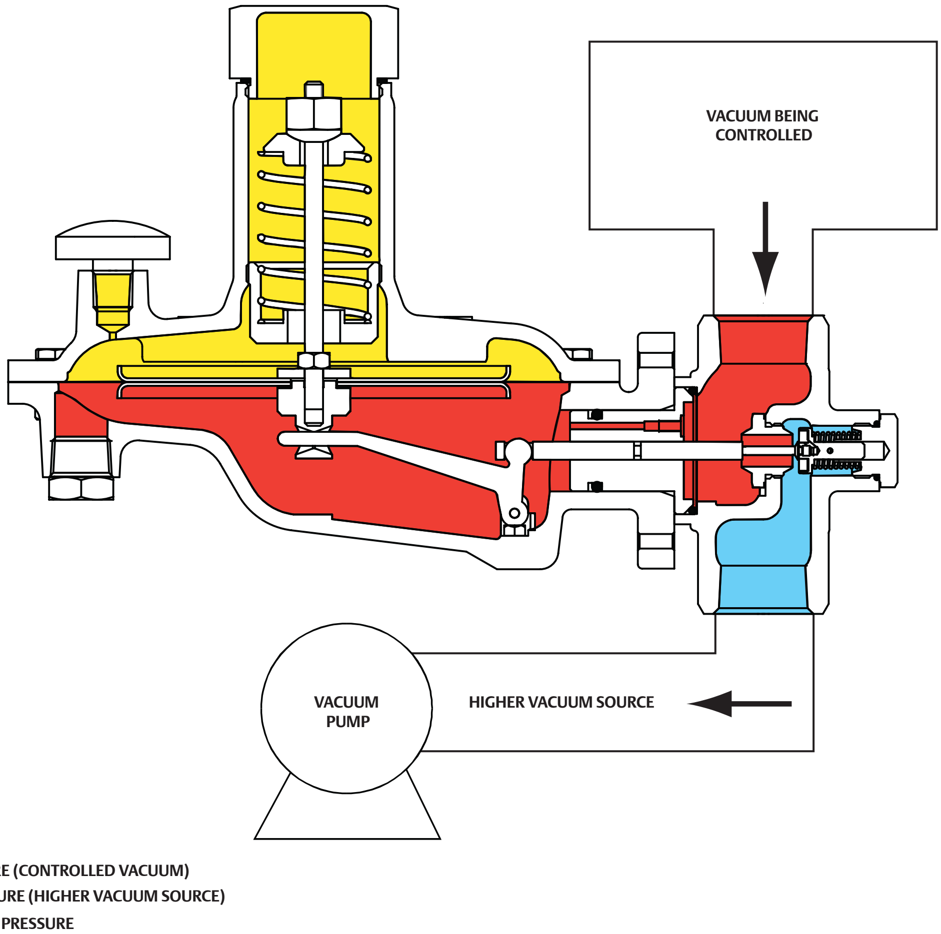

Figure 2. *Type T208VR with Internal Pressure Registration Operational Schematic*

Table 1. Body Sizes, End Connection Styles and Maximum Allowable Inlet (Casing) Pressures

BODY SIZE		BODY MATERIAL	END CONNECTION STYLE[1]	MAXIMUM ALLOWABLE INLET PRESSURE	
In.	DN			psig	bar
3/4 or 1	20 or 25	Gray cast iron	NPT	35	2.4
		WCC Carbon steel	NPT, CL150 RF	75	5.2
		CF8M/CF3M Stainless steel[2]			

1. All flanges are welded. Weld-on flange dimension is 14 in. / 356 mm face-to-face.
2. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.

Table 2. Available Construction and Trim Materials

AVAILABLE CONSTRUCTION MATERIAL				AVAILABLE TRIM OPTION			
Body and Casing	Guide Insert, Stem and Pusher Post	Diaphragm Head	Lever Assembly	Trim Option Code	Diaphragm Material	Disk and O-ring Material	Operating Temperature Range
Gray cast iron, WCC Carbon steel or CF8M/CF3M Stainless steel[1]	316 Stainless Steel	304 Stainless Steel	302 Stainless Steel	Standard	Nitrile (NBR)	Nitrile (NBR)	-40 to 180°F / -40 to 82°C
				VV	Fluorocarbon (FKM)	Fluorocarbon (FKM)	40 to 300°F / 4 to 149°C
				TV	Fluorinated Ethylene Propylene (FEP)	Fluorocarbon (FKM)	40 to 180°F / 4 to 82°C
				TN	Fluorinated Ethylene Propylene (FEP)	Nitrile (NBR)	-20 to 180°F / -29 to 82°C
				TK	Fluorinated Ethylene Propylene (FEP)	Perfluoroelastomer (FFKM)	0 to 180°F / -18 to 82°C
				TE	Fluorinated Ethylene Propylene (FEP)	Ethylene Propylene Diene (EPDM)	-20 to 180°F / -29 to 82°C

1. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.

Y600A Series

Pressure Reducing Regulator

Introduction

Y600A Series direct-operated, spring-loaded regulators provide economical pressure reducing control for a variety of residential, commercial and industrial applications. The large diaphragm area provides more accurate control at low-pressure settings and the pitot tube of the Type Y600A or Y600AR regulator also creates a dynamic boost that helps provide greater capacity.

Type Y600A features internal registration. Type Y600AR has internal registration and relief. Type Y600AM uses external registration with a 1/2 NPT downstream control line connection and an O-ring stem seal.

Body Size and End Connection Style

3/4 or 1 NPT

Flow and Sizing Coefficients

See Table 2

Pressure Registration

Internal or External

Maximum Inlet Pressure (Body Rating)

150 psig / 10.3 bar

Construction Materials

See Table 1

Maximum Operating Inlet Pressure

See Table 2

Flow Capacities

See Tables 4 to 7

Maximum Outlet (Casing) Pressure

20 psig / 1.4 bar

Outlet Pressure Ranges

4 in. w.c. to 7 psig /
10 to 483 mbar in 6 ranges
See Table 3

Temperature Capabilities

-20 to 180°F / -29 to 82°C

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Fuel Gas

Figure 1. Type Y600A Pressure Reducing Regulator

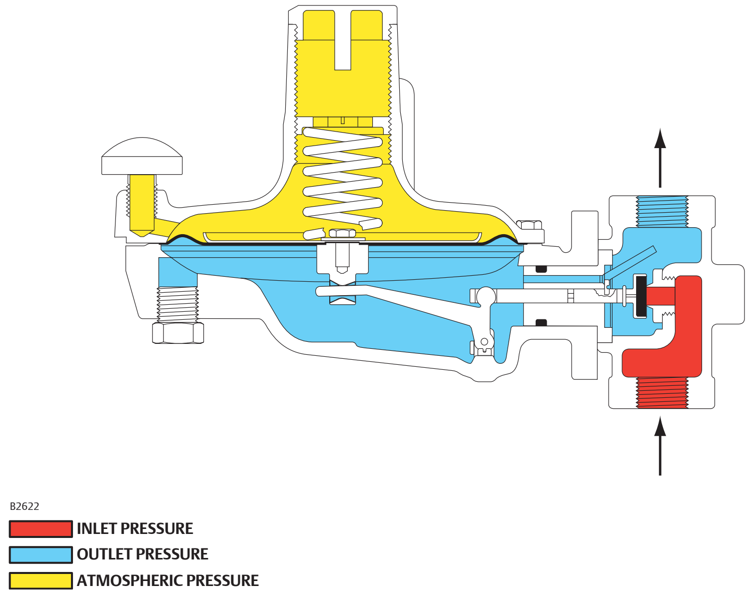

Figure 2. Type Y600A with Internal Pressure Registration Operational Schematic

Features

- **Easy Conversion Between Types Y600A and Y600AM**
- **Tamper-Resistant Adjustment**
- **Easy to maintain**
- **Precision Control at Low-Pressure Settings**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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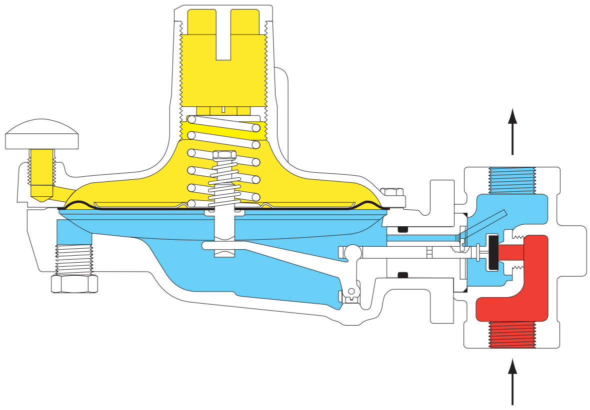
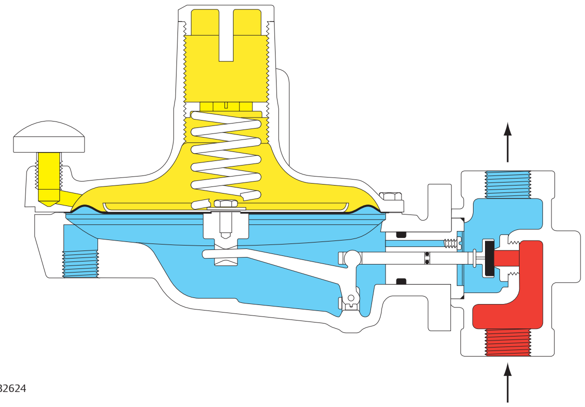


TYPE Y600AR WITH INTERNAL RELIEF/
INTERNAL PRESSURE REGISTRATION



TYPE Y600AM WITH EXTERNAL
PRESSURE REGISTRATION

INLET PRESSURE
OUTLET PRESSURE
ATMOSPHERIC PRESSURE

Figure 3. *Types Y600AR and Y600AM Operational Schematics*

Table 1. Construction Material

BODY, DIAPHRAGM CASING AND SPRING CASE	ORIFICE	SPRING AND LEVER	DIAPHRAGM AND DISK	PUSHER POST	ADJUSTING SCREW AND DISK HOLDER	CLOSING CAP	STEM	PITOT TUBE (FOR TYPES Y600A AND Y600AR ONLY) AND RELIEF VALVE SPRING
Cast iron	Aluminum	Zinc-plated steel	Nitrile (NBR)	**Types Y600A and Y600AM:** Aluminum **Type Y600AR:** Zinc	Aluminum	Thermoplastic	Stainless steel	Stainless steel

Table 2. Maximum Operating Inlet Pressure and Flow and Sizing Coefficient

ORIFICE SIZE		MAXIMUM OPERATING INLET PRESSURE								WIDE-OPEN FLOW COEFFICIENT FOR EXTERNAL RELIEF SIZING		C_1	IEC SIZING COEFFICIENT		
		With 1.2 psig / 0.08 bar or Less Outlet Pressure Setting		With 1.2 to 2.5 psig / 0.08 to 0.17 bar Outlet Pressure Setting		With 2.5 to 4.5 psig / 0.17 to 0.31 bar Outlet Pressure Setting		With 4.5 to 7 psig / 0.31 to 0.48 bar Outlet Pressure Setting		C_g	C_v		X_T	F_D	F_L
In.	mm	psig	bar	psig	bar	psig	bar	psig	bar						
1/8	3.2	150	10.3							12.3	0.35				
3/16	4.8	150	10.3	150	10.3	150	10.3	150	10.3	27.6	0.79				
1/4	6.4	75	5.2							50	1.43	35	0.78	0.50	0.89
3/8	9.5	35	2.4	60	4.1	60	4.1	60	4.1	110	3.14				
1/2	13	8	0.55	10	0.69	12	0.83	12	0.83	200	5.71				
9/16	14	5	0.34	6	0.41	8	0.55	8	0.55	250	7.14				

Table 3. Outlet (Control) Pressure Range

TYPE	CONTROL SPRING COLOR	OUTLET PRESSURE RANGE WITH SPRING CASE ABOVE DIAPHRAGM(1)		APPROXIMATE POINT ABOVE PRESSURE SETTING AT WHICH TYPE Y600AR INTERNAL RELIEF STARTS-TO-DISCHARGE	
Y600A, Y600AR and Y600AM	Red	4 to 8 in. w.c.	10 to 20 mbar	10 to 24 in. w.c.	25 to 60 mbar
	Unpainted	7 to 16 in. w.c.	17 to 40 mbar	10 to 26 in. w.c.	25 to 65 mbar
	Yellow	15 in. w.c. to 1.2 psig	37 to 83 mbar		
	Green	1.2 to 2.5 psig	83 mbar to 0.17 bar	0.5 to 2 psig	0.03 to 0.14 bar
	Light Blue	2.5 to 4.5 psig	0.17 to 0.31 bar	0.5 to 3 psig	0.03 to 0.21 bar
	Black	4.5 to 7 psig	0.31 to 0.48 bar	1 to 4 psig	0.07 to 0.28 bar

1. Minimum outlet pressure setting may be approximately 1 in. w.c. / 2 mbar lower if spring case is below diaphragm.

Air

Table 4. Capacities for 3/4-NPT Body Size

OUTLET PRESSURE RANGE, CONTROL SPRING COLOR	OFFSET FROM SETPOINT	OUTLET PRESSURE SETTING	INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF AIR											
					Orifice Size, In. / mm											
					1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
4 to 8 in. w.c. / 10 to 20 mbar Red	1 in. w.c. / 2 mbar	7 in. w.c. / 17 mbar	1	0.07	70	1.87	132	3.53	178	4.78	194	5.19	318	8.52	341	9.14
			5	0.34	171	4.57	217	5.82	349	9.35	380	10.2	403	10.8	752	20.1
			8	0.55	178	4.78	372	9.97	411	11.0	419	11.2	457	12.3		
			20	1.4	403	10.8	465	12.5	481	12.9	504	13.5				
			35	2.4	512	13.7	519	13.9	651	17.4	698	18.7				
			75	5.2	597	16.0	651	17.4	744	19.9						
			150	10.3	1302	34.9	1790	48.0								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	1 in. w.c. / 2 mbar	11 in. w.c. / 27 mbar	1	0.07	70	1.87	101	2.70	124	3.32	147	3.95	178	4.78	194	5.19
			5	0.34	124	3.32	194	5.19	217	5.82	271	7.27	411	11.0	581	15.6
			8	0.55	132	3.53	271	7.27	333	8.93	349	9.35	419	11.2		
			20	1.4	271	7.27	380	10.2	457	12.3	473	12.7				
			35	2.4	403	10.8	411	11.0	481	12.9	504	13.5				
			75	5.2	504	13.5	512	13.7	729	19.5						
			150	10.3	1302	34.9	1597	42.8								
15 in. w.c. to 1.2 psig / 37 to 83 mbar Yellow	5.5 in. w.c. / 14 mbar	15 in. w.c. / 37 mbar	2	0.14	70	1.87	264	7.06	388	10.4	698	18.7	853	22.8	891	23.9
			6	0.41	194	5.19	419	11.2	721	19.3	1271	34.1	1628	43.6		
			10	0.69	264	7.06	620	16.6	1070	28.7	1504	40.3				
			30	2.1	527	14.1	1124	30.1	1852	49.6	1899	50.9				
			60	4.1	899	24.1	1907	51.1	2697	72.3						
			150	10.3	1992	53.4	2100	56.3								
		1.2 psig / 83 mbar	2	0.14	70	1.87	202	5.40	318	8.52	465	12.5	628	16.8	543	14.5
			6	0.41	194	5.19	357	9.55	543	14.5	1000	26.8	1101	29.5		
			10	0.69	240	6.44	512	13.7	791	21.2	1101	29.5				
			30	2.1	519	13.9	859	23.0	1597	42.8	1883	50.5				
			60	4.1	884	23.7	1690	45.3	2596	69.6						
			150	10.3	1922	51.5	2054	55.0								
1.2 to 2.5 psig / 83 mbar to 0.17 bar Green	0.2 psig / 14 mbar	1.2 psig / 83 mbar	2	0.14	93	2.49	132	3.53	171	4.57	271	7.27	380	10.2	403	10.8
			6	0.41	140	3.74	264	7.06	349	9.35	574	15.4	659	17.7	829	22.2
			10	0.69	147	3.95	341	9.14	457	12.3	783	21.0	907	24.3		
			30	2.1	434	11.6	698	18.7	1201	32.2	1333	35.7				
			60	4.1	667	17.9	860	23.1	1922	51.5	1814	48.6				
			150	10.3	1542	41.3	2697	72.3	2713	72.7						
		2.5 psig / 0.14 bar	6	0.41	109	2.91	147	3.95	202	5.40	349	9.35	457	12.3	527	14.1
			10	0.69	132	3.53	264	7.06	380	10.2	442	11.8	667	17.9		
			30	2.1	333	8.93	512	13.7	760	20.4	798	21.4				
			60	4.1	581	15.6	659	17.7	1504	40.3	1744	46.7				
			150	10.3	1147	30.7	1798	48.2	2596	69.6						
2.5 to 4.5 psig / 0.17 to 0.31 bar Light Blue	0.3 psig / 21 mbar	2.5 psig / 0.17 bar	4	0.28	101	2.70	140	3.74	147	3.95	240	6.44	287	7.68	372	9.97
			8	0.55	109	2.91	217	5.82	279	7.48	403	10.8	550	14.7	620	16.6
			12	0.83	147	3.95	279	7.48	380	10.2	527	14.1	721	19.3		
			30	2.1	333	8.93	481	12.9	698	18.7	860	23.1				
			60	4.1	512	13.7	783	21.0	1341	35.9	1418	38.0				
			150	10.3	1217	32.6	1597	42.8	3581	96.0						
		4.5 psig / 0.31 bar	8	0.55	93	2.49	147	3.95	194	5.19	310	8.31	403	10.8	419	11.2
			12	0.83	124	3.32	163	4.36	248	6.65	411	11.0	558	15.0		
			30	2.1	233	6.23	357	9.55	589	15.8	643	17.2				
			60	4.1	457	12.3	628	16.8	953	25.5	1039	27.8				
			150	10.3	953	25.5	1271	34.1	2798	75.0						
4.5 to 7 psig / 0.31 to 0.48 bar Black	0.7 psig / 48 mbar	4.5 psig / 310 mbar	9	0.62	147	3.95	240	6.44	333	8.93	481	12.9	721	19.3	767	20.6
			12	0.83	163	4.36	310	8.31	434	11.6	628	16.8	891	23.9		
			30	2.1	403	10.8	667	17.9	853	22.8	1403	37.6				
			60	4.1	667	17.9	1178	31.6	1589	42.6	2100	56.3				
			150	10.3	1519	40.7	2697	72.3	3906	105						
		7 psig / 0.48 bar	9	0.62	124	3.32	163	4.36	209	5.61	403	10.8	481	12.9	512	13.7
			12	0.83	147	3.95	240	6.44	287	7.68	504	13.5	667	17.9		
			30	2.1	287	7.68	543	14.5	698	18.7	1031	27.6				
			60	4.1	620	16.6	1000	26.8	1333	35.7	1899	50.9				
			150	10.3	1480	39.7	2596	69.6	3139	84.1						

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

Air

Table 5. Capacities for 1-NPT Body Size

OUTLET PRESSURE RANGE, CONTROL SPRING COLOR	OFFSET FROM SETPOINT	OUTLET PRESSURE SETTING	INLET PRESSURE		CAPACITIES IN SCFH / Nm^3/h OF AIR, Orifice Size, In. / mm											
					1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h	SCFH	Nm^3/h
4 to 8 in. w.c. / 10 to 20 mbar Red	1 in. w.c. / 2 mbar	7 in. w.c. / 17 mbar	1	0.07	70	1.87	171	4.57	194	5.19	233	6.23	318	8.52	411	11.0
			5	0.34	171	4.57	333	8.93	349	9.35	884	23.7	1473	39.5	1488	39.9
			8	0.55	178	4.78	380	10.2	411	11.0	1659	44.4	1829	49.0		
			20	1.4	403	10.8	752	20.1	1403	37.6	907[1]	24.3[1]				
			35	2.4	550	14.7	1147	30.7	1783[1]	47.8[1]	721[1]	19.3[1]				
			75	5.2	798	21.4	853[1]	22.8[1]	1077[1]	28.9[1]						
			150	10.3	1302[1]	34.9[1]	899[1]	24.1[1]								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	1 in. w.c. / 2 mbar	11 in. w.c. / 27 mbar	1	0.07	70	1.87	124	3.32	132	3.53	163	4.36	178	4.78	194	5.19
			5	0.34	124	3.32	233	6.23	240	6.44	403	10.8	481	12.9	899	24.1
			8	0.55	132	3.53	279	7.48	333	8.93	899	24.1	1132	30.3		
			20	1.4	271	7.27	450	12.0	605	16.2	1263	33.9				
			35	2.4	434	11.6	798	21.4	2201	59.0	922	24.7				
			75	5.2	953	25.5	1000	26.8	1170	31.4						
			150	10.3	1349	36.1	961	25.8								
15 in. w.c. to 1.2 psig / 37 to 83 mbar Yellow	5.5 in. w.c. / 14 mbar	15 in. w.c. / 37 mbar	2	0.14	70	1.87	357	9.55	388	10.4	853	22.8	899	24.1	1008	27.0
			6	0.41	194	5.19	581	15.6	721	19.3	1938	51.9	2170	58.2		
			10	0.69	264	7.06	713	19.1	1232	33.0	2519	67.5				
			30	2.1	527	14.1	1209	32.4	2193	58.8	4232	113				
			60	4.1	899	24.1	1976	53.0	3581	96.0						
			150	10.3	1992	53.4	2147	57.5								
		1.2 psig / 83 mbar	2	0.14	70	1.87	310	8.31	357	9.55	636	17.0	651	17.4	698	18.7
			6	0.41	194	5.19	488	13.1	543	14.5	1201	32.2	1248	33.4		
			10	0.69	248	6.65	667	17.9	791	21.2	1798	48.2				
			30	2.1	519	13.9	1194	32.0	1976	53.0	3402	91.2				
			60	4.1	884	23.7	1976	53.0	3247	87.0						
			150	10.3	1992	53.4	2403	64.4								
1.2 to 2.5 psig / 83 mbar to 0.17 bar Green	0.2 psig / 14 mbar	1.2 psig / 83 mbar	2	0.14	93	2.49	163	4.36	178	4.78	279	7.48	481	12.9	512	13.7
			6	0.41	140	3.74	264	7.06	349	9.35	581	15.6	682	18.3	837	22.4
			10	0.69	147	3.95	434	11.6	504	13.5	891	23.9	1356	36.3		
			30	2.1	488	13.1	953	25.5	1240	33.2	1480	39.7				
			60	4.1	783	21.0	1899	50.9	2790	74.8	1876	50.3				
			150	10.3	1891	50.7	2697	72.3	2999	80.4						
		2.5 psig / 0.17 bar	6	0.41	109	2.91	202	5.40	209	5.61	388	10.4	519	13.9	527	14.1
			10	0.69	140	3.74	349	9.35	380	10.2	550	14.7	667	17.9		
			30	2.1	442	11.8	558	15.0	798	21.4	1271	34.1				
			60	4.1	659	17.7	1418	38.0	1953	52.3	2426	65.0				
			150	10.3	1697	45.5	2596	69.6	2697	72.3						
2.5 to 4.5 psig / 0.17 to 0.31 bar Light Blue	0.3 psig / 21 mbar	2.5 psig / 0.17 bar	4	0.28	109	2.91	140	3.74	147	3.95	318	8.52	333	8.93	372	9.97
			8	0.55	140	3.74	248	6.65	279	7.48	550	14.7	574	15.4	698	18.7
			12	0.82	147	3.95	310	8.31	380	10.2	721	19.3	744	19.9		
			30	2.1	333	8.93	481	12.9	698	18.7	1418	38.0				
			60	4.1	512	13.7	1248	33.4	1349	36.1	2302	61.7				
			150	10.3	1558	41.7	3170	84.9	5162	138						
		4.5 psig / 0.31 bar	8	0.55	93	2.49	147	3.95	194	5.19	380	10.2	403	10.8	419	11.2
			12	0.83	124	3.32	163	4.36	248	6.65	473	12.7	659	17.7		
			30	2.1	302	8.10	403	10.8	589	15.8	1054	28.2				
			60	4.1	488	13.1	651	17.4	953	25.5	2000	53.6				
			150	10.3	1077	28.9	2232	59.8	3867	104						
4.5 to 7 psig / 0.31 to 0.48 bar Black	0.7 psig / 48 mbar	4.5 psig / 0.31 bar	9	0.62	163	4.36	240	6.44	333	8.93	597	16.0	752	20.1	814	21.8
			12	0.83	178	4.78	310	8.31	434	11.6	783	21.0	1000	26.8		
			30	2.1	403	10.8	667	17.9	853	22.8	1612	43.2				
			60	4.1	682	18.3	1178	31.6	1589	42.6	2829	75.8				
			150	10.3	1597	42.8	2720	72.9	4650	125						
		7 psig / 0.48 bar	9	0.62	124	3.32	163	4.36	209	5.61	457	12.3	481	12.9	512	13.7
			12	0.83	163	4.36	240	6.44	287	7.68	597	16.0	690	18.5		
			30	2.1	287	7.68	543	14.5	698	18.7	1279	34.3				
			60	4.1	620	16.6	1000	26.8	1333	35.7	2139	57.3				
			150	10.3	1558	41.7	2627	70.4	3209	86.0						

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Indicates capacity limited due to boost.

Fuel Gas

Table 6. Capacities for 3/4-NPT Body Size

OUTLET PRESSURE RANGE, CONTROL SPRING COLOR	OFFSET FROM SETPOINT	OUTLET PRESSURE SETTING	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS											
					Orifice Size, In. / mm											
					1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
4 to 8 in. w.c. / 10 to 20 mbar Red	1 in. w.c. / 2 mbar	7 in. w.c. / 17 mbar	1	0.07	90	2.4	170	4.6	230	6.2	250	6.7	410	11.0	440	11.8
			5	0.34	220	5.9	280	7.5	450	12.1	490	13.1	520	13.9	970	25.9
			8	0.55	230	6.2	480	12.9	530	14.2	540	14.5	590	15.8		
			20	1.4	520	13.9	600	16.1	620	16.6	650	17.4				
			35	2.4	660	17.7	670	18.0	840	22.5	900	24.1				
			75	5.2	770	20.6	840	22.5	960	25.7						
			150	10.3	1680	45.0	2310	61.9								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	1 in. w.c. / 2 mbar	11 in. w.c. / 27 mbar	1	0.07	90	2.4	130	3.5	160	4.3	190	5.1	230	6.2	250	6.7
			5	0.34	160	4.3	250	6.7	280	7.5	350	9.4	530	14.2	750	20.1
			8	0.55	170	4.6	350	9.4	430	11.5	450	12.1	540	14.5		
			20	1.4	350	9.4	490	13.1	590	15.8	610	16.3				
			35	2.4	520	13.9	530	14.2	620	16.6	650	17.4				
			75	5.2	650	17.4	660	17.7	940	25.2						
			150	10.3	1680	45.0	2060	55.2								
15 in. w.c. to 1.2 psig / 37 to 83 mbar Yellow	5.5 in. w.c. / 14 mbar	15 in. w.c. / 37 mbar	2	0.14	90	2.4	340	9.1	500	13.4	900	24.1	1100	29.5	1150	30.8
			6	0.41	250	6.7	540	14.5	930	24.9	1640	43.9	2100	56.3		
			10	0.69	340	9.1	800	21.4	1380	37.0	1940	51.9				
			30	2.1	680	18.2	1450	38.8	2390	64.0	2450	65.7				
			60	4.1	1160	31.1	2460	66.0	3480	93.3						
			150	10.3	2570	68.8	2710	72.6								
		1.2 psig / 83 mbar	2	0.14	90	2.4	260	7.0	410	11.0	600	16.1	810	21.7	700	18.7
			6	0.41	250	6.7	460	12.3	700	18.7	1290	34.6	1420	38.0		
			10	0.69	310	8.3	660	17.7	1020	27.3	1420	38.0				
			30	2.1	670	18.0	1109	29.7	2060	55.2	2430	65.1				
			60	4.1	1140	30.6	2180	58.4	3350	89.8						
			150	10.3	2480	66.5	2650	71.0								
1.2 to 2.5 psig / 83 mbar to 0.17 bar Green	0.2 psig / 14 mbar	1.2 psig / 83 mbar	2	0.14	120	3.2	170	4.6	220	5.9	350	9.4	490	13.1	520	13.9
			6	0.41	180	4.8	340	9.1	450	12.1	740	19.8	850	22.8	1070	28.7
			10	0.69	190	5.1	440	11.8	590	15.8	1010	27.0	1170	31.3		
			30	2.1	560	15.0	900	24.1	1550	41.5	1720	46.1				
			60	4.1	860	23.1	1110	29.7	2480	66.5	2340	62.7				
			150	10.3	1990	53.3	3480	93.3	3500	93.8						
		2.5 psig / 0.14 bar	6	0.41	140	3.8	190	5.1	260	7.0	450	12.1	590	15.8	680	18.2
			10	0.69	170	4.6	340	9.1	490	13.1	570	15.3	860	23.1		
			30	2.1	430	11.5	660	17.7	980	26.3	1030	27.6				
			60	4.1	750	20.1	850	22.8	1940	51.9	2250	60.3				
			150	10.3	1480	39.7	2320	62.2	3350	89.8						
2.5 to 4.5 psig / 0.17 to 0.31 bar Light Blue	0.3 psig / 21 mbar	2.5 psig / 0.17 bar	4	0.28	130	3.5	180	4.8	190	5.1	310	8.3	370	9.9	480	12.9
			8	0.55	140	3.8	280	7.5	360	9.6	520	13.9	710	19.0	800	21.4
			12	0.83	190	5.1	360	9.6	490	13.1	680	18.2	930	24.9		
			30	2.1	430	11.5	620	16.6	900	24.1	1110	29.7				
			60	4.1	660	17.7	1010	27.0	1730	46.4	1830	49.0				
			150	10.3	1570	42.1	2060	55.2	4620	124						
		4.5 psig / 0.31 bar	8	0.55	120	3.2	190	5.1	250	6.7	400	10.7	520	13.9	540	14.5
			12	0.83	160	4.3	210	5.6	320	8.6	530	14.2	720	19.3		
			30	2.1	300	8.0	460	12.3	760	20.4	830	22.2				
			60	4.1	590	15.8	810	21.7	1230	32.9	1340	36.0				
			150	10.3	1230	32.9	1640	43.9	3610	96.8						
4.5 to 7 psig / 0.31 to 0.48 bar Black	0.7 psig / 48 mbar	4.5 psig / 310 mbar	9	0.62	190	5.1	310	8.3	430	11.5	620	16.6	930	24.9	990	26.5
			12	0.83	210	5.6	400	10.7	560	15.0	810	21.7	1150	30.8		
			30	2.1	520	13.9	860	23.1	1100	29.5	1810	48.5				
			60	4.1	860	23.1	1520	40.7	2050	55.0	2710	72.6				
			150	10.3	1960	52.5	3480	93.3	5040	135						
		7 psig / 0.48 bar	9	0.62	160	4.3	210	5.6	270	7.2	520	13.9	620	16.6	660	17.7
			12	0.83	190	5.1	310	8.3	370	9.9	650	17.4	860	23.1		
			30	2.1	370	9.9	700	18.7	900	24.1	1330	35.6				
			60	4.1	800	21.4	1290	34.6	1720	46.1	2450	65.7				
			150	10.3	1910	51.2	3350	89.8	4050	109						

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.

Fuel Gas

Table 7. Capacities for 1-NPT Body Size

OUTLET PRESSURE RANGE, CONTROL SPRING COLOR	OFFSET FROM SETPOINT	OUTLET PRESSURE SETTING	INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.6 SPECIFIC GRAVITY NATURAL GAS, Orifice Size, In. / mm											
					1/8 / 3.2		3/16 / 4.8		1/4 / 6.4		3/8 / 9.5		1/2 / 13		9/16 / 14	
			psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
4 to 8 in. w.c. / 10 to 20 mbar Red	1 in. w.c. / 2 mbar	7 in. w.c. / 17 mbar	1	0.07	90	2.4	220	5.9	250	6.7	300	8.0	410	10.9	530	14.2
			5	0.34	220	5.9	430	11.5	450	12.1	1140	30.6	1900	50.9	1920	51.5
			8	0.55	230	6.2	490	13.1	530	14.2	2140	57.4	2360	63.3		
			20	1.4	520	13.9	970	25.9	1810	48.5	1170[1]	31.4[1]				
			35	2.4	710	19.0	1480	39.7	2300[1]	61.6[1]	930[1]	24.9[1]				
			75	5.2	1030	27.6	1100[1]	29.5[1]	1390[1]	37.3[1]						
			150	10.3	1680[1]	45.0[1]	1160[1]	31.1[1]								
7 to 16 in. w.c. / 17 to 40 mbar Unpainted	1 in. w.c. / 2 mbar	11 in. w.c. / 27 mbar	1	0.07	90	2.4	160	4.3	170	4.6	210	5.6	230	6.2	250	6.7
			5	0.34	160	4.3	300	8.0	310	8.3	520	13.9	620	16.6	1160	31.1
			8	0.55	170	4.6	360	9.6	430	11.5	1160	31.1	1460	39.1		
			20	1.4	350	9.4	580	15.5	780	20.9	1630	43.7				
			35	2.4	560	15.0	1030	27.6	2840	76.1	1190[1]	31.8[1]				
			75	5.2	1230	32.9	1290	34.6	1510[1]	40.5[1]						
			150	10.3	1740	46.6	1240[1]	33.2[1]								
15 in. w.c. to 1.2 psig / 37 to 83 mbar Yellow	5.5 in. w.c. / 14 mbar	15 in. w.c. / 37 mbar	2	0.14	90	2.4	460	12.3	500	13.4	1100	29.5	1160	31.1	1300	34.8
			6	0.41	250	6.7	750	20.1	930	24.9	2500	67.0	2800	75.0		
			10	0.69	340	9.1	920	24.7	1590	42.6	3250	87.1				
			30	2.1	680	18.2	1560	41.8	2830	75.8	5460	146				
			60	4.1	1160	31.1	2550	68.3	4620	124						
			150	10.3	2570	68.9	2770	74.2								
		1.2 psig / 83 mbar	2	0.14	90	2.4	400	10.7	460	12.3	820	22.0	840	22.5	900	24.1
			6	0.41	250	6.7	630	16.9	700	18.7	1550	41.5	1610	43.1		
			10	0.69	320	8.6	860	23.1	1020	27.3	2320	62.2				
			30	2.1	670	18.0	1540	41.3	2550	68.3	4390	118				
			60	4.1	1140	30.6	2550	68.3	4190	112						
			150	10.3	2570	68.9	3100	83.1								
1.2 to 2.5 psig / 83 mbar to 0.17 bar Green	0.2 psig / 14 mbar	1.2 psig / 83 mbar	2	0.14	120	3.2	210	5.6	230	6.2	360	9.6	620	16.6	660	17.7
			6	0.41	180	4.8	340	9.1	450	12.1	750	20.1	880	23.6	1080	29.0
			10	0.69	190	5.1	560	15.0	650	17.4	1150	30.8	1750	47.0		
			30	2.1	630	16.9	1230	32.9	1600	42.9	1910	51.2				
			60	4.1	1010	27.0	2450	65.7	3600	96.5	2420	64.9				
			150	10.3	2440	65.4	3480	93.3	3870	104						
		2.5 psig / 0.17 bar	6	0.41	140	3.8	260	7.0	270	7.2	500	13.4	670	18.0	680	18.2
			10	0.69	180	4.8	450	12.1	490	13.1	710	19.0	860	23.1		
			30	2.1	570	15.3	720	19.3	1030	27.6	1640	43.9				
			60	4.1	850	22.8	1830	49.1	2520	67.5	3130	83.9				
			150	10.3	2190	58.7	3350	89.8	3480	93.3						
2.5 to 4.5 psig / 0.17 to 0.31 bar Light Blue	0.3 psig / 21 mbar	2.5 psig / 0.17 bar	4	0.28	140	3.8	180	4.8	190	5.1	410	11.0	430	11.5	480	12.9
			8	0.55	180	4.8	320	8.6	360	9.6	710	19.0	740	19.8	900	24.1
			12	0.82	190	5.1	400	10.7	490	13.1	930	24.9	960	25.7		
			30	2.1	430	11.5	620	16.6	900	24.1	1830	49.0				
			60	4.1	660	17.7	1610	43.1	1740	46.6	2970	79.6				
			150	10.3	2010	53.9	4090	110	6660	178						
		4.5 psig / 0.31 bar	8	0.55	120	3.2	190	5.1	250	6.7	490	13.1	520	13.9	540	14.5
			12	0.83	160	4.3	210	5.6	320	8.6	610	16.3	850	22.8		
			30	2.1	390	10.4	520	13.9	760	20.4	1360	36.4				
			60	4.1	630	16.9	840	22.5	1230	32.9	2580	69.1				
			150	10.3	1390	37.3	2880	77.2	4990	134						
4.5 to 7 psig / 0.31 to 0.48 bar Black	0.7 psig / 48 mbar	4.5 psig / 0.31 bar	9	0.62	210	5.6	310	8.3	430	11.5	770	20.6	970	25.9	1050	28.1
			12	0.83	230	6.2	400	10.7	560	15.0	1010	27.0	1290	34.6		
			30	2.1	520	13.9	860	23.1	1100	29.5	2080	55.7				
			60	4.1	880	23.6	1520	40.7	2050	55.0	3650	97.8				
			150	10.3	2060	55.2	3510	94.1	6000	161						
		7 psig / 0.48 bar	9	0.62	160	4.3	210	5.6	270	7.2	590	15.8	620	16.6	660	17.7
			12	0.83	210	5.6	310	8.3	370	9.9	770	20.6	890	23.9		
			30	2.1	370	9.9	700	18.7	900	24.1	1650	44.2				
			60	4.1	800	21.4	1290	34.6	1720	46.1	2760	74.0				
			150	10.3	2010	53.9	3390	90.9	4140	111						

- Shaded areas indicate where maximum operating inlet pressure for a given orifice size is exceeded.
1. Indicates capacity limited due to boost.

FISHER

Y610A, Y611A, Y612A Series

Vacuum Service Equipment and Relief Valve

Introduction

The Y610A, Y611A, and Y612A Series devices are used in a wide variety of vacuum and relief service applications. The Y610A Series devices are used as vacuum breakers, the Y611A Series devices are used as either vacuum breakers or relief valves, and the Y612A Series devices are used as vacuum regulators.

Available Configurations

See Table 1

Body Sizes (Inlet x Outlet) and End Connection Styles

1-1/2 x 1-1/2, 2 x 2 NPT or NPS 2 x 2 / DN 50 x 50, CL125 FF or CL250 RF flanged

Pressure Information[1]

Type Y610A or Y610AP Vacuum Breaker: See Table 3
Type Y611A or Y611AP Relief Valve: See Table 4
Type Y612A or Y612AP Vacuum Regulator: See Table 5

Typical Flow Capacities and Performance Curves

Y610A Series Vacuum Breakers: See Table 6 and Product Bulletin
Y611A Series Vacuum Breakers: See Product Bulletin
Y611A Series Relief Valves: See Table 7 and Product Bulletin
Y612A Series Vacuum Regulators: See Table 8 and Product Bulletin

Construction Materials

Body: Cast Iron (standard)
Spring and Diaphragm Cases: Aluminum
Diaphragm, O-rings and Wiper Ring: Nitrile (NBR)
Disk: Nitrile (NBR) (standard) or Fluorocarbon (FKM)
Seat Ring, Pusher Post, Stem Parts, Disk Holder, Adjusting Screw, Body Cap: Aluminum
Lever Assembly: Zinc-plated steel
Gaskets: Nitrile (NBR) or composition depending on location
Stabilizer Vent Flappers if Used: Nylon (PA)
Flapper Spring, Disk Spring, Screen, Snap Ring: Stainless steel
Bolting: Plated steel
Other Metal Parts: Steel, brass, stainless steel, zinc and/or aluminum depending on construction

Temperature Capabilities[1]

-20 to 150°F / -29 to 66°C

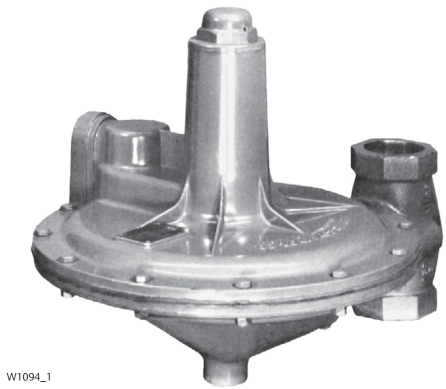


Figure 1. *Type Y610A or Y610AP Vacuum Breaker*

Port Diameters and Flow Coefficients

See Table 2

Pressure Setting Adjustment

Adjusting screw

Pressure Registration

See Table 1

Approximate Weights

NPS 1-1/2 x 1-1/2 / DN 40 x 40: 25 lbs / 11 kg
NPS 2 x 2 / DN 50 x 50: 30 lbs / 14 kg

Ordering Guide

To order this product, contact your local Sales Office.

Applications

- Air
- Process Gas

Features

- **Precision Control of Low-Pressure Setting**
- **Corrosion Resistance**
- **Installation Adaptability**
- **Tamper-Resistant Adjustment**
- **Rugged Construction**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Available Configurations

CONSTRUCTION	TYPE NUMBER					
	Y610A	Y610AP	Y611A	Y611AP	Y612A	Y612AP
Vacuum breaker	✓	✓	----	----	----	----
Vacuum breaker or relief valve	----	----	✓	✓	----	----
Relief pilot with solid throat	----	----	----	----	----	----
Relief pilot with bleed hole in throat for Type 66RR	----	----	----	----	----	----
Vacuum regulator	----	----	----	----	✓	✓
1-1/2 or 2 NPT end connections and spring case with 1 NPT screened vent	✓	✓	✓	✓	✓	✓
Internal registration	✓	----	✓	----	----	----
External registration with 1/2 NPT downstream control line connection	----	✓	----	✓	----	✓
Light diaphragm plate(s)	✓	✓	✓	✓	✓	✓
Heavy diaphragm plate(s)	----	----	----	----	----	----
O-ring stem seal	----	✓	----	✓	----	✓

1. Pipe nipples and flanges are 316 Stainless steel for flanged body assemblies.

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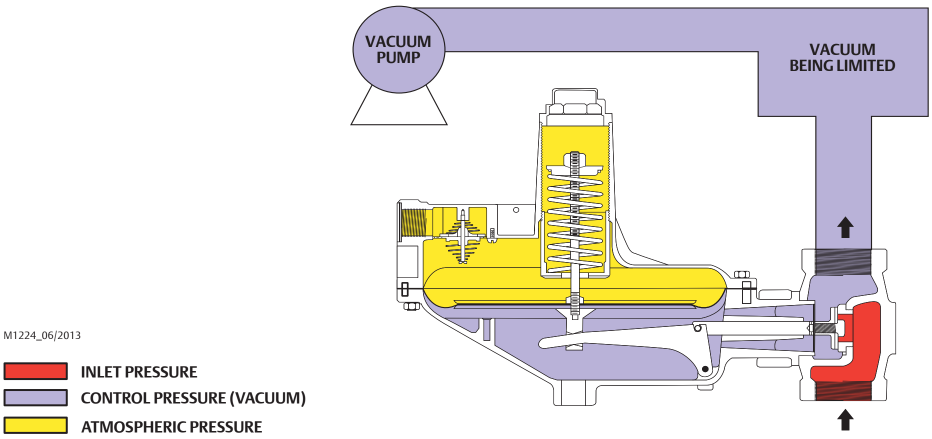

Figure 2. Y610A Series Vacuum Breaker Construction

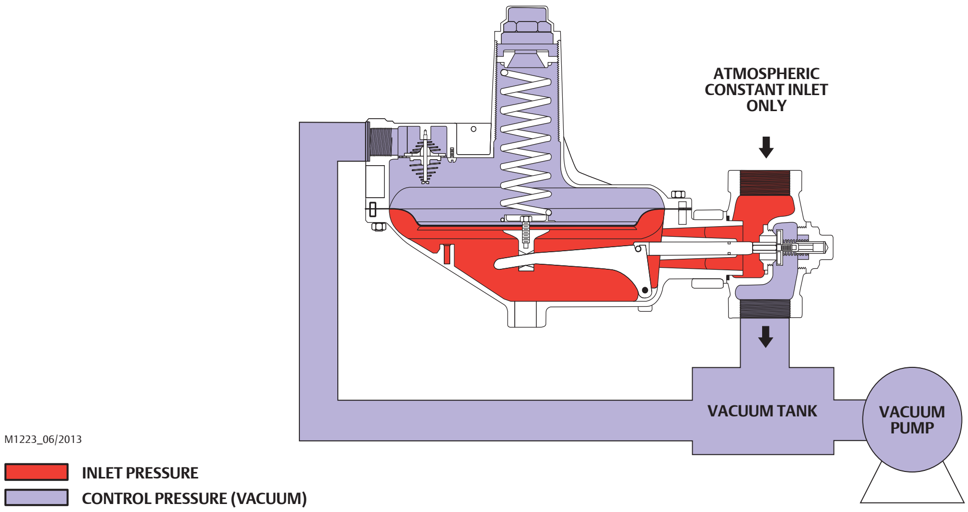

Figure 3. Y611A Series Vacuum Breaker Construction

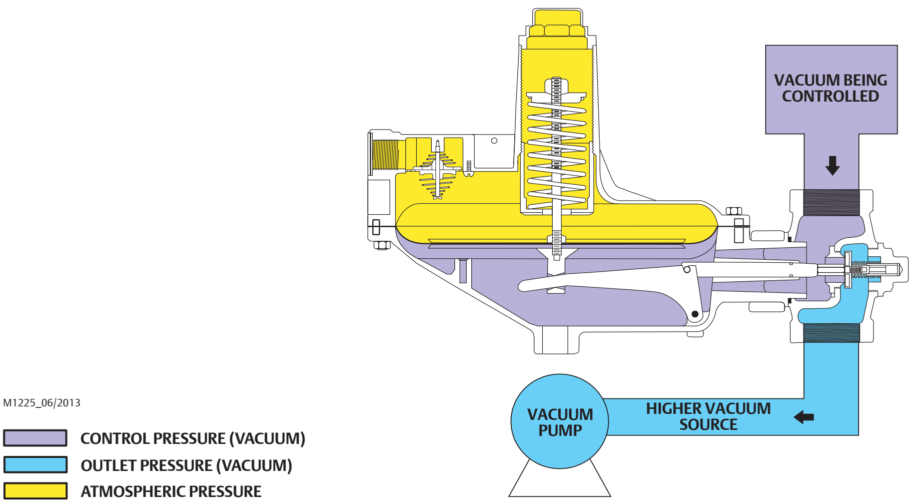

Figure 4. Y612A Series Vacuum Regulator Construction

Table 2. Port Diameters and Flow Coefficients

TYPE NUMBER	SEAT RING PORT DIAMETER		C_g WITH FULLY OPEN DISK	C_1
	Inch	mm		
Y610A, Y610AP, Y611A, Y611AP	1-3/16	30	720	35
Y612A, Y612AP	5/8 1 1-3/16	16 25 30	150 450 720	

Table 3. Types Y610A and Y610AP Vacuum Breaker Pressure Information

TYPE NUMBER	MAXIMUM ALLOWABLE INLET (BODY) PRESSURE		MAXIMUM EMERGENCY OUTLET (CASING) PRESSURE (POSITIVE)		OUTLET PRESSURE RANGE (VACUUM)		MAXIMUM ALLOWABLE VACUUM		CONTROL SPRING COLOR CODE	CHANGE IN OUTLET (CONTROLLED) PRESSURE REQUIRED TO FULLY OPEN VACUUM BREAKER	
	psig	bar	psig	bar	With Spring Case Above Diaphragm	With Spring Case Below Diaphragm	psig	bar		psig	mbar
Y610A, Y610AP	13	0.90	15	1.0	1 to 3 inches w.c. / 2 to 7 mbar	0 to 2 inches w.c. / 0 to 5 mbar	5.1	0.35	Brown Stripe	0.043	3
					1.5 to 5 inches w.c. / 4 to 12 mbar	0.50 to 4 inches w.c. / 1 to 10 mbar	5.2	0.36	Pink Stripe	0.078	5
					3 to 8 inches w.c. / 7 to 20 mbar	2 to 7 inches w.c. / 5 to 17 mbar	5.3	0.37	Purple Stripe	0.143	10
					8 to 16 inches w.c. / 20 to 40 mbar	7 to 15 inches w.c. / 17 to 37 mbar	5.6	0.39	Gray	0.181	12
					16 to 32 inches w.c. / 40 to 80 mbar	15 to 31 inches w.c. / 37 to 77 mbar	6.1	0.42	Unpainted	0.378	26
					0.25 to 3 psig / 0.02 to 0.21 bar	0.25 to 3 psig / 0.02 to 0.21 bar	8.0	0.55	Black	1.944	134

Table 4. Types Y611A and Y611AP Relief Valve Pressure Information

TYPE NUMBER	MAXIMUM ALLOWABLE INLET (CASING) PRESSURE[1]		MAXIMUM OPERATING INLET (RELIEF) PRESSURE TO PREVENT PART DAMAGE[1]		INLET RELIEF SET PRESSURE RANGE		CONTROL SPRING COLOR CODE	BUILDUP OVER INLET PRESSURE REQUIRED TO FULLY OPEN RELIEF VALVE	
	psig	bar	psig	bar	With Spring Case Above Diaphragm	With Spring Case Below Diaphragm		psig	mbar
Y611A, Y611AP	15	1.0	5.1	0.35	3 to 4 inches w.c. / 7 to 10 mbar	2 to 3 inches w.c. / 5 to 7 mbar	Red	0.089	6
			5.2	0.36	3.75 to 6 inches w.c / 9 to 15 mbar	2.75 to 5 inches w.c. / 7 to 12 mbar	Red	0.100	7
			5.3	0.37	5 to 8 inches w.c. / 12 to 20 mbar	4 to 7 inches w.c / 10 to 17 mbar	Black Stripe	0.124	9
			5.5	0.38	7 to 16 inches w.c. / 17 to 40 mbar	6 to 15 inches w.c. / 15 to 37 mbar	White Stripe	0.216	15
			6	0.41	10 to 30 inches w.c / 25 to 75 mbar	9 to 29 inches w.c. / 22 to 72 mbar	Green	0.351	24
			6.5	0.45	0.75 to 1.5 psig / 0.05 to 0.10 bar	0.75 to 1.5 psig / 0.05 to 0.10 bar	Blue	0.648	45
			7.5	0.52	1 to 2.5 psig / 0.07 to 0.17 bar	1 to 2.5 psig / 0.07 to 0.17 bar	Orange	1.026	71

1. Including buildup.

Table 5. Types Y612A and Y612AP Vacuum Regulator Pressure Information

MAXIMUM ALLOWABLE INLET (CASING) PRESSURE		MAXIMUM OPERATING INLET PRESSURE TO PREVENT PART DAMAGE		OUTLET PRESSURE RANGE (VACUUM)[1]		MAXIMUM ALLOWABLE VACUUM		CONTROL SPRING COLOR CODE	CHANGE IN OUTLET (CONTROLLED) PRESSURE REQUIRED TO FULLY OPEN VACUUM REGULATOR					
									5/8-Inch / 16 mm Port Diameter		1-Inch / 25 mm Port Diameter		1-3/16-Inch / 30 mm Port Diameter	
psig	bar	psig	bar	With Spring Case Above Diaphragm	With Spring Case Below Diaphragm	psig	bar		psig	mbar	psig	mbar	psig	mbar
15	1.0	5.1	0.35	1 to 3 inches w.c. / 2 to 7 mbar	0 to 2 inches w.c. / 0 to 5 mbar	5.1	0.35	Brown Stripe	0.089	6	0.053	4	0.076	5
		5.2	0.36	1.5 to 5 inches w.c. / 4 to 12 mbar	0.5 to 4 inches w.c. / 1 to 10 mbar	5.2	0.36	Pink Stripe	0.124	9	0.074	5	0.106	7
		5.3	0.37	3 to 8 inches w.c. / 7 to 20 mbar	2 to 7 inches w.c. / 5 to 17 mbar	5.3	0.37	Purple Stripe	0.189	13	0.112	8	0.161	11
		5.6	0.39	8 to 16 inches w.c. / 20 to 40 mbar	7 to 15 inches w.c. / 17 to 37 mbar	5.6	0.39	Gray	0.227	16	0.134	9	0.193	13
		6.1	0.42	16 to 32 inches w.c. / 40 to 80 mbar	15 to 31 inches w.c. / 37 to 77 mbar	6.1	0.42	Unpainted	0.405	28	0.240	17	0.345	24
		8.0	0.55	0.25 to 3 psig / 0.02 to 0.21 bar	0.25 to 3 psig / 0.02 to 0.21 bar	8.0	0.55	Black	1.944	134	1.152	79	1.656	114

1. With spring case above the diaphragm as shown in Figure 4. With spring case below diaphragm, range 0.6-inch w.c. / 1 mbar lower in each end.

Air

Table 6. Selected Y610A Series Vacuum Breaker Capacities			
BODY SIZE	CONTROL SPRING		CAPACITY, SCFH / Nm³/h OF AIR (INLET PRESSURE IS ATMOSPHERIC)
	Outlet Setting, Vacuum	Offset, Vacuum	
NPS 1-1/2 or 2 / DN 40 or 50 Type Y610A	2 inches w.c. / 5 mbar	1 inch w.c. / 2 mbar	1000 / 26.8
	4 inches w.c. / 10 mbar	1 inch w.c. / 2 mbar	1400 / 37.5
	7 inches w.c. / 17 mbar	1 inch w.c. / 2 mbar	1800 / 48.2
	14 inches w.c. / 35 mbar	2 inches w.c. / 5 mbar	1800 / 48.2
	28 inches w.c. / 70 mbar	6 inches w.c. / 15 mbar	1900 / 50.9
	2 psig / 0.14 bar	0.4 psig / 0.03 bar	2500 / 67.0

Air

Table 7A. Selected Y611A Series Relief Valve Capacities							
BODY SIZE	RELIEF SET PRESSURE	CAPACITY, SCFH / Nm³/h OF AIR AT FOLLOWING BUILD-UP OVER RELIEF SET PRESSURE					
		7 inches w.c. / 17 mbar	14 inches w.c. / 35 mbar	21 inches w.c. / 52 mbar	1 psig / 0.07 bar	1.5 psig / 0.10 bar	2 psig / 0.14 bar
NPS 1-1/2 or 2 / DN 40 or 50 Type Y611A	4 inches w.c. / 10 mbar	3000 / 80.4	4000 / 107	4500 / 121	5000 / 134	6000 / 161	7000 / 188
	5 inches w.c. / 12 mbar						
	7 inches w.c. / 17 mbar						
	14 inches w.c. / 35 mbar	2500 / 67	4000 / 107	5000 / 134	5500 / 147	6500 / 174	7500 / 201
	21 inches w.c. / 52 mbar	3000 / 80.4	4000 / 107	5000 / 134	6000 / 161	7000 / 188	8000 / 214
	1 psig / 0.07 bar	3000 / 80.4	4000 / 107	5500 / 147	6500 / 174	7500 / 201	8000 / 214
	1.25 psig / 0.09 bar	2000 / 53.6	4000 / 107	5000 / 134	6000 / 161	7500 / 201	8500 / 228
	2.5 psig / 0.17 bar	3500 / 93.8	5500 / 147	7000 / 188	8000 / 214	9500 / 255	10,500 / 281

Table 7B. Selected Y611A Series Relief Valve Capacities (continued)						
BODY SIZE	RELIEF SET PRESSURE	CAPACITY, SCFH / Nm³/h OF AIR AT FOLLOWING BUILD-UP OVER RELIEF SET PRESSURE				
		2.5 psig / 0.17 bar	3 psig / 0.21 bar	4 psig / 0.28 bar	5 psig / 0.34 bar	6 psig / 0.41 bar
NPS 1-1/2 or 2 / DN 40 or 50 Type Y611A	4 inches w.c. / 10 mbar	8000 / 214	8500 / 228	10,000 / 268	11,000 / 295	
	5 inches w.c. / 12 mbar					
	7 inches w.c. / 17 mbar					
	14 inches w.c. / 35 mbar	8000 / 214	9000 / 241	10,500 / 281	11,300 / 303	
	21 inches w.c. / 52 mbar	8500 / 228	9500 / 255	10,500 / 281	11,600 / 311	
	1 psig / 0.07 bar	9000 / 241	10,000 / 268	11,000 / 295	11,800 / 316	
	1.25 psig / 0.09 bar	9500 / 255	10,000 / 268	11,000 / 295	12,000 / 322	13,000 / 348
	2.5 psig / 0.17 bar	10,800 / 289	11,300 / 303	12,300 / 330	13,300 / 356	

- Shaded areas show where maximum operating inlet (relief) pressure to prevent part damage is exceeded.

Air

Table 8. Selected Y612A Series Vacuum Regulator Capacities					
CONSTRUCTION		CONTROL SPRING		CAPACITY, SCFH / Nm³/h OF AIR	AT OUTLET PRESSURE (VACUUM) OF:
		Inlet Setting, Vacuum	Offset, Vacuum		
NPS 1-1/2 or 2 / DN 40 or 50 Type Y612A	5/8-inch / 16 mm Seat Ring	16-inches w.c. / 40 mbar	3 inches w.c. / 7 mbar	1500 / 40.2	7.33 psig / 0.51 bar
	1-inch / 25 mm Seat Ring	1 psig / 0.07 bar	0.2 psig / 0.01 bar	2000 / 53.6	
	1-3/16-inch / 30 mm Seat Ring	3 psig / 0.21 bar	0.6 psig / 0.04 bar	3900 / 105	

Process Gas

Tables 6, 7, and 8 give selected flow capacity information for Y610A, Y611A, and Y612A Series devices, respectively. Flows are in SCFH (60°F and 14.7 psia) of air at 60°F. To determine equivalent capacities of 0.6 specific gravity natural gas, propane, butane, or nitrogen, multiply the Table 6, 7, or 8 capacity by the following appropriate conversion factor: 1.29 for 0.6 natural gas, 0.810 for propane, 0.707 for butane, or 1.018 for nitrogen. For gases of other specific gravities, multiply the given capacity by 1.0, and divide by the square root of the appropriate specific gravity. Then, if capacity is desired in normal cubic meters per hour at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

FISHER

Type Y692

Tank Blanketing Regulator

Introduction

An Accu-Pressure™ Gas Blanketing Regulator System reduces a high-pressure gas, such as Nitrogen, to maintain a protective environment above any liquid stored in a tank or vessel when the liquid is being pumped out. Also when the vessel is suddenly cooled, causing vapors inside the vessel to contract, the regulator system replaces the volume of contracting vapors with a volume of blanketing gas to prevent the internal vessel pressure from decreasing. In both cases, a slight positive vessel pressure prevents outside air, moisture and other contaminants from entering the vessel and the possible collapse of the vessel walls.

The Type Y692 is a direct-operated regulator used for accurate pressure control on very low-pressure blanketing systems. Downstream pressure is sensed through a pitot tube installed in the lower casing of the regulator for units with internal pressure registration or through a downstream control line for units with external pressure registration.

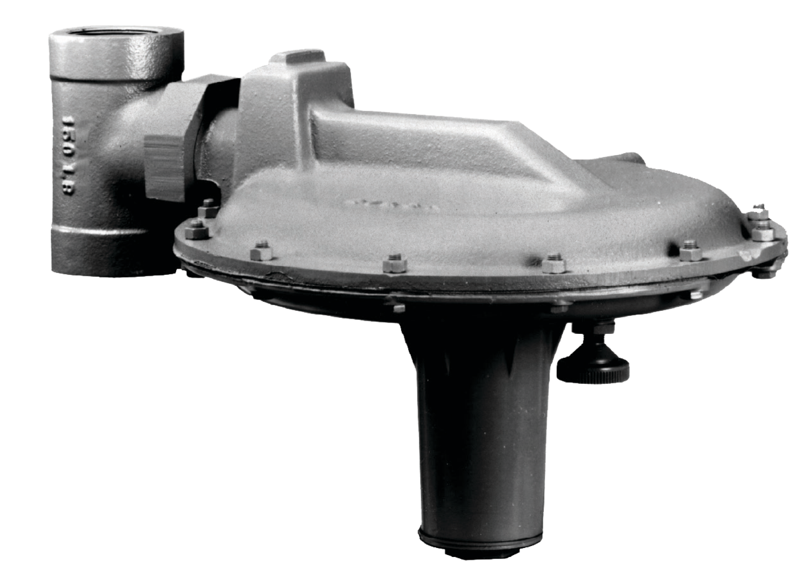

Figure 1. Type Y692 Low-Pressure Gas Blanketing Regulator

Body Sizes and End Connection Styles
See Table 1

Construction Materials
See Table 2

Maximum Inlet Pressure
150 psig / 10.3 bar

Maximum Outlet (Casing) Pressure
15 psig / 1.0 bar

Maximum Operating Outlet (Control) Pressure to Avoid Internal Part Damage
3 psig / 0.21 bar above outlet (control) pressure setting

Control Pressure Ranges
See Table 3

Relief Sizing Coefficients
See Table 4

Orifice Size
See Table 4

Flow Capacities
See Tables 5 to 8

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

Spring Case Connection
1/4 NPT

Temperature Capabilities
Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM): 0 to 300°F / -18 to 149°C
Perfluoroelastomer (FFKM): -20 to 300°F / -29 to 149°C
Ethylenepropylene (EPDM): -20 to 275°F / -29 to 135°C

IEC Sizing Coefficients
$\mathbf{X_T}$: 0.775; $\mathbf{F_D}$: 0.50; $\mathbf{F_L}$: 0.89

Approximate Weights
Cast Iron Body: 45 lbs / 20 kg
Steel/Stainless steel Body: 57 lbs / 26 kg

Canadian Registration Number (CRN)
Approved

Pressure Equipment Directive (PED) Category
The Type Y692 may be used as a safety accessory with pressure equipment in the PED Category.

Ordering Guide
To order this product, contact your local Sales Office.

Application

- Process Gas
- Tank Blanketing

Features

- Ease of Inspection and Maintenance
- Accuracy of Control
- Speed of Response
- Ease of Installation

Additional Technical Data
Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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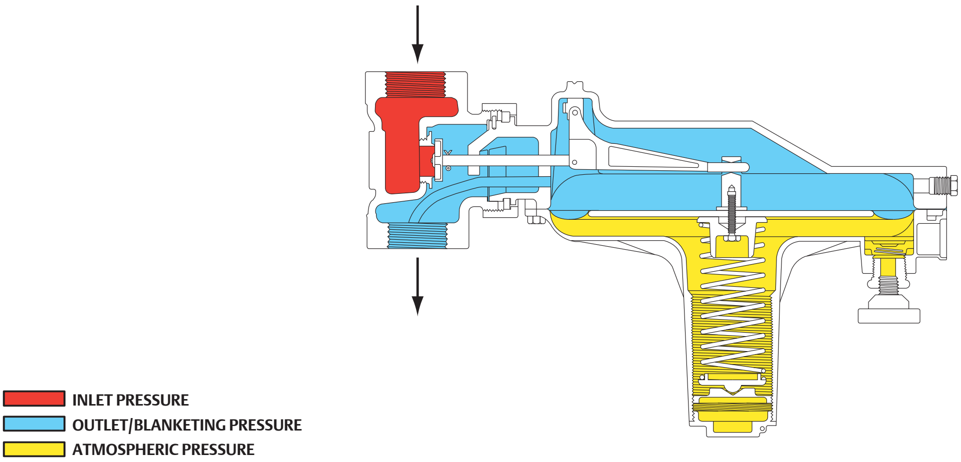

***Figure 2.** Type Y692 Operational Schematic*

Table 1. Body Sizes and End Connection Styles(1)

BODY SIZE		BODY MATERIAL		
In.	DN	Cast Iron	Steel	Stainless Steel
1-1/2	40	NPT	NPT, SWE, CL150 RF, CL300 RF or PN 16/25/40	NPT, CL150 RF, CL300 RF or PN 16/25/40
2	50	NPT or CL125 FF		

1. Fabricated by using slip-on flanges and socket welding nipples into body.

Table 2. Construction Materials

BODY, DIAPHRAGM CASE AND SPRING CASE	DIAPHRAGM	TRIM	DISK
Cast iron, WCC Steel or CF8M Stainless steel	Nitrile (NBR) **(standard)**, Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Silicone (VMQ)	Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Polytetrafluoroethylene (PTFE)

Table 3. Control Pressure Ranges

CONTROL PRESSURE RANGE WITH CASE BARREL POINTED DOWN(1)		CONTROL SPRING COLOR CODE	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
			In.	mm	In.	mm
Light Spring Assembly	1 to 3 in. w.c. / 2 to 7 mbar(2)(3)	Brown	0.109	2.77	6.12	155
	3 to 11 in. w.c. / 7 to 27 mbar(2)(4)	Iridite	0.148	3.76	6.00	152
	6.5 in. w.c. to 1.2 psig / 16 mbar to 83 mbar(5)	Green	0.187	4.75	6.00	152
	0.7 to 2 psig / 48 mbar to 0.14 bar	Blue	0.225	5.71	6.00	152
	1 to 3.2 psig / 69 mbar to 0.22 bar	Orange	0.250	6.35	6.00	152
Heavy spring Assembly	2 to 5.5 psig / 0.14 to 0.38 bar	Silver with Green stripe	0.363	9.22	6.00	152
	4 to 10 psig / 0.28 to 0.69 bar	Silver	0.406	10.3	6.00	152

1. Install with spring case pointing down to achieve low setpoints in these spring ranges.
2. Do not use Fluorocarbon (FKM) diaphragm with these springs at diaphragm temperature lower than 60°F / 16°C.
3. Installation with spring case pointing up will change outlet (control) pressure range to 3 to 5 in. w.c. / 7 to 12 mbar.
4. Installation with spring case pointing up will change outlet (control) pressure range to 5.75 to 14 in. w.c. / 14 to 35 mbar.
5. Installation with spring case pointing up will change outlet (control) pressure range to 7.5 in. w.c. to 1.3 psig / 19 to 90 mbar.

Table 4. Orifice Sizes and Coefficients for Relief Valve Sizing

BODY SIZE		ORIFICE SIZE		WIDE-OPEN C_v	WIDE-OPEN C_g	C_1
In.	DN	In.	mm			
1-1/2 and 2	40 and 50	1/4	6.4	1.51	53.0	35
		3/8	9.5	3.14	111	
		1/2	13	5.43	190	
		3/4	19	11.9	415	
		1	25	20	700	
		1-3/16	30	26	910	

Process Gas

Regulating capacities at selected pressures and outlet pressure flows in Tables 5 and 6 are given in SCFH (at 60°F and 14.7 psia) of 0.97 specific gravity nitrogen. Tables 7 and 8 give regulating capacities at selected pressures and outlet pressure flows in SCFH (at 60°F and 14.7 psia) and Nm³/h (at 0°C and 1.01325 bar) of air. To determine the equivalent capacities for other gases, multiply the capacities in Tables 7 and 8 by the following appropriate conversion factors: 1.29 for 0.6 specific gravity natural gas, 0.808 for propane or 0.707 for butane. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm³/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

Tank Blanketing

Table 5. Capacities in SCFH / Nm³/h of 0.97 Specific Gravity Nitrogen - NPS 1-1/2 / DN 40 Body

OUTLET PRESSURE RANGE[(1)], ACCURACY AND SPRING COLOR	OUTLET PRESSURE SETTING	INLET PRESSURE		ORIFICE SIZE, IN. / mm											
				1/4 / 6.4		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 3 in. w.c. / 2 to 7 mbar -1 to 2 in. w.c. / -2 to 5 mbar Brown	1 in. w.c. / 2 mbar	2	0.14	360	9.7	970	26.0	1750	46.9	3280	87.9	4750	127	3650	97.8
		5	0.34	680	18.2	1560	41.8	2800	75.0	3880	104	3650	97.8	2840	76.1
		10	0.69	1030	27.6	2350	63.0	4210	113	3880	104	3650	97.8		
		20	1.4	1580	42.3	3620	97.0	4900	131	3700	99.2				
		40	2.8	2500	67.0	3620	97.0	4900	131						
		60	4.1	3410	91.4	3620	97.0								
		80	5.5	4320	116										
		100	6.9	4510	121										
		125	8.6	4510	121										
		150	10.3	4510	121										
	3 in. w.c. / 7 mbar	2	0.14	360	9.7	970	26.0	1750	46.9	3280	87.9	4750	127	3650	97.8
		5	0.34	680	18.2	1560	41.8	2800	75.0	3880	104	3650	97.8	2840	76.1
		10	0.69	1030	27.6	2350	63.0	4210	113	3880	104	3650	97.8		
		20	1.4	1580	42.3	3620	97.0	4900	131	3700	99.2				
		40	2.8	2500	67.0	3620	97.0	4900	131						
		60	4.1	3410	91.4	3620	97.0								
		80	5.5	4320	116										
		100	6.9	4510	121										
		125	8.6	4510	121										
		150	10.3	4510	121										
3 to 11 in. w.c. / 7 to 27 mbar -1 to 2 in. w.c. / -2 to 5 mbar Iridite	7 in. w.c. / 17 mbar	0.5	0.03							950	25.5	1180	31.6	1330	35.6
		1	0.07	330	8.8	630	16.9	870	23.3	1340	35.9	1810	48.5	2290	61.4
		2	0.14	470	12.6	950	25.5	1300	34.8	2260	60.6	3160	84.7	4730	127
		5	0.34	770	20.6	1580	42.3	2520	67.5	6070	163	6100	163	6100	163
		13	0.9	1270	34.0	2590	69.4	4900	131	6100	163	6100	163		
		25	1.7	1850	49.6	4100	110	6100	163	6100	163				
		50	3.4	3040	81.5	6100	163	6100	163						
		100	6.9	5370	144	6100	163								
		150	10.3	6100	163										
6.5 in. w.c to 1.2 psig / 16 to 83 mbar, Green or 0.7 to 2 psig / 48 mbar to 0.14 bar, Blue 0.2 psig / 14 mbar	1.5 psig / 0.10 bar	2	0.14			789	21.1	1260	33.8	2050	54.9	2660	71.3	3220	86.3
		6	0.41			1740	46.6	2760	74.0	4730	127	9790	182	7530	202
		14	0.97			3156	84.6	5050	121	9470	254	12,500	335		
		30	2.1			4890	131	8050	216	13,360	358				
		50	3.4			7120	191	11,990	321						
		150	10.3			18,030	483								
1 to 3.2 psig / 69 mbar to 0.22 bar 0.6 psig / 41 mbar Orange	3 psig / 0.21 bar	3	0.21									2450	64.7	2840	76.1
		7	0.48			1550	41.5	2370	63.5	3950	106	5130	137	6312	169
		14	0.97			2370	63.5	3700	99.2	7020	188	7470	200		
		30	2.1			4500	121	7380	198	11,680	313				
		50	3.4			7020	188	10,750	288						
		150	10.3			17,250	462								
2 to 5.5 psig / 0.14 to 0.38 bar 0.5 psig / 34 mbar Silver with green stripe	5 psig / 0.34 bar	10	0.69	590	15.8	950	25.5	1180	31.6	1810	48.5	2200	59.0	2370	63.5
		15	1.0	789	21.1	1030	27.6	1580	42.3	2370	63.5	2840	76.1	3310	88.7
		20	1.4	950	25.5	1380	97.0	2200	59.0	2920	78.3	3310	88.7		
		35	2.4	1420	38.1	1970	52.8	2920	78.3	4020	108				
		60	4.1	2210	59.2	2920	78.3	4730	127						
		75	5.2	2760	74.0	3470	93.0	5680	152						
		100	6.9	3550	95.1	5130	137								
2 to 5.5 psig / 0.14 to 0.38 bar 1 psig / 69 mbar Silver with green stripe	5 psig / 0.34 bar	10	0.69	950	25.5	1500	40.2	2050	54.9	3230	86.6	4100	110	4580	123
		15	1.0	1180	31.6	1890	50.7	2760	74.0	4100	110	5520	148	6310	169
		20	1.4	1380	37.0	2200	59.0	3790	102	5130	137	6310	169		
		35	2.4	1970	52.8	3310	88.7	5130	137	7730	207				
		60	4.1	3160	84.7	5290	142	7890	211						
		75	5.2	4100	110	6390	171	10,260	275						
		100	6.9	5130	137	8680	233								
4 to 10 psig / 0.28 to 0.69 bar 1 psig / 69 mbar Silver	10 psig / 0.69 bar	15	1.0	708	19.0	1023	27.4	1338	35.9	1810	48.5	2518	67.5	2990	80.1
		20	1.4	944	25.3	1377	36.9	1967	52.7	2597	69.9	3148	84.4	4564	122
		25	1.7	1102	29.5	1652	44.3	2203	59.0	3148	84.4	4013	108		
		40	2.8	1810	48.5	2203	59.0	2912	78.0	4720	127				
		60	4.1	2361	63.3	3148	84.4	4643	124						
		75	5.2	2754	73.8	3541	94.9	5666	152						
		100	6.9	3541	94.9	5193	139								
4 to 10 psig / 0.28 to 0.69 bar 2 psig / 0.14 bar Silver	10 psig / 0.69 bar	15	1.0	1023	27.4	1731	46.4	2518	67.5	3620	97.0	4721	127	6295	169
		20	1.4	1259	33.7	2125	57.0	3384	90.7	5115	137	6295	169	7869	211
		25	1.7	1574	42.2	2675	71.7	3777	101	6453	173	7082	190		
		40	2.8	2282	61.2	3934	105	5272	141	8656	232				
		60	4.1	2990	80.1	5351	143	8656	232						
		75	5.2	4013	108	6531	175	10,230	274						
		100	6.9	5115	137	8656	232								

- Light shaded areas show where indicated droop would be exceeded regardless of capacity.
- Dark shaded areas show where maximum operating inlet pressure for a given orifice size is exceeded.

1. Spring ranges based on regulator installation with the spring case pointed down.

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Tank Blanketing

Table 6. Capacities in SCFH / Nm³/h of 0.97 Specific Gravity Nitrogen - NPS 2 / DN 50 Body

OUTLET PRESSURE RANGE[1], ACCURACY AND SPRING COLOR	OUTLET PRESSURE SETTING	INLET PRESSURE		ORIFICE SIZE, IN. / mm											
				1/4 / 6.4		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 3 in. w.c. / 2 to 7 mbar -1 to 2 in. w.c. / -2 to 5 mbar Brown	1 in. w.c. / 2 mbar	2	0.14	320	8.6	930	24.9	1750	46.9	4000	107	5010	134	5930	159
		5	0.34	680	18.2	1560	41.8	2800	75.0	6050	162	4630	124	4260	114
		10	0.69	1030	27.6	2350	63.0	4210	113	3650	97.8	4060	109		
		20	1.4	1580	42.3	3620	97.0	3450	92.5	3650	97.8				
		40	2.8	2500	67.0	4420	118	3450	92.5						
		60	4.1	3410	91.4	4420	118								
		80	5.5	3650	97.8										
		100	6.9	3650	97.8										
		125	8.6	3650	97.8										
		150	10.3	3650	97.8										
	3 in. w.c. / 7 mbar	2	0.14	320	8.6	930	24.9	1750	46.9	4000	107	5010	134	5930	159
		5	0.34	680	18.2	1560	41.8	2800	75.0	6050	162	4630	124	4260	114
		10	0.69	1030	27.6	2350	63.0	4210	113	3650	97.8	4060	109		
		20	1.4	1580	42.3	3620	97.0	3450	92.5	3650	97.8				
		40	2.8	2500	67.0	4420	118	3450	92.5						
		60	4.1	3410	91.4	4420	118								
		80	5.5	3650	97.8										
		100	6.9	3650	97.8										
		125	8.6	3650	97.8										
		150	10.3	3650	97.8										
3 to 11 in. w.c. / 7 to 27 mbar -1 to 2 in. w.c. / -2 to 5 mbar Iridite	7 in. w.c. / 17 mbar	0.5	0.03							950	25.5	1180	31.6	1330	36.5
		1	0.07	330	8.8	630	16.9	870	23.3	1340	35.9	1810	48.5	2290	61.4
		2	0.14	470	12.6	950	25.5	1300	34.8	2260	60.6	3160	84.7	4730	127
		5	0.34	770	20.6	1580	42.3	2520	67.5	6080	163	7890	211	7890	211
		13	0.90	1270	34.0	2590	69.4	4900	131	7890	211	7890	211		
		25	1.7	1850	49.6	4100	110	7180	192	7890	211				
		50	3.4	3040	81.5	6700	180	7890	211						
		100	6.9	5370	144	7890	211								
		150	10.3	7890	211										
6.5 in. w.c to 1.2 psig / 16 to 83 mbar, Green or 0.7 to 2 psig / 48 mbar to 0.14 bar, Blue 0.2 psig / 14 mbar	1 psig / 69 mbar	2	0.14			1030	27.6	1340	35.9	2450	65.7	3230	86.6	3390	90.9
		6	0.41			1970	52.8	2840	76.1	5680	152	7730	207	8760	235
		14	0.97			3390	90.9	5130	137	10,650	285	13,490	362		
		30	2.1			5130	137	8130	218	16,730	448				
		50	3.4			7120	191	11,990	321						
		150	10.3												
1 to 3.2 psig / 69 mbar to 0.22 bar 0.6 psig / 41 mbar Orange	3 psig / 0.21 bar	3	0.21									2550	68.3	3050	81.7
		7	0.48			1740	46.6	2600	69.7	4730	127	5880	158	7140	191
		14	0.97			3310	88.7	4180	112	770	206	10,450	280		
		30	2.1			5130	137	7930	213	14,480	388				
		50	3.4			7500	201	11,400	306						
		150	10.3			19,820	531								
2 to 5.5 psig / 0.14 to 0.38 bar 0.5 psig / 34 mbar Silver with green stripe	5 psig / 0.34 bar	10	0.69	590	15.8	950	25.5	1180	31.6	1810	48.5	2200	59.0	2370	63.5
		15	1.0	789	21.1	1030	27.6	1580	42.3	2370	63.5	2840	76.1	3310	88.7
		20	1.4	950	25.5	1380	37.0	2200	59.0	2920	78.3	2920	78.3		
		35	2.4	1420	38.1	1970	52.8	2920	78.3	4020	108				
		60	4.1	2210	59.2	2920	78.3	4730	127						
		75	5.2	2760	74.0	3470	93.0	5680	152						
		100	6.9	3550	95.1	5130	137								
2 to 5.5 psig / 0.14 to 0.38 bar 1 psig / 69 mbar Silver with green stripe	5 psig / 0.34 bar	10	0.69	950	25.5	1500	40.2	2050	54.9	4100	110	4100	110	4580	123
		15	1.0	1180	31.6	1890	50.7	2760	74.0	5520	148	5520	148	6310	169
		20	1.4	1380	37.0	2200	59.0	3790	102	6310	169	6310	169		
		35	2.4	1970	52.8	2050	54.9	5130	137						
		60	4.1	3160	84.7	5290	142	7890	207						
		75	5.2	4100	110	6390	171	10,260	275						
		100	6.9	5130	137	8680	233								
4 to 10 psig / 0.28 to 0.69 bar 1 psig / 69 mbar Silver	10 psig / 0.69 bar	15	1.0	708	19.0	1023	27.4	1338	35.9	2518	67.5	2518	67.5	2990	80.1
		20	1.4	944	25.3	1377	36.9	1967	52.7	3148	84.4	3148	84.4	4564	122
		25	1.7	1102	29.5	1652	44.3	2203	59.0	4013	108	4013	108		
		40	2.8	1810	48.5	2203	59.0	2912	78.0						
		60	4.1	2361	63.3	3148	84.4	4643	124						
		75	5.2	2754	73.8	3541	94.9	5666	152						
		100	6.9	3541	94.9	5193	139								
4 to 10 psig / 0.28 to 0.69 bar 2 psig / 0.14 bar Silver	10 psig / 0.69 bar	15	1.0	1023	27.4	1731	46.4	2518	67.5	4721	127	4721	127	6295	169
		20	1.4	1259	33.7	2125	57.0	3384	90.7	6295	169	6295	169	7869	211
		25	1.7	1574	42.2	2675	71.7	3777	101	7082	190	7082	190		
		40	2.8	2282	61.2	3934	105	5272	141						
		60	4.1	2990	80.1	5351	143	8656	232						
		75	5.2	4013	108	6531	175	10,230	274						
		100	6.9	5115	137	8656	232								

- Light shaded areas show where indicated droop would be exceeded regardless of capacity.
- Dark shaded areas show where maximum operating inlet pressure for a given orifice size is exceeded.
1. Spring ranges based on regulator installation with the spring case pointed down.

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Process Gas

Table 7. Capacities in SCFH / Nm³/h of Air - NPS 1-1/2 / DN 40 Body

OUTLET PRESSURE RANGE AND ACCURACY	OUTLET PRESSURE SETTING	INLET PRESSURE		ORIFICE SIZE, IN. / mm											
				1/4 / 6.4		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 3 in. w.c. / 2 to 7 mbar -1 to 2 in. w.c. / -2 to 5 mbar	1 in. w.c. / 2 mbar	2	0.14	355	9.51	955	25.6	1724	46.2	3231	86.6	4679	125	3595	96.3
		5	0.34	670	18.0	1537	41.2	2758	73.9	3822	102	3595	96.3	2797	75.0
		10	0.69	1015	27.2	2315	62.0	4147	111	3822	102	3595	96.3		
		20	1.4	1556	41.7	3566	95.6	4827	129	3645	97.7				
		40	2.8	2463	66.0	3566	95.6	4827	129						
		60	4.1	3359	90.0	3566	95.6								
		80	5.5	4255	114										
		100	6.9	4442	119										
		125	8.6	4442	119										
		150	10.3	4442	119										
	3 in. w.c. / 7 mbar	2	0.14	355	9.51	955	25.6	1724	46.2	3231	86.6	4679	125	3595	96.3
		5	0.34	670	18.0	1537	41.2	2758	73.9	3822	102	3595	96.3	2797	75.0
		10	0.69	1015	27.2	2315	62.0	4147	111	3822	102	3595	96.3		
		20	1.4	1556	41.7	3566	95.6	4827	129	3645	97.7				
		40	2.8	2463	66.0	3566	95.6	4827	129						
		60	4.1	3359	90.0	3566	95.6								
		80	5.5	4255	114										
		100	6.9	4442	119										
		125	8.6	4442	119										
		150	10.3	4442	119										
3 to 11 in. w.c. / 7 to 27 mbar -1 to 2 in. w.c. / -2 to 5 mbar	7 in. w.c. / 17 mbar	0.5	0.034							936	25.1	1162	31.1	1310	35.1
		1	0.069	325	8.71	621	16.6	857	23.0	1320	35.4	1783	47.8	2256	60.5
		2	0.14	463	12.4	936	25.1	1281	34.3	2226	59.7	3113	83.4	4659	125
		5	0.34	758	20.3	1556	41.7	2482	66.5	5979	160	6009	161	6009	161
		13	0.9	1251	33.5	2551	68.4	4827	129	6009	161	6009	161	6009	161
		25	1.7	1822	48.8	4039	108	6009	161	6009	161	6009	161		
		50	3.4	2994	80.2	6009	161	6009	161	6009	161	6009	161		
		100	6.9	5289	142	6009	161	6009	161	6009	161				
		150	10.3	6009	161	6009	161	6009	161						
0.7 to 2 psig / 48 to 138 mbar 0.2 psig / 14 mbar	1.5 psig / 103 mbar	2	0.14			777	20.8	1241	33.3	2019	54.1	2620	70.2	3172	85.0
		6	0.41			1714	45.9	2719	72.9	4659	125	6688	179	7417	199
		14	0.97			3109	83.3	4974	133	9328	250	12,313	330		
		30	2.1			4817	129	7929	212	13,160	353				
		50	3.4			7013	188	11,810	317						
		150	10.3			17,760	476								
1 to 3.2 psig / 69 to 221 mbar 0.6 psig / 41 mbar	3 psig / 207 mbar	3	0.21									2413	64.7	2797	75.0
		7	0.48			1527	40.9	2334	62.6	3891	104	5053	135	6217	167
		14	0.97			2334	62.6	3645	97.7	6915	185	7358	197		
		30	2.1			4433	119	7269	195	11,505	308				
		50	3.4			6915	185	10,589	284						
		150	10.3			16,991	455								
2 to 5.5 psig / 138 mbar to 0.4 bar 0.5 psig / 34 mbar	5 psig / 0.3 bar	2	0.14	355	9.51	955	25.6	1724	46.2	3231	86.6	4679	125	3595	96.3
		10	0.69	581	15.6	936	25.1	1162	31.1	1783	47.8	2167	58.1	2334	62.6
		15	1.0	777	20.8	1015	27.2	1556	41.7	2334	62.6	2797	75.0	3260	87.4
		20	1.4	936	25.1	1359	36.4	2167	58.1	2876	77.1	3260	87.4		
		35	2.4	1399	37.5	1940	52.0	2876	77.1	3960	106				
		60	4.1	2177	58.3	2876	77.1	4659	125						
		75	5.2	2719	72.9	3418	91.6	5595	150						
		100	6.9	3497	93.7	5053	135								
2 to 5.5 psig / 138 mbar to 0.4 bar 1 psig / 69 mbar	5 psig / 0.3 bar	10	0.69	936	25.1	1478	39.6	2019	54.1	3182	85.3	4039	108	4511	121
		15	1.0	1162	31.1	1862	49.9	2719	72.9	4039	108	5437	146	6215	167
		20	1.4	1359	36.4	2167	58.1	3733	100	5053	135	6215	167		
		35	2.4	1940	52.0	3260	87.4	5053	135	7614	204				
		60	4.1	3113	83.4	5211	140	7772	208						
		75	5.2	4039	108	6294	169	10,106	271						
		100	6.9	5053	135	8550	229								
4 to 10 psig / 276 mbar to 0.7 bar 1 psig / 69 mbar	10 psig / 0.7 bar	15	1.0	697	18.7	1008	27.0	1318	35.3	1783	47.8	2480	66.5	2945	78.9
		20	1.4	930	24.9	1356	36.3	1937	51.9	2558	68.6	3101	83.1	4496	120
		25	1.7	1085	29.1	1627	43.6	2170	58.2	3101	83.1	3953	106		
		40	2.8	1783	47.8	2170	58.2	2868	76.9	4650	125				
		60	4.1	2326	62.3	3101	83.1	4573	123						
		75	5.2	2713	72.7	3488	93.5	5581	150						
		100	6.9	3488	93.5	5115	137								
4 to 10 psig / 276 mbar to 0.7 bar 2 psig / 138 mbar	10 psig / 0.7 bar	15	1.0	1008	27.0	1705	45.7	2480	66.5	3566	95.6	4650	125	6201	166
		20	1.4	1240	33.2	2093	56.1	3333	89.3	5038	135	6201	166	7751	208
		25	1.7	1550	41.5	2635	70.6	3720	99.7	6356	170	6976	187		
		40	2.8	2248	60.2	3875	104	5193	139	8526	228				
		60	4.1	2945	78.9	5271	141	8526	228						
		75	5.2	3953	106	6433	172	10,077	270						
		100	6.9	5038	135	8526	228								

- Shaded areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

Process Gas

Table 8. Capacities in SCFH / Nm³/h of Air - NPS 2 / DN 50 Body

OUTLET PRESSURE RANGE AND ACCURACY	OUTLET PRESSURE SETTING	INLET PRESSURE		ORIFICE SIZE, IN. / mm											
				1/4 / 6.4		3/8 / 9.5		1/2 / 13		3/4 / 19		1 / 25		1-3/16 / 30	
		psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
1 to 3 in. w.c. / 2 to 7 mbar -1 to 2 in. w.c. / -2 to 5 mbar	1 in. w.c. / 2 mbar	2	0.14	315	8.44	916	24.5	1724	46.2	3940	106	4935	132	5841	157
		5	0.34	670	18.0	1537	41.2	2758	73.9	5959	160	4561	122	4196	112
		10	0.69	1015	27.2	2315	62.0	4147	111	3595	96.3	3999	107		
		20	1.4	1556	41.7	3566	95.6	3398	91.1	3595	96.3				
		40	2.8	2463	66.0	4354	117	3398	91.1						
		60	4.1	3359	90.0	4354	117								
		80	5.5	3595	96.3										
		100	6.9	3595	96.3										
		125	8.6	3595	96.3										
		150	10.3	3595	96.3										
	3 in. w.c. / 7 mbar	2	0.14	315	8.44	916	24.5	1724	46.2	3940	106	4935	132	5841	157
		5	0.34	670	18.0	1537	41.2	2758	73.9	5959	160	4561	122	4196	112
		10	0.69	1015	27.2	2315	62.0	4147	111	3595	96.3	3999	107		
		20	1.4	1556	41.7	3566	95.6	3398	91.1	3595	96.3				
		40	2.8	2463	66.0	4354	117	3398	91.1						
		60	4.1	3359	90.0	4354	117								
		80	5.5	3595	96.3										
		100	6.9	3595	96.3										
		125	8.6	3595	96.3										
		150	10.3	3595	96.3										
3 to 11 in. w.c. / 7 to 27 mbar -1 to 2 in. w.c. / -2 to 5 mbar	7 in. w.c. / 17 mbar	0.5	0.034							936	25.1	1162	31.1	1310	35.1
		1	0.069	325	8.71	621	16.6	857	23.0	1320	35.4	1783	47.8	2256	60.5
		2	0.14	463	12.4	936	25.1	1281	34.3	2226	59.7	3113	83.4	4659	125
		5	0.34	758	20.3	1556	41.7	2482	66.5	5989	161	7772	208	7772	208
		13	0.9	1251	33.5	2551	68.4	4827	129	7772	208	7772	208	7772	208
		25	1.7	1822	48.8	4039	108	7072	190	7772	208	7772	208		
		50	3.4	2994	80.2	6600	177	7772	208	7772	208	7772	208		
		100	6.9	5289	142	7772	208	7772	208	7772	208				
		150	10.3	7772	208	7772	208	7772	208						
6.5 in. w.c. to 1.2 psig / 16 to 83 mbar or 0.75 to 2 psig / 52 to 138 mbar 0.2 psig / 14 mbar	1 psig / 69 mbar	2	0.14			1015	27.2	1320	35.4	2413	64.7	3182	85.3	3339	89.5
		6	0.41			1940	52.0	2797	75.0	5595	150	7614	204	8629	231
		14	0.97			3339	89.5	5053	135	10,490	281	13,288	356		
		30	2.1			5053	135	8008	215	16,479	442				
		50	3.4			7013	188	11,810	317						
		150	10.3					18,035	483						
1 to 3.2 psig / 69 to 221 mbar 0.6 psig / 41 mbar	3 psig / 207 mbar	3	0.21									2512	67.3	3004	80.5
		7	0.48			1714	45.9	2561	68.6	4659	125	5792	155	7033	188
		14	0.97			3260	87.4	4117	110	7585	203	10,293	276		
		30	2.1			5053	135	7811	209	14,263	382				
		50	3.4			7388	198	11,229	301						
		150	10.3			19,523	523								
2 to 5.5 psig / 138 mbar to 0.4 bar 0.5 psig / 34 mbar	5 psig / 0.3 bar	10	0.69	581	15.6	936	25.1	1162	31.1	1783	47.8	2167	58.1	2334	62.6
		15	1.0	777	20.8	1015	27.2	1556	41.7	2334	62.6	2797	75.0	3260	87.4
		20	1.4	936	25.1	1359	36.4	2167	58.1	2876	77.1	2876	77.1		
		35	2.4	1399	37.5	1940	52.0	2876	77.1	3960	106				
		60	4.1	2177	58.3	2876	77.1	4659	125						
		75	5.2	2719	72.9	3418	91.6	5595	150						
		100	6.9	3497	93.7	5053	135								
2 to 5.5 psig / 138 mbar to 0.4 bar 1 psig / 69 mbar	5 psig / 0.3 bar	10	0.69	936	25.1	1478	39.6	2019	54.1	3182	85.3	4039	108	4511	121
		15	1.0	1162	31.1	1862	49.9	2719	72.9	4039	108	5437	146	6215	167
		20	1.4	1359	36.4	2167	58.1	3733	100	5053	135	6215	167		
		35	2.4	1940	52.0	2019	54.1	0553	135	7614	204				
		60	4.1	3113	83.4	5211	140	7772	208						
		75	5.2	4039	108	6294	169	10,106	271						
		100	6.9	5053	135	8550	229								
4 to 10 psig / 276 mbar to 0.7 bar 1 psig / 69 mbar	10 psig / 0.7 bar	15	1.0	697	18.7	1008	27.0	1318	35.3	1783	47.8	2480	66.5	2945	78.9
		20	1.4	930	24.9	1356	36.3	1937	51.9	2558	68.6	3101	83.1	4496	120
		25	1.7	1085	29.1	1627	43.6	2170	58.2	3101	83.1	3953	106		
		40	2.8	1783	47.8	2170	58.2	2868	76.9	4650	125				
		60	4.1	2326	62.3	3101	83.1	4573	123						
		75	5.2	2713	72.7	3488	93.5	5581	150						
		100	6.9	3488	93.5	5115	137								
4 to 10 psig / 276 mbar to 0.7 bar 2 psig / 138 mbar	10 psig / 0.7 bar	15	1.0	1008	27.0	1705	45.7	2480	66.5	3566	95.6	4650	125	6201	166
		20	1.4	1240	33.2	2093	56.1	3333	89.3	5038	135	6201	166	7751	208
		25	1.7	1550	41.5	2635	70.6	3720	99.7	6356	170	6976	187		
		40	2.8	2248	60.2	3875	104	5193	139	8526	228				
		60	4.1	2945	78.9	5271	141	8526	228						
		75	5.2	3953	106	6433	172	10,077	270						
		100	6.9	5038	135	8526	228								

- Shaded areas indicate where maximum operating inlet pressure for a given orifice is exceeded.

Y692VB Series
Vacuum Breaker

Introduction

The Y692VB Series vacuum breakers are used in applications where an increase in vacuum must be limited. An increase in vacuum (decrease in absolute pressure) beyond a certain value registers on the diaphragm of the Y692VB Series, moving the disk away from the seat. This permits atmosphere or a positive pressure to enter the system and restore the controlled vacuum to its original pressure setting. The Type Y692VBM has a control line connection and O-ring stem seal to block the throat for external pressure registration.

Body Sizes and End Connection Styles
See Table 1

Maximum Allowable Inlet (Positive) Pressure and Orifice Sizes
3/4 in. / 19 mm Orifice:
30 psig / 2.1 bar
1-3/16 in. / 30 mm Orifice:
13 psig / 0.89 bar

Maximum Casing Pressure
8 psig / 0.55 bar vacuum

Change in Vacuum Control Pressure to Wide-Open
See Table 3

Vacuum Control Pressure Ranges
See Table 3

Capacities
See Table 6

Flow Coefficients
See Table 4

Pressure Registration
Type Y692VB: Internal
Type Y692VBM: External

Spring Case Connection
3/4 NPT

Type Y692VB Gauge Tap Connection
1/4 NPT

Type Y692VBM Control Line Connection
1/2 NPT

Material Temperature Capabilities
Nitrile (NBR): -40 to 180°F / -40 to 82°C
Fluorocarbon (FKM):
40 to 300°F / 4 to 149°C
Ethylenepropylene (EPDM):
-20 to 200°F / -29 to 93°C
Perfluoroelastomer (FFKM):
0 to 300°F / -17 to 149°C
Silicone (VMQ):
-40 to 400°F / -40 to 204°C

Approximate Weights
Cast Iron:
45 lbs / 20 kg
Steel, Stainless Steel, and Hastelloy® C:
57 lbs / 26 kg

Ordering Guide
To order this product, contact your local Sales Office.

Application

Process Gas

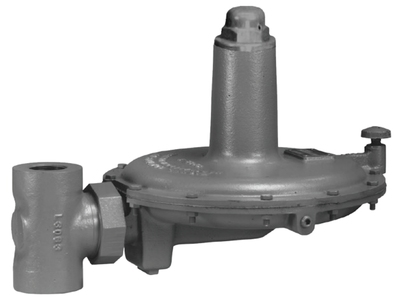

Figure 1. Type Y692VB Vacuum Breaker

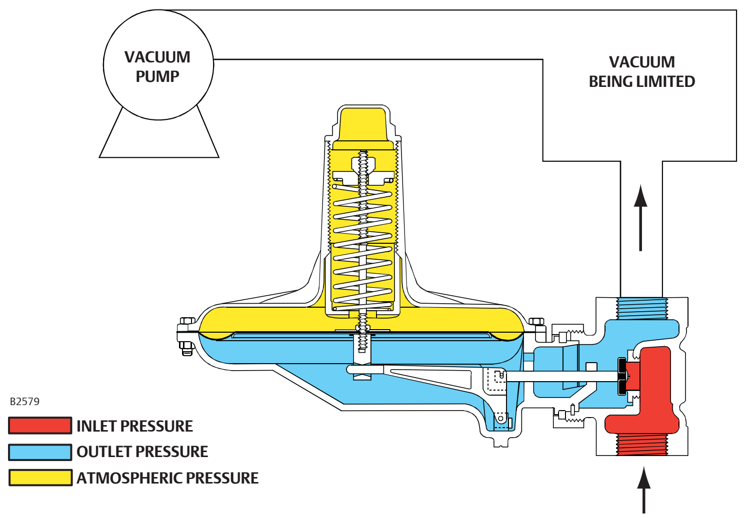

Figure 2. Type Y692VB Vacuum Breaker Operational Schematic

Features

- **Precision Control of Low-Pressure Settings**
- **Installation Adaptability**
- **Corrosion Resistance**
- **Tamper-Resistant Adjustment**

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

6/09

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Table 1. Body Sizes and End Connection Styles			
BODY SIZE, NPS / DN	CONSTRUCTION MATERIAL AND END CONNECTION STYLE[1]		
	Cast Iron	Steel or Stainless Steel	Hastelloy® C
1-1/2 / 40	NPT	NPT, SWE, CL150 RF, CL300 RF, or PN 16/25/40	NPT or CL150 RF
2 / 50	NPT or CL125 FF		

1. All flanges are welded on to the body and have a face-to-face dimension of 14 in. / 356 mm.

Table 2. Construction Materials

BODY	DIAPHRAGM CASING	SPRING CASE	DIAPHRAGM	TRIM	DISK
Cast iron, WCC Steel, CF8M Stainless steel, or Hastelloy® C	Cast iron, WCC Steel, CF8M Stainless steel, or Hastelloy® C	Cast iron, WCC Steel, Aluminum or CF8M Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (EPDM), or Silicone (VMQ)	302 Stainless steel, 316 Stainless steel, or Hastelloy® C	Nitrile (NBR), Fluorocarbon (FKM), Neoprene (CR), Polytetrafluoroethylene (PTFE), Ethylenepropylene (EPDM), or Perfluoroelastomer (FFKM)

Table 3. Vacuum Control Pressure Ranges and Spring Part Numbers

VACUUM CONTROL PRESSURE RANGE[1]	CHANGE IN VACUUM CONTROL PRESSURE TO REACH WIDE-OPEN	SPRING COLOR	SPRING WIRE DIAMETER
1 to 3 in. w.c. / 2 to 7 mbar[2] 1.5 to 5 in. w.c. / 4 to 12 mbar[2] 3 to 8 in. w.c. / 7 to 20 mbar[2]	1.2 in. w.c. / 3 mbar 2.2 in. w.c. / 5 mbar 4.0 in. w.c. / 10 mbar	Brown Unpainted Purple	0.109 in. / 2.77 mm 0.120 in. / 3.05 mm 0.148 in. / 3.76 mm
8 to 16 in. w.c. / 20 to 40 mbar 16 to 32 in. w.c. / 40 to 80 mbar 0.25 to 3 psig / 17 to 207 mbar	5.0 in. w.c. / 13 mbar 10.5 in. w.c. / 26 mbar 2 psig / 138 mbar	Gray Unpainted Black	0.156 in. / 3.96 mm 0.187 in. / 4.75 mm 0.275 in. / 6.99 mm

1. Pressure ranges are based on the spring case pointing up. Pointing the spring case down increases the pressure range 1.7 in. w.c. / 4 mbar. (Example: 1 to 3 in. w.c. / 2 to 7 mbar changes to 2.7 to 4.7 in. w.c. / 7 to 12 mbar).
2. Do not use Fluorocarbon (FKM) with these springs at diaphragm temperatures lower than 40°F / 4°C.

Table 4. Flow Coefficients

ORIFICE SIZE, IN. / mm	WIDE-OPEN C_g	WIDE-OPEN C_v	C_1	K_m
3/4 / 19 1-3/16 / 30	260 720	7.4 20.6	35 35	0.79

Table 5. IEC Sizing Coefficients

X_T	F_D	F_L
0.76	0.50	0.89

Table 6. Y692VB Series Capacities (based on atmospheric inlet pressure)

VACUUM CONTROL PRESSURE RANGE	VACUUM CONTROL PRESSURE SETTING	CHANGE IN VACUUM	MAXIMUM ALLOWABLE VACUUM PRESSURE	CAPACITIES IN. SCFH / Nm³/h OF AIR	
				3/4 in. / 19 mm Orifice	1-3/16 in. / 30 mm Orifice
1 to 3 in. w.c. / 2 to 7 mbar 1.5 to 5 in. w.c. / 4 to 12 mbar 3 to 8 in. w.c. / 7 to 20 mbar	2 in. w.c. / 5 mbar 4 in.w.c. / 10 mbar 7 in. w.c. / 17 mbar	1 in. w.c. / 2 mbar 1 in. w.c. / 2 mbar 1 in. w.c. / 2 mbar	8 psig / 0.55 bar	500 / 13.4 700 / 18.8 900 / 24.1	1000 / 26.8 1400 / 37.5 1800 / 48.2
8 to 16 in. w.c. / 20 to 40 mbar 16 to 32 in. w.c. / 40 to 80 mbar 0.25 to 3 psig / 17 to 207 mbar	14 in. w.c. / 35 mbar 28 in. w.c. / 70 mbar 2 psig / 138 mbar	2 in. w.c. / 5 mbar 6 in. w.c. / 15 mbar 0.4 psig / 28 mbar		900 / 24.1 1000 / 26.8 1300 / 34.8	1800 / 48.2 1900 / 50.9 2500 / 67.0

To determine equivalent capacities of 0.6 specific gravity natural gas, propane, butane, or nitrogen, multiply the calculated capacity by the following appropriate conversion factor: 1.29 for 0.6 natural gas, 0.810 for propane, 0.707 for butane, or 1.018 for nitrogen. For gases of other specific gravities, divide by the square root of the appropriate specific gravity. Then, if capacity is desired in Nm³/h at 0°C and 1.01325 bar, multiply SCFH by 0.0268.

Type Y693
Tank Blanketing Regulator

Introduction

An Accu-Pressure™ Gas Blanketing Regulator System reduces a high-pressure gas, such as Nitrogen, to maintain a protective environment above any liquid stored in a tank or vessel when the liquid is being pumped out. Also when the vessel is suddenly cooled, causing vapors inside the vessel to contract, the regulator system replaces the volume of contracting vapors with a volume of blanketing gas to prevent the internal vessel pressure from decreasing. In both cases, a slight positive vessel pressure prevents outside air, moisture and other contaminants from entering the vessel and the possible collapse of the vessel walls.

The Type Y693 is a direct-operated regulator used for accurate pressure control on low pressure blanketing systems. Downstream pressure is sensed through an external control line in the lower casing of the regulator.

Body Sizes and End Connection Styles
See Table 1

Maximum Inlet Pressure
150 psig / 10.3 bar

Maximum Outlet Pressure
10 psig / 0.69 bar

Maximum Outlet Pressure (Casing)
15 psig / 1.0 bar

Maximum Operating Outlet Pressure to Avoid Internal Part Damage
2 psig / 0.14 bar above outlet pressure setting

Construction Materials
See Table 2

Outlet Pressure Ranges
See Table 3

Material Temperature Capabilities
Nitrile (NBR): -20 to 180°F / -29 to 82°C
Fluorocarbon (FKM): 40 to 300°F / 4 to 149°C
PTFE: 0 to 300°F / -18 to 149°C

Flow Coefficients
Wide-Open C_g: 185
Wide-Open C_v: 5.6
C_1: 33
K_m: 0.79

IEC Sizing Coefficients
X_T: 0.69
F_D: 0.50
F_L: 0.89

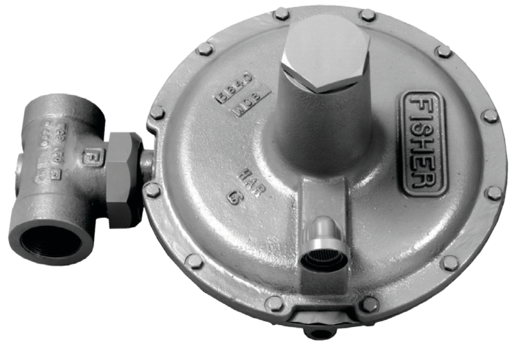

Figure 1. Type Y693 Tank Blanketing Regulator

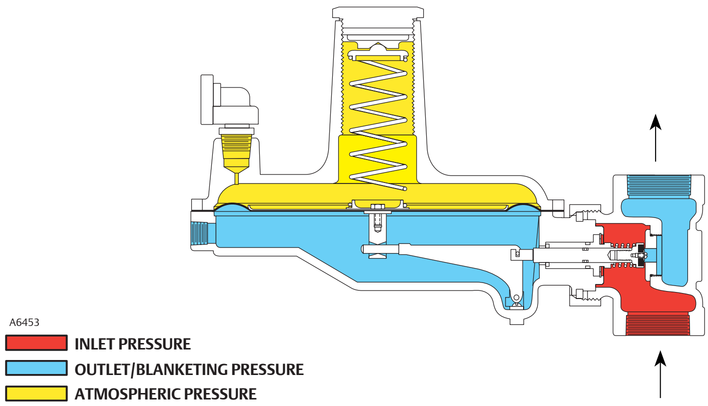

Figure 2. Type Y693 Operational Schematic

Flow Capacities
See Table 4

Spring Case Connection
3/4 NPT female connection

Approximate Weights
Cast iron with Aluminum: 22 lbs / 10 kg
WCC Steel or CF8M Stainless steel: 57 lbs / 26 kg
WCC Steel with Aluminum: 35 lbs / 16 kg

Orifice Diameter
1/2 in. / 13 mm

Ordering Guide
To order this product, contact your local Sales Office.

Application

- Tank Blanketing

Features

- Ease of Inspection and Maintenance
- Accuracy of Control
- Inlet Pressure Sensitivity
- Speed of Response
- Variety of Materials
- Outlet Pressure Stability
- Tight Shutoff Capability

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Body Sizes and End Connection Styles

BODY SIZE		BODY MATERIAL	
In.	DN	Cast Iron	Steel or Stainless Steel
1-1/2	40	NPT	NPT, CL150 RF, CL300 RF or PN 16/25/40
2	50	NPT or CL125 FF	

Table 2. Type Y693 Regulator Construction Materials

PART NAME	MATERIAL	
	Aluminum Lower Casing Version	Steel or Stainless Steel Lower Casing Version
Body	Cast iron	WCB steel or Stainless steel
Body Gasket	Composition	Composition
Union Nut	- - - -	Steel or Stainless steel
Spring case	Aluminum	Aluminum, WCB steel or Stainless steel
Lower casing	Aluminum	WCB steel or Stainless steel
Orifice and bias spring	Stainless steel	Stainless steel
Pusher post and stem	Aluminum	Stainless steel
Lever assembly	Steel	Stainless steel
Diaphragm	Nitrile (NBR) or Fluorocarbon (FKM)	Nitrile (NBR) or Fluorocarbon (FKM)
Control spring, spring seat and split ring	Plated steel	Plated steel
Diaphragm plate	Aluminum and Steel	Aluminum and Steel
Disk and O-rings	Nitrile (NBR) and Stainless steel, Fluorocarbon (FKM) and Stainless steel, PTFE and Stainless steel	Nitrile (NBR) and Stainless steel or Fluorocarbon (FKM) and Stainless steel or PTFE and Stainless steel

Table 3. Outlet (Control) Pressure Ranges

DIAPHRAGM PLATE	OUTLET PRESSURE RANGES[1]		COLOR CODE	CONTROL SPRING WIRE DIAMETER		CONTROL SPRING FREE LENGTH	
	In. w.c.	mbar		In.	mm	In.	mm
Light diaphragm plate	0.5 to 2.0 2 to 5 5 to 8 8 to 18 18 to 32	1.2 to 5 5 to 12 12 to 20 20 to 45 45 to 80	Brown Red Black White Stripe Green	0.109 0.120 0.130 0.156 0.182	2.77 3.05 3.30 3.96 4.62	6.12 7.531 7.88 7.50 7.25	155 191 200 190 184
Heavy diaphragm plate	1 to 2 psig 1.5 to 3.3 psig 2 to 5 psig	0.07 to 0.14 bar 0.10 to 0.23 bar 0.14 to 0.34 bar	Blue Orange Yellow	0.225 0.250 0.283	5.72 6.35 7.19	7.093 6.91 6.50	176 180 165
Heavy diaphragm plate with brass closing cap and heavy duty spring adjustor	2 to 5.5 psig 4 to 10 psig	0.14 to 0.38 bar 0.28 to 0.69 bar	Green Stripe Red	0.363 0.406	9.22 10.3	6.00 6.00	152 152

1. Outlet pressure ranges are for installations with the spring barrel positioned in any direction. After installation always check/adjust the pressure setting.

Table 4. Typical Type Y693 Blanketing Regulator Capacities in SCFH / Nm³/h of 0.97 Specific Gravity Nitrogen

SPRING RANGE AND COLOR	CONTROL PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.97 SPECIFIC GRAVITY NITROGEN FOR 1-1/2 AND 2 IN. / DN 40 AND 50 BODIES WITH A 1/2 IN. / 13 mm ORIFICE					
					Deviation from Setpoint					
					±0.5 In. w.c. / ±1 mbar		-0.5 to 1 In. w.c. / -1 to 2 mbar		-0.5 to 2 In. w.c. / -1 to 5 mbar	
	In. w.c.	mbar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
0.5 to 2 in. w.c. / 1 to 5 mbar Brown	0.5[1]	1[1]	2 5 10 20 40 60 80 100 125 150	0.14 0.34 0.69 1.4 2.8 4.1 5.5 6.9 8.6 10.3	750 1570 2500 5000 8800 12,100 7100 7100 7100 7100	20.1 42.1 67.0 134 236 324 190 190 190 190	750 1570 2500 5000 8800 12,100 15,400 15,200 14,200 12,200	20.1 42.1 67.0 134 236 324 413 407 381 327	750 1570 2500 5000 8800 12,100 15,400 18,600 22,700 26,700	20.1 42.1 67.0 134 236 324 413 498 608 716

1. For set pressures less than 1 in. w.c. / 2 mbar use only Nitrile (NBR) elastomers.

-continued-

Table 4. Typical Type Y693 Blanketing Regulator Capacities in SCFH / Nm³/h of 0.97 Specific Gravity Nitrogen (continued)

SPRING RANGE AND COLOR	CONTROL PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.97 SPECIFIC GRAVITY NITROGEN FOR 1-1/2 AND 2 IN. / DN 40 AND 50 BODIES WITH A 1/2 IN. / 13 mm ORIFICE					
					Deviation from Setpoint					
					±0.5 In. w.c. / ±1 mbar		±1 In. w.c. / ±2 mbar		-1 to 2 In. w.c. / -2 to 5 mbar	
	In. w.c.	mbar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
0.5 to 2 in. w.c. / 1 to 5 mbar Brown	1	2	2 5 10 20 40 60 80 100 125 150	0.14 0.34 0.69 1.4 2.8 4.1 5.5 6.9 8.6 10.3	750 1570 2500 5000 8800 12,100 7100 7100 7100 7100	20.1 42.1 67.0 134 236 324 190 190 190 190	1270 2280 3400 5200 8800 12,100 15,400 15,200 14,200 12,200	34.0 61.1 91.1 139 236 324 413 407 381 327	1270 2280 3400 5200 8800 12,100 15,400 18,600 22,700 26,700	34.0 61.1 91.1 139 236 324 413 498 608 716
2 to 5 in. w.c. / 5 to 12 mbar Red	3	7	2 5 10 20 40 60 80 100 125 150	0.14 0.34 0.69 1.4 2.8 4.1 5.5 6.9 8.6 10.3	750 1570 2500 5000 8800 12,100 11,200 11,200 11,200 11,200	20.1 42.1 67.0 134 236 324 300 300 300 300	1270 2280 3400 5200 8800 12,100 15,400 14,200 14,200 14,200	34.0 61.1 91.1 139 236 324 413 381 381 381	1270 2280 3400 5200 8800 12,100 15,400 18,600 22,700 26,700	34.0 61.1 91.1 139 236 324 413 498 608 716
5 to 8 in. w.c. / 12 to 20 mbar Black	7	17	2 5 10 20 40 60 80 100 125 150	0.14 0.34 0.69 1.4 2.8 4.1 5.5 6.9 8.6 10.3	710 1370 2110 3050 5580 10,200 14,200 18,600 11,200 11,200	19.0 36.7 56.5 81.7 150 273 381 498 300 300	1070 2030 3130 4260 8020 11,500 15,400 18,600 22,700 26,700	28.7 54.4 83.9 114 215 308 413 498 608 716	1070 2030 3130 4260 8020 11,500 15,400 18,600 22,700 26,700	28.7 54.4 83.9 114 215 308 413 498 608 716

Table 4. Typical Type Y693 Blanketing Regulator Capacities in SCFH / Nm³/h of 0.97 Specific Gravity Nitrogen (continued)

SPRING RANGE AND COLOR	CONTROL PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.97 SPECIFIC GRAVITY NITROGEN FOR 1-1/2 AND 2 IN. / DN 40 AND 50 BODIES WITH A 1/2 IN. / 13 mm ORIFICE			
					Deviation from Setpoint			
					±1 In. w.c. / ±2 mbar		±2 In. w.c. / ±5 mbar	
	In. w.c.	mbar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h
8 to 18 in. w.c. / 20 to 45 mbar Gray	11	27	2 5 10 20 40 60 80 100 125 150	0.14 0.34 0.69 1.4 2.8 4.1 5.5 6.9 8.6 10.3	660 1270 2130 3050 7110 9540 13,200 18,600 22,700 26,700	17.7 34.0 57.1 81.7 191 256 354 498 608 716	1020 1830 2840 4060 7610 12,100 15,400 18,600 22,700 26,700	27.3 49.0 76.1 109 204 324 413 498 608 716
					Deviation from Setpoint			
					±1 In. w.c. / ±2 mbar		±2 In. w.c. / ±5 mbar	
					SCFH	Nm³/h	SCFH	Nm³/h
18 to 32 in. w.c. / 45 to 80 mbar Dark green	20	50	2 5 10 20 40 60 80 100 125 150	0.14 0.34 0.69 1.4 2.8 4.1 5.5 6.9 8.6 10.3	590 810 1100 1520 2740 4060 6600 9140 22,700 26,700	15.8 21.7 29.5 40.7 73.4 109 177 245 608 716	710 1420 1830 3050 6090 10,200 15,400 18,600 22,700 26,700	19.0 38.1 49.0 81.7 163 273 413 498 608 716

-continued-

Table 4. Typical Type Y693 Blanketing Regulator Capacities in SCFH / Nm³/h of 0.97 Specific Gravity Nitrogen (continued)

SPRING RANGE AND COLOR	CONTROL PRESSURE SETTING		INLET PRESSURE		CAPACITIES IN SCFH / Nm³/h OF 0.97 SPECIFIC GRAVITY NITROGEN FOR 1-1/2 AND 2 IN. / DN 40 AND 50 BODIES WITH A 1/2 IN. / 13 mm ORIFICE			
					Deviation from Setpoint			
					±0.1 In. w.c. / ±0.007 mbar		±0.2 In. w.c. / ±0.014 mbar	
	psig	mbar	psig	bar	SCFH	Nm³/h	SCFH	Nm³/h
1 to 2 psig / 69 to 138 mbar Dark blue	1	69	2 5 10 20 40 60 80 100	0.14 0.34 0.69 1.4 2.8 4.1 5.5 6.9	250 1100 1780 2640 4470 6500 9140 10,400	6.70 29.5 47.7 70.8 120 174 245 279	860 1830 2940 4870 8120 11,100 15,400 18,600	23.0 49.0 78.8 131 218 297 413 498
					Deviation from Setpoint			
					±0.3 In. w.c. / ±0.021 mbar		±0.6 In. w.c. / ±0.041 mbar	
					SCFH	Nm³/h	SCFH	Nm³/h
1.5 to 3.3 psig / 103 to 228 mbar Orange	3	0.21 bar	5 10 20 40 60 80 100	0.34 0.69 1.4 2.8 4.1 5.5 6.9	1220 2540 3860 7100 9340 13,200 15,800	32.7 68.1 103 190 250 354 423	1730 3400 5200 8880 12,100 15,400 18,600	46.4 91.1 139 238 324 413 498
					Deviation from Setpoint			
					±0.5 In. w.c. / ±1 mbar		±1 In. w.c. / ±2 mbar	
					SCFH	Nm³/h	SCFH	Nm³/h
2 to 5 psig / 138 mbar to 0.3 bar Yellow	3	0.21	7 10 20 40 60 80 100	0.48 0.69 1.4 2.8 4.1 5.5 6.9	1400 2330 4060 6900 9740 12,800 15,200	37.5 62.4 109 185 261 343 407	2200 3050 5200 8880 12,100 15,400 18,600	59.0 81.7 139 238 324 413 498
					Deviation from Setpoint			
					±0.6 In. w.c. / ±1 mbar		±1 In. w.c. / ±2 mbar	
					SCFH	Nm³/h	SCFH	Nm³/h
2 to 5.5 psig / 138 mbar to 0.4 bar Green Stripe	5	0.35	7 10 20 40 60 80 100	0.48 0.69 1.4 2.8 4.1 5.5 6.9	1200 1420 2440 4260 5890 7510 9140	32.2 38.1 65.4 114 158 201 245	1600 2230 3760 6290 8730 11,400 14,200	42.9 59.8 101 169 234 306 381
					Deviation from Setpoint			
					±0.6 In. w.c. / ±1 mbar		±2 In. w.c. / ±5 mbar	
					SCFH	Nm³/h	SCFH	Nm³/h
4 to 10 psig / 276 mbar to 0.7 bar Silver	10	0.69	15 20 40 60 80 100	1.0 1.4 2.8 4.1 5.5 6.9	1600 2030 3650 5080 6500 7920	42.9 54.4 97.8 136 174 212	2600 3500 6680 9300 11,900 14,900	69.7 93.8 179 249 319 399

Introduction

The Accu-Pressure™ Type Y696 is a direct-operated vapor recovery regulator. Type Y696 is available in two configurations, internal registration and external registration which requires control line. This regulator is used to sense an increase vessel pressure and vent excessive internal tank pressure to an appropriate vapor recovery disposal or reclamation system.

Body Size and End Connection Style

See Table 1

Construction Materials

See Table 2

Maximum Allowable Inlet and Outlet Pressure

15 psig / 1.0 bar

Orifice Diameter

1 in. / 25 mm

Control Pressure Ranges

See Table 3

Flow Capacities

See Table 4

Wide-Open Flow Coefficients

C_V: 14.7
C_g: 515
C_1: 35

Pressure Registration

Internal or External

Vent Connections

1/4 NPT

Spring Case Connection

1/4 NPT

Temperature Capabilities

Nitrile (NBR):
-20 to 180°F / -29 to 82°C
Fluorocarbon (FKM):
40 to 300°F / 4 to 149°C
Perfluoroelastomer (FFKM):
0 to 300°F / -18 to 149°C
Ethylenepropylene (EPDM):
-20 to 275°F / -29 to 135°C

Applications

- Process Gas
- Vapor Recovery

Figure 1. Type Y696 Vapor Recovery Regulator

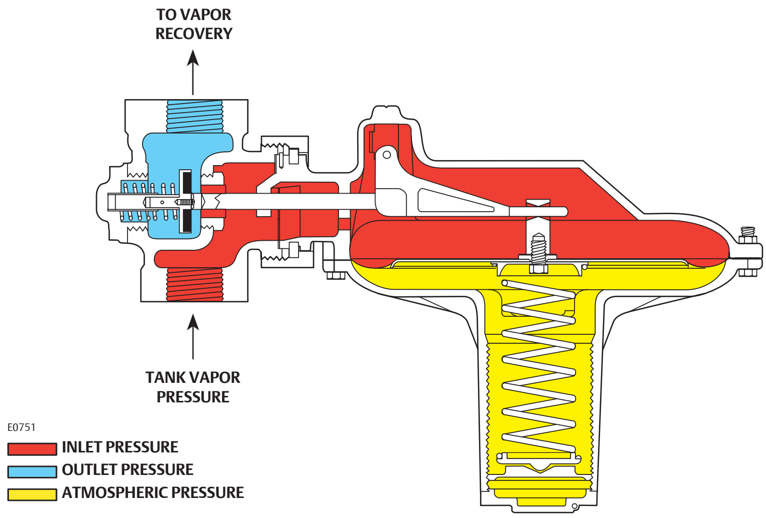

Figure 2. Type Y696 Vapor Recovery Regulator Operational Schematic

Approximate Weight

Cast iron: 45 lbs / 20 kg
Steel and Stainless Steel: 57 lbs / 26 kg

Features

- Simplicity
- Precision Control
- Rugged Construction
- Ease of Inspection and Maintenance
- Variety of Construction Materials

Ordering Guide

To order this product, contact your local Sales Office.

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Table 1. Body Sizes and End Connection Style(1)				
BODY SIZE, NPS / DN	BODY MATERIAL			
	Cast Iron	Steel	Stainless Steel	Hastelloy® C
1-1/2 and 2 / 40 and 50	NPT	NPT, SWE, CL150 RF, CL300 RF, PN 16/25/40	NPT, SWE, CL150 RF, CL300 RF, PN 16/25/40	CL150 RF

1. End connections for other than U.S. standard can usually be provided, consult your local Sales Office.

Table 2. Construction Materials					
BODY	SPRING CASE	DIAPHRAGM CASE	TRIM	DIAPHRAGM	DISK
Cast iron, CF8M Stainless steel or Hastelloy® C	Cast iron, Steel or CF8M Stainless steel	Cast iron, Steel, CF8M Stainless steel or Hastelloy® C	302 Stainless steel, 316 Stainless steel or Hastelloy® C	Nitrile (NBR) (standard), Fluorocarbon (FKM) or Ethylenepropylene (EPDM)	Nitrile (NBR), Fluorocarbon (FKM), Perfluoroelastomer (FFKM), PTFE, or Ethylenepropylene (EPDM)

Table 3. Control Pressure Ranges						
CONTROL PRESSURE RANGE		SPRING COLOR	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
In. w.c.	mbar		In.	mm	In.	mm
2 to 5(1)(2) 5 to 15(1)(2) 8 in. w.c. to 1 psig	5 to 12(1)(2) 12 to 37(1)(2) 20 to 69	Red Gray Dark Green	0.135 0.156 0.187	3.43 3.96 4.75	5.38 6.63 6.00	137 168 152
1 to 2.8 psig 2 to 3.5 psig 4 to 7 psig	69 mbar to 0.19 bar 0.14 to 0.24 bar 0.28 to 0.48 bar	Orange Green stripe Red	0.250 0.363 0.406	6.35 9.22 10.3	6.00 6.00 6.00	152 152 152

1. Spring ranges based on spring case installed pointed down. When installed pointed up, spring range increases 2 in. w.c. / 5 mbar.
2. Do not use Fluorocarbon (FKM) diaphragm with these springs at diaphragm temperatures lower than 60°F / 16°C.

Vapor Recovery

Table 4. Capacities								
CONTROL PRESSURE RANGE AND COLOR	SET PRESSURE		BUILDUP TO OBTAIN WIDE-OPEN TRAVEL		OUTLET PRESSURE VACUUM		CAPACITIES IN SCFH / Nm³/h OF 0.97 SPECIFIC GRAVITY NITROGEN	
	In. w.c.	mbar	In. w.c.	mbar	psig	bar	SCFH	Nm³/h
2 to 5 in. w.c. / 5 to 12 mbar Red	2	5	2.6	6	0 2.5 5	0 0.17 0.34	1420 5130 6560	38.1 137 176
	4	10	2.6	6	0 2.5 5	0 0.17 0.34	1680 5200 6600	45.0 139 177
5 to 15 in. w.c. / 12 to 37 mbar Gray	15	37	3.9	10	0 2.5 5	0 0.17 0.34	2810 5580 6850	75.3 150 184
8 in. w.c. to 1 psig / 20 to 69 mbar Dark Green	21	52	7.7	19	0 2.5 5	0 0.17 0.34	3510 5950 7160	94.1 159 192
1 to 2.8 psig / 69 mbar to 0.19 bar Orange	2 psig	0.14 bar	23	57	0 2.5 5	0 0.17 0.34	5820 7410 8340	156 199 224
2 to 3.5 psig / 0.14 to 0.24 bar Green Stripe	3 psig	0.21 bar	3.2 psig	0.22 bar	0 2.5 5	0 0.17 0.34	8790 9770 10,400	236 262 279
4 to 7 psig / 0.28 to 0.48 bar Red	5 psig	0.34 bar	5.87 psig	0.41 bar	0 2.5 5	0 0.17 0.34	12,000 12,700 13,100	322 340 351

Process Gas

Table 4 gives typical nitrogen regulating capacities at selected inlet pressures and control pressure settings. Flows are in SCFH (at 60°F and 14.7 psia) and Nm³/h (at 0°C and 1.01325 bar) of 0.97 specific gravity nitrogen. For gases of other specific gravities, multiply the given SCFH capacity of nitrogen by 0.985 and divide by the square root of the appropriate specific gravity of the gas required. Then, if capacity is desired in Nm³/h, multiply SCFH by 0.0268.

Introduction

The Y696VR Series are direct-operated vacuum regulators used where a decrease in vacuum (increase in absolute pressure) must be limited, such as between a tank and vacuum source to control vacuum in the tank. The Type Y696VR has internal pressure registration. The Type Y696VRM has a control line connection port and blocked throat for external pressure registration.

Body Sizes and End Connection Styles

See Table 1

Construction Materials

See Table 2

Maximum Allowable Emergency Inlet (Casing) Pressure

±15 psig / ±1.03 bar

Maximum Allowable Pressure without Internal Parts Damage

±8 psig / ±0.55 bar

Maximum Downstream Pressure

Full Vacuum

Wide-Open Flow Coefficients

C_g: 515; **C_v:** 14.7; **C_1:** 35

Vacuum Control Pressure Ranges

See Table 3

Capacities

See Table 4

Spring Case Connection

3/4 NPT

Control Line Connection

1/2 NPT

Gauge Tap Connection

1/4 NPT

Pressure Registration

Type Y696VR: Internal
Type Y696VRM: External

Material Temperature Capabilities

Nitrile (NBR): -40 to 180°F / -40 to 82°C
Fluorocarbon (FKM):
40 to 300°F / 4 to 149°C
Ethylenepropylene (EPDM):
-20 to 200°F / -29 to 93°C
Perfluoroelastomer (FFKM):
0 to 300°F / -18 to 149°C
Silicone (VMQ):
-40 to 400°F / -40 to 204°C

Figure 1. *Type Y696VR Vacuum Regulator*

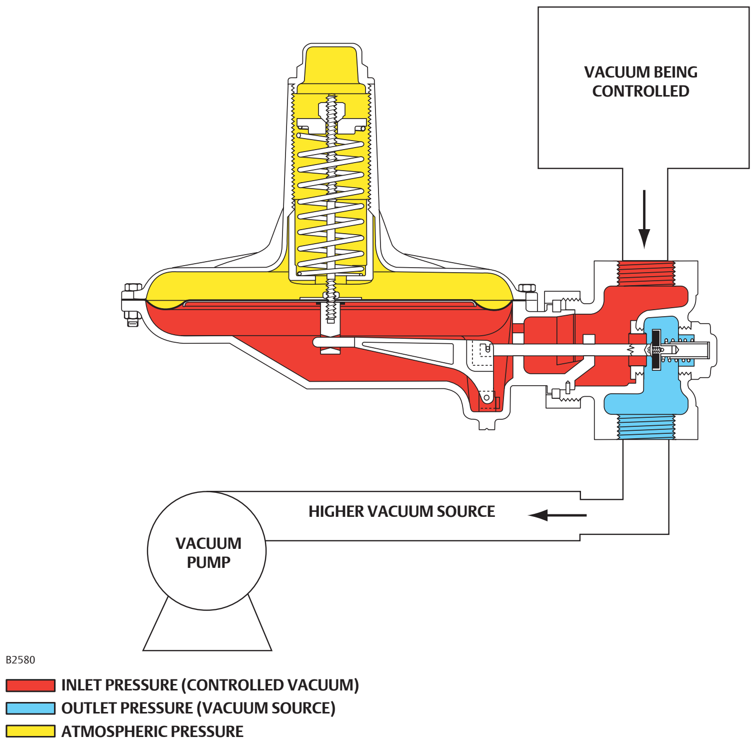

Figure 2. *Type Y696VR Operational Schematic*

Ordering Guide

To order this product, contact your local Sales Office.

Additional Technical Data

Link directly to more information on this product. **Click** on the QR code or **scan** with your smart phone.

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Application

- Process Gas

Features

- Precision Control of Low Pressure Settings
- Installation Adaptability
- Corrosion Resistance

Table 1. Body Sizes and End Connection Styles[1]

BODY SIZE, IN. / DN	CONSTRUCTION MATERIAL AND END CONNECTION STYLE[2]		
	Cast Iron	Steel or Stainless Steel	Hastelloy® C
1-1/2 / 40 2 / 50	NPT	NPT, SWE, CL150 RF, CL300 RF or PN 16/25/40	CL150 RF

1. End connections for other than U.S. standards can usually be provided; consult the local Sales Office.
2. All flanges are welded on to the body and have a face-to-face dimension of 14 in. / 356 mm.

Table 2. Construction Materials

BODY	DIAPHRAGM CASE	SPRING CASE	DIAPHRAGM	TRIM	DISK
Cast iron, WCC Steel (NACE), CF8M Stainless steel (NACE) or Hastelloy® C	Cast iron, WCC Steel (NACE), CF8M Stainless steel or Hastelloy® C	Cast iron, WCC Steel, Aluminum or CF8M Stainless steel	Nitrile (NBR), Fluorocarbon (FKM), Ethylenepropylene (EPDM) or Silicone (VMQ)	302 Stainless steel **(standard)**, 316 Stainless steel (NACE) or Hastelloy® C	Nitrile (NBR), Fluorocarbon (FKM) **(standard)**, Perfluoroelastomer (FFKM), Neoprene (CR), Polytetrafluoroethylene (PTFE) or Ethylenepropylene (EPDM)

Table 3. Vacuum Control Pressure Ranges

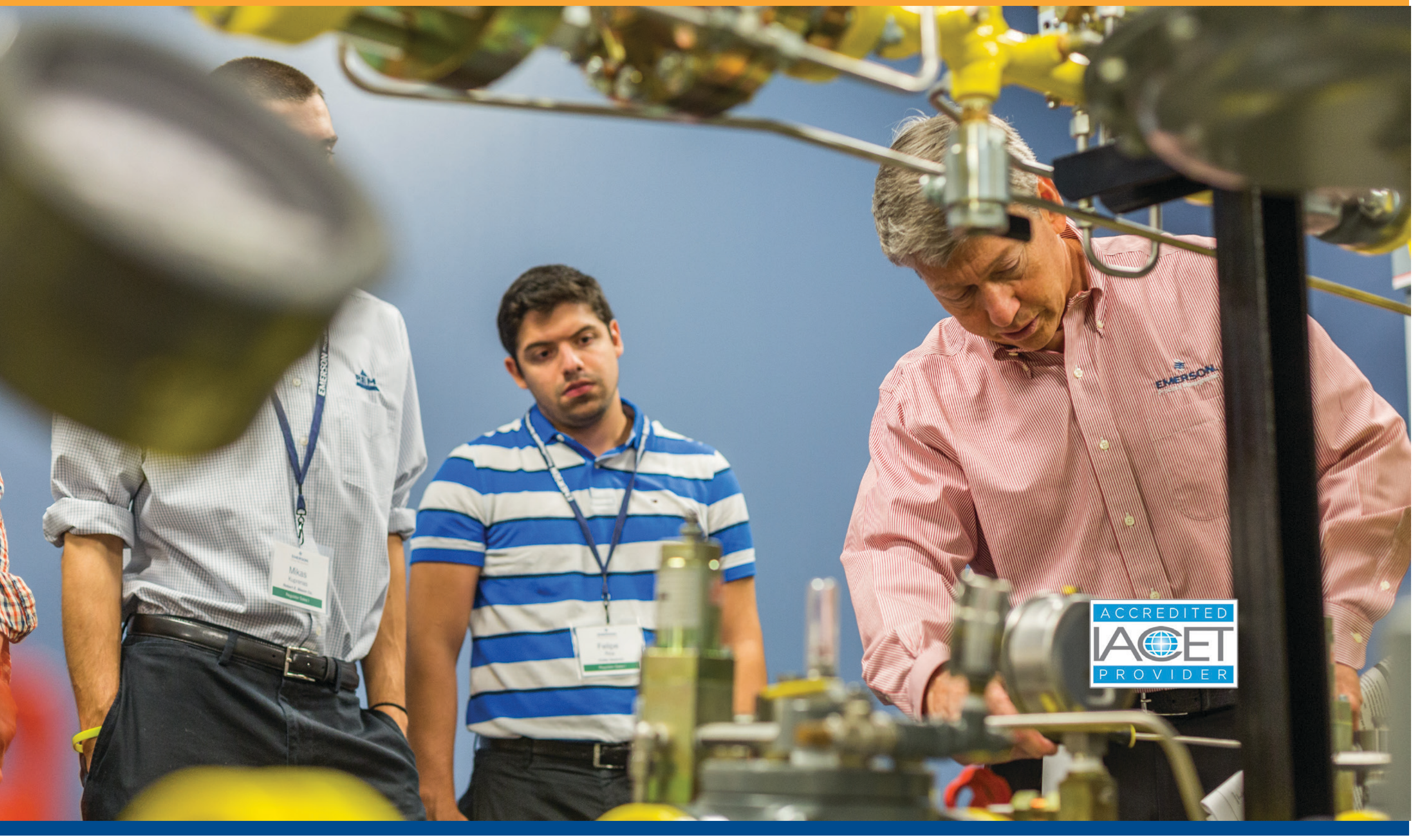
VACUUM CONTROL PRESSURE RANGE[1]		CHANGE IN VACUUM CONTROL PRESSURE TO REACH WIDE-OPEN		SPRING COLOR	SPRING WIRE DIAMETER	
In. w.c.	mbar	In. w.c.	mbar		In.	mm
1 to 3[2] 1-1/2 to 5[2] 3 to 8[2]	2 to 7[2] 4 to 12[2] 7 to 20[2]	1.5 2 3	4 5 7	Brown Unpainted Purple	0.109 0.120 0.148	2.77 3.05 3.76
8 to 16 16 to 32 0.25 to 3 psig	20 to 40 40 to 80 17 to 207	4 7 1.2 psig	10 17 83	Gray Unpainted Black	0.156 0.187 0.275	3.96 4.75 6.99

1. Pressure ranges are based on the spring case pointing up. Pointing the spring case down increases the pressure range 1.7 in. w.c. / 4.2 mbar. (Example: 1 to 3 in. w.c. / 2.5 to 7.5 mbar changes to 2.7 to 4.7 in. w.c. / 6.7 to 11.7 mbar.
2. Do not use Fluorocarbon (FKM) diaphragm with these springs at diaphragm temperatures lower than 40°F / 4°C.

Table 4. Y696VR Series Capacities

VACUUM CONTROL PRESSURE RANGE		VACUUM CONTROL PRESSURE SETTING		CHANGE IN VACUUM CONTROL PRESSURE TO REACH WIDE-OPEN		CAPACITIES OF AIR		DOWNSTREAM VACUUM	
In. w.c.	mbar	In. w.c.	mbar	In. w.c.	mbar	SCFH	Nm³/h	psig vacuum	bar vacuum
1 to 3 1-1/2 to 5 3 to 8	2 to 7 4 to 12 7 to 20	3 5 8	7 12 20	1.5 2 3	4 5 7	6953 6920 6876	186 185 184	7	0.48
8 to 16 16 to 32 0.25 to 3 psig	20 to 40 40 to 80 17 to 207	16 24 2 psig	40 60 138	4 7 1.2 psig	10 17 83	6722 6612 6496	180 177 174		

Educational Services



The need for training is more critical than ever to achieving and maintaining cost-effective operations.

Emerson's Educational Services offers various courses and other training programs to provide the knowledge and skills to operate, maintain and manage pressure regulators and systems within customers' operations. Through a mixture of theoretical and practical applications, training program participants learn the fundamentals of and advancements in, pressure control and regulator operations and maintenance.

Whether it is classroom-based training, web-based discussions or eLearning programs, Emerson works hard to ensure customers know how to get the best from their entire process and operation.

For more information, contact Educational Services.

Educational Services

Tel: 972-548-3534

Email: Education.Regulators@Emerson.com

Technical

The Technical Reference section includes articles covering regulator theory, sizing, selection, overpressure protection and other topics relating to regulators.
This section begins with the basic theory of regulators and ends with conversion tables and other informative charts.

This section is for general reference only. For additonal information please contact your local Sales Office.

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Glossary

Fundamentals of Gas Pressure Regulators

The primary function of any gas regulator is to match the flow of gas through the regulator to the demand for gas placed upon the system. At the same time, the regulator must maintain the system pressure within certain acceptable limits.

A typical gas pressure system might be similar to that shown in Figure 1, where the regulator is placed upstream of the valve or other device that is varying its demand for gas from the regulator.

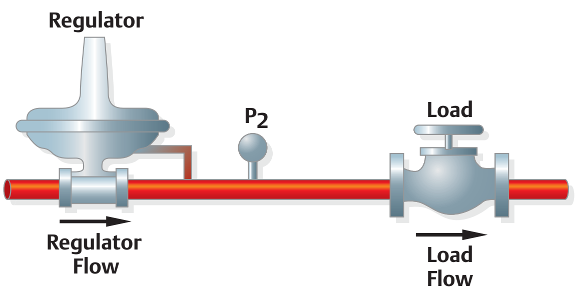


Figure 1

If the load flow decreases, the regulator flow must decrease also. Otherwise, the regulator would put too much gas into the system and the pressure (P_2) would tend to increase. On the other hand, if the load flow increases, then the regulator flow must increase also in order to keep P_2 from decreasing due to a shortage of gas in the pressure system.

From this simple system, it is easy to see that the prime job of the regulator is to put exactly as much gas into the piping system as the load device takes out.

If the regulator were capable of instantaneously matching its flow to the load flow, then we would never have major transient variation in the pressure (P_2) as the load changes rapidly. From practical experience we all know that this is normally not the case, and in most real-life applications, we would expect some fluctuations in P_2 whenever the load changes abruptly.

Because the regulator's job is to modulate the flow of gas into the system, we can see that one of the essential elements of any regulator is a restricting element that will fit into the flow stream and provide a variable restriction that can modulate the flow of gas through the regulator.

Figure 2 shows a schematic of a typical regulator restricting element. This restricting element is usually some type of valve arrangement. It can be a single-port globe valve, a cage style valve, butterfly valve or any other type of valve that is capable of operating as a variable restriction to the flow.

In order to cause this restricting element to vary, some type of loading force will have to be applied to it. Thus we see that the second essential element of a gas regulator is a Loading Element that can apply the needed force to the restricting element.

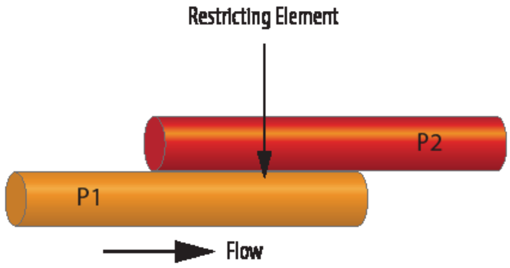


Figure 2

The loading element can be one of any number of things such as a weight, a hand jack, a spring, a diaphragm actuator or a piston actuator, to name a few of the more common ones.

A diaphragm actuator and a spring are frequently combined, as shown in Figure 3, to form the most common type of loading element. A loading pressure is applied to a diaphragm to produce a loading force that will act to close the restricting element. The spring provides a reverse loading force which acts to overcome the weight of the moving parts and to provide a fail-safe operating action that is more positive than a pressure force.

So far, we have a restricting element to modulate the flow through the regulator and we have a loading element that can apply the necessary force to operate the restricting element. But, how do we know when we are modulating the gas flow correctly? How do we know when we have the regulator flow matched to the load flow? It is rather obvious that we need some type of Measuring Element which will tell us when these two flows have been perfectly matched. If we had some economical method of directly measuring these flows, we could use that approach; however, this is not a very feasible method.

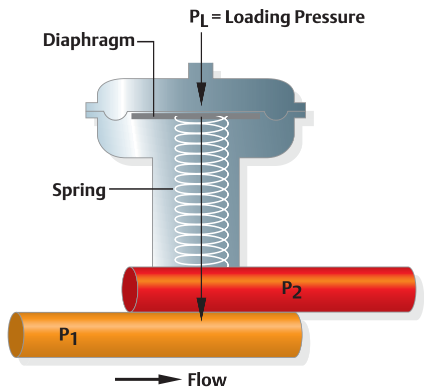


Figure 3

We noted earlier in our discussion of Figure 1 that the system pressure (P_2) was directly related to the matching of the two flows. If the restricting element allows too much gas into the system, P_2 will increase. If the restricting element allows too little gas into the system, P_2 will decrease. We can use this convenient fact to provide a simple means of measuring whether or not the regulator is providing the proper flow.

Manometers, Bourdon tubes, bellows, pressure gauges and diaphragms are some of the possible measuring elements that we might use. Depending upon what we wish to accomplish, some of these measuring elements would be more advantageous than others. The diaphragm, for instance, will not only act as a measuring element which responds to changes in the measured pressure, but it also acts simultaneously as a loading element. As such, it produces a force to operate the restricting element that varies in response to changes in the measured pressure. If we add this typical measuring element to the loading element and the restricting element that we selected earlier, we will have a complete gas pressure regulator as shown in Figure 4.

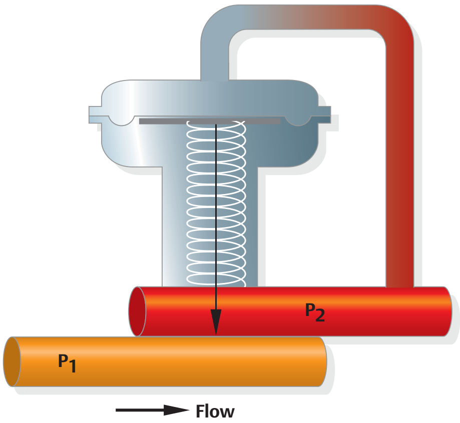


Figure 4

Let's review the action of this regulator. If the restricting element tries to put too much gas into the system, the pressure (P_2) will increase. The diaphragm, as a measuring element, responds to this increase in pressure and, as a loading element, produces a force which compresses the spring and thereby restricts the amount of gas going into the system. On the other hand, if the regulator doesn't put enough gas into the system, the pressure (P_2) falls and the diaphragm responds by producing less force. The spring will then overcome the reduced diaphragm force and open the valve to allow more gas into the system. This type of self-correcting action is known as negative feedback. This example illustrates that there are three essential elements needed to make any operating gas pressure regulator. They are a restricting element, a loading element and a measuring element. Regardless of how sophisticated the system may become, it still must contain these three essential elements.

Pilot-Operated Regulators

So far we have only discussed direct-operated regulators. This is the name given to that class of regulators where the measured pressure is applied directly to the loading element with no intermediate hardware. There are really only two basic configurations of direct-operated regulators that are practical. These two basic types are illustrated in Figures 4 and 5.

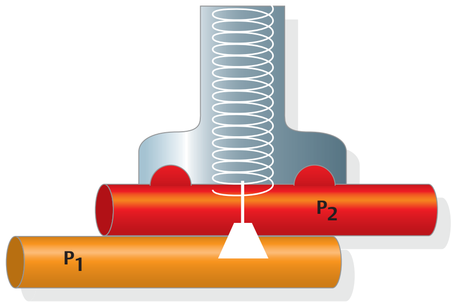


Figure 5

If the proportional band of a given direct-operated regulator is too great for a particular application, there are a number of things we can do. From our previous examples we recall that spring rate, valve travel and effective diaphragm area were the three parameters that affect the proportional band. In the last section we pointed out the way to change these parameters in order to improve the proportional band. If these changes are either inadequate or impractical, the next logical step is to install a pressure amplifier in the measuring or sensing line. This pressure amplifier is frequently referred to as a pilot.

Conclusion

It should be obvious at this point that there are fundamentals to understand in order to properly select and apply a gas regulator to do a specific job. Although these fundamentals are profuse in number and have a sound theoretical base, they are relatively straightforward and easy to understand.

As you are probably aware by now, we made a number of simplifying assumptions as we progressed. This was done in the interest of gaining a clearer understanding of these fundamentals without getting bogged down in special details and exceptions. By no means has the complete story of gas pressure regulation been told. The subject of gas pressure regulation is much broader in scope than can be presented in a single document such as this, but it is sincerely hoped that this application guide will help to gain a working knowledge of some fundamentals that will enable one to do a better job of designing, selecting, applying, evaluating or troubleshooting any gas pressure regulation equipment.

Instrument engineers agree that the simpler a system is the better it is, as long as it provides adequate control. In general, regulators are simpler devices than control valves. Regulators are self-contained, direct-operated control devices which use energy from the controlled system to operate whereas control valves require external power sources, transmitting instruments and control instruments.

Specific Regulator Types

Within the broad categories of direct-operated and pilot-operated regulators fall virtually all of the general regulator designs, including:

- Pressure reducing regulators
- Backpressure regulators
- Pressure relief valves
- Pressure switching valves
- Vacuum regulators and breakers

Pressure Reducing Regulators

A pressure reducing regulator maintains a desired reduced outlet pressure while providing the required fluid flow to satisfy a downstream demand. The pressure which the regulator maintains is the outlet pressure setting (setpoint) of the regulator.

Types of Pressure Reducing Regulators

This section describes the various types of regulators. All regulators fit into one of the following two categories:

1. Direct-Operated (also sometimes called Self-Operated)
2. Pilot-Operated

Direct-Operated (Self-Operated) Regulators

Direct-operated regulators are the simplest style of regulators. At low set pressures, typically below 1 psig / 0.07 bar, they can have very accurate (±1%) control. At high control pressures, up to 500 psig / 34.5 bar, 10 to 20% control is typical.

In operation, a direct-operated, pressure reducing regulator senses the downstream pressure through either internal pressure registration or an external control line. This downstream pressure opposes a spring which moves the diaphragm and valve plug to change the size of the flow path through the regulator.

Pilot-Operated Regulators

Pilot-operated regulators are preferred for high flow rates or where precise pressure control is required. A popular type of pilot-operated system uses two-path control. In two-path control, the main valve diaphragm responds quickly to downstream pressure changes, causing an immediate correction in the main valve plug position. At the same

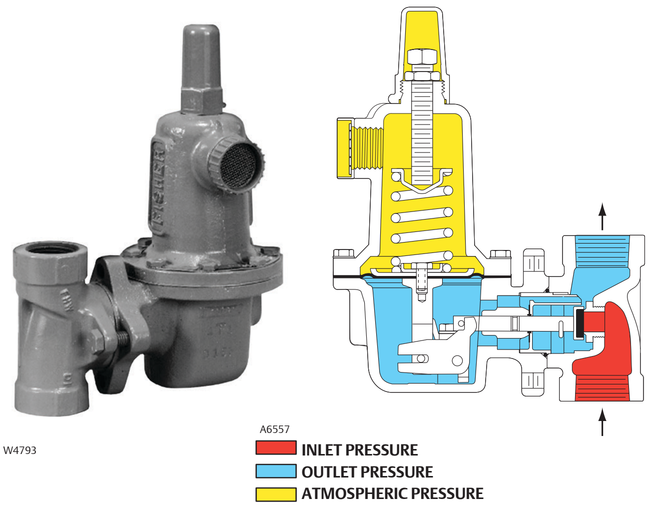


Figure 1. *Type 627 Direct-Operated Regulator and Operational Schematic*

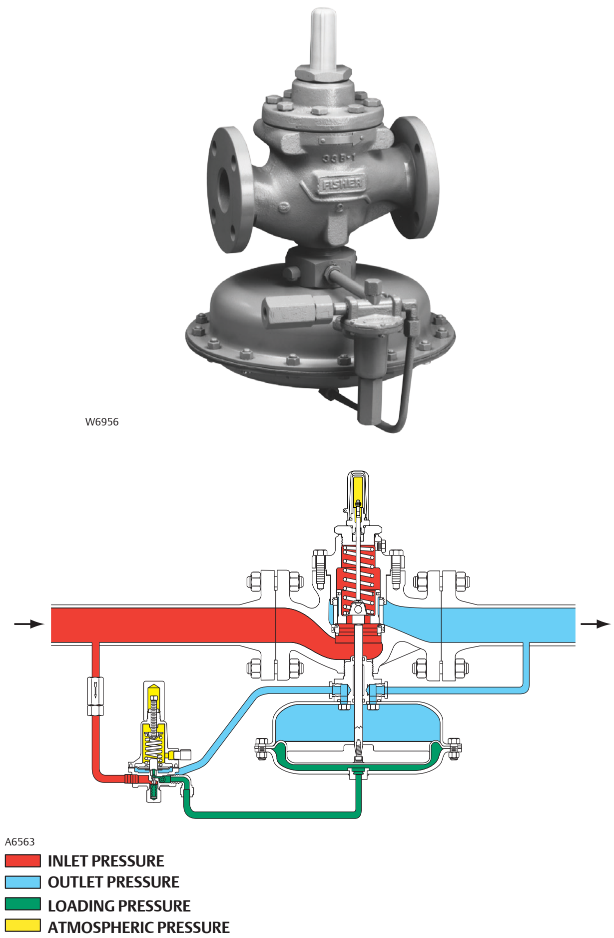


Figure 2. *Type 1098-EGR Pilot-Operated Regulator and Operational Schematic*

time, the pilot diaphragm diverts some of the reduced inlet pressure to the other side of the main valve diaphragm to control the final positioning of the main valve plug. Two-path control results in fast response and accurate control.

Backpressure Regulators and Pressure Relief Valves

A backpressure regulator maintains a desired upstream pressure by varying the flow in response to changes in upstream pressure. A pressure relief valve limits pressure build-up (prevents overpressure) at its location in a pressure system. The relief valve opens to prevent a rise of internal pressure in excess of a specified value. The pressure at which the relief valve begins to open pressure is the relief pressure setting.

Relief valves and backpressure regulators are the same devices. The name is determined by the application. Fisher™ relief valves are not ASME safety relief valves.

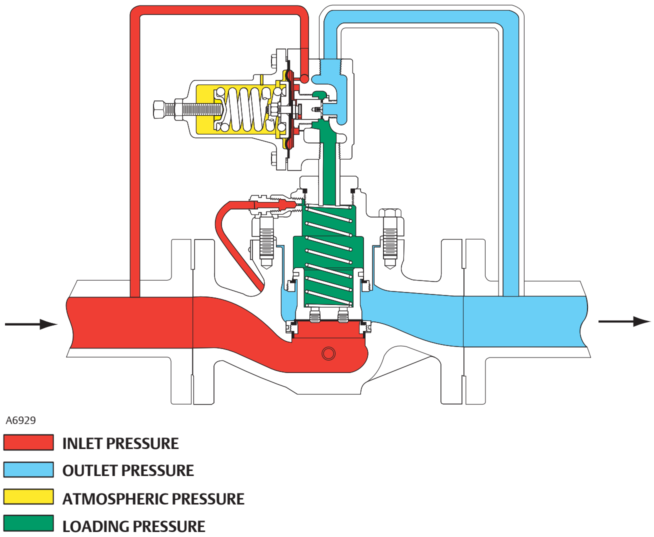


Figure 3. *Type 63EG-98HM Pilot-Operated Relief Valve or Backpressure Regulator Schematic*

Pressure Switching Valves

Pressure switching valves are used in pneumatic logic systems. These valves are for either two-way or three-way switching. Two-way switching valves are used for on/off service in pneumatic systems.

Three-way switching valves direct inlet pressure from one outlet port to another whenever the sensed pressure exceeds or drops below a preset limit.

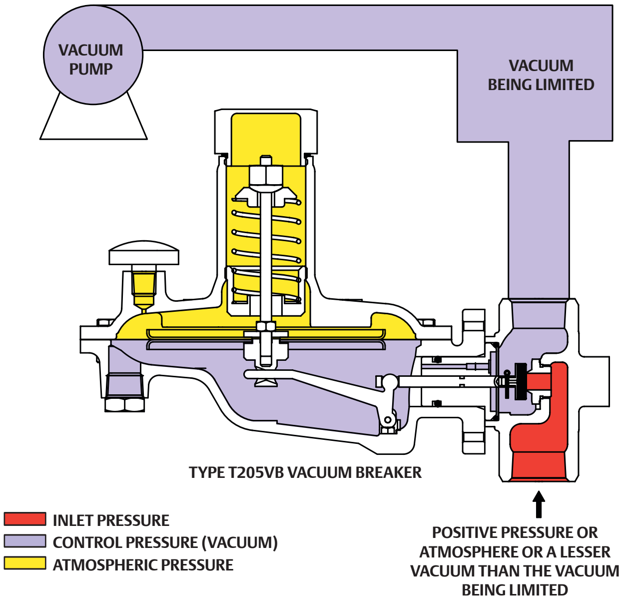


Figure 4. *Typical Vacuum Breaker*

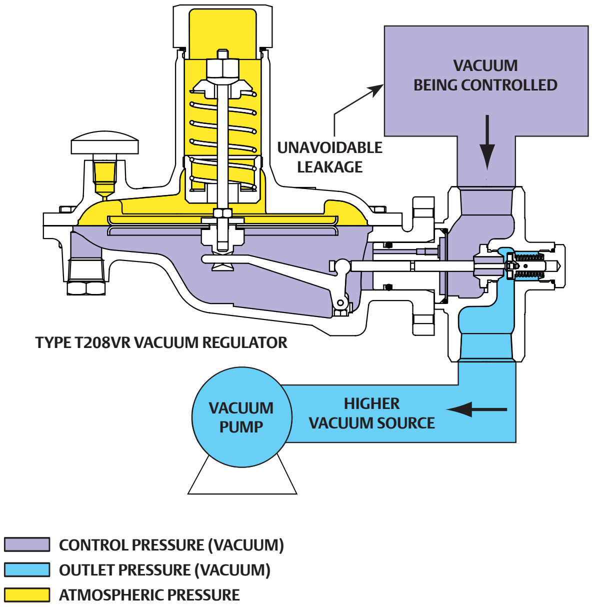


Figure 5. *Typical Vacuum Regulator*

Vacuum Regulators and Breakers

Vacuum regulators and vacuum breakers are devices used to control vacuum. A vacuum regulator maintains a constant vacuum at the regulator inlet with a higher vacuum connected to the outlet. During operation, a vacuum regulator remains closed until a vacuum decrease (a rise in absolute pressure) exceeds the spring setting and opens the valve disk. A vacuum breaker prevents a vacuum from exceeding a specified value. During operation, a vacuum breaker remains closed until an increase in vacuum (a decrease in absolute pressure) exceeds the spring setting and opens the valve disk.

Regulator Selection Criteria

This section describes the procedure normally used to select regulators for various applications. For most applications, there is generally a wide choice of regulators that will accomplish the required function. The vendor and the customer, working together, have the task of deciding which of the available regulators is best suited for the job at hand. The selection procedure is essentially a process of elimination wherein the answers to a series of questions narrow the choice down to a specific regulator.

Control Application

To begin the selection procedure, it is necessary to define what the regulator is going to do. In other words, what is the control application? The answer to this question will determine the general type of regulator required, such as:

- Pressure reducing regulators
- Backpressure regulators
- Pressure relief valves
- Vacuum regulators
- Vacuum breakers

The selection criteria used in selecting each of these general regulator types is described in greater detail in the following subsections.

Pressure Reducing Regulator Selection

The majority of applications require a pressure reducing regulator. Assuming the application calls for a pressure reducing regulator, the following parameters must be determined:

- Outlet pressure to be controlled
- Inlet pressure to the regulator
- Capacity required
- Shutoff capability required
- Process fluid
- Process fluid temperature
- Accuracy required
- Pipe size required
- End connection style
- Material requirements
- Control line needed
- Stroking speed
- Overpressure protection

Outlet Pressure to be Controlled

For a pressure reducing regulator, the first parameter to determine is the required outlet pressure. When the outlet pressure is known, it helps determine:

- Spring requirements
- Casing pressure rating
- Body outlet rating
- Orifice rating and size
- Regulator size

Inlet Pressure of the Regulator

The next parameter is the inlet pressure. The inlet pressure (minimum and maximum) determines the:

- Pressure rating for the body inlet
- Orifice pressure rating and size
- Main spring (in a pilot-operated regulator)
- Regulator size

If the inlet pressure varies significantly, it can have an effect on:

- Accuracy of the controlled pressure
- Capacity of the regulator
- Regulator style (two-stage or unloading)

Capacity Required

The required flow capacity influences the following decisions:

- Size of the regulator
- Orifice size
- Style of regulator (direct-operated or pilot-operated)

Shutoff Capability

The required shutoff capability determines the type of disk material:

- Standard disk materials are Nitrile (NBR) and Neoprene (CR), these materials provide the tightest shutoff.
- Other materials, such as Nylon (PA), Polytetrafluoroethylene (PTFE), Fluorocarbon (FKM) and Ethylenepropylene (EPDM) are used when standard material cannot be used.
- Metal disks are used in high temperatures and when elastomers are not compatible with the process fluid; however, tight shutoff is typically not achieved.

Introduction to Regulators

Process Fluid

Each process fluid has its own set of unique characteristics in terms of its chemical composition, corrosive properties, impurities, flammability, hazardous nature, toxic effect, explosive limits and molecular structure. In some cases special care must be taken to select the proper materials that will come in contact with the process fluid.

Process Fluid Temperature

Fluid temperature might determine the materials used in the regulator. Standard regulators use Steel and Nitrile (NBR) or Neoprene (CR) elastomers that are good for a temperature range of -40 to 180°F / -40 to 82°C. Temperatures above and below this range may require other materials, such as Stainless steel, Ethylenepropylene (EPDM) or Perfluoroelastomer (FFKM).

Accuracy Required

The accuracy requirement of the process determines the acceptable droop (also called proportional band or offset). Regulators fall into the following groups as far as droop is concerned:

- **Rough-cut Group** — This group generally includes many first-stage, rough-cut direct-operated regulators. This group usually has the highest amount of droop. However, some designs are very accurate, especially the low-pressure gas or air types, such as house service regulators, which incorporate a relatively large diaphragm casing.
- **Close-control Group** — This group usually includes pilot-operated regulators. They provide high accuracy over a large range of flows. Applications that require close control include these examples:
  - Burner control where the fuel/air ratio is critical to burner efficiency and the gas pressure has a significant effect on the fuel/air ratio.
  - Metering devices, such as gas meters, which require constant input pressures to ensure accurate measurement.

Pipe Size Required

If the pipe size is known, it gives the specifier of a new regulator a more defined starting point. If, after making an initial selection of a regulator, the regulator is larger than the pipe size, it usually means that an error has been made either in selecting the pipe size or the regulator or in determining the original parameters (such as pressure or flow) required for regulator selection. In many cases, the outlet piping needs to be larger than the regulator for the regulator to reach full capacity.

End Connection Style

In general, the following end connections are available for the indicated regulator sizes:

- Pipe threads or socket weld: 2 in. / DN 50 and smaller
- Flanged: 1 in. / DN 25 and larger
- Butt weld: 1 in. / DN 25 and larger

Note: Not all end connections are available for all regulators.

Required Materials

The regulator construction materials are generally dictated by the application. Standard materials are:

- Aluminum
- Cast iron or Ductile iron
- Steel
- Bronze and Brass
- Stainless steel

Special materials required by the process can have an effect on the type of regulator that can be used. Oxygen service, for example, requires special materials, requires special cleaning preparation and requires that no oil or grease be in the regulator.

Control Lines

For pressure registration, control lines are connected downstream of a pressure reducing regulator and upstream of a backpressure regulator. Typically large direct-operated regulators have external control lines and small direct-operated regulators have internal registration instead of a control line. Most pilot-operated regulators have external control lines, but this should be confirmed for each regulator type considered.

Stroking Speed

Stroking speed is often an important selection criteria. Direct-operated regulators are very fast and pilot-operated regulators are slightly slower. Both types are faster than most control valves. When speed is critical, techniques can be used to decrease stroking time.

Overpressure Protection

The need for overpressure protection should always be considered. Overpressure protection is generally provided by an external relief valve or in some regulators, by an internal relief valve. Internal relief is an option that you must choose at the time of purchase. The capacity of internal relief is usually limited in comparison with a separate relief valve. Other methods such as shutoff valves or monitor regulators can also be used.

Regulator Replacement

When a regulator is being selected to replace an existing regulator, the existing regulator can provide the following information:

- Style of regulator
- Size of regulator
- Type number of the regulator
- Special requirements for the regulator, such as downstream pressure sensing through a control line versus internal pressure registration.

Regulator Price

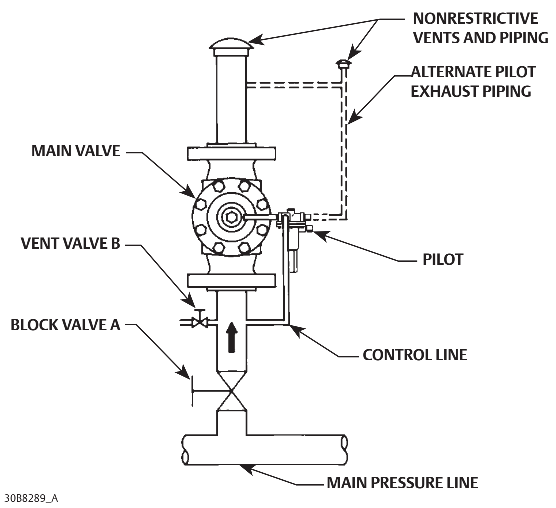
The price of a regulator is only a part of the cost of ownership. Additional costs include installation and maintenance. In selecting a regulator, you should consider all of the costs that will accrue over the life of the regulator. The regulator with a low initial cost might not be the most economical in the long run. For example, a direct-operated regulator is generally less expensive, but a pilot-operated regulator might provide more capacity for the initial investment. To illustrate, a 2 in. / DN 50 pilot-operated regulator can have the same capacity and a lower price than a 3 in. / DN 80, direct-operated regulator.

Backpressure Regulator Selection

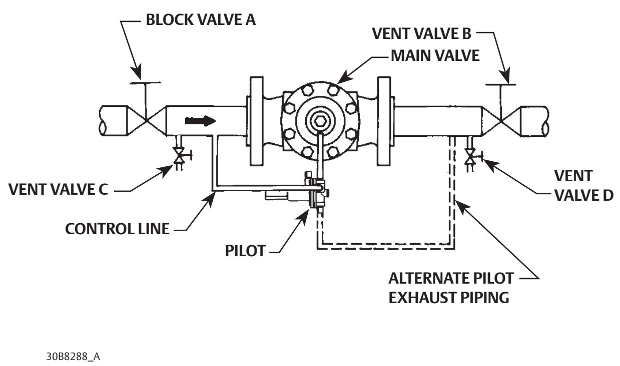
Backpressure regulators control the inlet pressure rather than the outlet pressure. The selection criteria for a backpressure regulator the same as for a pressure reducing regulator.

Relief Valve Selection

An external relief valve is a form of backpressure regulator. A relief valve opens when the inlet pressure exceeds a set value. Relief is generally to atmosphere. The selection criteria is the same as for a pressure reducing regulator.



RELIEF PRESSURE CONTROL AT RELIEF VALVE INLET

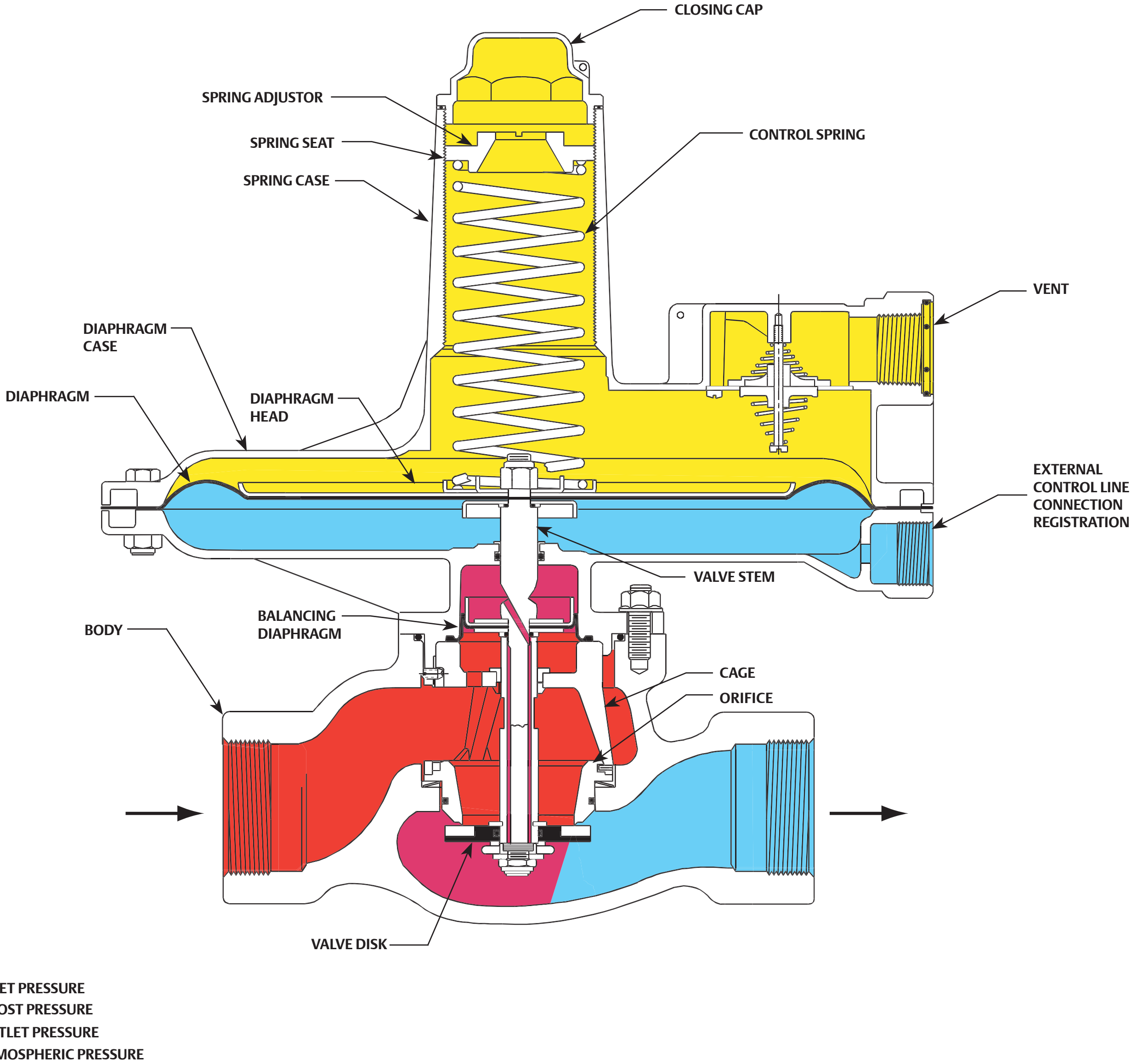


BACKPRESSURE CONTROL

Figure 6. *Backpressure Regulator/Relief Valve Applications*

Regulator Components

Straight Stem Style Direct-Operated Regulator Components



Type 133L

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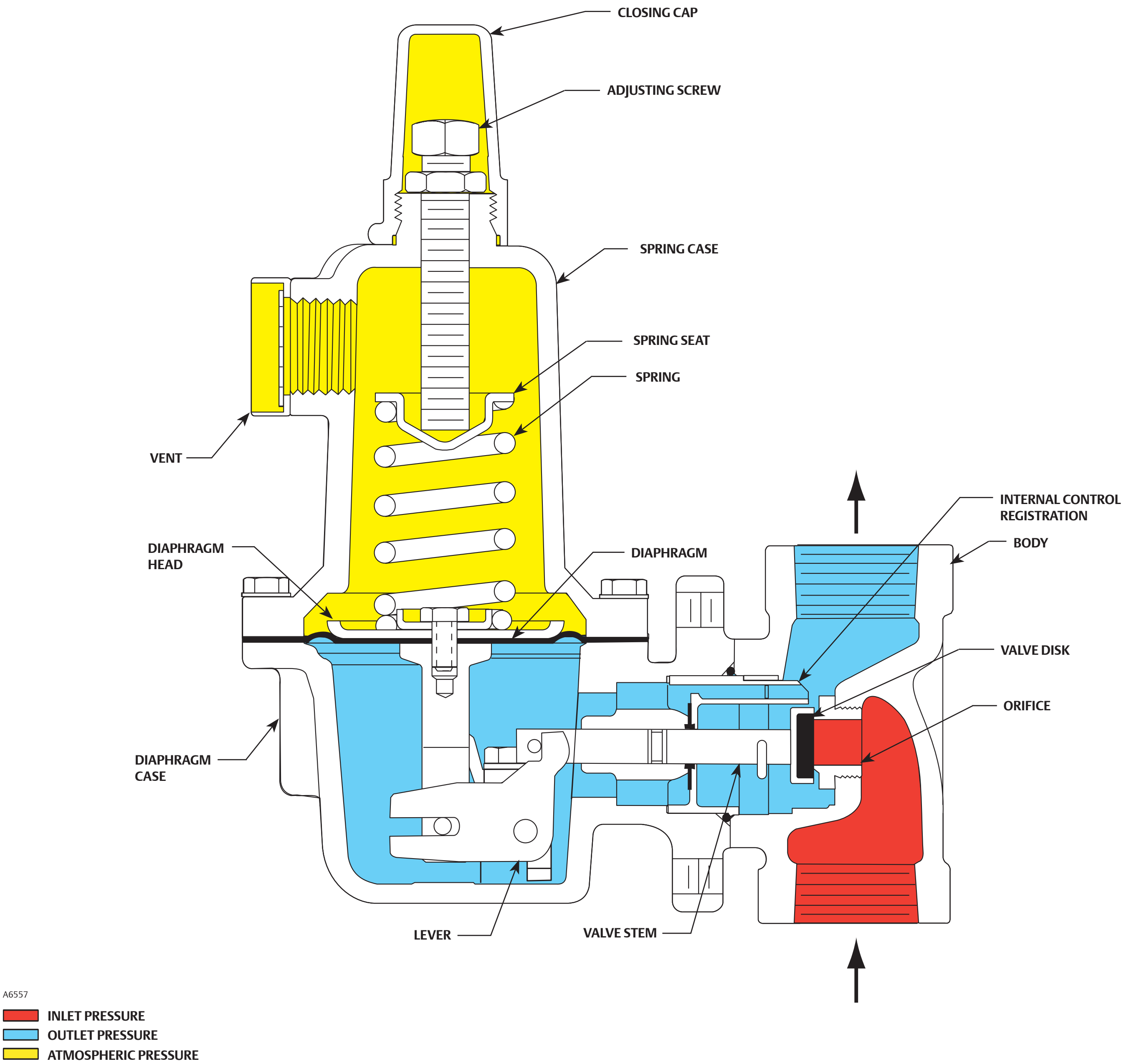
Lever Style Direct-Operated Regulator Components



Type 627

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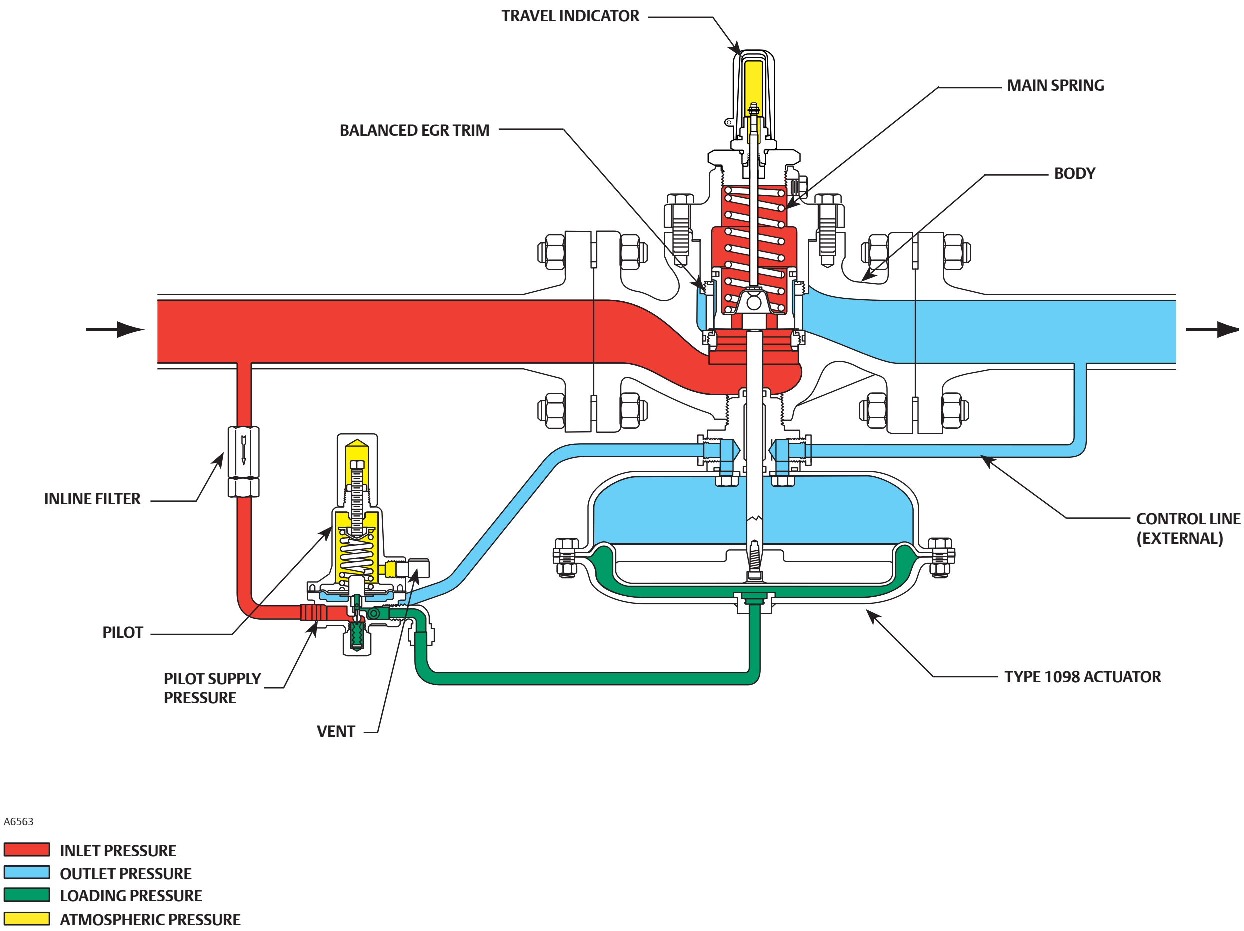
Loading Style (Two-Path Control) Pilot-Operated Regulator Components



Type 1098-EGR

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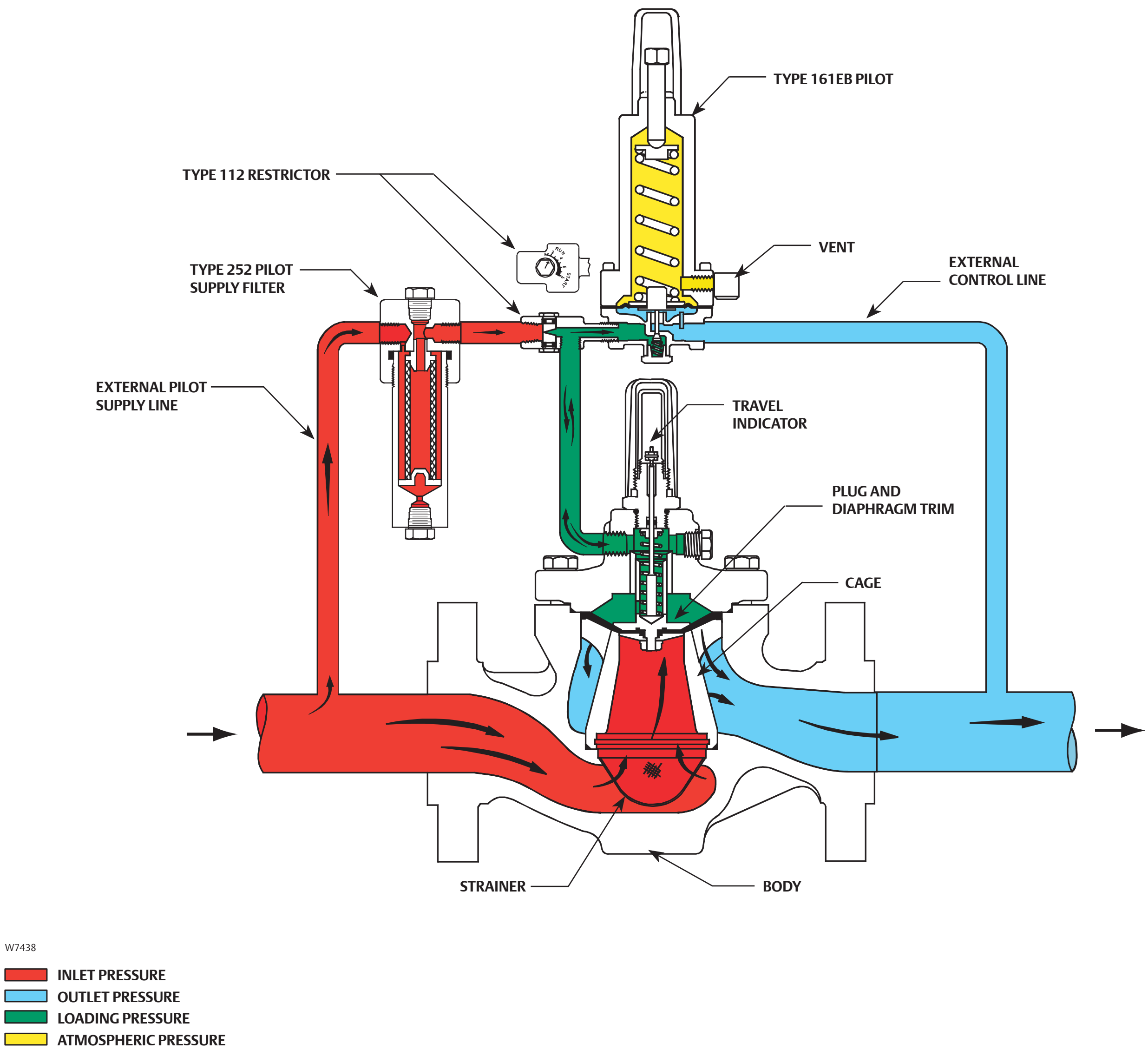
Unloading Style Pilot-Operated Regulator Components



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Principles of Direct-Operated Regulators

Introduction

Pressure regulators have become very familiar items over the years and nearly everyone has grown accustomed to seeing them in factories, public buildings, by the roadside and even on the outside of their own homes. As is frequently the case with such familiar items, we have a tendency to take them for granted. It's only when a problem develops or when we are selecting a regulator for a new application, that we need to look more deeply into the fundamentals of the regulator's operation.

Regulators provide a means of controlling the flow of a gas or other fluid supply to downstream processes or customers. An ideal regulator would supply downstream demand while keeping downstream pressure constant; however, the mechanics of direct-operated regulator construction are such that there will always be some deviation (droop or offset) in downstream pressure.

Figure 1. *Direct-Operated Regulators*

Regulator Basics

A pressure reducing regulator must satisfy a downstream demand while maintaining the system pressure within certain acceptable limits. When the flow rate is low, the regulator plug or disk approaches its seat and restricts the flow. When demand increases, the plug or disk moves away from its seat, creating a larger opening and increased flow. Ideally, a regulator should provide a constant downstream pressure while delivering the required flow.

The service regulator mounted on the meter outside virtually every home serves as an example. As appliances such as a furnace or stove call for the flow of more gas, the service regulator responds by delivering the required flow. As this happens, the pressure should be held constant. This is important because the gas meter, which is the cash register of the system, is often calibrated for a given pressure.

Direct-operated regulators have many commercial and residential uses. Typical applications include industrial, commercial and domestic gas service, instrument air supply and a broad range of applications in industrial processes.

Regulators automatically adjust flow to meet downstream demand. Before regulators were invented, someone had to watch a pressure gauge for pressure drops which signaled an increase in downstream demand. When the downstream pressure decreased, more flow was required. The operator then opened the regulating valve until the gauge pressure increased, showing that downstream demand was being met.

Essential Elements

Direct-operated regulators have three essential elements:

- A restricting element— a valve, disk or plug
- A measuring element— generally a diaphragm
- A loading element— generally a spring

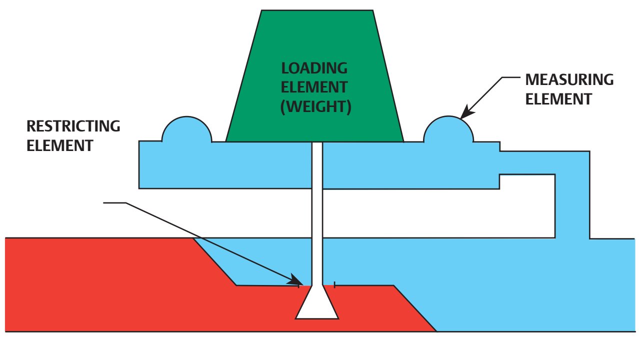

Figure 2. *Three Essential Elements*

Restricting Element

The regulator's restricting element is generally a disk or plug that can be positioned fully open, fully closed or somewhere in between to control the amount of flow. When fully closed, the disk or plug seats tightly against the valve orifice or seat ring to shutoff flow.

Measuring Element

The measuring element is usually a flexible diaphragm that senses downstream pressure (P_2). The diaphragm moves as pressure beneath it changes. The restricting element is often attached to the diaphragm with a stem so that when the diaphragm moves, so does the restricting element.

Loading Element

A weight or spring acts as the loading element. The loading element counterbalances downstream pressure (P_2). The amount of unbalance between the loading element and the measuring element determines the position of the restricting element. Therefore, we can adjust the desired amount of flow through the regulator or setpoint, by varying the load. Some of the first direct-operated regulators used weights as loading elements. Most modern regulators use springs.

Regulator Operation

To examine how the regulator works, let's consider these values for a direct-operated regulator installation:

- Upstream Pressure (P_1) = 100 psig
- Downstream Pressure (P_2) = 10 psig
- Pressure Drop Across the Regulator (P) = 90 psi
- Diaphragm Area (A_D) = 10 in^2
- Loading Weight = 100 lbs.

Let's examine a regulator in equilibrium as shown in Figure 3. The pressure acting against the diaphragm creates a force acting up to 100 lbs.

Diaphragm Force (F_D) = Pressure (P_2) x Area of Diaphragm (A_D)
or
F_D = 10 psig x 10 in^2 = 100 lbs

The 100 lbs weight acts down with a force of 100 lbs, so all the opposing forces are equal and the regulator plug remains stationary.

Increasing Demand

If the downstream demand increases, P_2 will drop. The pressure on the diaphragm drops, allowing the regulator to open further. Suppose in our example P_2 drops to 9 psig. The force acting up then equals 90 lbs (9 psig x 10 in^2 = 90 lbs). Because of the unbalance of the measuring element and the loading element, the restricting element will move to allow passage of more flow.

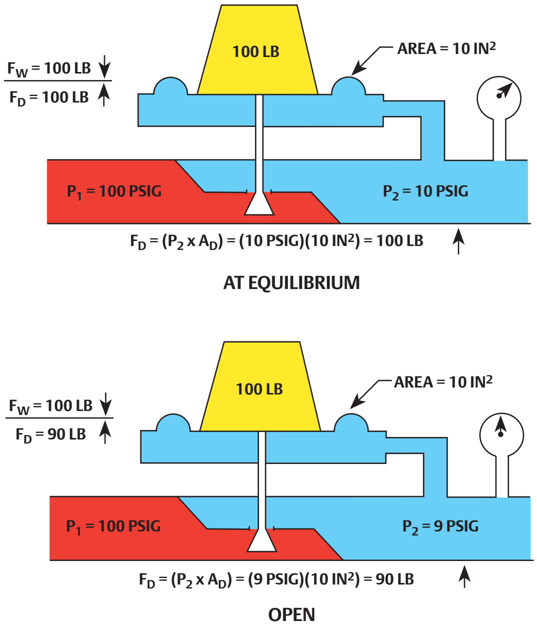

Figure 3. *Elements*

Decreasing Demand

If the downstream demand for flow decreases, downstream pressure increases. In our example, suppose P_2 increases to 11 psig. The force acting up against the weight becomes 110 lbs (11 psig x 10 in^2 = 110 lbs). In this case, unbalance causes the restricting element to move up to pass less flow or lockup.

Weights versus Springs

One of the problems with weight-loaded systems is that they are slow to respond. So if downstream pressure changes rapidly, our weight-loaded regulator may not be able to keep up. Always behind, it may become unstable and cycle—continuously going from the fully open to the fully closed position. There are other problems. Because the amount of weight controls regulator setpoint, the regulator is not easy to adjust. The weight will always have to be on top of the diaphragm. So, let's consider using a spring. By using a spring instead of a weight, regulator stability increases because a spring has less stiffness.

Principles of Direct-Operated Regulators

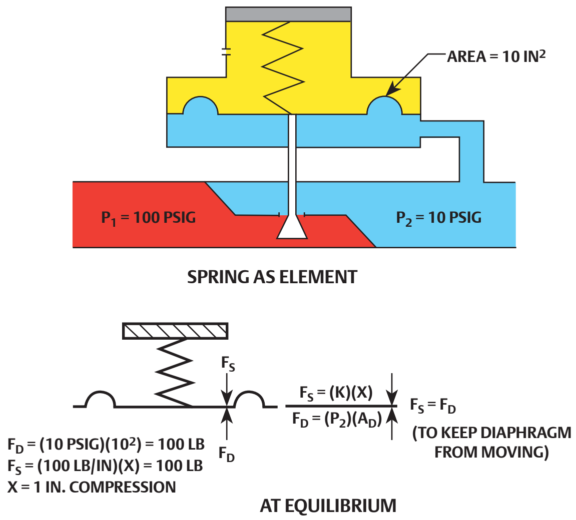

Figure 4. *Spring as Element*

Spring Rate

We choose a spring for a regulator by its spring rate (K). K represents the amount of force necessary to compress the spring 1 in. For example, a spring with a rate of 100 lbs/in. needs 100 lbs of force to compress it 1 in., 200 lbs of force to compress it 2 in. and so on.

Equilibrium with a Spring

Instead of a weight, let's substitute a spring with a rate of 100 lbs/in. And, with the regulator's spring adjustor, we'll wind in 1 in. of compression to provide a spring force (F_S) of 100 lbs. This amount of compression of the regulator spring determines setpoint or the downstream pressure that we want to hold constant. By adjusting the initial spring compression, we change the spring loading force, so P_2 will be at a different value in order to balance the spring force.

Now the spring acts down with a force of 100 lbs and the downstream pressure acts up against the diaphragm producing a force of 100 lbs ($F_D = P_2 \times A_D$). Under these conditions the regulator has achieved equilibrium; that is, the plug or disk is holding a fixed position.

Spring as Loading Element

By using a spring instead of a fixed weight, we gain better control and stability in the regulator. The regulator will now be less likely to go fully open or fully closed for any change in downstream pressure (P_2). In effect, the spring acts like a multitude of different weights.

Throttling Example

Assume we still want to maintain 10 psig downstream. Consider what happens now when downstream demand increases and pressure P_2 drops to 9 psig. The diaphragm force (F_D) acting up is now 90 lbs.

$$F_D = P_2 \times A_D$$
$$F_D = 9 \text{ psig} \times 10 \text{ in}^2$$
$$F_D = 90 \text{ lbs}$$

We can also determine how much the spring will move (extend) which will also tell us how much the disk will travel. To keep the regulator in equilibrium, the spring must produce a force (F_S) equal to the force of the diaphragm. The formula for determining spring force (F_S) is:

$$F_S = (K)(X)$$

where K = spring rate in lbs/in. and X = travel or compression in in.

We know F_S is 90 lbs and K is 100 lbs/in., so we can solve for X with:

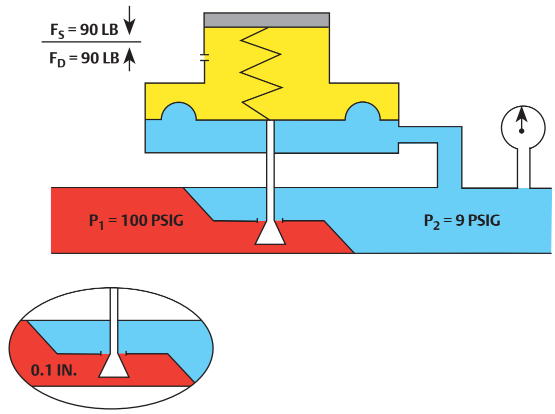

Figure 5. *Plug Travel*

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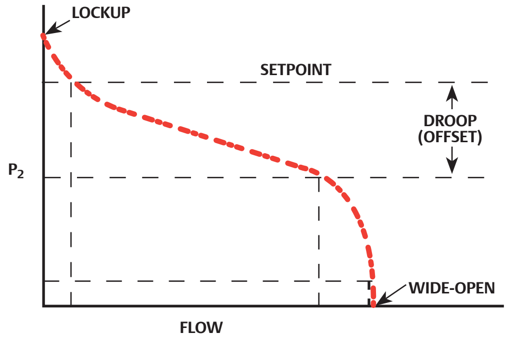

AS THE FLOW RATE APPROACHES ZERO, P_2 INCREASES STEEPLY. LOCKUP IS THE TERM APPLIED TO THE VALUE OF P_2 AT ZERO FLOW.

Figure 6. *Typical Performance Curve*

$X = F_S \div K$
$X = 90$ lbs $\div$ 100 lbs/in.
$X = 0.9$ in.

The spring, and therefore the disk, has moved down 1/10 in., allowing more flow to pass through the regulator body.

Regulator Operation and P_2

Now we see the irony in this regulator design. We recall that the purpose of an ideal regulator is to match downstream demand while keeping P_2 constant. But for this regulator design to increase flow, there must be a change in P_2.

Regulator Performance

We can check the performance of any regulating system by examining its characteristics. Most of these characteristics can be best described using pressure versus flow curves as shown in Figure 6.

Performance Criteria

We can plot the performance of an ideal regulator such that no matter how the demand changes, our regulator will match that demand (within its capacity limits) with no change in the downstream pressure (P_2). This straight line performance becomes the standard against which we can measure the performance of a real regulator.

Setpoint

The constant pressure desired is represented by the setpoint. But no regulator is ideal. The downward sloping line on the diagram represents pressure (P_2) plotted as a function of flow for an actual direct-operated regulator. The setpoint is determined by the initial compression of the regulator spring. By adjusting the initial spring compression you change the spring loading force, so P_2 will be at a different value in order to balance the spring force. This establishes setpoint.

Droop

Droop, proportional band and offset are terms used to describe the phenomenon of P_2 dropping below setpoint as flow increases. Droop is the amount of deviation from setpoint at a given flow, expressed as a percentage of setpoint. This “droop” curve is important to a user because it indicates regulating (useful) capacity.

Capacity

Capacities published by regulator manufacturers are given for different amounts of droop. Let’s see why this is important.

Let’s say that for our original problem, with the regulator set at 10 psig, our process requires 200 SCFH (standard cubic feet per hour) with no more than a 1 psi drop in setpoint. We need to keep the pressure at or above 9 psig because we have a low limit safety switch set at 9 psig that will shut the system down if pressure falls below this point.

Figure 6 illustrates the performance of a regulator that can do the job. And, if we can allow the downstream pressure to drop below 9 psig, the regulator can allow even more flow.

The capacities of a regulator published by manufacturers are generally given for 10% droop and 20% droop. In our example, this would relate to flow at 9 psig and at 8 psig.

Accuracy

The accuracy of a regulator is determined by the amount of flow it can pass for a given amount of droop. The closer the regulator is to the ideal regulator curve (setpoint), the more accurate it is.

Lockup

Lockup is the pressure above setpoint that is required to shut the regulator off tight. In many regulators, the orifice has a knife edge while the disk is a soft material. Some extra pressure, P_2, is required to force the soft disk into the knife edge to make a tight seal. The amount of extra pressure required is lockup pressure. Lockup pressure may be important for a number of reasons. Consider the example above where a low pressure limit switch would shut down the system if P_2 fell below 9 psig. Now consider the same system with a high pressure safety cut out switch set a 10.5 psig. Because our regulator has a lockup pressure of 11 psig, the high limit switch will shut the system down before the regulator can establish tight shutoff. Obviously, we’ll want to select a regulator with a lower lockup pressure.

Principles of Direct-Operated Regulators

Spring Rate and Regulator Accuracy

Using our initial problem as an example, let's say we now need the regulator to flow 300 SCFH at a droop of 10% from our original setpoint of 10 psig. Ten percent of 10 psig = 1 psig, so P_2 cannot drop below 10 to 1 or 9 psi. Our present regulator would not be accurate enough. For our regulator to pass 300 SCFH, P_2 will have to drop to 8 psig or 20% droop.

Spring Rate and Droop

One way to make our regulator more accurate is to change to a lighter spring rate. To see how spring rate affects regulator accuracy, let's return to our original example. We first tried a spring with a rate of 100 lbs/in. Let's substitute one with a rate of 50 lbs/in. To keep the regulator in equilibrium, we'll have to initially adjust the spring to balance the 100 lbs force produced by P_2 acting on the diaphragm. Recall how we calculate spring force:

$$F_S = K \text{ (spring rate) x } X \text{ (compression)}$$

Knowing that F_S must equal 100 lbs and K = 50 lbs/in., we can solve for X or spring compression, with:

$$X = F_S \div K \text{ or } X = 2 \text{ in.}$$

So, we must wind in 2 in. of initial spring compression to balance diaphragm force, F_D.

Effect on Plug Travel

We saw before that with a spring rate of 100 lbs/in., when P_2 dropped from 10 to 9 psig, the spring relaxed (and the valve disk traveled) 0.1 in. Now let's solve for the amount of disk travel with the lighter spring rate of 50 lbs/in. The force produced by the diaphragm is still 90 lbs.

$$F_D = P_2 \text{ x } A_D$$

To maintain equilibrium, the spring must also produce a force of 90 lbs. Recall the formula that determines spring force:

$$F_S = (K)(X)$$

Because we know F_S must equal 90 lbs and our spring rate (K) is 50 lbs/in., we can solve for compression (X) with:

$$X = F_S \div K$$
$$X = 90 \text{ lbs} \div 50 \text{ lbs/in.}$$
$$X = 1.8 \text{ in.}$$

To establish setpoint, we originally compressed this spring 2 in. Now it has relaxed so that it is only compressed 1.8 in., a change of 0.2 in. So with a spring rate of 50 lbs/in., the regulator responded to a 1 psig drop in P_2 by opening twice as far as it did with a spring rate of 100 lbs/in. Therefore, our regulator is now more accurate because it has greater capacity for the same change in P_2. In other words, it has less droop or offset. Using this example, it is easy to see how capacity and accuracy are related and how they are related to spring rate.

Light Spring Rate

Experience has shown that choosing the lightest available spring rate will provide the most accuracy (least droop). For example, a spring with a range of 35 to 100 psig is more accurate than a spring with a range of 90 to 200 psig. If you want to set your regulator at 100 psig, the 35 to 100 psig spring will provide better accuracy.

Practical Limits

While a lighter spring can reduce droop and improve accuracy, using too light a spring can cause instability problems. Fortunately, most of the work in spring selection is done by regulator manufacturers. They determine spring rates that will provide good performance for a given regulator and publish these rates along with other sizing information.

Diaphragm Area and Regulator Accuracy

Diaphragm Area

Until this point, we have assumed the diaphragm area to be constant. In practice, the diaphragm area changes with travel. We're interested in this changing area because it has a major influence on accuracy and droop.

Diaphragms have convolutions in them so that they are flexible enough to move over a rated travel range. As they change position, they also change shape because of the pressure applied to them. Consider the example shown in Figure 7. As downstream pressure (P_2) drops, the diaphragm moves down. As it moves down, it changes shape and diaphragm area increases because the centers of the convolutions become further apart. The larger diaphragm area magnifies the effect of P_2 so even less P_2 is required to hold the diaphragm in place. This is called diaphragm effect. The result is decreased accuracy because incremental changes in P_2 do not result in corresponding changes in spring compression or disk position.

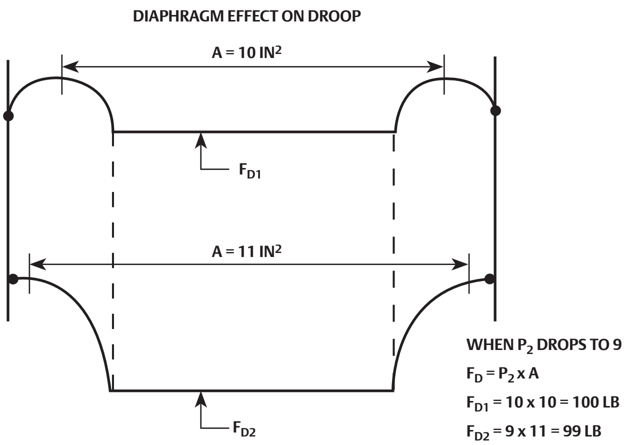

Figure 7. *Changing Diaphragm Area*

Increasing Diaphragm Area

To better understand the effects of changing diaphragm area, let's calculate the forces in the exaggerated example given in Figure 7. First, assume that the regulator is in equilibrium with a downstream pressure P_2 of 10 psig. Also assume that the area of the diaphragm in this position is 10 in^2. The diaphragm force (F_D) is:

$$F_D = (P_2)(A_D)$$
$$F_D = (10 \text{ psi})\ (10 \text{ in}^2)$$
$$F_D = 100 \text{ lbs}$$

Now assume that downstream pressure drops to 9 psig signaling the need for increased flow. As the diaphragm moves, its area increases to 11 in^2. The diaphragm force now produced is:

$$F_D = (9 \text{ psi})\ (11 \text{ in}^2)$$
$$F_D = 99 \text{ lbs}$$

The change in diaphragm area increases the regulator's droop. While it's important to note that diaphragm effect contributes to droop, diaphragm sizes are generally determined by manufacturers for different regulator types, so there is rarely a user option.

Diaphragm Size and Sensitivity

Also of interest is the fact that increasing diaphragm size can result in increased sensitivity. A larger diaphragm area will produce more force for a given change in P_2. Therefore, larger diaphragms are often used when measuring small changes in low-pressure applications. Service regulators used in domestic gas service are an example.

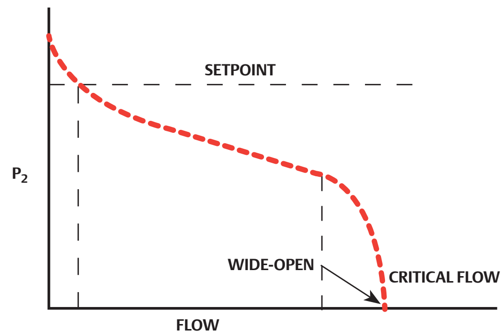

Figure 8. *Critical Flow*

Restricting Element and Regulator Performance

Critical Flow

Although changing the orifice size can increase capacity, a regulator can pass only so much flow for a given orifice size and inlet pressure, no matter how much we improve the unit's accuracy. Shown in Figure 8, after the regulator is wide-open, reducing P_2 does not result in higher flow. This area of the flow curve identifies critical flow. To increase the amount of flow through the regulator, the flowing fluid must pass at higher and higher velocities. But, the fluid can only go so fast. Holding P_1 constant while decreasing P_2, flow approaches a maximum which is the speed of sound in that particular gas or its sonic velocity. Sonic velocity depends on the inlet pressure and temperature for the flowing fluid. Critical flow is generally anticipated when downstream pressure (P_2) approaches a value that is less than or equal to one-half of inlet pressure (P_1).

Orifice Size and Capacity

One way to increase capacity is to increase the size of the orifice. The variable flow area between disk and orifice depends directly on orifice diameter. Therefore, the disk will not have to travel as far with a larger orifice to establish the required regulator flow rate and droop is reduced. Sonic velocity is still a limiting factor, but the flow rate at sonic velocity is greater because more gas is passing through the larger orifice.

Stated another way, a given change in P_2 will produce a larger change in flow rate with a larger orifice than it would with a smaller orifice. However, there are definite limits to the size of orifice that can be used. Too large an orifice makes the regulator more sensitive to fluctuating inlet pressures. If the regulator is overly sensitive, it will have a tendency to become unstable and cycle.

Principles of Direct-Operated Regulators

Orifice Size and Stability

One condition that results from an oversized orifice is known as the “bathtub stopper” effect. As the disk gets very close to the orifice, the forces of fluid flow tend to slam the disk into the orifice and shutoff flow. Downstream pressure drops and the disk opens. This causes the regulator to cycle—open, closed, open, closed. By selecting a smaller orifice, the disk will operate farther away from the orifice so the regulator will be more stable.

Orifice Size, Lockup and Wear

A larger orifice size also requires a higher shutoff pressure or lockup pressure. In addition, an oversized orifice usually produces faster wear on the valve disk and orifice because it controls flow with the disk near the seat. This wear is accelerated with high flow rates and when there is dirt or other erosive material in the flow stream.

Orifice Guideline

Experience indicates that using the smallest possible orifice is generally the best rule-of-thumb for proper control and stability.

Increasing P_1

Regulator capacity can be increased by increasing inlet pressure (P_1).

Factors Affecting Regulator Accuracy

As we have seen, the design elements of a regulator—the spring, diaphragm and orifice size—can affect its accuracy. Some of these inherent limits can be overcome with changes to the regulator design.

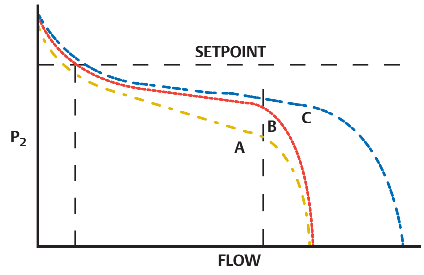

Figure 9. *Increased Sensitivity*

Performance Limits

The three curves in Figure 9 summarize the effects of spring rate, diaphragm area and orifice size on the shape of the controlled pressure-flow rate curve. Curve A is a reference curve representing a typical regulator. Curve B represents the improved performance from either increasing diaphragm area or decreasing spring rate. Curve C represents the effect of increasing orifice size. Note that increased orifice size also offers higher flow capabilities. But remember that too large an orifice size can produce problems that will negate any gains in capacity.

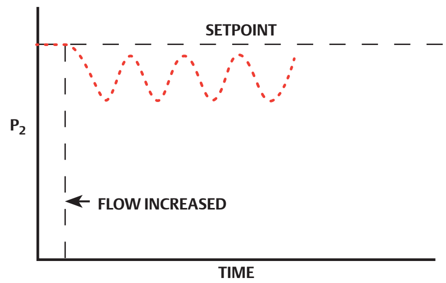

Figure 10. *Cycling*

Cycling

The sine wave in Figure 10 might be what we see if we increase regulator sensitivity beyond certain limits. The sine wave indicates instability and cycling.

Design Variations

All direct-operated regulators have performance limits that result from droop. Some regulators are available with features designed to overcome or minimize these limits.

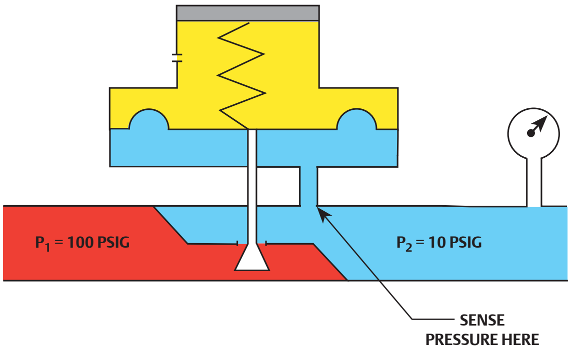

Figure 11. *Pitot Tube*

Improving Regulator Accuracy with a Pitot Tube

In addition to the changes we can make to diaphragm area, spring rate, orifice size and inlet pressure, we can also improve regulator accuracy by adding a pitot tube as shown in Figure 11. Internal to the regulator, the pitot tube connects the diaphragm casing with a low-pressure, high velocity region within the regulator body. The pressure at this area will be lower than P_2 further downstream. By using a pitot tube to measure the lower pressure, the regulator will make more dramatic changes in response to any change in P_2. In other words, the pitot tube tricks the regulator, causing it to respond more than it would otherwise.

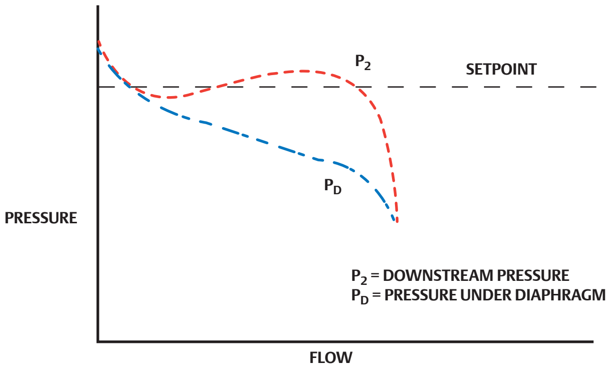

Figure 12. *Performance with Pitot Tube*

Numerical Example

For example, we'll establish setpoint by placing a gauge downstream and adjusting spring compression until the gauge reads 10 psig for P_2. Because of the pitot tube, the regulator might actually be sensing a lower pressure. When P_2 drops from 10 psig to 9 psig, the pressure sensed by the pitot tube may drop from 8 psig to 6 psig. Therefore, the regulator opens further than it would if it were sensing actual downstream pressure.

Decreased Droop (Boost)

The pitot tube offers one chief advantage for regulator accuracy, it decreases droop. Shown in Figure 12, the diaphragm pressure, P_D, must drop just as low with a pitot tube as without to move the disk far enough to supply the required flow. But the solid curve shows that P_2 does not decrease as much as it did without a pitot tube. In fact, P_2 may increase. This is called boost instead of droop. So the use of a pitot tube, or similar device, can dramatically improve droop characteristics of a regulator.

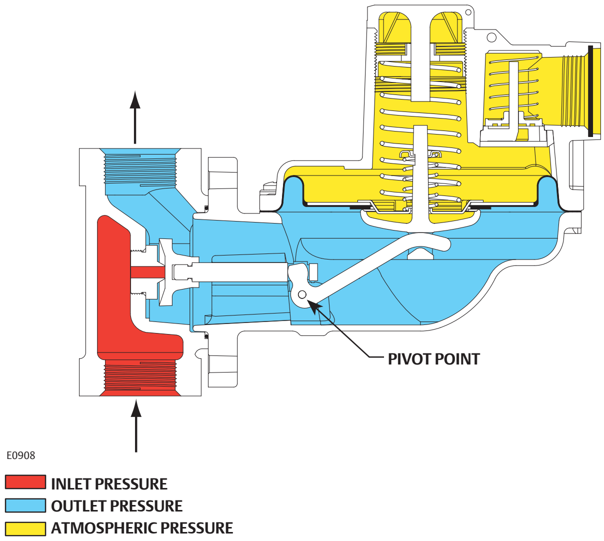

Figure 13. *Lever Style Regulator*

Improving Performance with a Lever

The lever style regulator is a variation of the simple direct-operated regulator. It operates in the same manner, except that it uses a lever to gain mechanical advantage and provide a high shutoff force.

In earlier discussions, we noted that the use of a larger diaphragm can result in increased sensitivity. This is because any change in P_2 will result in a larger change in diaphragm force. The same result is obtained by using a lever to multiply the force produced by the diaphragm as shown in Figure 13.

The main advantage of lever designs is that they provide increased force for lockup without the extra cost, size and weight associated with larger diaphragms, diaphragm casings and associated parts.

Principles of Pilot-Operated Regulators

Pilot-Operated Regulator Basics

In the evolution of pressure regulator designs, the shortcomings of the direct-operated regulator naturally led to attempts to improve accuracy and capacity. A logical next step in regulator design is to use what we know about regulator operation to explore a method of increasing sensitivity that will improve all of the performance criteria discussed.

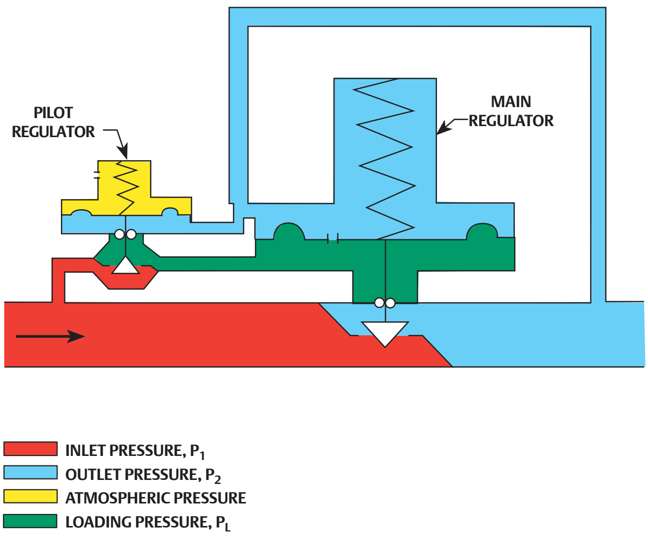

Figure 1. *Pilot-Operated Regulator*

Regulator Pilots

To improve the sensitivity of our regulator, we would like to be able to sense P_2 and then somehow make a change in loading pressure (P_L) that is greater than the change in P_2. To accomplish this, we can use a device called a pilot or pressure amplifier.

The major function of the pilot is to increase regulator sensitivity. If we can sense a change in P_2 and translate it into a larger change in P_L, our regulator will be more responsive (sensitive) to changes in demand. In addition, we can significantly reduce droop so its effect on accuracy and capacity is minimized.

Gain

The amount of amplification supplied by the pilot is called "gain". To illustrate, a pilot with a gain of 20 will multiply the effect of a 1 psi change on the main diaphragm by 20. For example, a decrease in P_2 opens the pilot to increase P_L 20 times as much.

Identifying Pilots

Analysis of pilot-operated regulators can be simplified by viewing them as two independent regulators connected together. The smaller of the two is generally the pilot.

Setpoint

We may think of the pilot as the "brain" of the system. Setpoint and many performance variables are determined by the pilot. It senses P_2 directly and will continue to make changes in P_L on the main regulator until the system is in equilibrium. The main regulator is the "muscle" of the system and may be used to control large flows and pressures.

Spring Action

Notice that the pilot uses a spring-open action as found in direct-operated regulators. The main regulator, shown in Figure 1, uses a spring-close action. The spring, rather than loading pressure, is used to achieve shutoff. Increasing P_L from the pilot onto the main diaphragm opens the main regulator.

Pilot Advantage

Because the pilot is the controlling device, many of the performance criteria we have discussed apply to the pilot. For example, droop is determined mainly by the pilot. By using very small pilot orifices and light springs, droop can be made small. Because of reduced droop, we will have greater usable capacity. Pilot lockup determines the lockup characteristics for the system. The main regulator spring provides tight shutoff whenever the pilot is locked up.

Gain and Restrictions

Stability

Although increased gain (sensitivity) is often considered an advantage, it also increases the gain of the entire pressure regulator system. If the system gain is too high, it may become unstable. In other words, the regulator might tend to oscillate; over-reacting by continuously opening and closing. Pilot gain can be modified to tune the regulator to the system. To provide a means for changing gain, every pilot-operated regulator system contains both a fixed and a variable restriction. The relative size of one restriction compared to the other can be varied to change gain and speed of response.

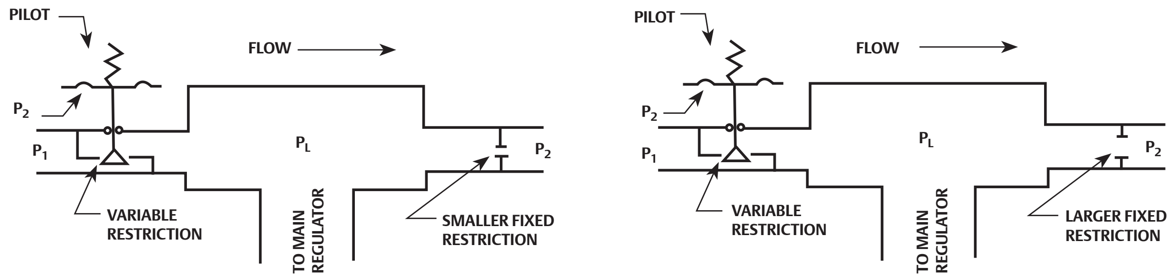

Figure 2. *Fixed Restrictions and Gain (Used on Two-Path Control Systems)*

Restrictions, Response Time and Gain

Consider the example shown in Figure 2 with a small fixed restriction. Decreasing P_2 will result in pressure P_L increasing. Increasing P_2 will result in a decrease in P_L while P_L bleeds out through the small fixed restriction.

If a larger fixed restriction is used with a variable restriction, the gain (sensitivity) is reduced. A larger decrease in P_2 is required to increase P_L to the desired level because of the larger fixed restriction.

Loading and Unloading Designs

A loading pilot-operated design (Figure 2), also called two-path control, is so named because the action of the pilot loads P_L onto the main regulator measuring element. The variable restriction or pilot orifice, opens to increase P_L.

An unloading pilot-operated design (Figure 3) is so named because the action of the pilot unloads P_L from the main regulator.

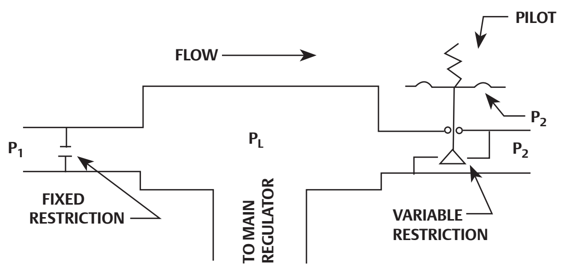

Figure 3. *Unloading Systems*

Two-Path Control (Loading Design)

In two-path control systems (Figure 4), the pilot is piped so that P_2 is registered on the pilot diaphragm and on the main regulator diaphragm at the same time. When downstream demand is constant, P_2 positions the pilot diaphragm so that flow through the pilot will keep P_2 and P_L on the main regulator diaphragm. When P_2 changes, the force on top of the main regulator diaphragm and on the bottom of the pilot diaphragm changes. As P_2 acts on the main diaphragm, it begins repositioning the main valve plug. This immediate reaction to changes in P_2 tends to make two-path designs faster than other pilot-operated regulators. Simultaneously, P_2 acting on the pilot diaphragm repositions the pilot valve

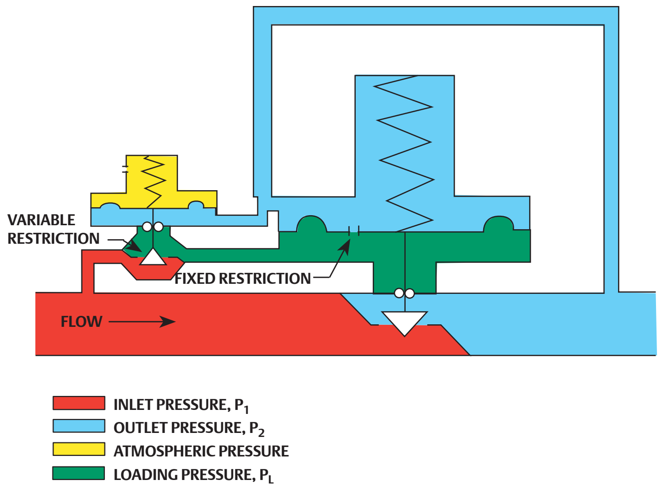

Figure 4. *Two-Path Control*

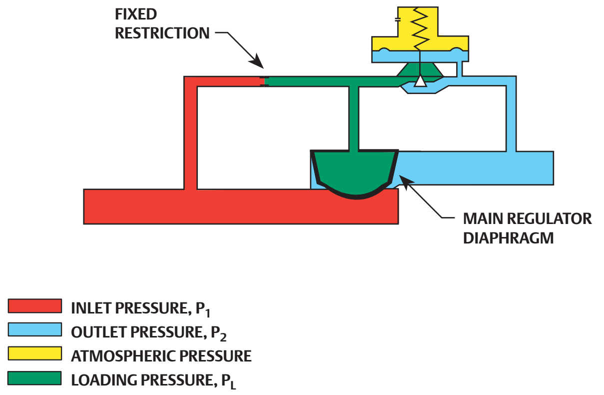

Figure 5. *Unloading Control*

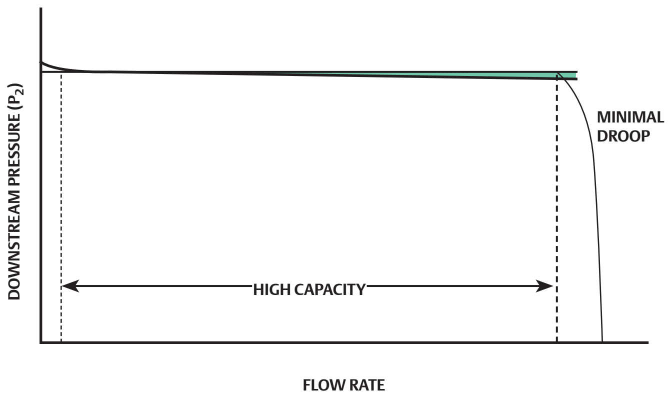

Figure 6. *Pilot-Operated Regulator Performance*

and changes P_L on the main regulator diaphragm. This adjustment to P_L accurately positions the main regulator valve plug. P_L on the main regulator diaphragm bleeds through a fixed restriction until the forces on both sides are in equilibrium. At that point, flow through the regulator valve matches the downstream demand.

Two-Path Control Advantages

The primary advantages of two-path control are speed and accuracy. These systems may limit droop to less than 1%. They are well suited to systems with requirements for high accuracy, large capacity and a wide range of pressures.

Unloading Control

Unloading systems (Figure 5) locate the pilot so that P_2 acts only on the pilot diaphragm. P_1 constantly loads under the regulator diaphragm and has access to the top of the diaphragm through a fixed restriction.

When downstream demand is constant, the pilot valve is open enough that P_L holds the position of the main regulator diaphragm. When downstream demand changes, P_2 changes and the pilot diaphragm reacts accordingly. The pilot valve adjusts P_L to reposition and hold the main regulator diaphragm.

Unloading Control Advantages

Unloading systems are not quite as fast as two-path systems and they can require higher differential pressures to operate. However, they are simple and more economical, especially in large regulators. Unloading control is used with popular elastomer diaphragm style regulators. These regulators use a flexible membrane to throttle flow.

Performance Summary

Accuracy

Because of their high gain, pilot-operated regulators are extremely accurate. Droop for a direct-operated regulator might be in the range of 10 to 20 % whereas pilot-operated regulators are between 1 and 3% with values under 1% possible.

Capacity

Pilot-operated designs provide high capacity for two reasons. First, we have shown that capacity is related to droop. And because droop can be made very small by using a pilot, capacity is increased. In addition, the pilot becomes the “brain” of the system and controls a larger, sometimes much larger, main regulator. This also allows increased flow capabilities.

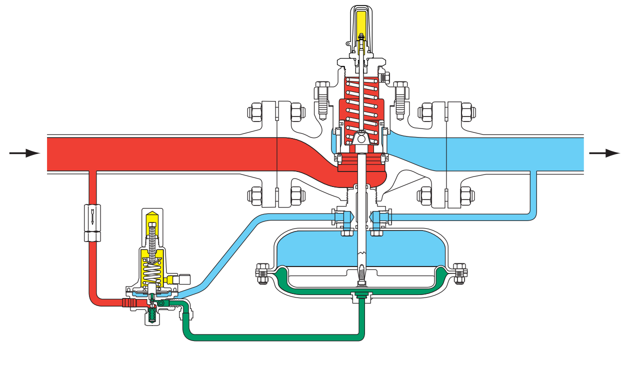

Figure 7. *Type 1098-EGR, Typical Two-Path Control*

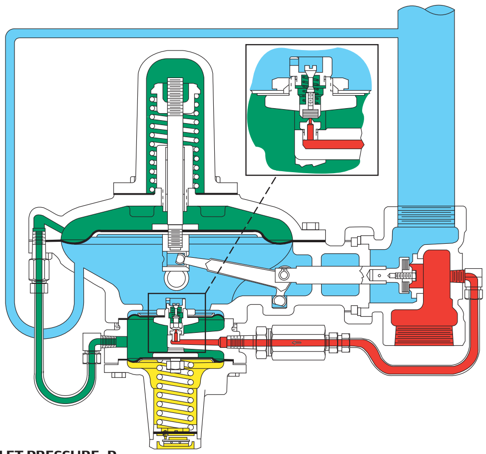

Figure 8. *Type 99, Typical Two-Path Control with Integrally Mounted Pilot*

Lockup

The lockup characteristics for a pilot-operated regulator are the lockup characteristics of the pilot. Therefore, with small orifices, lockup pressures can be small.

Applications

Pilot-operated regulators should be considered whenever accuracy, capacity and/or high pressure are important selection criteria. They can often be applied to high capacity services with greater economy than a control valve and actuator with controller.

Two-Path Control

In some designs (Figure 7), the pilot and main regulator are separate components. In others (Figure 8), the system is integrated into a single package. All, however, follow the basic design concepts discussed earlier.

Type 1098-EGR

The schematic in Figure 7 illustrates the Type 1098-EGR regulator's operation. It can be viewed as a model for all two-path, pilot-operated regulators. The pilot is simply a sensitive direct-operated regulator used to send loading pressure to the main regulator diaphragm.

Identify the inlet pressure (P_1). Find the downstream pressure (P_2). Follow it to where it opposes the loading pressure on the main regulator diaphragm. Then, trace P_2 back to where it opposes the control spring in the pilot. Finally, locate the route of P_2 between the pilot and the regulator diaphragm.

Changes in P_2 register on the pilot and main regulator diaphragms at the same time. As P_2 acts on the main diaphragm, it begins repositioning the main valve plug. Simultaneously, P_2 acting on the pilot diaphragm repositions the pilot valve and changes P_L on the main regulator diaphragm. This adjustment in P_L accurately positions the main regulator valve plug.

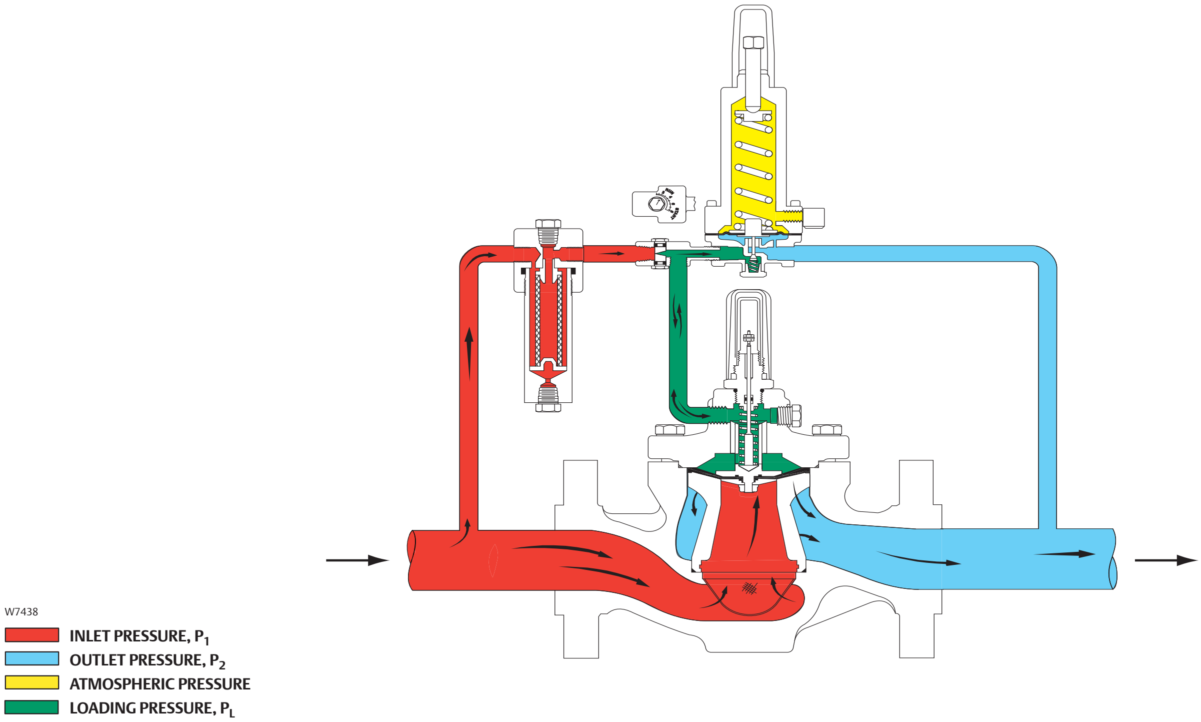

Figure 9. *Type EZR, Unloading Design*

As downstream demand is met, P_2 rises. Because P_2 acts directly on both the pilot and main regulator diaphragms, this design provides fast response.

Type 99

The schematic in Figure 8 illustrates another typical two-path control design, the Type 99. The difference between the Type 1098-EGR and the Type 99 is the integrally mounted pilot of the Type 99.

The pilot diaphragm measures P_2. When P_2 falls below the pilot setpoint, the diaphragm moves away from the pilot orifice and allows loading pressure to increase. This loads the top of the main regulator diaphragm and strokes the main regulator valve open further.

Unloading Design

Unloading designs incorporate a molded composition diaphragm that serves as the combined loading and restricting component of the main regulator. Full upstream pressure (P_1) is used to load the regulator diaphragm when it is seated. The regulator shown in Figure 9 incorporates an elastomeric valve closure member.

Unloading regulator designs are slower than two-path control systems because the pilot must first react to changes in P_2 before the main regulator valve moves. Recall that in two-path designs, the pilot and main regulator diaphragms react simultaneously.

P_1 passes through a fixed restriction and fills the space above the regulator diaphragm. This fixed restriction can be adjusted to increase or decrease regulator gain. P_1 also fills the cavity below the regulator diaphragm. Because the surface area on the top side of the diaphragm is larger than the area exposed to P_1 below, the diaphragm is forced down against the cage to close the regulator.

When downstream demand increases, the pilot opens. When the pilot opens, regulator loading pressure escapes downstream much faster than P_1 can bleed through the fixed restriction. As pressure above the regulator diaphragm decreases, P_1 forces the diaphragm away from its seat.

When downstream demand is reduced, P_2 increases until it's high enough to compress the pilot spring and close the pilot valve. As the pilot valve closes, P_1 continues to pass through the fixed restriction and flows into the area above the main regulator diaphragm. This loading pressure, P_L, forces the diaphragm back toward the cage, reducing flow through the regulator.

Selecting and Sizing Pressure Reducing Regulators

Introduction

Those who are new to the regulator selection and sizing process are often overwhelmed by the sheer number of regulator types available and the seemingly endless lists of specifications in manufacturer's literature. This application guide is designed to assist you in selecting a regulator that fits your application's specific needs.

Although it might seem obvious, the first step is to consider the application itself. Some applications immediately point to a group of regulators designed specifically for that type of service. The Application Guide has sections to help identify regulators that are designed for specific applications. There are Application Maps, Quick Selection Guides, an Applications section and Product Pages. The Application Map shows some of the common applications and the regulators that are used in those applications. The Quick Selection Guide lists the regulators by application and provides important selection information about each regulator. The Applications section explains the applications covered in the section and it also explains many of the application considerations. The Product Pages provide specific details about the regulators that are suitable for the applications covered in the section. To begin selecting a regulator, turn to the Quick Selection Guide in the appropriate Applications section.

Quick Selection Guides

Quick Selection Guides identify the regulators with the appropriate pressure ratings, outlet pressure ranges and capacities. These guides quickly narrow the range of potentially appropriate regulators. The choices identified by using a Quick Selection Guide can be narrowed further by using the Product Pages to find more information about each of the regulators.

Product Pages

Identifying the regulators that can pass the required flow narrows the possible choices further. When evaluating flow requirements, consider the minimum inlet pressure and maximum flow requirements. Again, this worst case combination ensures that the regulator can pass the required flow under all anticipated conditions.

After one or more regulators have been identified as potentially suitable for the service conditions, consult specific Product Pages to check regulator specifications and capabilities. The application requirements are compared to regulator specifications to narrow the range of appropriate selections. The following specifications can be evaluated in the Product Pages:

- Product description and available sizes
- Maximum inlet and outlet pressures (operating and emergency)
- Outlet pressure ranges
- Flow capacity
- End connection styles
- Regulator construction materials
- Accuracy
- Pressure registration (internal or external)
- Temperature capabilities

After comparing the regulator capabilities with the application requirements, the choices can be narrowed to one or a few regulators. Final selection might depend upon other factors including special requirements, availability, price and individual preference.

Special Requirements

Finally, evaluate any special considerations, such as the need for external control lines, special construction materials or internal overpressure protection. Although overpressure protection might be considered during sizing and selection, it is not covered in this section.

The Role of Experience

Experience in the form of knowing what has worked in the past and familiarity with specific products, has great value in regulator sizing and selection. Knowing the regulator performance characteristics required for a specific application simplifies the process. For example, when fast speed of response is required, a direct-operated regulator may come to mind; or a pilot-operated regulator with an auxiliary, large capacity pilot to speed changes in loading pressure.

Sizing Equations

Sizing equations are useful when sizing pilot-operated regulators and relief valves. They can also be used to calculate the wide-open flow of direct-operated regulators. Use the capacity tables or curves in this application guide when sizing direct-operated regulators and relief/backpressure regulators. The sizing equations are in the Valve Sizing Calculations section.

Selecting and Sizing Pressure Reducing Regulators

General Sizing Guidelines

The following are intended to serve only as guidelines when sizing pressure reducing regulators. When sizing any regulator, consult with experienced personnel or the regulator manufacturer for additional guidance and information relating to specific applications.

Body Size

Regulator body size should never be larger than the pipe size. However, a properly sized regulator may be smaller than the pipeline.

Construction

Be certain that the regulator is available in materials that are compatible with the controlled fluid and the temperatures used. Also, be sure that the regulator is available with the desired end connections.

Pressure Ratings

While regulators are sized using minimum inlet pressures to ensure that they can provide full capacity under all conditions, pay particular attention to the maximum inlet and outlet pressure ratings.

Wide-Open Flow Rate

The capacity of a regulator when it has failed wide-open is usually greater than the regulating capacity. For that reason, use the regulating capacities when sizing regulators and the wide-open flow rates only when sizing relief valves.

Outlet Pressure Ranges and Springs

If two or more available springs have published outlet pressure ranges that include the desired pressure setting, use the spring with the lower range for better accuracy. Also, it is not necessary to attempt to stay in the middle of a spring range, it is acceptable to use the full published outlet pressure range without sacrificing spring performance or life.

Accuracy

Of course, the need for accuracy must be evaluated. Accuracy is generally expressed as droop or the reduction of outlet pressure experienced as the flow rate increases. It is stated in percent, in. w.c. or lbs/in^2. It indicates the difference between the outlet pressure at low flow rates and the outlet pressure at the published maximum flow rate. Droop is also called offset or proportional band.

Inlet Pressure Losses

The regulator inlet pressure used for sizing should be measured directly at the regulator inlet. Measurements made at any distance upstream from the regulator are suspect because line loss can significantly reduce the actual inlet pressure to the regulator. If the regulator inlet pressure is given as a system pressure upstream, some compensation should be considered. Also, remember that downstream pressure always changes to some extent when inlet pressure changes.

Orifice Diameter

The recommended selection for orifice size is the smallest diameter that will handle the flow. This can benefit operation in several ways: instability and premature wear might be avoided, relief valves may be smaller and lockup pressures may be reduced.

Speed of Response

Direct-operated regulators generally have faster response to quick flow changes than pilot-operated regulators.

Turn-Down Ratio

Within reasonable limits, most soft-seated regulators can maintain pressure down to zero flow. Therefore, a regulator sized for a high flow rate will usually have a turndown ratio sufficient to handle pilot-light sized loads during periods of low demand.

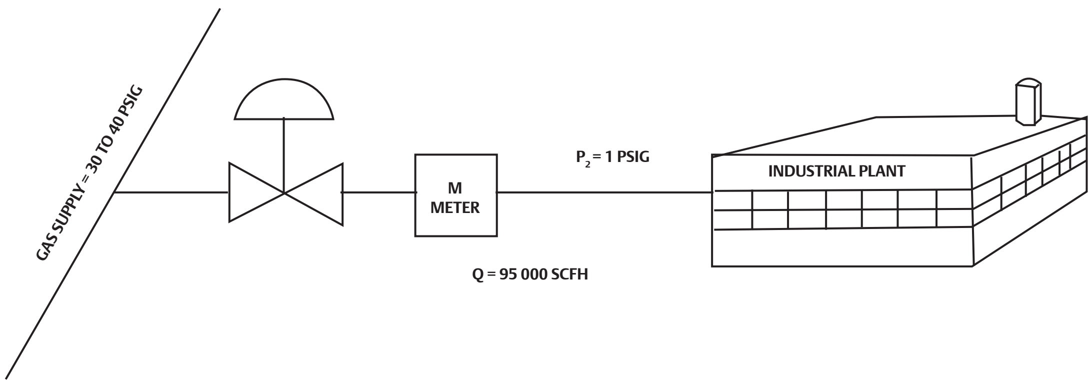

Figure 1. *Natural Gas Supply*

Sizing Exercise: Industrial Plant Gas Supply

Regulator selection and sizing generally requires some subjective evaluation and decision making. For those with little experience, the best way to learn is through example. Therefore, these exercises present selection and sizing problems for practicing the process of identifying suitable regulators.

Our task is to select a regulator to supply reduced pressure natural gas to meet the needs of a small industrial plant. The regulated gas is metered before entering the plant. The selection parameters are:

- Minimum inlet pressure, P_{1min} = 30 psig
- Maximum inlet pressure, P_{1max} = 40 psig
- Outlet pressure setting, P_2 = 1 psig
- Flow, Q = 95 000 SCFH
- Accuracy (droop required) = 10% or less

Quick Selection Guide

Turn to the Commercial/Industrial Quick Selection Guide. From the Quick Selection Guide, we find that the choices are:

- Type 133
- Type 1098-EGR

Product Pages

Under the product number on the Quick Selection Guide is the page number of the product page. Look at the flow capacities of each of the possible choices. From the product pages we found the following:

- At 30 psig inlet pressure and 10% droop, the Type 133 has a flow capacity of 90,000 SCFH. This regulator does not meet the required flow capacity.
- At 30 psig inlet pressure, the Type 1098-EGR has a flow capacity of 131,000 SCFH. By looking at the Proportional Band (Droop) table, we see that the Type 6352 pilot with the yellow pilot spring and the green main valve has 0.05 psig droop. This regulator meets the selection criteria.

Final Selection

We find that the Type 1098-EGR meets the selection criteria.

Overpressure Protection Methods

Overpressure protective devices are of vital concern. Safety codes and current laws require their installation each time a pressure reducing station is installed that supplies gas from any system to another system with a lower maximum allowable operating pressure.

Methods of Overpressure Protection

The most commonly used methods of overpressure protection, not necessarily in order of use or importance, include:

- Relief Valves (Figure 1)
- Monitors (Figures 2 and 3)
- Series Regulation (Figure 4)
- Shutoff (Figure 5)
- Relief Monitor (Figure 6)

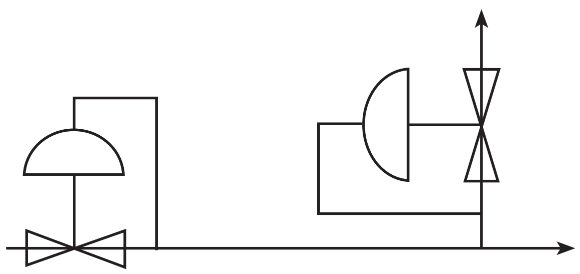

***Figure 1.** Relief Valve Schematic*

Relief Valves

A relief valve is a device that vents process fluid to atmosphere to maintain the pressure downstream of the regulator below the safe maximum pressure. Relief is a common form of overpressure protection typically used for low to medium capacity applications. (Note: Fisher™ relief valves are not ASME safety relief valves.)

Types of Relief Valves

The basic types of relief valves are:

- Pop type
- Direct-operated relief valves
- Pilot-operated relief valves
- Internal relief valves

The pop type relief valve is the simplest form of relief. Pop relief valves tend to go wide-open once the pressure has exceeded its setpoint by a small margin. The setpoint can drift over time and because of its quick opening characteristic the pop relief can sometimes become unstable when relieving, slamming open and closed. Many have a non-adjustable setpoint that is set and pinned at the factory.

If more accuracy is required from a relief valve, the direct-operated relief valve would be the next choice. They can throttle better than a pop relief valve and tend to be more stable, yet are still relatively simple. Although there is less drift in the setpoint of the direct-operated relief valve, a significant amount of build-up is often required to obtain the required capacity.

The pilot-operated relief valves have the most accuracy, but are also the most complicated and expensive type of relief. They use a pilot to dump loading pressure, fully stroking the main valve with very little build-up above setpoint. They have a large capacity and are available in larger sizes than other types of relief.

Many times, internal relief will provide adequate protection for a downstream system. Internal relief uses a relief valve built into the regulator for protection. If the pressure builds too far above the setpoint of the regulator, the relief valve in the regulator opens up, allowing excess pressure to escape through the regulator vent.

Advantages

The relief valve is considered to be the most reliable type of overpressure protection because it is not subject to blockage by foreign objects in the line during normal operations. It also imposes no decrease in the regulator capacity which it is protecting and it has the added advantage of being its own alarm when it vents. It is normally reasonable in cost and keeps the customer in service despite the malfunction of the pressure reducing valve.

Disadvantages

When the relief valve blows, it could possibly create a hazard in the surrounding area by venting. The relief valve must be sized carefully to relieve the gas or fluid that could flow through the pressure reducing valve at its maximum inlet pressure and in the wide-open position, assuming no flow to the downstream. Therefore, each application must be sized individually. The requirement for periodic testing of relief valves also creates an operational and/or public relations problem.

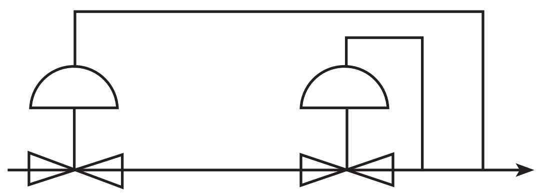

Figure 2. Monitoring Regulators Schematic

Monitoring Regulators

Monitoring is overpressure control by containment. When the working pressure reducing valve ceases to control the pressure, a second regulator installed in series, which has been sensing the downstream pressure, goes into operation to maintain the downstream pressure at a slightly higher than normal pressure. The monitoring concept is gaining in popularity, especially in low-pressure systems, because very accurate relay pilots permit reasonably close settings of the working and monitoring regulators.

The two types of wide-open monitoring are upstream and downstream monitoring. One question often asked is, "Which is better, upstream or downstream monitoring?" Using two identical regulators, there is no difference in overall capacity with either method.

When using monitors to protect a system or customer who may at times have zero load, a small relief valve is sometimes installed downstream of the monitor system with a setpoint just above the monitor. This allows for a token relief in case dust or dirt in the system prevents bubble tight shutoff of the regulators.

Advantages

The major advantage is that there is no venting to atmosphere. During an overpressure situation, monitoring keeps the customer on line and keeps the downstream pressure relatively close to the setpoint of the working regulator. Testing is relatively easy and safe. To perform a periodic test on a monitor, increase the outlet set pressure of the working device and watch the pressure to determine if the monitor takes over.

Disadvantages

Compared to relief valves, monitoring generally requires a higher initial investment. Monitoring regulators are subject to blocking, which is why filters or strainers are specified with increasing frequency. Because the monitor is in series, it is an added restriction in the line. This extra restriction can sometimes force one to use a larger, more expensive working regulator.

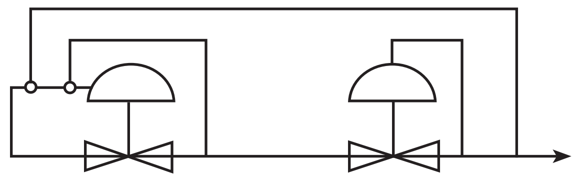

Figure 3. Working Monitor Schematic

Working Monitor

A variation of monitoring overpressure protection that overcomes some of the disadvantages of a wide-open monitor is the "working monitor" concept wherein a regulator upstream of the working regulator uses two pilots. This additional pilot permits the monitoring regulator to act as a series regulator to control an intermediate pressure during normal operation. In this way, both units are always operating and can be easily checked for proper operation. Should the downstream pressure regulator fail to control, however, the monitoring pilot takes over the control at a slightly higher than normal pressure and keeps the customer on line. This is pressure control by containment and eliminates public relations problems.

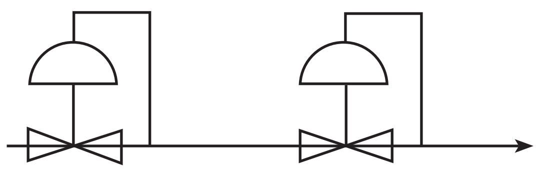

Figure 4. Series Regulation Schematic

Series Regulation

Series regulation is also overpressure protection by containment in that two regulators are set in the same pipeline. The first unit maintains an inlet pressure to the second valve that is within the maximum allowable operating pressure of the downstream system. Under this setup, if either regulator should fail, the resulting downstream pressure maintained by the other regulator would not exceed the safe maximum pressure.

This type of protection is normally used where the regulator station is reducing gas to a pressure substantially below the maximum allowable operating pressure of the distribution system being supplied. Series regulation is also found frequently in farm taps and in similar situations within the guidelines mentioned above.

Overpressure Protection Methods

Advantages

Again, nothing is vented to atmosphere.

Disadvantages

Because the intermediate pressure must be cut down to a pressure that is safe for the entire downstream, the second-stage regulator often has very little pressure differential available to create flow. This can sometimes make it necessary to increase the size of the second regulator significantly. Another drawback occurs when the first-stage regulator fails and no change in the final downstream pressure is noticed because the system operates in what appears to be a "normal" manner without benefit of protection. Also, the first-stage regulator and intermediate piping must be capable of withstanding and containing maximum upstream pressure.

The second-stage regulator must also be capable of handling the full inlet pressure in case the first-stage unit fails to operate. In case the second-stage regulator fails, its actuator will be subjected to the intermediate pressure set by the first-stage unit. The second-stage actuator pressure ratings should reflect this possibility.

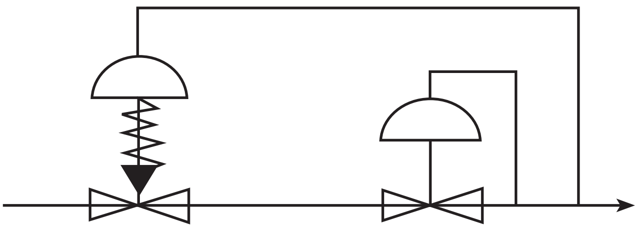

***Figure 5.** Shutoff Schematic*

Shutoff Devices

The shutoff device also accomplishes overpressure protection by containment. In this case, the customer is shutoff completely until the cause of the malfunction is determined and the device is manually reset. Many gas distribution companies use this as an added measure of protection for places of public assembly such as schools, hospitals, churches and shopping centers. In those cases, the shutoff device is a secondary form of overpressure protection. Shutoff valves are also commonly used by boiler manufacturers in combustion systems.

Advantages

By shutting off the customer completely, the safety of the downstream system is assured. Again, there is no public relations problem or hazard from venting gas or other media.

Disadvantages

The customer may be shutoff because debris has temporarily lodged under the seat of the operating regulator, preventing tight shutoff. A small relief valve can take care of this situation.

On a distribution system with a single supply, using a slam-shut can require two trips to each customer, the first to shutoff the service valve and the second visit after the system pressure has been restored to turn the service valve back on and re-light the appliances. In the event a shutoff is employed on a service line supplying a customer with processes such as baking, melting metals or glass making, the potential economic loss could dictate the use of an overpressure protection device that would keep the customer online.

Another problem associated with shutoffs is encountered when the gas warms up under no-load conditions. For instance, a regulator locked up at approximately 7 in. w.c. could experience a pressure rise of approximately 0.8 in. w.c. per degree Fahrenheit rise, which could cause the high-pressure shutoff to trip when there is actually no equipment failure.

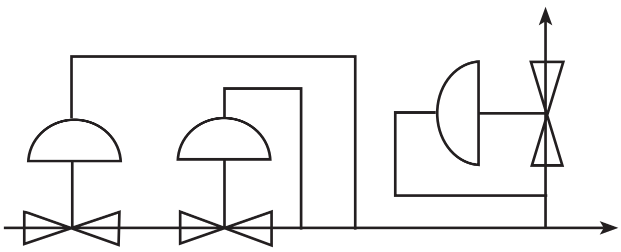

***Figure 6.** Relief Monitor Schematic*

Relief Monitor

Another concept in overpressure protection for small industrial and commercial loads, up to approximately 10,000 ft^3/hr, incorporates both an internal relief valve and a monitor. In this device, the relief capacity is purposely restricted to prevent excess venting of gas in order to bring the monitor into operation more quickly. The net result is that the downstream pressure is protected, in some cases to less than 1 psig. The amount of gas vented under maximum inlet pressure conditions does not exceed the amount vented by a domestic relief type service regulator.

Table 1. Types Of Overpressure Protection

PERFORMANCE QUESTIONS	RELIEF	WORKING MONITOR	MONITOR	SERIES REGULATION	SHUTOFF	RELIEF MONITOR
Keeps application online?	Yes	Yes	Yes	Yes	No	Yes
Venting to atmosphere?	Yes	No	No	No	No	Minor
Manual resetting required after operation?	No	No	No	No	Yes	No
Reduces capacity of regulator?	No	Yes	Yes	Yes	No	No
Constantly working during normal operation?	No	Yes	No	Yes	No	Yes
Demands “emergency” action?	Yes	No	No	No	Yes	Maybe
Will surveillance of pressure charts indicate partial loss of performance of overpressure devices?	No	Yes	Maybe	Yes	No	No
Will surveillance of pressure charts indicate regulator has failed and safety device is in control?	Yes	Yes	Yes	Yes	Yes	Yes

With this concept, the limitation by regulator manufacturers of inlet pressure by orifice size, as is found in “full relief” devices, is overcome. Downstream protection is maintained, even with abnormally high inlet pressure. Public relations problems are kept to a minimum by the small amount of vented gas. Also, the unit does not require manual resetting, but can go back into operation automatically.

Dust or dirt can clear itself off the seat, but if the obstruction to the disk closing still exists when the load goes on, the customer would be kept online. When the load goes off, the downstream pressure will again be protected. During normal operation, the monitoring portion of the relief monitor is designed to move slightly with minor fluctuations in downstream pressure or flow.

Summary

From the foregoing discussion, it becomes obvious that there are many design philosophies available and many choices of equipment to meet overpressure protection requirements.

Also, assume the overpressure device will be called upon to operate sometime after it is installed. The overall design must include an analysis of the conditions created when the protection device operates.

Table 1 shows:

- What happens when the various types of overpressure protection devices operate
- The type of reaction required
- The effect upon the customer or the public
- Some technical conditions

These are the general characteristics of the various types of safety devices. From the conditions and results shown, it is easier to decide which type of overpressure equipment best meets your needs. Undoubtedly, compromises will have to be made between the conditions shown here and any others which may govern your operating parameters.

Principles of Relief Valves

Overpressure Protection

Overpressure protection is a primary consideration in the design of any piping system. The objective of overpressure protection is to maintain the pressure downstream of a regulator at a safe maximum value.

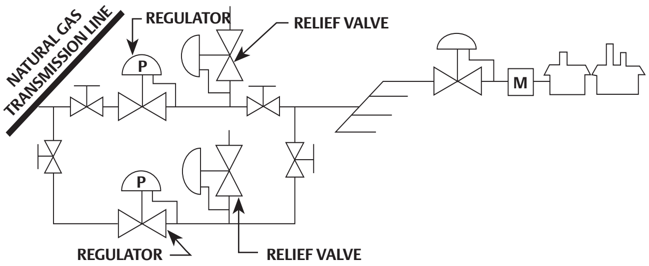

Figure 1. *Distribution System*

In the system shown in Figure 1, a high-pressure transmission system delivers natural gas through a pressure reducing regulator to a lower pressure system that distributes gas to individual customers. The regulators, the piping and the devices that consume gas are protected from overpressure by relief valves. The relief valve's setpoint is adjusted to a level established by the lowest maximum pressure rating of any of the lower pressure system components.

Maximum Pressure Considerations

Overpressure occurs when the pressure of a system is above the setpoint of the device controlling its pressure. It is evidence of some failure in the system (often the upstream regulator) and it can cause the entire system to fail if it's not limited. To implement overpressure protection, the weakest part in the pressure system is identified and measures are taken to limit overpressure to that component's maximum pressure rating. The most vulnerable components are identified by examining the maximum pressure ratings of the:

- Downstream equipment
- Low-pressure side of the main regulator
- Piping

The lowest maximum pressure rating of the three is the maximum allowable pressure.

Downstream Equipment

The downstream component (appliance, burner, boiler, etc.) with the lowest maximum pressure rating sets the highest pressure that all the downstream equipment can be subjected to.

Main Regulator

Pressure reducing regulators have different pressure ratings which refer to the inlet, outlet and internal components. The lowest of these should be used when determining the maximum allowable pressure.

Piping

Piping is limited in its ability to contain pressure. In addition to any physical limitations, some applications must also conform to one or more applicable pressure rating codes or regulations.

Relief Valves

Relief involves maintaining the pressure downstream of a regulator at a safe maximum pressure using any device that vents fluid to a lower pressure system (often the atmosphere). Relief valve exhaust must be directed or piped to a safe location. Relief valves perform this function. They are considered to be one of the most reliable types of overpressure protection available and are available in a number of different types. Fisher™ relief valves are not ASME safety relief valves.

W1921

H200 SERIES POP TYPE

W1870

TYPE 289 DIRECT-OPERATED

W3167

TYPE 289P-6358 PILOT-OPERATED

W4793

TYPE 627 WITH INTERNAL RELIEF

Figure 2. *Types of Relief Valves*

Relief Valve Popularity

Relief valves are popular for several reasons. They do not block the normal flow through a line. They do not decrease the capacities of the regulators they protect. And, they have the added advantage of being an alarm if they vent to atmosphere.

Relief Valve Types

Relief valves are available in four general types. These include: pop type, direct-operated, pilot-operated and internal relief valves.

Selection Criteria

Pressure Build-up

A relief valve has a setpoint at which it begins to open. For the valve to fully open and pass the maximum flow, pressure must build up to some level above the setpoint of the relief valve. This is known as pressure build-up over setpoint or simply build-up.

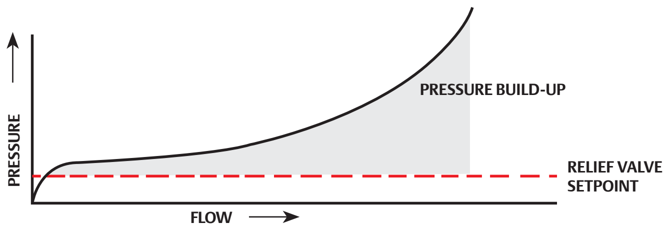

Figure 3. *Pressure Build-up*

Periodic Maintenance

A relief valve installed in a system that normally performs within design limits is very seldom exercised. The relief valve sits and waits for a failure. If it sits for long periods it may not perform as expected. Disks may stick in seats, setpoints can shift over time and small passages can become clogged with pipeline debris. Therefore, periodic maintenance and inspection is recommended. Maintenance requirements might influence the selection of a relief valve.

Cost Versus Performance

Given several types of relief valves to choose from, selecting one type is generally based on the ability of the valve to provide adequate protection at the most economical cost. Reduced pressure build-up and increased capacity generally come at an increased price.

Installation and Maintenance Considerations

Initial costs are only a part of the overall cost of ownership. Maintenance and installation costs must also be considered over the life of the relief valve. For example, internal relief might be initially more economical than an external relief valve. However, maintaining a regulator with internal relief requires that the system be shut down and the regulator isolated. This may involve additional time and the installation of parallel regulators and relief valves if flow is to be maintained to the downstream system during maintenance operations.

Pop Type Relief Valve

The most simple type of relief valve is the pop type. They are used wherever economy is the primary concern and some setpoint drift is acceptable.

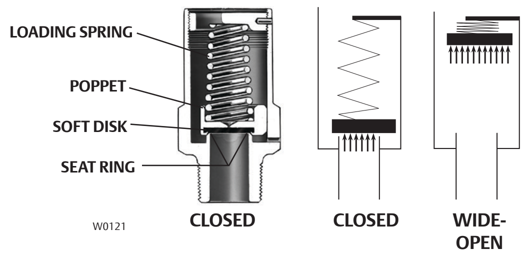

Figure 4. *Pop Type Relief Valve Construction and Operation*

Operation

Pop type relief valves are essentially on-off devices. They operate in either the closed or wide-open position. Pop type designs register pressure directly on a spring-opposed poppet. The poppet assembly includes a soft disk for tight shutoff against the seat ring. When the inlet pressure increases above setpoint, the poppet assembly is pushed away from the seat. As the poppet rises, pressure registers against a greater surface area of the poppet. This dramatically increases the force on the poppet. Therefore, the poppet tends to travel to the fully open position reducing pressure build-up.

Principles of Relief Valves

Build-up Over Setpoint

Recall that pressure build-up relates capacity to pressure; increasing capacity requires some increase in pressure. In throttling relief valves, pressure build-up is related to accuracy. In pop type relief valves, build-up over setpoint results largely because the device is a restriction to flow rather than the spring rate of the valve's loading spring.

Fixed Setpoint

The setpoint of a pop type valve cannot be adjusted by the user. The spring is initially loaded by the manufacturer. A pinned spring retainer keeps the spring in position. This is a safety measure that prevents tampering with the relief valve setpoint.

Typical Applications

This type of relief valve may be used where venting to the atmosphere is acceptable, when the process fluid is compatible with the soft disk and when relief pressure variations are allowable. They are often used as inexpensive token relief. For example, they may be used simply to provide an audible signal of an overpressure condition.

These relief valves may be used to protect against overpressure stemming from a regulator with a minimal amount of seat leakage. Unchecked, this seat leakage could allow downstream pressure to build to full P_1 over time. The use of a small pop type valve can be installed to protect against this situation.

These relief valves are also commonly installed with a regulator in a natural gas system farm tap, in pneumatic lines used to operate air drills, jackhammers and other pneumatic equipment and in many other applications.

Advantages

Pop type relief valves use few parts. Their small size allows installation where space is limited. Also, low initial cost, easy installation and high capacity per dollar invested can result in economical system relief.

Disadvantages

The setpoint of a pop type relief valve may change over time. The soft disk may stick to the seat ring and cause the pop pressure to increase.

As an on-off device, this style of relief valve does not throttle flow over a pressure range. Because of its on-off nature, this type of relief valve may create pressure surges in the downstream system.

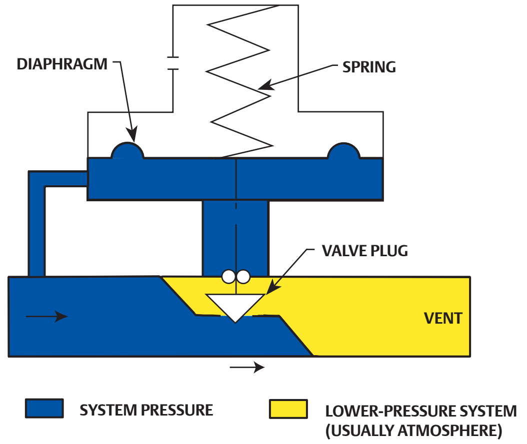

Figure 5. *Direct-Operated Relief Valve Schematic*

If the relief valve capacity is significantly larger than the failed regulator's capacity, the relief valve may over-compensate each time it opens and closes. This can cause the downstream pressure system to become unstable and cycle. Cycling can damage the relief valve and downstream equipment.

Direct-Operated Relief Valves

Compared to pop type relief valves, direct-operated relief valves provide throttling action and may require less pressure build-up to open the relief valve.

Operation

A schematic of a direct-operated relief valve is shown in Figure 5. It looks like an ordinary direct-operated regulator except that it senses upstream pressure rather than downstream pressure. And, it uses a spring-close rather than a spring-open action. It contains the same essential elements as a direct-operated regulator:

- A diaphragm that measures system pressure
- A spring that provides the initial load to the diaphragm and is used to establish the relief setpoint
- A valve that throttles the relief flow

Opening the Valve

As the inlet pressure rises above the setpoint of the relief valve, the diaphragm is pushed upward moving the valve plug away from the seat. This allows fluid to escape.

Pressure Build-up Over Setpoint

As system pressure increases, the relief valve opens wider. This allows more fluid to escape and protects the system. The increase in pressure above the relief setpoint that is required to produce more flow through the relief valve is referred to as pressure build-up. The spring rate and orifice size influence the amount of pressure build-up that is required to fully stroke the valve.

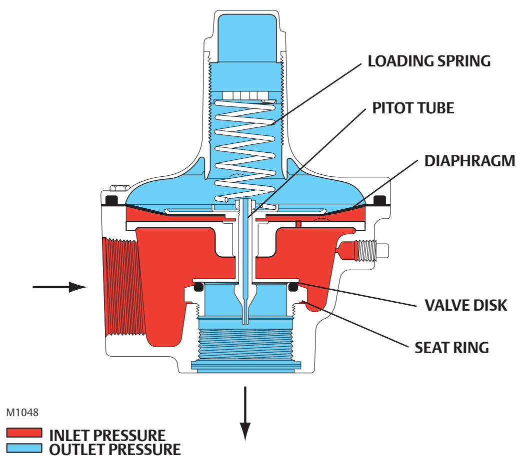

Figure 6. *Type 289 Relief Valve with Pitot Tube*

Product Example

Pitot Tube

The relief valve shown in Figure 6 includes a pitot tube to reduce pressure build-up. When the valve is opening, high fluid velocity through the seat ring creates an area of relatively low pressure. Low pressure near the end of the pitot tube draws fluid out of the volume above the relief valve diaphragm and creates a partial vacuum which helps to open the valve. The partial vacuum above the diaphragm increases the relief valve capacity with less pressure build-up over setpoint.

Typical Applications

Direct-operated relief valves are commonly used in natural gas systems supplying commercial enterprises such as restaurants and laundries and in industry to protect industrial furnaces and other equipment.

Selection Criteria

Pressure Build-up

Some direct-operated relief valves require significant pressure build-up to achieve maximum capacity. Others, such as those using pitot tubes, often pass high flow rates with minimal pressure build-up. Direct-operated relief valves can provide good accuracy within their design capacities.

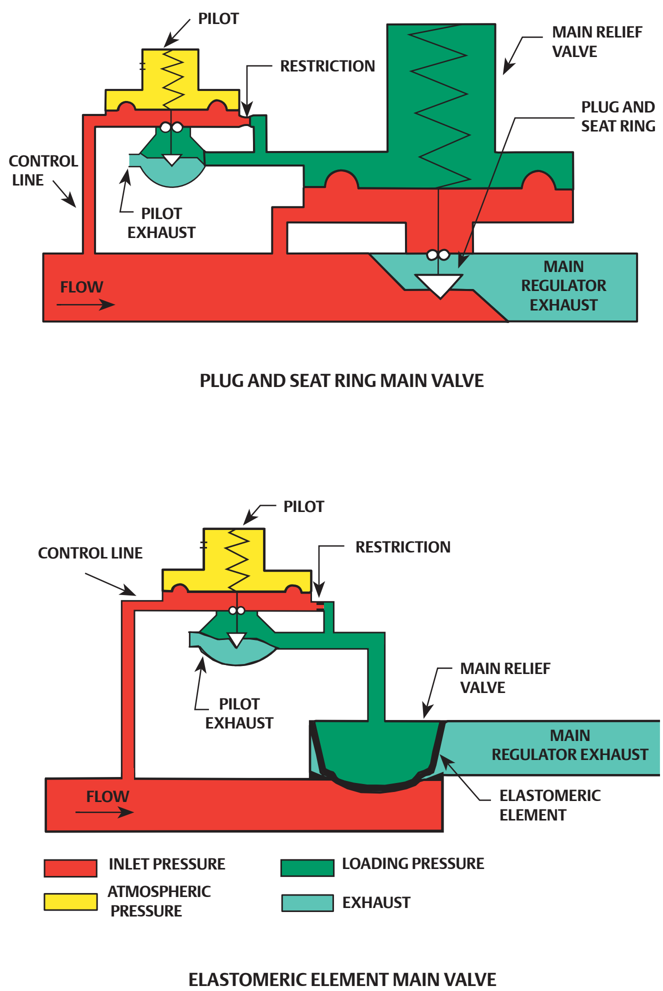

Figure 7. *Pilot-Operated Designs*

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Cost Versus Performance

The purchase price of a direct-operated relief valve is typically lower than that of a pilot-operated design of the same size. However, pilot-operated designs may cost less per unit of capacity at very high flow rates.

Pilot-Operated Relief Valves

Pilot-operated relief valves utilize a pair of direct-operated relief valves; a pilot and a main relief valve. The pilot increases the effect of changes in inlet pressure on the main relief valve.

Operation

The operation of a pilot-operated relief valve is quite similar to the operation of a pilot-operated pressure reducing regulator. In normal operation, when system pressure is below setpoint of the relief valve, the pilot remains closed. This allows loading pressure to register on top of the main relief valve diaphragm. Loading pressure on top of the diaphragm is opposed by an equal pressure (inlet pressure) on the bottom side of the diaphragm. With little or no pressure differential across the diaphragm, the spring keeps the valve seated. Notice that a light-rate spring may be used because it does not oppose a large pressure differential across the diaphragm. The light-rate spring enables the main valve to travel to the wide-open position with little pressure build-up.

Increasing Inlet Pressure

When the inlet pressure rises above the relief setpoint, the pilot spring is compressed and the pilot valve opens. The open pilot bleeds fluid out of the main valve spring case, decreasing pressure above the main relief valve diaphragm. If loading pressure escapes faster than it can be replaced through the restriction, the loading pressure above the main relief valve diaphragm is reduced and the relief valve opens. System overpressure exhausts through the vent.

Decreasing Inlet Pressure

If inlet pressure drops back to the relief valve setpoint, the pilot loading spring pushes the pilot valve plug back against the pilot valve seat. Inlet pressure again loads the main relief valve diaphragm and closes the main valve.

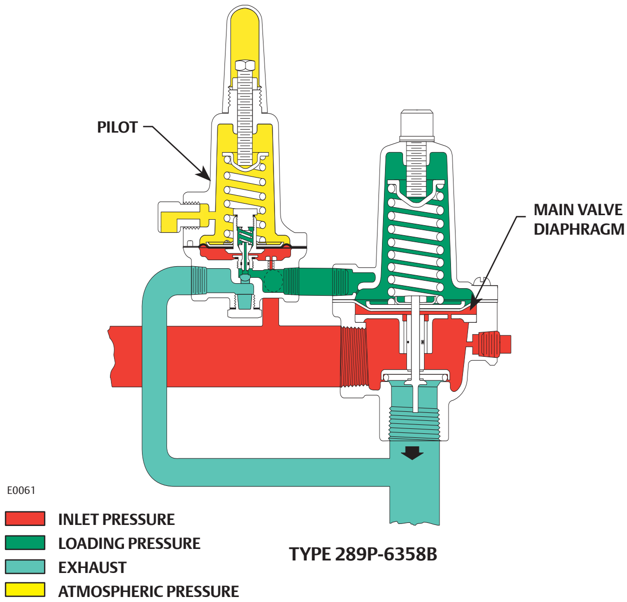


Figure 8. *Pilot-Operated Relief Valve*

Control Line

The control line connects the pilot with the pressure that is to be limited. When overpressure control accuracy is a high priority, the control line tap is installed where protection is most critical.

Product Example

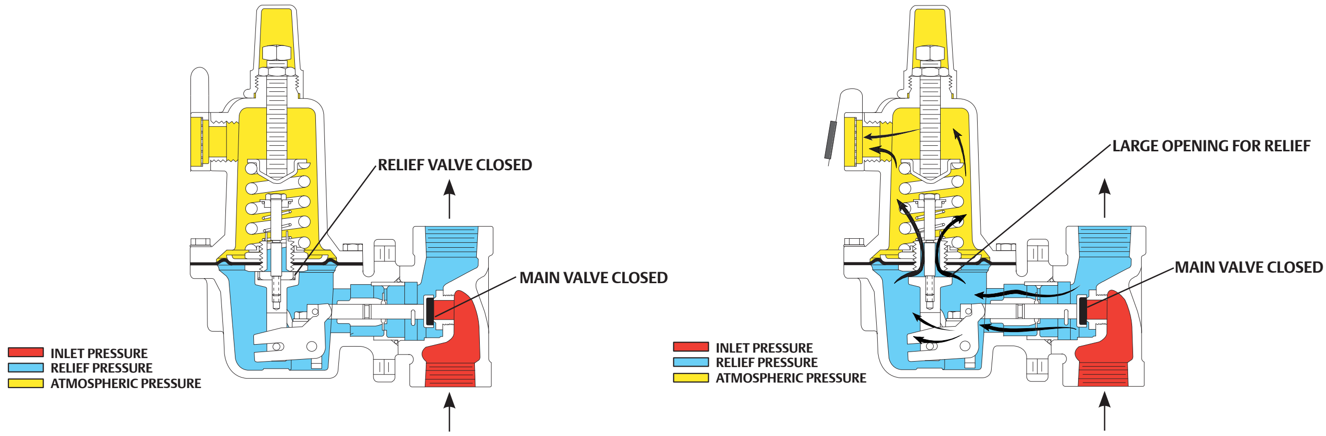
Physical Description

This relief valve is a direct-operated relief valve with a pilot attached (Figure 8). The pilot is a modified direct-operated relief valve, the inlet pressure loads the diaphragm and flows through a restriction to supply loading pressure to the main relief valve diaphragm.

Operation

During normal operation, the pilot is closed allowing loading pressure to register above the main relief valve's diaphragm. This pressure is opposed by inlet pressure acting on the bottom of the diaphragm.

If inlet pressure rises above setpoint, the pilot valve opens, exhausting the loading pressure. If loading pressure is reduced above the main relief valve diaphragm faster than it is replaced through the pilot fixed restriction, loading pressure is reduced and inlet pressure below the diaphragm will cause the main regulator to open.



REGULATORS THAT INCLUDE INTERNAL RELIEF VALVES OFTEN ELIMINATE THE REQUIREMENT FOR EXTERNAL OVERPRESSURE PROTECTION. THE ILLUSTRATION ON THE LEFT SHOWS THE REGULATOR WITH BOTH THE RELIEF VALVE AND THE REGULATOR VALVE IN THE CLOSED POSITION. THE ILLUSTRATION ON THE RIGHT SHOWS THE SAME UNIT AFTER P_2 HAS INCREASED ABOVE THE RELIEF VALVE SETPOINT. THE DIAPHRAGM HAS MOVED OFF THE RELIEF VALVE SEAT ALLOWING FLOW (EXCESS PRESSURE) TO EXHAUST THROUGH THE SCREENED VENT.

Figure 9. *Internal Relief Design*

If inlet pressure falls below the relief set pressure, the pilot spring will again close the pilot exhaust, increasing loading pressure above the main relief valve diaphragm. This increasing loading pressure causes the main valve to travel towards the closed position.

Performance

Pilot-operated relief valves are able to pass large flow rates with a minimum pressure build-up.

Typical Applications

Pilot-operated relief valves are used in applications requiring high capacity and low pressure build-up.

Selection Criteria

Minimal Build-up

The use of a pilot to load and unload the main diaphragm and the light-rate spring enables the main valve to travel wide-open with little pressure build-up over setpoint.

Throttling Action

The sensitive pilot produces smooth throttling action when inlet pressure rises above setpoint. This helps to maintain a steady downstream system pressure.

Internal Relief

Regulators that include internal relief valves may eliminate the requirement for external overpressure protection.

Operation

The regulator shown in Figure 9 includes an internal relief valve. The relief valve has a measuring element (the main regulator diaphragm), a loading element (a light spring) and a restricting element (a valve seat and disk). The relief valve assembly is located in the center of the regulator diaphragm.

Build-up Over Setpoint

Like other spring-loaded designs, internal relief valves will only open wider if the inlet pressure increases. The magnitude of pressure build-up is determined by the spring rates of the loading spring plus the main spring. Both springs are considered because they act together to resist diaphragm movement when pressure exceeds the relief valve setpoint.

Product Example

A typical internal relief regulator construction is shown in Figure 9. The illustration on the left shows the regulator with both the relief valve and regulator valve in the closed position. The illustration on the right shows the same unit after the inlet pressure has increased above the relief valve setpoint. The diaphragm has moved off the relief valve seat allowing the excess pressure to exhaust through the vent.

Principles of Relief Valves

Performance and Typical Applications

This design is available in configurations that can protect many pressure ranges and flow rates. Internal relief is often used in applications such as farm taps, industrial applications where atmospheric exhaust is acceptable and house service regulators.

Selection Criteria

Pressure Build-up

Relief setpoint is determined by a combination of the relief valve and regulator springs; this design generally requires significant pressure build-up to reach its maximum relief flow rate. For the same reason, internal relief valves have limited relief capacities. They may provide full relief capacity, but should be carefully sized for each application.

Space

Internal relief has a distinct advantage when there is not enough space for an external relief valve.

Cost versus Performance

Because a limited number of parts are simply added to the regulator, this type of overpressure protection is relatively inexpensive compared to external relief valves of comparable capacity.

Maintenance

Because the relief valve is an integral part of the regulator's diaphragm, the regulator must be taken out of service when maintenance is performed. Therefore, the application should be able to tolerate either the inconvenience of intermittent supply or the expense of parallel regulators and relief valves.

Selection and Sizing Criteria

There are a number of common steps in the relief valve selection and sizing process. For every application, the maximum pressure conditions, the wide-open regulator flow capacity and constant downstream demand should be determined. Finally, this information is used to select an appropriate relief valve for the application.

Maximum Allowable Pressure

Downstream equipment includes all the components of the system that contain pressure; household appliances, tanks, tools, machines, outlet rating of the upstream regulators or other equipment. The component with the lowest maximum pressure rating establishes the maximum allowable system pressure.

Regulator Ratings

Pressure reducing regulators upstream of the relief valve have ratings for their inlet, outlet and internal components. The lowest rating should be used when determining maximum allowable pressure.

Piping

Piping pressure limitations imposed by governmental agencies, industry standards, manufacturers or company standards should be verified before defining the maximum overpressure level.

Maximum Allowable System Pressure

The smallest of the pressure ratings mentioned above should be used as the maximum allowable pressure. This pressure level should not be confused with the relief valve setpoint which must be set below the maximum allowable system pressure.

Determining Required Relief Valve Flow

A relief valve must be selected to exhaust enough flow to prevent the pressure from exceeding the maximum allowable system pressure. To determine this flow, review all upstream components for the maximum possible flow that will cause overpressure. If overpressure is caused by a pressure reducing regulator, use the regulator's wide-open flow coefficient to calculate the required flow of the relief valve. This regulator's wide-open flow is larger than the regulating flow used to select the pressure reducing regulator.

Sizing equations have been developed to standardize valve sizing. Refer to the Valve Sizing Calculations section to find these equations and explanations on how they are used.

Determine Constant Demand

In some applications, the required relief capacity can be reduced by subtracting any load that is always on the system. This procedure should be approached with caution because it may be difficult to predict the worst-case scenario for downstream equipment failures. It may also be important to compare the chances of making a mistake in predicting the level of continuous flow consumption with the potential negative aspects of an error. Because of the hazards involved, relief valves are often sized assuming no continuous flow to downstream equipment.

Selecting Relief Valves

Required Information

We have already reviewed the variables required to calculate the regulator's wide-open flow rate. In addition, we need to know the type and temperature of the fluid in the system and the size of the piping. Finally, if a vent stack will be required, any additional build-up due to vent stack resistance should be considered.

Regulator Lockup Pressure

A relief valve setpoint is adjusted to a level higher than the regulator's lockup pressure. If the relief valve setpoint overlaps lockup pressure of the regulator, the relief valve may open while the regulator is still attempting to control the system pressure.

Identify Appropriate Relief Valves

Once the size, relief pressure and flow capacity are determined, we can identify a number of potentially suitable relief valves using the Quick Selection Guide in the front of each application section in this application guide. These selection guides give relief set (inlet) pressures, capacities and type numbers. These guides can then be further narrowed by reviewing individual product pages in each section.

Final Selection

Final selection is usually a matter of compromise. Relief capacities, build-up levels, sensitivity, throttling capabilities, cost of installation and maintenance, space requirements, initial purchase price and other attributes are all considered when choosing any relief valve.

Applicable Regulations

The relief valves installed in some applications must meet governmental, industry or company criteria.

Sizing and Selection Exercise

To gain a better understanding of the selection and sizing process, it may be helpful to step through a typical relief valve sizing exercise.

Initial Parameters

We'll assume that we need to specify an appropriate relief valve for a regulator serving a large plant air supply. There is sufficient space to install the relief valve and the controlled fluid is clean plant air that can be exhausted without adding a vent stack.

Performance Considerations

The plant supervisor wants the relief valve to throttle open smoothly so that pressure surges will not damage instruments and equipment in the downstream system. This will require the selection of a relief valve that will open smoothly. Plant equipment is periodically shut down but the air supply system operates continuously. Therefore, the relief valve must also have the capacity to exhaust the full flow of the upstream system.

Upstream Regulator

The regulator used is 1 in. in size with a 3/8 in. orifice. The initial system parameters of pressure and flow were determined when the regulator was sized for this application.

Pressure Limits

The plant maintenance engineer has determined that the relief valve should begin to open at 20 psig and downstream pressure should not rise above 30 psig maximum allowable system pressure.

Relief Valve Flow Capacity

The wide-open regulator flow is calculated to be 23,188 SCFH.

Principles of Relief Valves

Relief Valve Selection

Quick Selection Guide

Find the Relief Valve Quick Selection Guide in this Application Guide; it gives relief set (inlet) pressures and comparative flow capacities of various relief valves. Because this guide is used to identify potentially suitable relief valves, we can check the relief set (inlet) pressures closest to 20 psig and narrow the range of choices. We find that two relief valves have the required flow capacity at our desired relief set (inlet) pressure.

Product Pages

If we look at the product pages for the potential relief valves, we find that a 1 in. Type 289H provides the required capacity within the limits of pressure build-up specified in our initial parameters.

Checking Capacity

Capacity curves for the 1 in. Type 289H with this spring are shown in Figure 10. By following the curve for the 20 psig setpoint to the point where it intersects with the 30 psig division, we find that our relief valve can handle more than the 23,188 SCFH required.

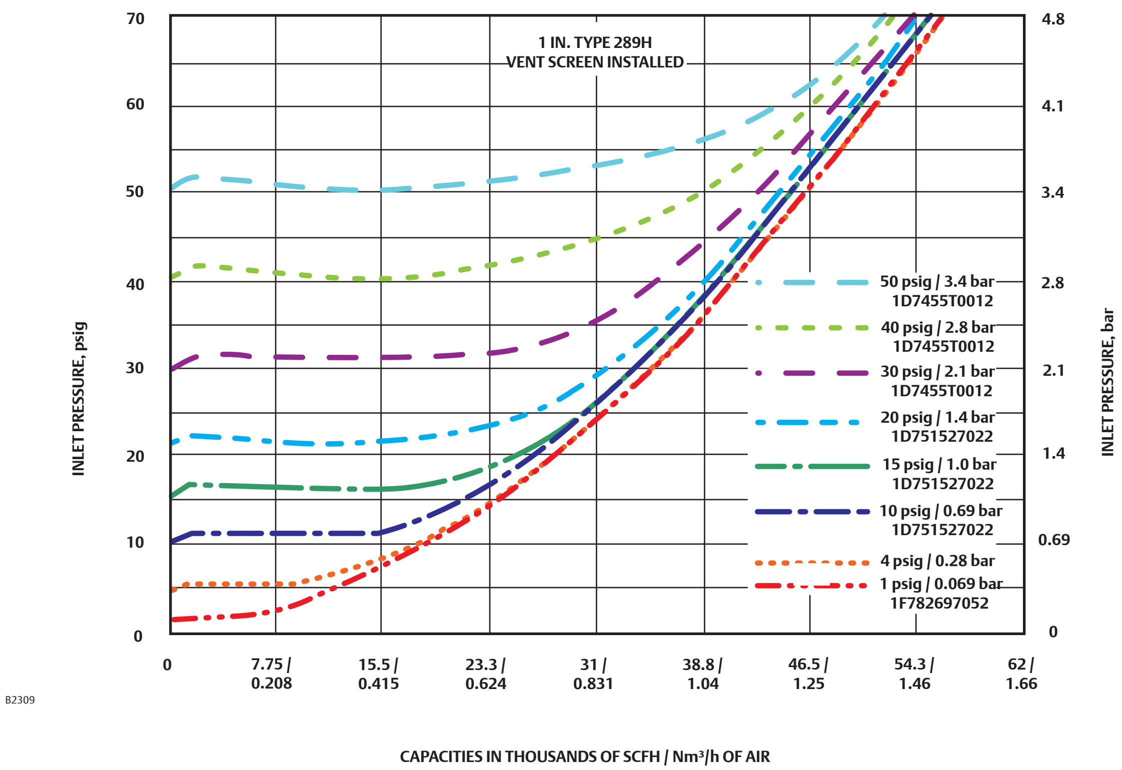


Figure 10. *Type 289H Flow Capacities*

Principles of Series Regulation and Monitor Regulators

Series Regulation

Series regulation is one of the simplest systems used to provide overpressure protection by containment. In the example shown in Figure 1, the inlet pressure is 100 psig, the desired downstream pressure is 10 psig and the maximum allowable operating pressure (MAOP) is 40 psig. The setpoint of the downstream regulator is 10 psig and the setpoint of the upstream regulator is 30 psig.

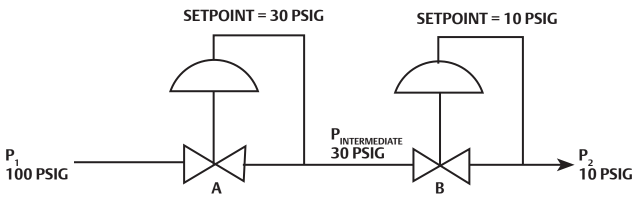


Figure 1. *Series Regulation*

Failed System Response

If regulator B fails, downstream pressure (P_2) is maintained at the setpoint of regulator A less whatever drop is required to pass the required flow through the failed regulator B. If regulator A fails, the intermediate pressure will be 100 psig. Regulator B must be able to withstand 100 psig inlet pressure.

Regulator Considerations

Either direct-operated or pilot-operated regulators may be used in this system. Should regulator A fail, $P_{Intermediate}$ will approach P_1 so the outlet rating and spring casing rating of regulator A must be high enough to withstand full P_1. This situation may suggest the use of a relief valve between the two regulators to limit the maximum value of $P_{Intermediate}$.

Applications and Limitations

A problem with series regulation is maintaining tight control of P_2 if the downstream regulator fails. In this arrangement, it is often impractical to have the setpoints very close together. If they are, the pressure drop across regulator B will be quite small. With a small pressure drop, a very large regulator may be required to pass the desired flow.

Because of the problem in maintaining close control of P_2, series regulation is best suited to applications where the regulator station is reducing pressure to a value substantially below the maximum allowable operating pressure of the downstream system. Farm taps are a good example. The problem of low-pressure drop across the second regulator is less pronounced in low flow systems.

Upstream Wide-Open Monitors

The only difference in configuration between series regulation and monitors is that in monitor installations, both regulators sense downstream pressure, P_2. Thus, the upstream regulator must have a control line.

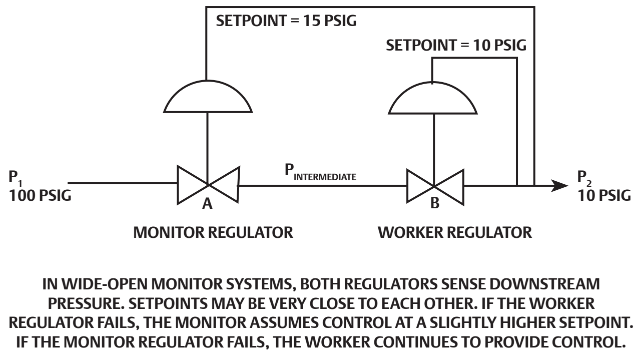


Figure 2. *Wide-Open Upstream Monitor*

System Values

In the example shown in Figure 2, assume that P_1 is 100 psig and the desired downstream pressure, P_2, is 10 psig. Also assume that the maximum allowable operating pressure of the downstream system is 20 psig; this is the limit we cannot exceed. The setpoint of the downstream regulator is set at 10 psig to maintain the desired P_2 and the setpoint of the upstream regulator is set at 15 psig to maintain P_2 below the maximum allowable operating pressure.

Normal Operation

When both regulators are functioning properly, regulator B holds P_2 at its setpoint of 10 psig. Regulator A, sensing a pressure lower than its setpoint of 15 psig tries to increase P_2 by going wide-open. This configuration is known as an upstream wide-open monitor where upstream regulator A monitors the pressure established by regulator B. Regulator A is referred to as the monitor or standby regulator while regulator B is called the worker or the operator.

Principles of Series Regulation and Monitor Regulators

Worker Regulator B Fails

If regulator B fails open, regulator A, the monitor, assumes control and holds P_2 at 15 psig. Note that pressure $P_{Intermediate}$ is now P_2 plus whatever drop is necessary to pass the required flow through the failed regulator B.

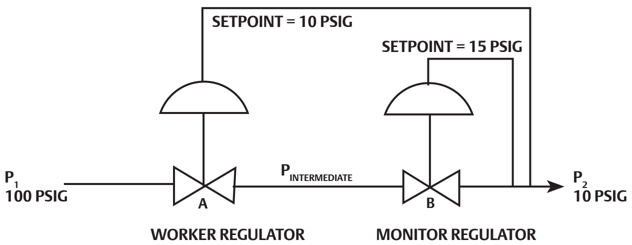
Equipment Considerations

Wide-open monitoring systems may use either direct- or pilot-operated regulators, the choice of which is dependent on other system requirements. Obviously, the upstream regulator must have external registration capability in order to sense downstream pressure, P_2.

In terms of ratings, $P_{Intermediate}$ will rise to full P_1 when regulator A fails, so the body outlet of regulator A and the inlet of regulator B must be rated for full P_1.

Downstream Wide-Open Monitors

The difference between upstream and downstream monitor systems (Figure 3) is that the functions of the two regulators are reversed. In other words, the monitor or standby regulator, is downstream of the worker or operator. Systems can be changed from upstream to downstream monitors, and vice versa, by simply reversing the setpoints of the two regulators.



THE ONLY DIFFERENCE BETWEEN UPSTREAM WIDE-OPEN MONITOR SYSTEMS AND DOWNSTREAM WIDE-OPEN MONITOR SYSTEMS IS THE ROLE EACH REGULATOR PLAYS. WORKERS AND MONITORS MAY BE SWITCHED BY SIMPLY REVERSING THE SETPOINTS.

Figure 3. *Wide-Open Downstream Monitor*

Normal Operation

Again, assume an inlet pressure of 100 psig and a controlled pressure (P_2) of 10 psig. Regulator A is now the worker so it maintains P_2 at its setpoint of 10 psig. Regulator B, the monitor, is set at 15 psig and so remains open.

Worker Regulator A Fails

If the worker, regulator A, fails in an open position, the monitor, regulator B, senses the increase in P_2 and holds P_2 at its setpoint of 15 psig. Note that $P_{Intermediate}$ is now P_1 minus whatever drop is taken across the failed regulator A.

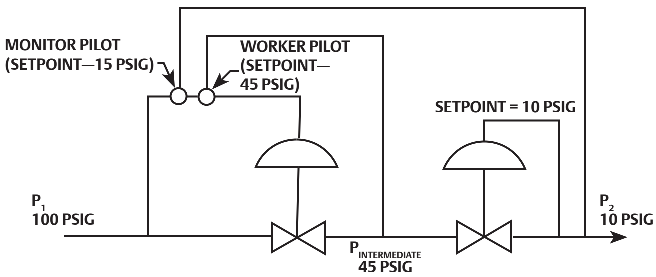
Upstream Versus Downstream Monitors

The decision to use either an upstream or downstream monitor system is largely a matter of personal preference or company policy.

In normal operation, the monitor remains open while the worker is frequently exercised. Many users see value in changing the system from an upstream to a downstream monitor at regular intervals, much like rotating the tires on an automobile. Most fluids have some impurities such as moisture, rust or other debris, which may deposit on regulator components, such as stems and cause them to become sticky or bind. Therefore, occasionally reversing the roles of the regulators so that both are exercised is sometimes seen as a means of ensuring that protection is available when needed. The job of switching is relatively simple as only the setpoints of the two regulators are changed. In addition, the act of changing from an upstream to a downstream monitor requires that someone visit the site so there is an opportunity for routine inspection.

Working Monitors

Working monitors (Figure 4) use design elements from both series regulation and wide-open monitors. In a working monitor installation, the two regulators are continuously working as series regulators to take two pressure cuts.



WORKING MONITOR SYSTEMS MUST USE A PILOT-OPERATED REGULATOR AS THE MONITOR, WHICH IS ALWAYS IN THE UPSTREAM POSITION. TWO PILOTS ARE USED ON THE MONITOR REGULATOR; ONE TO CONTROL THE INTERMEDIATE PRESSURE AND ONE TO MONITOR THE DOWNSTREAM PRESSURE. BY TAKING TWO PRESSURE DROPS, BOTH REGULATORS ARE ALLOWED TO EXERCISE.

Figure 4. *Working Monitor*

Downstream Regulator

The downstream regulator may be either direct or pilot-operated. It is installed just as in a series or wide-open monitor system. Its setpoint controls downstream pressure, P_2.

Upstream Regulator

The upstream regulator must be a pilot-operated type because it uses two pilots; a monitor pilot and a worker pilot. The worker pilot is connected just as in series regulation and controls the intermediate pressure $P_{Intermediate}$. Its setpoint 45 psig is at some intermediate value that allows the system to take two pressure drops. The monitor pilot is in series ahead of the worker pilot and is connected so that it senses downstream pressure, P_2. The monitor pilot setpoint 15 psig is set slightly higher than the normal P_2 10 psig.

Normal Operation

When both regulators are performing properly, downstream pressure is below the setting of the monitor pilot, so it is fully open trying to raise system pressure. Standing wide-open, the monitor pilot allows the worker pilot to control the intermediate pressure, $P_{Intermediate}$ at 45 psig. The downstream regulator is controlling P_2 at 10 psig.

Downstream Regulator Fails

If the downstream regulator fails, the monitor pilot will sense the increase in pressure and take control at 15 psig.

Upstream Regulator Fails

If the upstream regulator fails, the downstream regulator will remain in control at 10 psig. Note that the downstream regulator must be rated for the full system inlet pressure P_1 of 100 psig because this will be its inlet pressure if the upstream regulator fails. Also note that the outlet rating of the upstream regulator and any other components that are exposed to $P_{Intermediate}$, must be rated for full P_1.

Sizing Monitor Regulators

The difficult part of sizing monitor regulators is that $P_{Intermediate}$ is needed to determine the flow capacity for both regulators. Because $P_{Intermediate}$ is not available, other sizing methods are used to determine the capacity. There are three methods for sizing monitor regulators: estimating flow when pressure drop is critical, assuming $P_{Intermediate}$ to calculate flow and the Fisher Monitor Sizing Program.

Estimating Flow when Pressure Drop is Critical

If the pressure drop across both regulators from P_1 to P_2 is critical (assume $P_{Intermediate} = P_1 - P_2/2 + P_2$, $P_1 - P_{Intermediate} \geq P_1$ and $P_{Intermediate} - P_2 \geq 1/2\ P_{Intermediate}$) and both regulators are the same type, the capacity of the two regulators together is 70 to 73% of a single regulator reducing the pressure from P_1 to P_2.

Assuming $P_{Intermediate}$ to Determine Flow

Assume $P_{Intermediate}$ is halfway between P_1 and P_2. Guess a regulator size. Use the assumed $P_{Intermediate}$ and the C_g for each regulator to calculate the available flow rate for each regulator. If $P_{Intermediate}$ was correct, the calculated flow through each regulator will be the same. If the flows are not the same, change $P_{Intermediate}$ and repeat the calculations. ($P_{Intermediate}$ will go to the correct assumed pressure whenever the flow demand reaches maximum capacity.)

Fisher™ Monitor Sizing Program

Our Monitoring Sizing Program is available on the Regulators Toolkit — visit Emerson.com\RegulatorToolkit to download the toolkit.

Vacuum Control

Vacuum Applications

Vacuum regulators and vacuum breakers are widely used in process plants. Conventional regulators and relief valves might be suitable for vacuum service if applied correctly. This section provides fundamentals and examples.

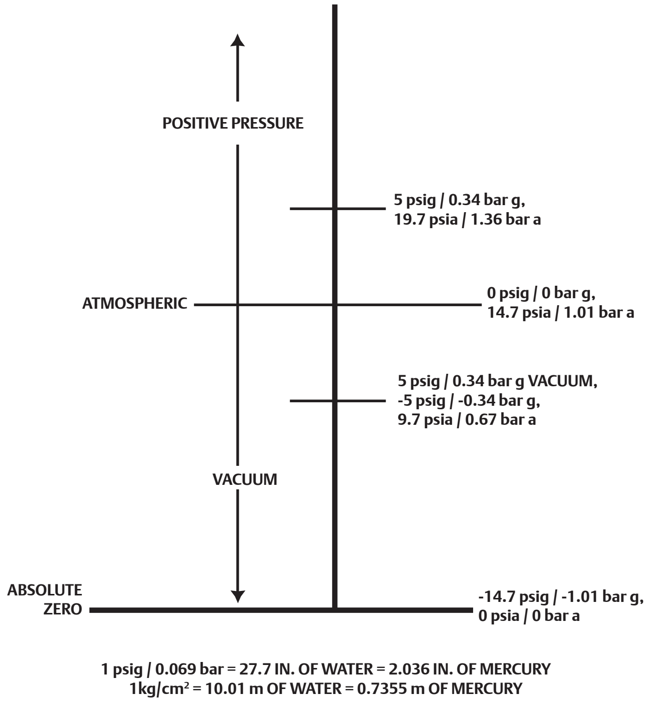


Figure 1. *Vacuum Terminology*

Vacuum Terminology

Engineers use a variety of terms to describe vacuum, which can cause some confusion. Determine whether the units are in absolute pressure or gauge pressure (0 psig / 0 bar g) is atmospheric pressure.

- 5 psig / 0.34 bar g vacuum is 5 psi / 0.34 bar below atmospheric pressure.
- -5 psig / -0.34 bar g is 5 psi / 0.34 bar below atmospheric pressure.
- 9.7 psia / 0.67 bar a is 9.7 psi / 0.67 bar above absolute zero or 5 psi / 0.34 bar below atmospheric pressure (14.7 psia - 5 psi = 9.7 psia / 1.01 bar a - 0.34 bar = 0.67 bar a).

Vacuum Control Devices

Just like there are pressure reducing regulators and pressure relief valves for positive pressure service, there are also two basic types of valves for vacuum service. The terms used for each are sometimes confusing. Therefore, it is sometimes necessary to ask further questions to determine the required function of the valve. The terms vacuum regulator and vacuum breaker will be used in these pages to differentiate the two types.

Vacuum Regulators

Vacuum regulators maintain a constant vacuum at the regulator inlet. A loss of this vacuum (increase in absolute pressure) beyond setpoint registers on the diaphragm and opens the disk. It depends on the valve as to which side of the diaphragm control pressure is measured. Opening the valve plug permits a downstream vacuum of lower absolute pressure than the controlled vacuum to restore the upstream vacuum to its original setting.

Besides the typical vacuum regulator, a conventional regulator can be suitable if applied correctly. Any pressure reducing regulator (spring to open device) that has an external control line connection and an O-ring stem seal can be used as a vacuum regulator. Installation requires a control line to connect the vacuum being controlled and the spring case. The regulator spring range is now a negative pressure range and the body flow direction is the same as in conventional pressure reducing service.

Vacuum Breakers (Relief Valves)

Vacuum breakers are used in applications where an increase in vacuum must be limited. An increase in vacuum (decrease in absolute pressure) beyond a certain value causes the diaphragm to move and open the disk. This permits atmospheric pressure or a positive pressure or an upstream vacuum that has higher absolute pressure than the downstream vacuum, to enter the system and restore the controlled vacuum to its original pressure setting.

A vacuum breaker is a spring-to-close device, meaning that if there is no pressure on the valve the spring will push the valve plug into its seat. There are various Fisher™ brand products to handle this application. Some valves are designed as vacuum breakers. Fisher brand relief valves can also be used as vacuum breakers.

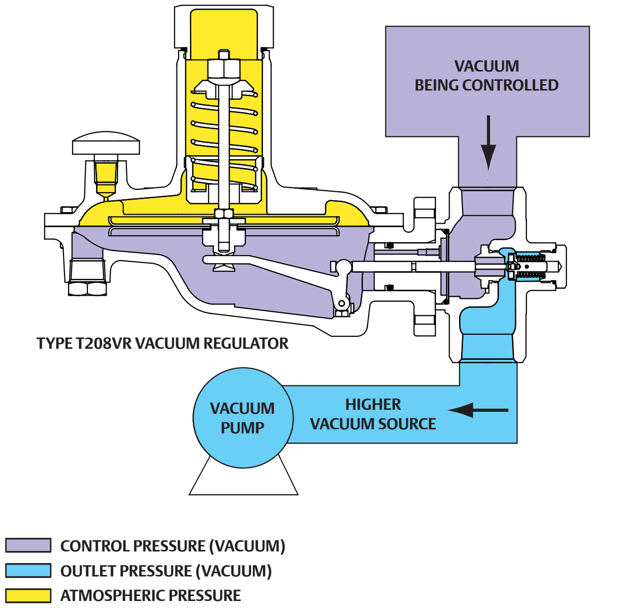


Figure 2. *Typical Vacuum Regulator*

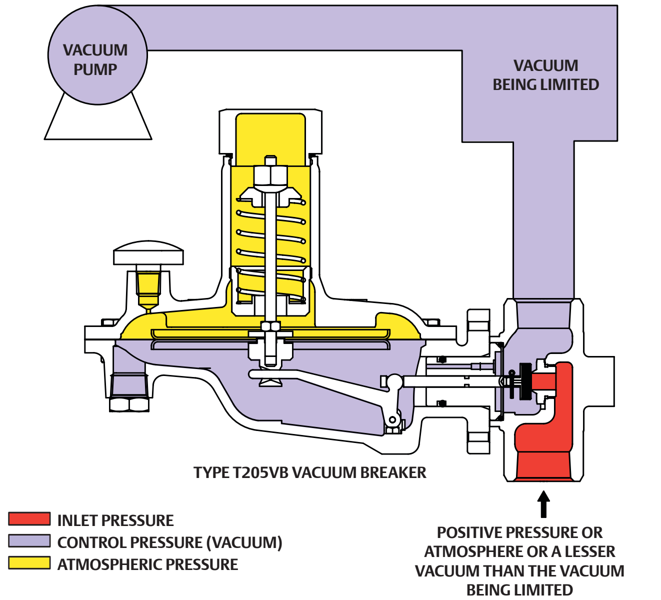


Figure 3. *Typical Vacuum Breaker*

A conventional relief valve can be used as a vacuum breaker, as long as it has a threaded spring case vent so a control line can be attached. If inlet pressure is atmospheric air, then the internal pressure registration from body inlet to lower casing admits atmospheric pressure to the lower casing. If inlet pressure is not atmospheric, a relief valve in which the lower casing can be vented to atmosphere when the body inlet is pressurized must be chosen. In this case, the terminology “blocked throat” and “external registration with O-ring stem seal” are used for clarity.

A spring that normally has a range of 6 to 11 in. w.c. / 15 to 27 mbar positive pressure will now have a range of 6 to 11 in. w.c. / 15 to 27 mbar vacuum (negative pressure). It may be expedient to bench set the vacuum breaker if the type chosen uses a spring case closing cap. Removing the closing cap to gain access to the adjusting screw will admit air into the spring case when in vacuum service.

Vacuum Regulator Installation Examples

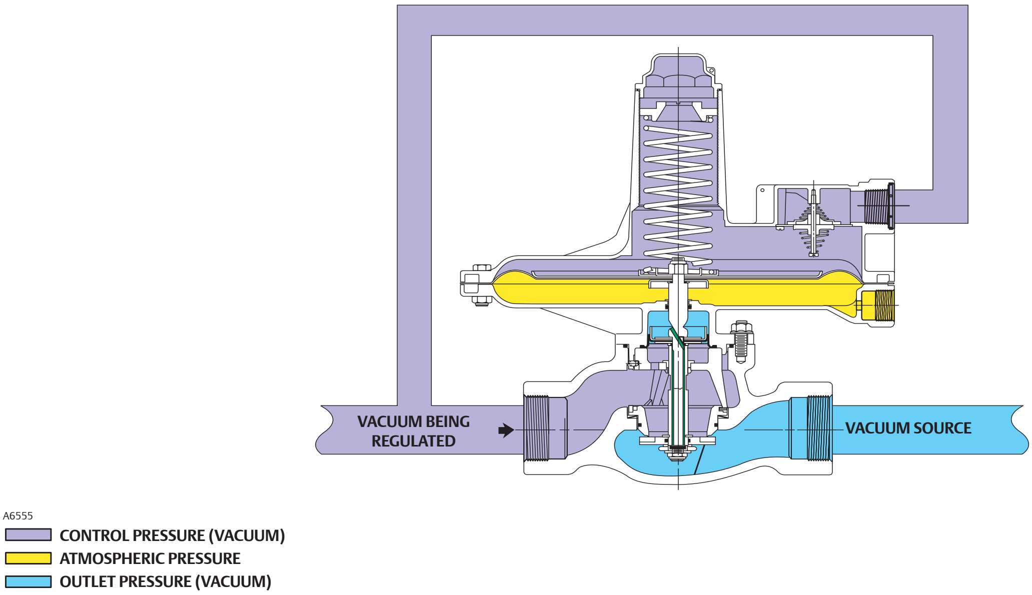


Figure 4. *Type 133L*

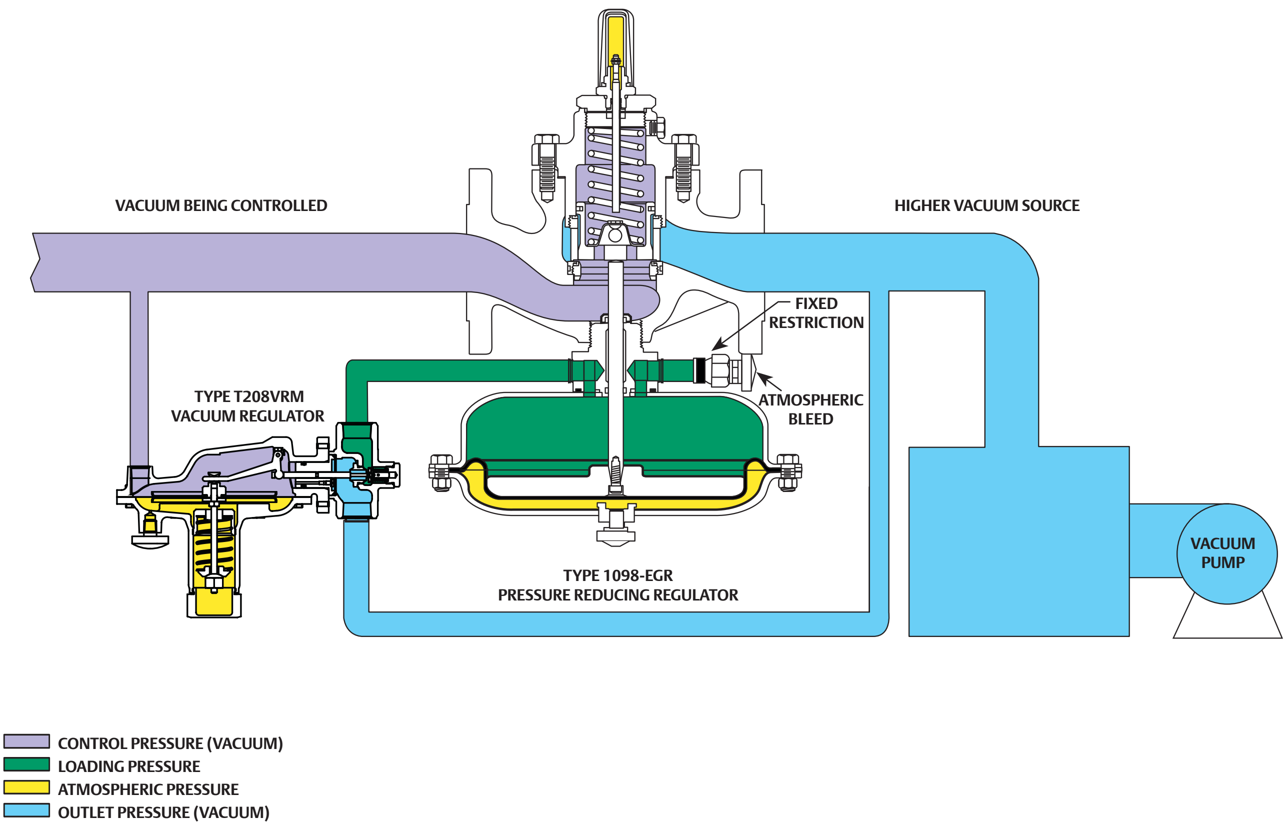


Figure 5. *Type T208VRM used with Type 1098-EGR in a Vacuum Regulator Installation*

Vacuum Breaker Installation Examples

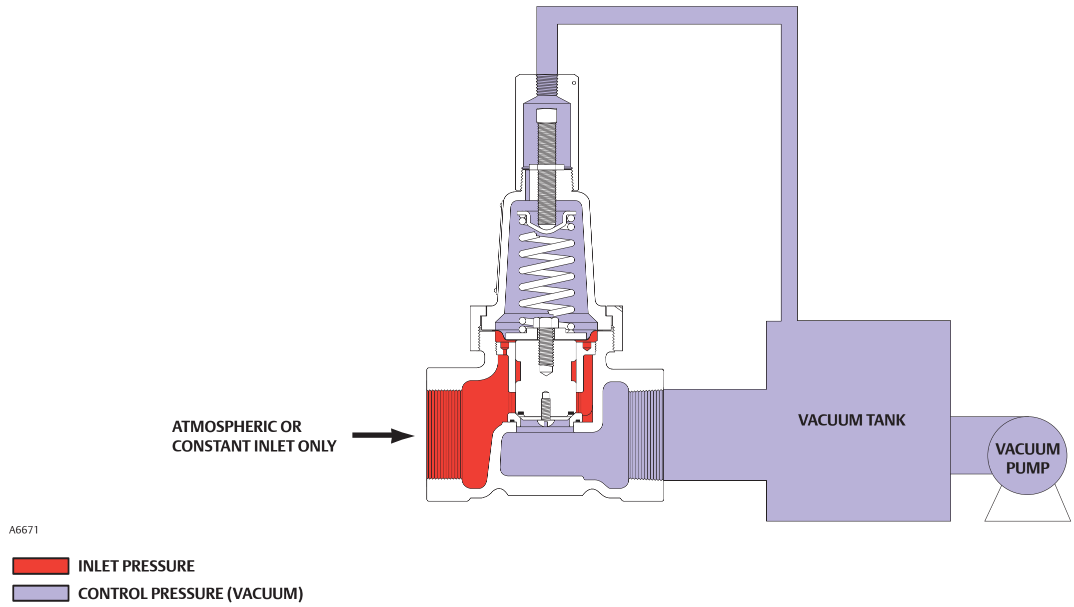


Figure 6. *Type 1805*

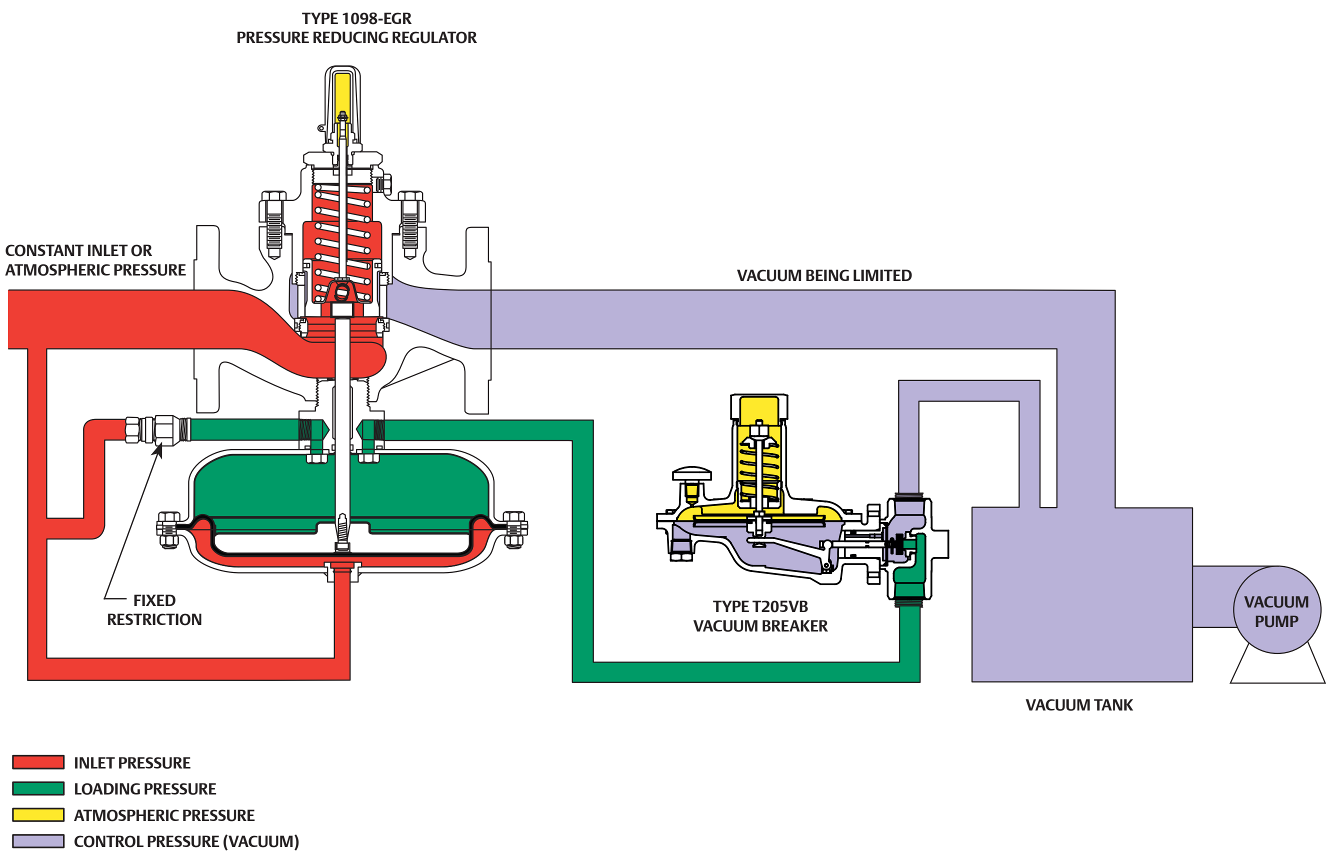


Figure 7. *Type T205VB used with Type 1098-EGR in a Vacuum Breaker Installation. If the positive pressure exceeds the Type 1098-EGR casing rating, then a Type 67CF with a Type H800 relief valve should be added.*

Vacuum Breaker Installation Examples

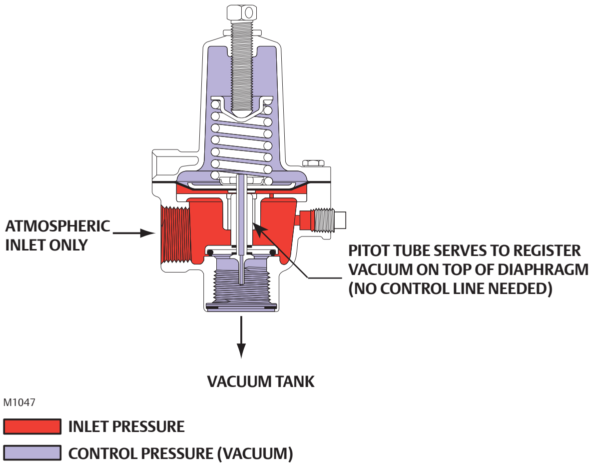
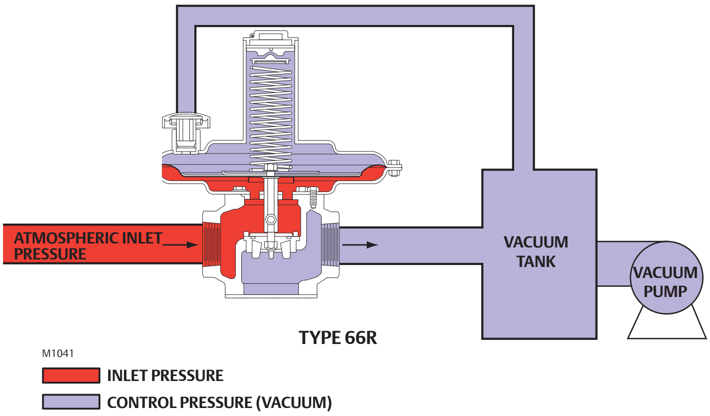


Figure 8. *Type 289H Relief Valve used in a Vacuum Breaker Installation*



If inlet is positive pressure:

- Select balancing diaphragm and tapped lower casing construction.
- Leave lower casing open to atmospheric pressure.

Figure 9. *Type 66R Relief Valve used in a Vacuum Breaker Installation*

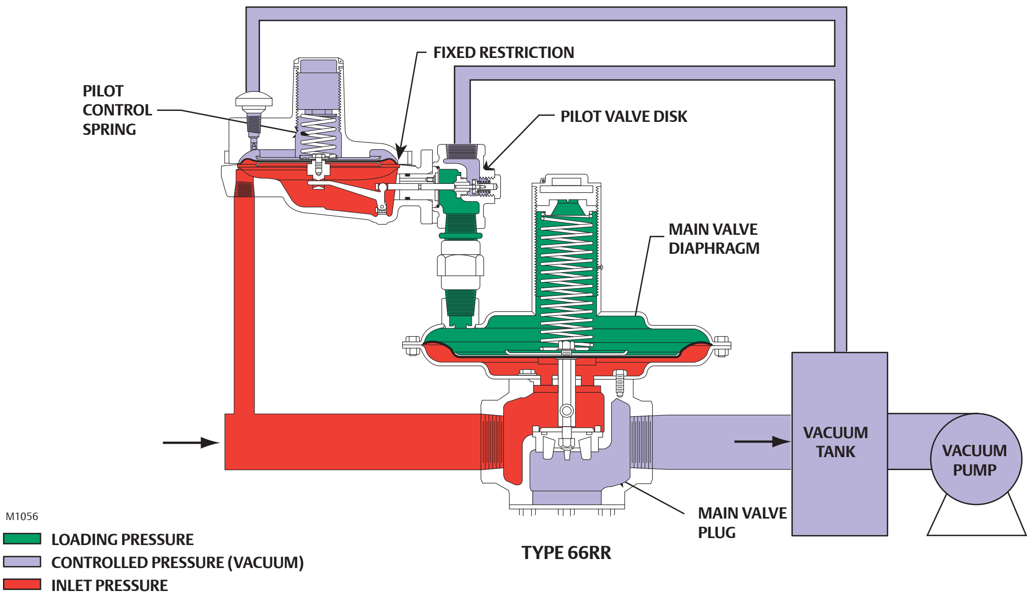


Figure 10. *Type 66RR Relief Valve used in a Vacuum Breaker Installation*

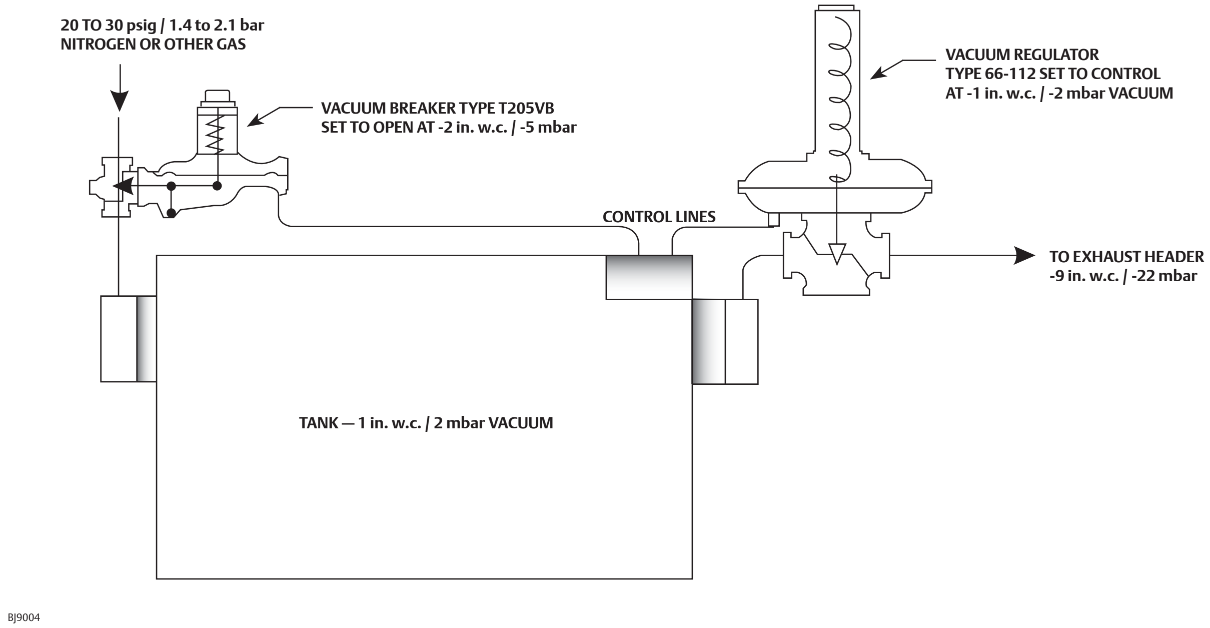


Figure 11. *Example of Gas Blanketing in Vacuum*

Gas Blanketing in Vacuum

When applications arise where the gas blanketing requirements are in vacuum, a combination of a vacuum breaker and a regulator may be used. For example, in low inches of water column vacuum, a Type T205VB vacuum breaker and a Type 66-112 vacuum regulator can be used for very precise control.

Vacuum blanketing is useful for vessel leakage to atmosphere and the material inside the vessel is harmful to the surrounding environment. If leakage were to occur, only outside air would enter the vessel because of the pressure differential in the tank. Therefore, any process vapors in the tank would be contained.

Features of Fisher™ Brand Vacuum Regulators and Breakers

- **Precision Control of Low Pressure Settings**—Large diaphragm areas provide more accurate control at low pressure settings. Some of these regulators are used as pilots on our Tank Blanketing and Vapor Recovery Regulators. Therefore, they are designed to be highly accurate, usually within 1 in. w.c. / 2 mbar.
- **Corrosion Resistance**—Constructions are available in a variety of materials for compatibility with corrosive process gases. Wide selection of elastomers compatible with flowing media.
- **Rugged Construction**—Diaphragm case and internal parts are designed to withstand vibration and shock.
- **Wide Product Offering**—Fisher brand regulators can be either direct-operated or pilot-operated regulators.
- **Fisher Brand Advantage**—Widest range of products and a proven history in the design and manufacture of process control equipment. A sales channel that offers local stock and support.
- **Spare Parts**—Low cost parts that are interchangeable with other Fisher brand in your plant.
- **Easy Sizing and Selection**—Most applications can be sized utilizing the Fisher brand Sizing Program and Sizing Coefficients.

Valve Sizing Calculations (Traditional Method)

Introduction

Fisher™ regulators and valves have traditionally been sized using equations derived by the company. There are now standardized calculations that are becoming accepted worldwide. Some product literature continues to demonstrate the traditional method, but the trend is to adopt the standardized method. Therefore, both methods are covered in this application guide.

Improper valve sizing can be both expensive and inconvenient. A valve that is too small will not pass the required flow and the process will be starved. An oversized valve will be more expensive and it may lead to instability and other problems.

The days of selecting a valve based upon the size of the pipeline are gone. Selecting the correct valve size for a given application requires a knowledge of process conditions that the valve will actually see in service. The technique for using this information to size the valve is based upon a combination of theory and experimentation.

Sizing for Liquid Service

Using the principle of conservation of energy, Daniel Bernoulli found that as a liquid flows through an orifice, the square of the fluid velocity is directly proportional to the pressure differential across the orifice and inversely proportional to the specific gravity of the fluid. The greater the pressure differential, the higher the velocity; the greater the density, the lower the velocity. The volume flow rate for liquids can be calculated by multiplying the fluid velocity times the flow area.

By taking into account units of measurement, the proportionality relationship previously mentioned, energy losses due to friction and turbulence and varying discharge coefficients for various types of orifices (or valve bodies), a basic liquid sizing equation can be written as follows

$$Q = C_V \sqrt{\Delta P / G} \qquad (1)$$

where:

- Q = Capacity in gallons per minute
- C_v = Valve sizing coefficient determined experimentally for each style and size of valve, using water at standard conditions as the test fluid
- ΔP = Pressure differential in psi
- G = Specific gravity of fluid (water at 60°F = 1.0000)

Thus, C_v is numerically equal to the number of U.S. gallons of water at 60°F that will flow through the valve in one minute when the pressure differential across the valve is 1 lb/in^2. C_v varies with both size and style of valve, but provides an index for comparing liquid capacities of different valves under a standard set of conditions.

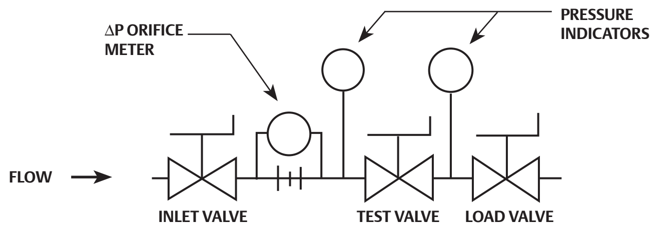


Figure 1. *Standard FCI Test Piping for C_v Measurement*

To aid in establishing uniform measurement of liquid flow capacity coefficients (C_v) among valve manufacturers, the Fluid Controls Institute (FCI) developed a standard test piping arrangement, shown in Figure 1. Using such a piping arrangement, most valve manufacturers develop and publish C_v information for their products, making it relatively easy to compare capacities of competitive products.

To calculate the expected C_v for a valve controlling water or other liquids that behave like water, the basic liquid sizing equation above can be re-written as follows

$$C_V = Q\sqrt{\frac{G}{\Delta P}} \qquad (2)$$

Viscosity Corrections

Viscous conditions can result in significant sizing errors in using the basic liquid sizing equation, since published C_v values are based on test data using water as the flow medium. Although the majority of valve applications will involve fluids where viscosity corrections can be ignored or where the corrections are relatively small, fluid viscosity should be considered in each valve selection.

Emerson has developed a nomograph (Figure 2) that provides a viscosity correction factor (F_v). It can be applied to the standard C_v coefficient to determine a corrected coefficient (C_{vr}) for viscous applications.

Finding Valve Size

Using the C_v determined by the basic liquid sizing equation and the flow and viscosity conditions, a fluid Reynolds number can be found by using the nomograph in Figure 2. The graph of Reynolds number vs. viscosity correction factor (F_v) is used to determine the correction factor needed. (If the Reynolds number is greater than 3500, the correction will be ten percent or less.) The actual required C_v (C_{vr}) is found by the equation:

$$C_{vr} = F_V\, C_V \qquad (3)$$

From the valve manufacturer's published liquid capacity information, select a valve having a C_v equal to or higher than the required coefficient (C_{vr}) found by the equation above.

EMERSON

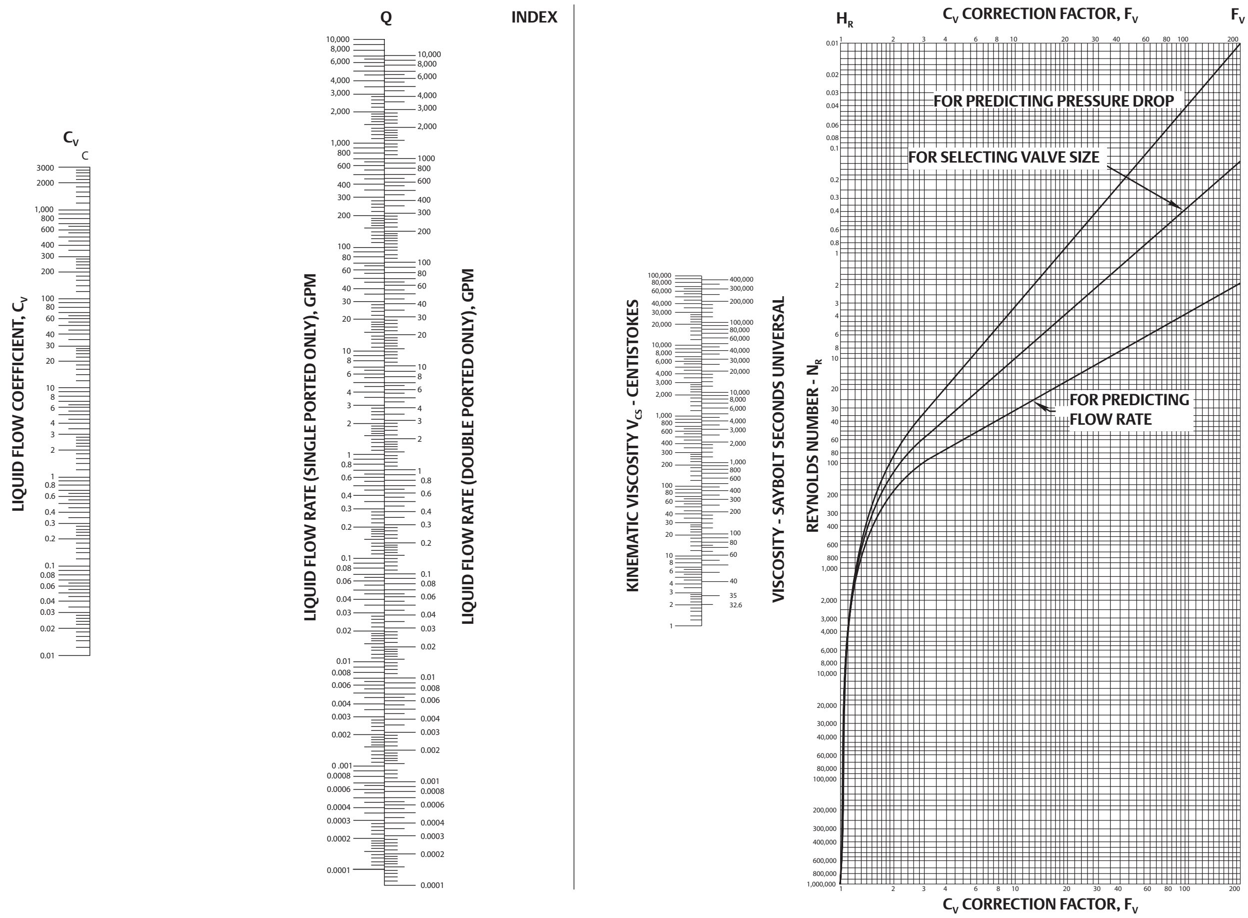


Figure 2. *Nomograph for Determining Viscosity Correction*

Nomograph Instructions

Use this nomograph to correct for the effects of viscosity. When assembling data, all units must correspond to those shown on the nomograph. For high-recovery, ball-type valves, use the liquid flow rate Q scale designated for single-ported valves. For butterfly and eccentric disk rotary valves, use the liquid flow rate Q scale designated for double-ported valves.

Nomograph Equations

1. Single-Ported Valves: $N_R = 17{,}250 \dfrac{Q}{\sqrt{C_V \nu_{CS}}}$

2. Double-Ported Valves: $N_R = 12{,}200 \dfrac{Q}{\sqrt{C_V \nu_{CS}}}$

Nomograph Procedure

1. Lay a straight edge on the liquid sizing coefficient on C_v scale and flow rate on Q scale. Mark intersection on index line. Procedure A uses value of C_{vc}; Procedures B and C use value of C_{vr}.

2. Pivot the straight edge from this point of intersection with index line to liquid viscosity on proper n scale. Read Reynolds number on N_R scale.

3. Proceed horizontally from intersection on N_R scale to proper curve and then vertically upward or downward to F_v scale. Read C_v correction factor on F_v scale.

Valve Sizing Calculations (Traditional Method)

Predicting Flow Rate

Select the required liquid sizing coefficient (C_{vr}) from the manufacturer's published liquid sizing coefficients (C_v) for the style and size valve being considered. Calculate the maximum flow rate (Q_{max}) in gallons per minute (assuming no viscosity correction required) using the following adaptation of the basic liquid sizing equation:

$$Q_{max} = C_{vr} \sqrt{\Delta P / G} \quad (4)$$

Then incorporate viscosity correction by determining the fluid Reynolds number and correction factor F_v from the viscosity correction nomograph and the procedure included on it.

Calculate the predicted flow rate (Q_{pred}) using the formula:

$$Q_{pred} = \frac{Q_{max}}{F_V} \quad (5)$$

Predicting Pressure Drop

Select the required liquid sizing coefficient (C_{vr}) from the published liquid sizing coefficients (C_v) for the valve style and size being considered. Determine the Reynolds number and correct factor F_v from the nomograph and the procedure on it. Calculate the sizing coefficient (C_{vc}) using the formula:

$$C_{VC} = \frac{C_{vr}}{F_v} \quad (6)$$

Calculate the predicted pressure drop (ΔP_{pred}) using the formula:

$$\Delta P_{pred} = G\,(Q/C_{vc})^2 \quad (7)$$

Flashing and Cavitation

The occurrence of flashing or cavitation within a valve can have a significant effect on the valve sizing procedure. These two related physical phenomena can limit flow through the valve in many applications and must be taken into account in order to accurately size a valve. Structural damage to the valve and adjacent piping may also result. Knowledge of what is actually happening within the valve might permit selection of a size or style of valve which can reduce or compensate for, the undesirable effects of flashing or cavitation.

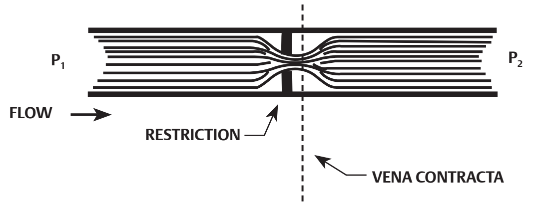


Figure 3. *Vena Contracta*

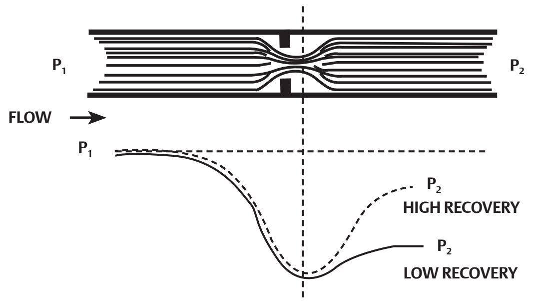


Figure 4. *Comparison of Pressure Profiles for High and Low Recovery Valves*

The "physical phenomena" label is used to describe flashing and cavitation because these conditions represent actual changes in the form of the fluid media. The change is from the liquid state to the vapor state and results from the increase in fluid velocity at or just downstream of the greatest flow restriction, normally the valve port. As liquid flow passes through the restriction, there is a necking down or contraction, of the flow stream. The minimum cross-sectional area of the flow stream occurs just downstream of the actual physical restriction at a point called the vena contracta, as shown in Figure 3.

To maintain a steady flow of liquid through the valve, the velocity must be greatest at the vena contracta, where cross sectional area is the least. The increase in velocity (or kinetic energy) is accompanied by a substantial decrease in pressure (or potential energy) at the vena contracta. Farther downstream, as the fluid stream expands into a larger area, velocity decreases and pressure increases. But, of course, downstream pressure never recovers completely to equal the pressure that existed upstream of the valve. The pressure differential (ΔP) that exists across the valve is a measure of the amount of energy that was dissipated in the valve. Figure 4 provides a pressure profile explaining the differing performance of a streamlined high recovery valve, such as a ball valve and a valve with lower recovery capabilities due to greater internal turbulence and dissipation of energy.

Regardless of the recovery characteristics of the valve, the pressure differential of interest pertaining to flashing and cavitation is the differential between the valve inlet and the vena contracta. If pressure at the vena contracta should drop below the vapor pressure of the fluid (due to increased fluid velocity at this point) bubbles will form in the flow stream. Formation of bubbles will increase greatly as vena contracta pressure drops further below the vapor pressure of the liquid. At this stage, there is no difference between flashing and cavitation, but the potential for structural damage to the valve definitely exists.

If pressure at the valve outlet remains below the vapor pressure of the liquid, the bubbles will remain in the downstream system and the process is said to have "flashed." Flashing can produce serious erosion damage to the valve trim parts and is characterized by a smooth, polished appearance of the eroded surface. Flashing damage is normally greatest at the point of highest velocity, which is usually at or near the seat line of the valve plug and seat ring.

However, if downstream pressure recovery is sufficient to raise the outlet pressure above the vapor pressure of the liquid, the bubbles will collapse or implode, producing cavitation. Collapsing of the vapor bubbles releases energy and produces a noise similar to what one would expect if gravel were flowing through the valve. If the bubbles collapse in close proximity to solid surfaces, the energy released gradually wears the material leaving a rough, cylinder like surface. Cavitation damage might extend to the downstream pipeline, if that is where pressure recovery occurs and the bubbles collapse. Obviously, "high recovery" valves tend to be more subject to cavitation, since the downstream pressure is more likely to rise above the vapor pressure of the liquid.

Choked Flow

Aside from the possibility of physical equipment damage due to flashing or cavitation, formation of vapor bubbles in the liquid flow stream causes a crowding condition at the vena contracta which tends to limit flow through the valve. So, while the basic liquid sizing equation implies that there is no limit to the amount of flow through a valve as long as the differential pressure across the valve increases, the realities of flashing and cavitation prove otherwise. If valve

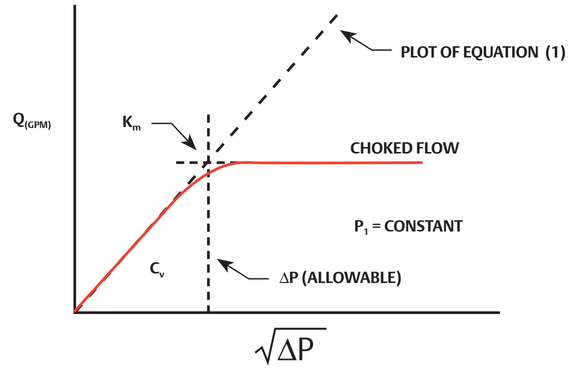


Figure 5. *Flow Curve Showing C_v and K_m*

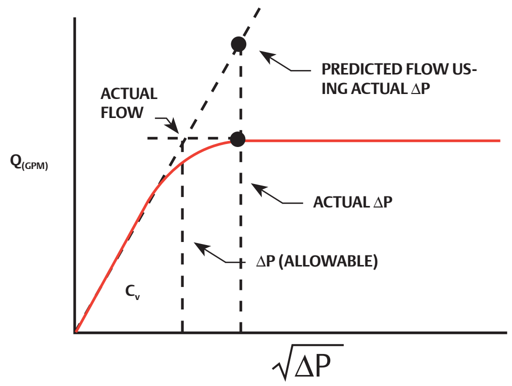
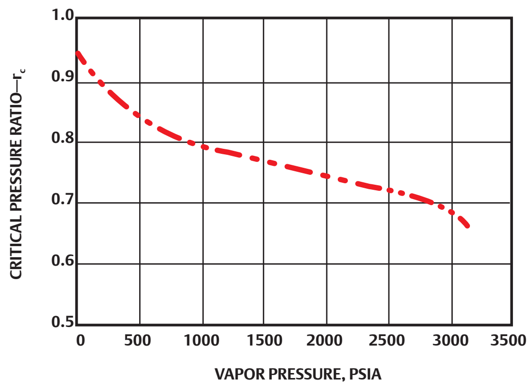


Figure 6. *Relationship Between Actual ΔP and ΔP Allowable*

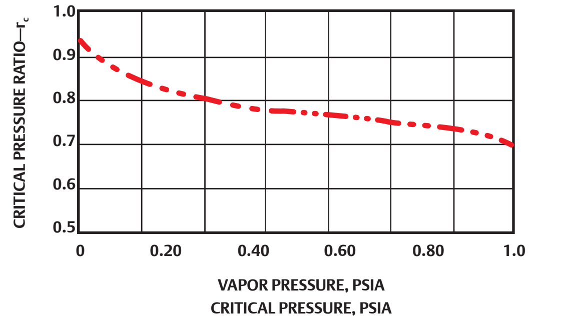
pressure drop is increased slightly beyond the point where bubbles begin to form, a choked flow condition is reached. With constant upstream pressure, further increases in pressure drop (by reducing downstream pressure) will not produce increased flow. The limiting pressure differential is designated ΔP_{allow} and the valve recovery coefficient (K_m) is experimentally determined for each valve, in order to relate choked flow for that particular valve to the basic liquid sizing equation. K_m is normally published with other valve capacity coefficients. Figures 5 and 6 show these flow vs. pressure drop relationships.

Valve Sizing Calculations (Traditional Method)



USE THIS CURVE FOR WATER. ENTER ON THE ABSCISSA AT THE WATER VAPOR PRESSURE AT THE VALVE INLET. PROCEED VERTICALLY TO INTERSECT THE CURVE. MOVE HORIZONTALLY TO THE LEFT TO READ THE CRITICAL PRESSURE RATIO, R_C, ON THE ORDINATE.

Figure 7. *Critical Pressure Ratios for Water*



USE THIS CURVE FOR LIQUIDS OTHER THAN WATER. DETERMINE THE VAPOR PRESSURE/CRITICAL PRESSURE RATIO BY DIVIDING THE LIQUID VAPOR PRESSURE AT THE VALVE INLET BY THE CRITICAL PRESSURE OF THE LIQUID. ENTER ON THE ABSCISSA AT THE RATIO JUST CALCULATED AND PROCEED VERTICALLY TO INTERSECT THE CURVE. MOVE HORIZONTALLY TO THE LEFT AND READ THE CRITICAL PRESSURE RATIO, R_C, ON THE ORDINATE.

Figure 8. *Critical Pressure Ratios for Liquid Other than Water*

Use the following equation to determine maximum allowable pressure drop that is effective in producing flow. Keep in mind, however, that the limitation on the sizing pressure drop, ΔP_{allow}, does not imply a maximum pressure drop that may be controlled y the valve.

$$\Delta P_{allow} = K_m (P_1 - r_c P_v) \qquad (8)$$

where:

- ΔP_{allow} = maximum allowable differential pressure for sizing purposes, psi
- K_m = valve recovery coefficient from manufacturer's literature
- P_1 = body inlet pressure, psia
- r_c = critical pressure ratio determined from Figures 7 and 8
- P_v = vapor pressure of the liquid at body inlet temperature, psia (vapor pressures and critical pressures for many common liquids are provided in the Physical Constants of Hydrocarbons and Physical Constants of Fluids tables; refer to the Table of Contents for the page number).

After calculating ΔP_{allow}, substitute it into the basic liquid sizing equation $Q = C_V\sqrt{\Delta P / G}$ to determine either Q or C_v. If the actual ΔP is less the ΔP_{allow}, then the actual ΔP should be used in the equation.

The equation used to determine ΔP_{allow} should also be used to calculate the valve body differential pressure at which significant cavitation can occur. Minor cavitation will occur at a slightly lower pressure differential than that predicted by the equation, but should produce negligible damage in most globe-style control valves.

Consequently, initial cavitation and choked flow occur nearly simultaneously in globe-style or low-recovery valves.

However, in high-recovery valves such as ball or butterfly valves, significant cavitation can occur at pressure drops below that which produces choked flow. So although ΔP_{allow} and K_m are useful in predicting choked flow capacity, a separate cavitation index (K_c) is needed to determine the pressure drop at which cavitation damage will begin (ΔP_c) in high-recovery valves.

The equation can be expressed:

$$\Delta P_C = K_C (P_1 - P_V) \qquad (9)$$

This equation can be used anytime outlet pressure is greater than the vapor pressure of the liquid.

Addition of anti-cavitation trim tends to increase the value of K_m. In other words, choked flow and incipient cavitation will occur at substantially higher pressure drops than was the case without the anti-cavitation accessory.

Table 1. Liquid Sizing Equation Application

EQUATION		
1	$Q = C_v\sqrt{\Delta P / G}$	Basic liquid sizing equation. Use to determine proper valve size for a given set of service conditions. (Remember that viscosity effects and valve recovery capabilities are not considered in this basic equation.)
2	$C_V = Q\sqrt{\frac{G}{\Delta P}}$	Use to calculate expected C_v for valve controlling water or other liquids that behave like water.
3	$C_{vr} = F_V\, C_V$	Use to find actual required C_v for equation (2) after including viscosity correction factor.
4	$Q_{max} = C_{vr}\sqrt{\Delta P / G}$	Use to find maximum flow rate assuming no viscosity correction is necessary.
5	$Q_{pred} = \frac{Q_{max}}{F_V}$	Use to predict actual flow rate based on equation (4) and viscosity factor correction.
6	$C_{VC} = \frac{C_{vr}}{F_v}$	Use to calculate corrected sizing coefficient for use in equation (7).
7	$\Delta P_{pred} = G\,(Q/C_{vc})^2$	Use to predict pressure drop for viscous liquids.
8	$\Delta P_{allow} = K_m\,(P_1 - r_c\,P_v)$	Use to determine maximum allowable pressure drop that is effective in producing flow.
9	$\Delta P_C = K_C\,(P_1 - P_V)$	Use to predict pressure drop at which cavitation will begin in a valve with high recovery characteristics.

Liquid Sizing Summary

The most common use of the basic liquid sizing equation is to determine the proper valve size for a given set of service conditions. The first step is to calculate the required C_v by using the sizing equation. The ΔP used in the equation must be the actual valve pressure drop or ΔP_{allow}, whichever is smaller. The second step is to select a valve, from the manufacturer's literature, with a C_v equal to or greater than the calculated value.

Accurate valve sizing for liquids requires use of the dual coefficients of C_v and K_m. A single coefficient is not sufficient to describe both the capacity and the recovery characteristics of the valve. Also, use of the additional cavitation index factor K_c is appropriate in sizing high recovery valves, which may develop damaging cavitation at pressure drops well below the level of the choked flow.

Liquid Sizing Nomenclature

C_v = valve sizing coefficient for liquid determined experimentally for each size and style of valve, using water at standard conditions as the test fluid

C_{vc} = calculated C_v coefficient including correction for viscosity

C_{vr} = corrected sizing coefficient required for viscous applications

ΔP = differential pressure, psi

ΔP_{allow} = maximum allowable differential pressure for sizing purposes, psi

ΔP_c = pressure differential at which cavitation damage begins, psi

F_v = viscosity correction factor

G = specific gravity of fluid (water at 60°F = 1.0000)

K_c = dimensionless cavitation index used in determining ΔP_c

K_m = valve recovery coefficient from manufacturer's literature

P_1 = body inlet pressure, psia

P_v = vapor pressure of liquid at body inlet temperature, psia

Q = flow rate capacity, gallons per minute

Q_{max} = designation for maximum flow rate, assuming no viscosity correction required, gallons per minute

Q_{pred} = predicted flow rate after incorporating viscosity correction, gallons per minute

r_c = critical pressure ratio

Valve Sizing Calculations (Traditional Method)

Sizing for Gas or Steam Service

A sizing procedure for gases can be established based on adaptions of the basic liquid sizing equation. By introducing conversion factors to change flow units from gallons per minute to cubic feet per hour and to relate specific gravity in meaningful terms of pressure, an equation can be derived for the flow of air at 60°F. Because 60°F corresponds to 520° on the Rankine absolute temperature scale and because the specific gravity of air at 60°F is 1.0, an additional factor can be included to compare air at 60°F with specific gravity (G) and absolute temperature (T) of any other gas. The resulting equation an be written:

$$Q_{SCFH} = 59.64\, C_v P_1 \sqrt{\frac{\Delta P}{P_1}} \sqrt{\frac{520}{GT}} \qquad (A)$$

The equation shown above, while valid at very low pressure drop ratios, has been found to be very misleading when the ratio of pressure drop (ΔP) to inlet pressure (P_1) exceeds 0.02. The deviation of actual flow capacity from the calculated flow capacity is indicated in Figure 8 and results from compressibility effects and critical flow limitations at increased pressure drops.

Critical flow limitation is the more significant of the two problems mentioned. Critical flow is a choked flow condition caused by increased gas velocity at the vena contracta. When velocity at the vena contracta reaches sonic velocity, additional increases in ΔP by reducing downstream pressure produce no increase in flow. So, after critical flow condition is reached (whether at a pressure drop/inlet pressure ratio of about 0.5 for glove valves or at much lower ratios for high recovery valves) the equation above becomes completely useless. If applied, the C_v equation gives a much higher indicated capacity than actually will exist. And in the case of a high recovery valve which reaches critical flow at a low pressure drop ratio (as indicated in Figure 8), the critical flow capacity of the valve may be overestimated by as much as 300 percent.

The problems in predicting critical flow with a C_v-based equation led to a separate gas sizing coefficient based on air flow tests. The coefficient (C_g) was developed experimentally for each type and size of valve to relate critical flow to absolute inlet pressure. By including the correction factor used in the previous equation to compare air at 60°F with other gases at other absolute temperatures, the critical flow equation an be written:

$$Q_{critical} = C_g P_1 \sqrt{520 / GT} \qquad (B)$$

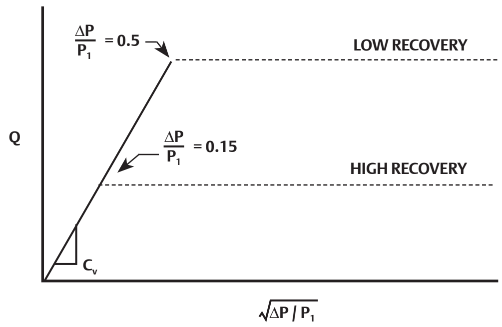


Figure 9. *Critical Flow for High and Low Recovery Valves with Equal C_v*

Universal Gas Sizing Equation

To account for differences in flow geometry among valves, equations (A) and (B) were consolidated by the introduction of an additional factor (C_1). C_1 is defined as the ratio of the gas sizing coefficient and the liquid sizing coefficient and provides a numerical indicator of the valve's recovery capabilities. In general, C_1 values can range from about 16 to 37, based on the individual valve's recovery characteristics. As shown in the example, two valves with identical flow areas and identical critical flow (C_g) capacities can have widely differing C_1 values dependent on the effect internal flow geometry has on liquid flow capacity through each valve. Example:

High Recovery Valve

C_g = 4680
C_v = 254
C_1 = C_g/C_v
= 4680/254
= 18.4

Low Recovery Valve

C_g = 4680
C_v = 135
C_1 = C_g/C_v
= 4680/135
= 34.7

So we see that two sizing coefficients are needed to accurately size valves for gas flow—C_g to predict flow based on physical size or flow area and C_1 to account for differences in valve recovery characteristics. A blending equation, called the Universal Gas Sizing Equation, combines equations (A) and (B) by means of a sinusoidal function and is based on the "perfect gas" laws. It can be expressed in either of the following manners:

$$Q_{SCFH} = \sqrt{\frac{520}{GT}}\; C_g\, P_1\, \text{SIN}\left[\left(\frac{59.64}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right)\right] \text{rad} \qquad \text{(C)}$$

OR

$$Q_{SCFH} = \sqrt{\frac{520}{GT}}\; C_g\, P_1\, \text{SIN}\left[\left(\frac{3417}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right)\right] \text{Deg} \qquad \text{(D)}$$

In either form, the equation indicates critical flow when the sine function of the angle designated within the brackets equals unity. The pressure drop ratio at which critical flow occurs is known as the critical pressure drop ratio. It occurs when the sine angle reaches $\pi/2$ radians in equation (C) or 90 degrees in equation (D). As pressure drop across the valve increases, the sine angle increases from zero up to $\pi/2$ radians (90°). If the angle were allowed to increase further, the equations would predict a decrease in flow. Because this is not a realistic situation, the angle must be limited to 90 degrees maximum.

Although "perfect gases," as such, do not exist in nature, there are a great many applications where the Universal Gas Sizing Equation, (C) or (D), provides a very useful and usable approximation.

General Adaptation for Steam and Vapors

The density form of the Universal Gas Sizing Equation is the most general form and can be used for both perfect and non-perfect gas applications. Applying the equation requires knowledge of one additional condition not included in previous equations, that being the inlet gas, steam or vapor density (d_1) in lbs/ft^3. (Steam density can be determined from tables.)

Then the following adaptation of the Universal Gas Sizing Equation can be applied:

$$Q_{lb/hr} = 1.06\sqrt{d_1 P_1}\; C_g\, \text{SIN}\left(\frac{3417}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right) \text{Deg} \qquad \text{(E)}$$

Special Equation Form for Steam Below 1000 psig

If steam applications do not exceed 1000 psig, density changes can be compensated for by using a special adaptation of the Universal Gas Sizing Equation. It incorporates a factor for amount of superheat in degrees Fahrenheit (T_{sh}) and also a sizing coefficient (C_s) for steam. Equation (F) eliminates the need for finding the density of superheated steam, which was required in Equation (E). At pressures below 1000 psig, a constant relationship exists between the gas sizing coefficient (C_g) and the steam coefficient (C_s). This relationship can be expressed: $C_s = C_g/20$. For higher steam pressure application, use Equation (E).

$$Q_{lb/hr} = \left[\left(\frac{C_S\, P_1}{1 + 0.00065T_{sh}}\right)\right] \text{SIN}\left[\left(\frac{3417}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right)\right] \text{Deg} \qquad \text{(F)}$$

Gas and Steam Sizing Summary

The Universal Gas Sizing Equation can be used to determine the flow of gas through any style of valve. Absolute units of temperature and pressure must be used in the equation. When the critical pressure drop ratio causes the sine angle to be 90 degrees, the equation will predict the value of the critical flow. For service conditions that would result in an angle of greater than 90 degrees, the equation must be limited to 90 degrees in order to accurately determine the critical flow.

Most commonly, the Universal Gas Sizing Equation is used to determine proper valve size for a given set of service conditions. The first step is to calculate the required C_g by using the Universal Gas Sizing Equation. The second step is to select a valve from the manufacturer's literature. The valve selected should have a C_g which equals or exceeds the calculated value. Be certain that the assumed C_1 value for the valve is selected from the literature.

It is apparent that accurate valve sizing for gases that requires use of the dual coefficient is not sufficient to describe both the capacity and the recovery characteristics of the valve.

Proper selection of a control valve for gas service is a highly technical problem with many factors to be considered. Leading valve manufacturers provide technical information, test data, sizing catalogs, nomographs, sizing slide rules and computer or calculator programs that make valve sizing a simple and accurate procedure.

Table 2. Gas and Steam Sizing Equation Application

	EQUATION	
A	$Q_{SCFH} = 59.64\, C_V P_1 \sqrt{\frac{\Delta P}{P_1}} \sqrt{\frac{520}{GT}}$	Use only at very low pressure drop (DP/P_1) ratios of 0.02 or less.
B	$Q_{critical} = C_g P_1 \sqrt{520 / GT}$	Use only to determine critical flow capacity at a given inlet pressure.
C	$Q_{SCFH} = \sqrt{\frac{520}{GT}}\; C_g\, P_1\, SIN \left[\left(\frac{59.64}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right)\right] rad$ OR	Universal Gas Sizing Equation. Use to predict flow for either high or low recovery valves, for any gas adhering to the perfect gas laws and under any service conditions.
D	$Q_{SCFH} = \sqrt{\frac{520}{GT}}\; C_g\, P_1\, SIN \left[\left(\frac{3417}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right)\right] Deg$	
E	$Q_{lb/hr} = 1.06 \sqrt{d_1 P_1}\; C_g\, SIN \left(\frac{3417}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right) Deg$	Use to predict flow for perfect or non-perfect gas sizing applications, for any vapor including steam, at any service condition when fluid density is known.
F	$Q_{lb/hr} = \left[\left(\frac{C_S\, P_1}{1 + 0.00065 T_{sh}}\right)\right] SIN \left[\left(\frac{3417}{C_1}\right)\left(\sqrt{\frac{\Delta P}{P_1}}\right)\right] Deg$	Use only to determine steam flow when inlet pressure is 1000 psig or less.

Gas and Steam Sizing Nomenclature

C_1 = C_g/C_v
C_g = gas sizing coefficient
C_s = steam sizing coefficient, $C_g/20$
C_v = liquid sizing coefficient
d_1 = density of steam or vapor at inlet, lbs/ft³
G = gas specific gravity (air = 1.0)
P_1 = valve inlet pressure, psia
ΔP = pressure drop across valve, psi
$Q_{critical}$ = critical flow rate, SCFH
Q_{SCFH} = gas flow rate, SCFH
$Q_{lb/hr}$ = steam or vapor flow rate, lbs/hr
T = absolute temperature of gas at inlet, degrees Rankine
T_{sh} = degrees of superheat, °F

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Introduction

Fisher™ regulators and valves have traditionally been sized using equations derived by the company. There are now standardized calculations that are becoming accepted world wide. Some product literature continues to demonstrate the traditional method, but the trend is to adopt the standardized method. Therefore, both methods are covered in this application guide.

Liquid Valve Sizing

Standardization activities for control valve sizing can be traced back to the early 1960s when a trade association, the Fluids Control Institute, published sizing equations for use with both compressible and incompressible fluids. The range of service conditions that could be accommodated accurately by these equations was quite narrow and the standard did not achieve a high degree of acceptance. In 1967, the ISA established a committee to develop and publish standard equations. The efforts of this committee culminated in a valve sizing procedure that has achieved the status of American National Standard. Later, a committee of the International Electrotechnical Commission (IEC) used the ISA works as a basis to formulate international standards for sizing control valves. (Some information in this introductory material has been extracted from ANSI/ISA S75.01 standard with the permission of the publisher, the ISA.) Except for some slight differences in nomenclature and procedures, the ISA and IEC standards have been harmonized. ANSI/ISA Standard S75.01 is harmonized with IEC Standards 534-2-1 and 534-2-2. (IEC Publications 534-2, Sections One and Two for incompressible and compressible fluids, respectively.)

In the following sections, the nomenclature and procedures are explained and sample problems are solved to illustrate their use.

Sizing Valves for Liquids

Following is a step-by-step procedure for the sizing of control valves for liquid flow using the IEC procedure. Each of these steps is important and must be considered during any valve sizing procedure. Steps 3 and 4 concern the determination of certain sizing factors that may or may not be required in the sizing equation depending on the service conditions of the sizing problem. If one, two or all three of these sizing factors are to be included in the equation for a particular sizing problem, refer to the appropriate factor determination section(s) located in the text after the sixth step.

1. *Specify the variables required to size the valve as follows:*
   - Desired design
   - Process fluid (water, oil, etc.) and
   - Appropriate service conditions q or w, P_1, P_2 or ΔP, T_1, G_f, P_v, P_c and υ.

   The ability to recognize which terms are appropriate for a specific sizing procedure can only be acquired through experience with different valve sizing problems. If any of the above terms appears to be new or unfamiliar, refer to the Abbreviations and Terminology Table 1 for a complete definition.

2. *Determine the equation constant, N.*

   N is a numerical constant contained in each of the flow equations to provide a means for using different systems of units. Values for these various constants and their applicable units are given in the Equation Constants Table 2.

   Use N_1, if sizing the valve for a flow rate in volumetric units (GPM or Nm^3/h).

   Use N_6, if sizing the valve for a flow rate in mass units (lb/hr or kg/hr).

3. *Determine F_p, the piping geometry factor.*

   F_p is a correction factor that accounts for pressure losses due to piping fittings such as reducers, elbows or tees that might be attached directly to the inlet and outlet connections of the control valve to be sized. If such fittings are attached to the valve, the F_p factor must be considered in the sizing procedure. If, however, no fittings are attached to the valve, F_p has a value of 1.0 and simply drops out of the sizing equation.

   For rotary valves with reducers (swaged installations) and other valve designs and fitting styles, determine the F_p factors by using the procedure for determining F_p, the Piping Geometry Factor, page 637.

4. *Determine q_{max} (the maximum flow rate at given upstream conditions) or ΔP_{max} (the allowable sizing pressure drop).*

   The maximum or limiting flow rate (q_{max}), commonly called choked flow, is manifested by no additional increase in flow rate with increasing pressure differential with fixed upstream conditions. In liquids, choking occurs as a result of vaporization of the liquid when the static pressure within the valve drops below the vapor pressure of the liquid.

   The IEC standard requires the calculation of an allowable sizing pressure drop (ΔP_{max}), to account for the possibility of choked flow conditions within the valve. The calculated ΔP_{max} value is compared with the actual pressure drop specified in the service conditions and the lesser of these two values is used in the sizing equation. If it is desired to use ΔP_{max} to account for the possibility of choked flow conditions, it can be calculated using the procedure for determining q_{max}, the Maximum Flow Rate or ΔP_{max}, the Allowable Sizing Pressure Drop. If it can be recognized that choked flow conditions will not develop within the valve, ΔP_{max} need not be calculated.

5. *Solve for required C_v, using the appropriate equation:*
   - For volumetric flow rate units:

   $$C_v = \frac{q}{N_1 F_p \sqrt{\frac{P_1 - P_2}{G_f}}}$$

   - For mass flow rate units:

   $$C_v = \frac{w}{N_6 F_p \sqrt{(P_1 - P_2)\gamma}}$$

   In addition to C_v, two other flow coefficients, K_v and A_v, are used, particularly outside of North America. The following relationships exist:

   $K_v = (0.865)\,(C_v)$

   $A_v = (2.40 \times 10^{-5})\,(C_v)$

6. *Select the valve size using the appropriate flow coefficient table and the calculated C_v value.*

Valve Sizing (Standardized Method)

Table 1. Abbreviations and Terminology

SYMBOL		SYMBOL	
C_v	Valve sizing coefficient	P_1	Upstream absolute static pressure
d	Nominal valve size	P_2	Downstream absolute static pressure
D	Internal diameter of the piping	P_c	Absolute thermodynamic critical pressure
F_d	Valve style modifier, dimensionless	P_v	Vapor pressure absolute of liquid at inlet temperature
F_F	Liquid critical pressure ratio factor, dimensionless	ΔP	Pressure drop (P_1-P_2) across the valve
F_k	Ratio of specific heats factor, dimensionless	$\Delta P_{max(L)}$	Maximum allowable liquid sizing pressure drop
F_L	Rated liquid pressure recovery factor, dimensionless	$\Delta P_{max(LP)}$	Maximum allowable sizing pressure drop with attached fittings
F_{LP}	Combined liquid pressure recovery factor and piping geometry factor of valve with attached fittings (when there are no attached fittings, F_{LP} equals F_L), dimensionless	q	Volume rate of flow
F_P	Piping geometry factor, dimensionless	q_{max}	Maximum flow rate (choked flow conditions) at given upstream conditions
G_f	Liquid specific gravity (ratio of density of liquid at flowing temperature to density of water at 60°F), dimensionless	T_1	Absolute upstream temperature (Kelvin or deg Rankine)
G_g	Gas specific gravity (ratio of density of flowing gas to density of air with both at standard conditions[1], i.e., ratio of molecular weight of gas to molecular weight of air), dimensionless	w	Mass rate of flow
k	Ratio of specific heats, dimensionless	x	Ratio of pressure drop to upstream absolute static pressure ($\Delta P/P_1$), dimensionless
K	Head loss coefficient of a device, dimensionless	x_T	Rated pressure drop ratio factor, dimensionless
M	Molecular weight, dimensionless	Y	Expansion factor (ratio of flow coefficient for a gas to that for a liquid at the same Reynolds number), dimensionless
N	Numerical constant	Z	Compressibility factor, dimensionless
		γ^1	Specific weight at inlet conditions
		υ	Kinematic viscosity, centistokes

1. Standard conditions are defined as 60°F and 14.7 psia.

Table 2. Equation Constants[1]

		N	w	q	p[2]	γ	T	d, D
N_1		0.0865 0.865 1.00	- - - - - - - - - - - -	Nm^3/h Nm^3/h GPM	kPa bar psia	- - - - - - - - - - - -	- - - - - - - - - - - -	- - - - - - - - - - - -
N_2		0.00214 890	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	mm in.
N_5		0.00241 1000	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	mm in.
N_6		2.73 27.3 63.3	kg/hr kg/hr lb/hr	- - - - - - - - - - - -	kPa bar psia	kg/m^3 kg/m^3 lb/ft^3	- - - - - - - - - - - -	- - - - - - - - - - - -
N_7[3]	Normal Conditions T_N = 0°C	3.94 394	- - - - - - - -	Nm^3/h Nm^3/h	kPa bar	- - - - - - - -	Kelvin Kelvin	- - - - - - - -
	Standard Conditions T_s = 16°C	4.17 417	- - - - - - - -	Nm^3/h Nm^3/h	kPa bar	- - - - - - - -	Kelvin Kelvin	- - - - - - - -
	Standard Conditions T_s = 60°F	1360	- - - -	SCFH	psia	- - - -	deg Rankine	- - - -
N_8		0.948 94.8 19.3	kg/hr kg/hr lb/hr	- - - - - - - - - - - -	kPa bar psia	- - - - - - - - - - - -	Kelvin Kelvin deg Rankine	- - - - - - - - - - - -
N_9[3]	Normal Conditions T_N = 0°C	21.2 2120	- - - - - - - -	Nm^3/h Nm^3/h	kPa bar	- - - - - - - -	Kelvin Kelvin	- - - - - - - -
	Standard Conditions T_S = 16°C	22.4 2240	- - - - - - - -	Nm^3/h Nm^3/h	kPa bar	- - - - - - - -	Kelvin Kelvin	- - - - - - - -
	Standard Conditions T_S = 60°F	7320	- - - -	SCFH	psia	- - - -	deg Rankine	- - - -

1. Many of the equations used in these sizing procedures contain a numerical constant, N, along with a numerical subscript. These numerical constants provide a means for using different units in the equations. Values for the various constants and the applicable units are given in the above table. For example, if the flow rate is given in U.S. GPM and the pressures are psia, N_1 has a value of 1.00. If the flow rate is Nm^3/h and the pressures are kPa, the N_1 constant becomes 0.0865.
2. All pressures are absolute.
3. Pressure base is 101.3 kPa = 1.01 bar = 14.7 psia.

Determining Piping Geometry Factor (F_p)

Determine an F_p factor if any fittings such as reducers, elbows or tees will be directly attached to the inlet and outlet connections of the control valve that is to be sized. When possible, it is recommended that F_p factors be determined experimentally by using the specified valve in actual tests.

Calculate the F_p factor using the following equation:

$$F_p = \left[1 + \frac{\Sigma K}{N_2}\left(\frac{C_v}{d^2}\right)^2\right]^{-1/2}$$

where,

N_2 = Numerical constant found in Table 2. Equation Constants
d = Assumed nominal valve size
C_v = Valve sizing coefficient at 100% travel for the assumed valve size

In the above equation, the ΣK term is the algebraic sum of the velocity head loss coefficients of all of the fittings that are attached to the control valve.

$$\Sigma K = K_1 + K_2 + K_{B1} - K_{B2}$$

where,
K_1 = Resistance coefficient of upstream fittings
K_2 = Resistance coefficient of downstream fittings
K_{B1} = Inlet Bernoulli coefficient
K_{B2} = Outlet Bernoulli coefficient

The Bernoulli coefficients, K_{B1} and K_{B2}, are used only when the diameter of the piping approaching the valve is different from the diameter of the piping leaving the valve, whereby:

$$K_{B1} \text{ or } K_{B2} = 1 - \left(\frac{d}{D}\right)^4$$

where,

d = Nominal valve size
D = Internal diameter of piping

If the inlet and outlet piping are of equal size, then the Bernoulli coefficients are also equal, $K_{B1} = K_{B2}$ and therefore they are dropped from the equation.

The most commonly used fitting in control valve installations is the short-length concentric reducer. The equations for this fitting are as follows:

- For an inlet reducer:

$$K_1 = 0.5\left(1 - \frac{d^2}{D^2}\right)^2$$

- For an outlet reducer:

$$K_2 = 1.0\left(1 - \frac{d^2}{D^2}\right)^2$$

- For a valve installed between identical reducers:

$$K_1 + K_2 = 1.5\left(1 - \frac{d^2}{D^2}\right)^2$$

Determining Maximum Flow Rate (q_{max})

Determine either q_{max} or ΔP_{max} if it is possible for choked flow to develop within the control valve that is to be sized. The values can be determined by using the following procedures.

$$q_{max} = N_1 F_L C_V \sqrt{\frac{P_1 - F_F P_V}{G_f}}$$

Values for F_F, the liquid critical pressure ratio factor, can be obtained from Figure 1 or from the following equation:

$$F_F = 0.96 - 0.28\sqrt{\frac{P_V}{P_C}}$$

Values of F_L, the recovery factor for rotary valves installed without fittings attached, can be found in published coefficient tables. If the given valve is to be installed with fittings such as reducer attached to it, F_L in the equation must be replaced by the quotient F_{LP}/F_P, where:

$$F_{LP} = \left[\frac{K_1}{N_2}\left(\frac{C_V}{d^2}\right)^2 + \frac{1}{F_L^2}\right]^{-1/2}$$

and

$$K_1 = K_1 + K_{B1}$$

where,

K_1 = Resistance coefficient of upstream fittings

K_{B1} = Inlet Bernoulli coefficient

(See the procedure for Determining F_p, the Piping Geometry Factor, for definitions of the other constants and coefficients used in the above equations.)

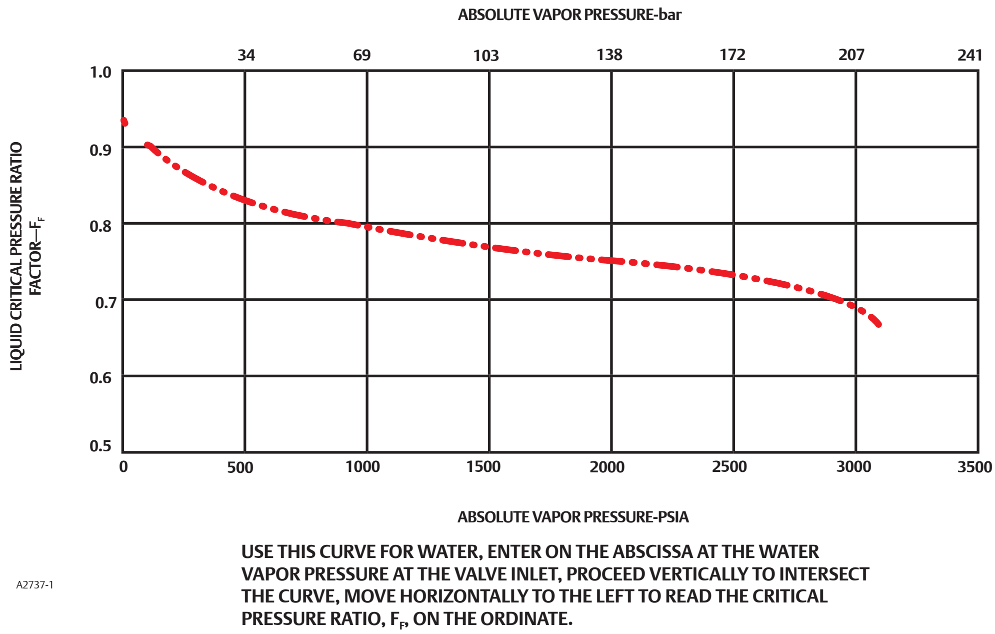


Figure 1. *Liquid Critical Pressure Ratio Factor for Water*

Determining Allowable Sizing Pressure Drop (ΔP_{max})

ΔP_{max} (the allowable sizing pressure drop) can be determined from the following relationships:

For valves installed without fittings:

$$\Delta P_{max(L)} = F_L^{\,2} (P_1 - F_F P_V)$$

For valves installed with fittings attached:

$$\Delta P_{max(LP)} = \left(\frac{F_{LP}}{F_P}\right)^2 (P_1 - F_F P_V)$$

where,

P_1 = Upstream absolute static pressure

P_2 = Downstream absolute static pressure

P_v = Absolute vapor pressure at inlet temperature

Values of F_F, the liquid critical pressure ratio factor, can be obtained from Figure 1 or from the following equation:

$$F_F = 0.96 - 0.28 \sqrt{\frac{P_V}{P_c}}$$

An explanation of how to calculate values of F_{LP}, the recovery factor for valves installed with fittings attached, is presented in the preceding procedure Determining q_{max} (the Maximum Flow Rate).

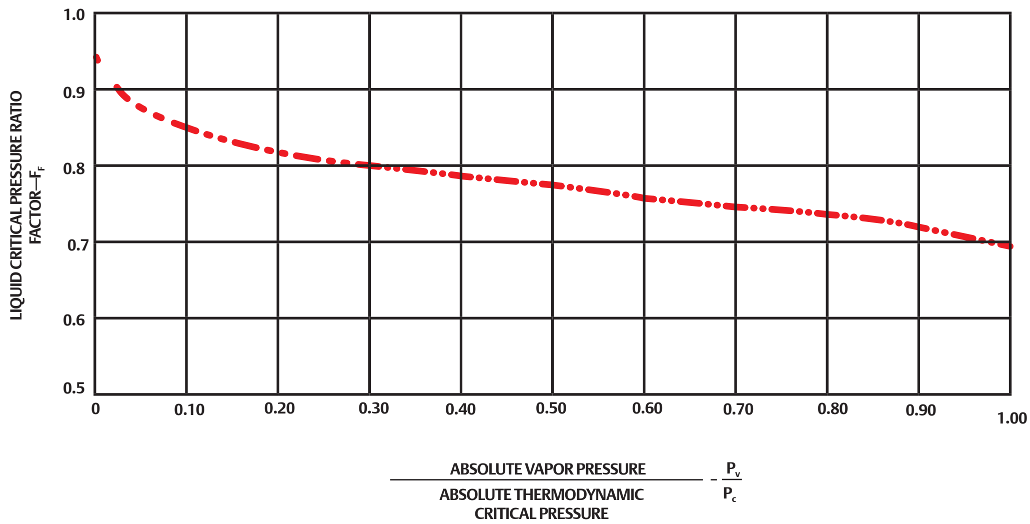
Once the ΔP_{max} value has been obtained from the appropriate equation, it should be compared with the actual service pressure differential ($\Delta P = P_1 - P_2$). If ΔP_{max} is less than ΔP, this is an indication that choked flow conditions will exist under the service conditions specified. If choked flow conditions do exist ($\Delta P_{max} < P_1 - P_2$), then step 5 of the procedure for Sizing Valves for Liquids must be modified by replacing the actual service pressure differential ($P_1 - P_2$) in the appropriate valve sizing equation with the calculated ΔP_{max} value.

Note

Once it is known that choked flow conditions will develop within the specified valve design (ΔP_{max} is calculated to be less than ΔP), a further distinction can be made to determine whether the choked flow is caused by cavitation or flashing. The choked flow conditions are caused by flashing if the outlet pressure of the given valve is less than the vapor pressure of the flowing liquid. The choked flow conditions are caused by cavitation if the outlet pressure of the valve is greater than the vapor pressure of the flowing liquid.

Liquid Sizing Sample Problem

Assume an installation that, at initial plant startup, will not be operating at maximum design capability. The lines are sized for the ultimate system capacity, but there is a desire to install a control valve now which is sized only for currently anticipated requirements. The line size is 8 in. / DN 200 and an ASME CL300 globe valve with an equal percentage cage has been specified. Standard concentric reducers will be used to install the valve into the line. Determine the appropriate valve size.



USE THIS CURVE FOR LIQUIDS OTHER THAN WATER. DETERMINE THE VAPOR PRESSURE/CRITICAL PRESSURE RATIO BY DIVIDING THE LIQUID VAPOR PRESSURE AT THE VALVE INLET BY THE CRITICAL PRESSURE OF THE LIQUID. ENTER ON THE ABSCISSA AT THE RATIO JUST CALCULATED AND PROCEED VERTICALLY TO INTERSECT THE CURVE. MOVE HORIZONTALLY TO THE LEFT AND READ THE CRITICAL PRESSURE RATIO, F_F, ON THE ORDINATE.

Figure 2. *Liquid Critical Pressure Ratio Factor for Liquids Other Than Water*

1. *Specify the necessary variables required to size the valve:*
   - Desired Valve Design—ASME CL300 globe valve with equal percentage cage and an assumed valve size of 3 in.
   - Process Fluid—liquid propane
   - Service Conditions—q = 800 GPM / 3028 l/min

   P_1 = 300 psig / 20.7 bar = 314.7 psia / 21.7 bar a

   P_2 = 275 psig / 19.0 bar = 289.7 psia / 20.0 bar a

   ΔP = 25 psi / 1.7 bar

   T_1 = 70°F / 21°C

   G_f = 0.50

   P_v = 124.3 psia / 8.6 bar a

   P_c = 616.3 psia / 42.5 bar a
2. *Use an N_1 value of 1.0 from Table 2. Equation Constants.*
3. *Determine F_p, the piping geometry factor.*

   Because it is proposed to install a 3 in. valve in an 8 in. / DN 200 line, it will be necessary to determine the piping geometry factor, F_p, which corrects for losses caused by fittings attached to the valve.

$$F_p = \left[1 + \frac{\Sigma K}{N_2}\left(\frac{C_v}{d^2}\right)^2\right]^{-1/2}$$

where,

N_2 = 890, from Table 2. Equation Constants

d = 3 in. / 76 mm, from step 1

C_v = 121, from the flow coefficient table for an ASME CL300, 3 in. globe valve with equal percentage cage

To compute ΣK for a valve installed between identical concentric reducers:

$$\Sigma K = K_1 + K_2$$

$$= 1.5\left(1 - \frac{d^2}{D^2}\right)^2$$

$$= 1.5\left(1 - \frac{(3)^2}{(8)^2}\right)^2$$

$$= 1.11$$

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Valve Sizing (Standardized Method)

where,

D = 8 in. / 203 mm, the internal diameter of the piping so,

$$F_p = \left[1 + \frac{1.11}{890}\left(\frac{121}{3^2}\right)^2\right]^{-1/2}$$

$$= 0.90$$

4. *Determine ΔP_{max} (the Allowable Sizing Pressure Drop.)*

   Based on the small required pressure drop, the flow will not be choked ($\Delta P_{max} > \Delta P$).

5. *Solve for C_v, using the appropriate equation.*

$$C_v = \frac{q}{N_1 F_p \sqrt{\frac{P_1 - P_2}{G_f}}}$$

$$= \frac{800}{(1.0)(0.90)\sqrt{\frac{25}{0.5}}}$$

$$= 125.7$$

6. *Select the valve size using the flow coefficient table and the calculated C_v value.*

   The required C_v of 125.7 exceeds the capacity of the assumed valve, which has a C_v of 121. Although for this example it may be obvious that the next larger size (4 in.) would be the correct valve size, this may not always be true and a repeat of the above procedure should be carried out.

   Assuming a 4 in. valve, C_v = 203. This value was determined from the flow coefficient table for an ASME CL300, 4 in. globe valve with an equal percentage cage.

   Recalculate the required C_v using an assumed C_v value of 203 in the F_p calculation.

where,

$$\Sigma K = K_1 + K_2$$

$$= 1.5\left(1 - \frac{d^2}{D^2}\right)^2$$

$$= 1.5\left(1 - \frac{16}{64}\right)^2$$

$$= 0.84$$

and

$$F_p = \left[1.0 + \frac{\Sigma K}{N_2}\left(\frac{C_v}{d^2}\right)^2\right]^{-1/2}$$

$$= \left[1.0 + \frac{0.84}{890}\left(\frac{203}{4^2}\right)^2\right]^{-1/2}$$

$$= 0.93$$

and

$$C_v = \frac{q}{N_1 F_p \sqrt{\frac{P_1 - P_2}{G_f}}}$$

$$= \frac{800}{(1.0)(0.93)\sqrt{\frac{25}{0.5}}}$$

$$= 121.7$$

This solution indicates only that the 4 in. valve is large enough to satisfy the service conditions given. There may be cases, however, where a more accurate prediction of the C_v is required. In such cases, the required C_v should be redetermined using a new F_p value based on the C_v value obtained above. In this example, C_v is 121.7, which leads to the following result:

$$F_p = \left[1.0 + \frac{\Sigma K}{N_2}\left(\frac{C_v}{d^2}\right)^2\right]^{-1/2}$$

$$= \left[1.0 + \frac{0.84}{890}\left(\frac{121.7}{4^2}\right)^2\right]^{-1/2}$$

$$= 0.97$$

The required C_v then becomes:

$$C_v = \frac{q}{N_1 F_p \sqrt{\frac{P_1 - P_2}{G_f}}}$$

$$= \frac{800}{(1.0)(0.97)\sqrt{\frac{25}{0.5}}}$$

$$= 116.2$$

Because this newly determined C_v is very close to the C_v used initially for this recalculation (116.2 versus 121.7), the valve sizing procedure is complete and the conclusion is that a 4 in. valve opened to about 75% of total travel should be adequate for the required specifications.

Gas and Steam Valve Sizing

Sizing Valves for Compressible Fluids

Following is a six-step procedure for the sizing of control valves for compressible flow using the ISA standardized procedure. Each of these steps is important and must be considered during any valve sizing procedure. Steps 3 and 4 concern the determination of certain sizing factors that may or may not be required in the sizing equation depending on the service conditions of the sizing problem. If it is necessary for one or both of these sizing factors to be included in the sizing equation for a particular sizing problem, refer to the appropriate factor determination section(s), which is referenced and located in the following text.

1. *Specify the necessary variables required to size the valve as follows:*

   - Desired valve design (e.g. balanced globe with linear cage)
   - Process fluid (air, natural gas, steam, etc.) and
   - Appropriate service conditions— q or w, P_1, P_2 or ΔP, T_1, G_g, M, k, Z and γ_1

   The ability to recognize which terms are appropriate for a specific sizing procedure can only be acquired through experience with different valve sizing problems. If any of the above terms appear to be new or unfamiliar, refer to the Abbreviations and Terminology Table 1 in Liquid Valve Sizing Section for a complete definition.

2. *Determine the equation constant, N.*

   N is a numerical constant contained in each of the flow equations to provide a means for using different systems of units. Values for these various constants and their applicable units are given in the Equation Constants Table 2 in Liquid Valve Sizing Section.

   Use either N_7 or N_9 if sizing the valve for a flow rate in volumetric units (SCFH or Nm^3/h). Which of the two constants to use depends upon the specified service conditions. N_7 can be used only if the specific gravity, G_g, of the following gas has been specified along with the other required service conditions. N_9 can be used only if the molecular weight, M, of the gas has been specified.

   Use either N_6 or N_8 if sizing the valve for a flow rate in mass units (lb/hr or kg/hr). Which of the two constants to use depends upon the specified service conditions. N_6 can be used only if the specific weight, γ_1, of the flowing gas has been specified along with the other required service conditions. N_8 can be used only if the molecular weight, M, of the gas has been specified.

3. *Determine F_p, the piping geometry factor.*

   F_p is a correction factor that accounts for any pressure losses due to piping fittings such as reducers, elbows or tees that might be attached directly to the inlet and outlet connections of the control valves to be sized. If such fittings are attached to the valve, the F_P factor must be considered in the sizing procedure. If, however, no fittings are attached to the valve, F_P has a value of 1.0 and simply drops out of the sizing equation.

   Also, for rotary valves with reducers and other valve designs and fitting styles, determine the F_P factors by using the procedure for Determining F_P, the Piping Geometry Factor, which is located in Liquid Valve Sizing Section.

4. *Determine Y, the expansion factor, as follows:*

   $$Y = 1 - \frac{x}{3F_k x_T}$$

   where,

   F_k = k/1.4, the ratio of specific heats factor

   k = Ratio of specific heats

   x = $\Delta P/P_1$, the pressure drop ratio

   x_T = The pressure drop ratio factor for valves installed without attached fittings. More definitively, x_T is the pressure drop ratio required to produce critical or maximum, flow through the valve when F_k = 1.0

   If the control valve to be installed has fittings such as reducers or elbows attached to it, then their effect is accounted for in the expansion factor equation by replacing the x_T term with a new factor x_{TP}. A procedure for determining the x_{TP} factor is described in the following section for Determining x_{TP}, the Pressure Drop Ratio Factor.

   Note

   Conditions of critical pressure drop are realized when the value of x becomes equal to or exceeds the appropriate value of the product of either $F_k x_T$ or $F_k x_{TP}$ at which point:

   $$y = 1 - \frac{x}{3F_k x_T} = 1 - 1/3 = 0.667$$

   Although in actual service, pressure drop ratios can and often will, exceed the indicated critical values, this is the point where critical flow conditions develop. Thus, for a constant P_1, decreasing P_2 (i.e., increasing ΔP) will not result in an increase in the flow rate through the valve. Values of x, therefore, greater than the product of either $F_k x_T$ or $F_k x_{TP}$ must never be substituted in the expression for Y. This means that Y can never be less than 0.667. This same limit on values of x also applies to the flow equations that are introduced in the next section.

5. *Solve for the required C_v using the appropriate equation:*

   For volumetric flow rate units—

   - If the specific gravity, G_g, of the gas has been specified:

   $$C_v = \frac{q}{N_7 F_P P_1 Y \sqrt{\frac{x}{G_g T_1 Z}}}$$

- If the molecular weight, M, of the gas has been specified:

$$C_v = \frac{q}{N_7 F_P P_1 Y \sqrt{\dfrac{x}{M T_1 Z}}}$$

For mass flow rate units—

- If the specific weight, γ_1, of the gas has been specified:

$$C_v = \frac{w}{N_6 F_P Y \sqrt{x P_1 \gamma_1}}$$

- If the molecular weight, M, of the gas has been specified:

$$C_v = \frac{w}{N_8 F_P P_1 Y \sqrt{\dfrac{x M}{T_1 Z}}}$$

In addition to C_v, two other flow coefficients, K_v and A_v, are used, particularly outside of North America. The following relationships exist:

$K_v = (0.865)(C_v)$

$A_v = (2.40 \times 10^{-5})(C_v)$

6. *Select the valve size using the appropriate flow coefficient table and the calculated C_v value.*

Determining x_{TP}, the Pressure Drop Ratio Factor

If the control valve is to be installed with attached fittings such as reducers or elbows, then their effect is accounted for in the expansion factor equation by replacing the x_T term with a new factor, x_{TP}.

$$x_{TP} = \frac{x_T}{F_p^{\,2}}\left[1 + \frac{x_T K_i}{N_5}\left(\frac{C_v}{d^2}\right)^2\right]^{-1}$$

where,

N_5 = Numerical constant found in Table 2. Equation Constants

d = Assumed nominal valve size

C_v = Valve sizing coefficient from flow coefficient table at 100% travel for the assumed valve size

F_p = Piping geometry factor

x_T = Pressure drop ratio for valves installed without fittings attached. x_T values are included in the flow coefficient tables

In the above equation, K_i, is the inlet head loss coefficient, which is defined as:

$K_i = K_1 + K_{B1}$

where,

K_1 = Resistance coefficient of upstream fittings (see the procedure for Determining F_p, the Piping Geometry Factor, which is contained in the section for Sizing Valves for Liquids).

K_{B1} = Inlet Bernoulli coefficient (see the procedure for Determining F_p, the Piping Geometry Factor, which is contained in the section for Sizing Valves for Liquids).

Compressible Fluid Sizing Sample Problem No. 1

Determine the size and percent opening for a Fisher™ Design V250 ball valve operating with the following service conditions. Assume that the valve and line size are equal.

1. *Specify the necessary variables required to size the valve:*

- Desired valve design—Design V250 valve
- Process fluid—Natural gas
- Service conditions—

P_1 = 200 psig / 13.8 bar = 214.7 psia / 14.8 bar a

P_2 = 50 psig / 3.4 bar = 64.7 psia / 4.5 bar a

ΔP = 150 psi / 10.3 bar

$x = \Delta P/P_1 = 150/214.7 = 0.70$

T_1 = 60°F / 16°C = 520°R

M = 17.38

$G_g = 0.60$

k = 1.31

$q = 6.0 \times 10^6$ SCFH

2. *Determine the appropriate equation constant, N, from the Equation Constants Table 2 in Liquid Valve Sizing Section.*

Because both G_g and M have been given in the service conditions, it is possible to use an equation containing either N_7 or N_9. In either case, the end result will be the same. Assume that the equation containing G_g has been arbitrarily selected for this problem. Therefore, N_7 = 1360.

3. *Determine F_p, the piping geometry factor.*

Since valve and line size are assumed equal, F_p = 1.0.

4. *Determine Y, the expansion factor.*

$$F_k = \frac{k}{1.40}$$

$$= \frac{1.31}{1.40}$$

$$= 0.94$$

It is assumed that an 8 in. Design V250 valve will be adequate for the specified service conditions. From the flow coefficient Table 4, x_T for an 8 in. Design V250 valve at 100% travel is 0.137.

x = 0.70 (This was calculated in step 1.)

Since conditions of critical pressure drop are realized when the calculated value of x becomes equal to or exceeds the appropriate value of $F_k x_T$, these values should be compared.

$F_k x_T = (0.94)(0.137)$

$= 0.129$

Because the pressure drop ratio, x = 0.70 exceeds the calculated critical value, $F_k x_T = 0.129$, choked flow conditions are indicated. Therefore, Y = 0.667 and $x = F_k x_T = 0.129$.

5. *Solve for required C_v using the appropriate equation.*

$$C_v = \frac{q}{N_7 F_P P_1 Y \sqrt{\dfrac{x}{G_g T_1 Z}}}$$

The compressibility factor, Z, can be assumed to be 1.0 for the gas pressure and temperature given and $F_P = 1$ because valve size and line size are equal.

So,

$$C_v = \frac{6.0 \times 10^6}{(1360)(1.0)(214.7)(0.667)\sqrt{\dfrac{0.129}{(0.6)(520)(1.0)}}} = 1515$$

6. *Select the valve size using the flow coefficient table and the calculated C_v value.*

The above result indicates that the valve is adequately sized (rated C_v = 2190). To determine the percent valve opening, note that the required C_v occurs at approximately 83 degrees for the 8 in. Design V250 valve. Note also that, at 83 degrees opening, the x_T value is 0.252, which is substantially different from the rated value of 0.137 used initially in the problem. The next step is to rework the problem using the x_T value for 83 degrees travel.

The $F_k x_T$ product must now be recalculated.

$x = F_k x_T$

$= (0.94)(0.252)$

$= 0.237$

The required C_v now becomes:

$$C_v = \frac{q}{N_7 F_P P_1 Y \sqrt{\dfrac{x}{G_g T_1 Z}}}$$

$$= \frac{6.0 \times 10^6}{(1360)(1.0)(214.7)(0.667)\sqrt{\dfrac{0.237}{(0.6)(520)(1.0)}}}$$

$= 1118$

The reason that the required C_v has dropped so dramatically is attributable solely to the difference in the x_T values at rated and 83 degrees travel. A C_v of 1118 occurs between 75 and 80 degrees travel.

The appropriate flow coefficient table indicates that x_T is higher at 75 degrees travel than at 80 degrees travel. Therefore, if the problem were to be reworked using a higher x_T value, this should result in a further decline in the calculated required C_v.

Reworking the problem using the x_T value corresponding to 78 degrees travel (i.e., $x_T = 0.328$) leaves:

$x = F_k x_T$

$= (0.94)(0.328)$

$= 0.308$

and,

$$C_v = \frac{q}{N_7 F_P P_1 Y \sqrt{\dfrac{x}{G_g T_1 Z}}}$$

$$= \frac{6.0 \times 10^6}{(1360)(1.0)(214.7)(0.667)\sqrt{\dfrac{0.308}{(0.6)(520)(1.0)}}}$$

$= 980$

The above C_v of 980 is quite close to the 75 degree travel C_v. The problem could be reworked further to obtain a more precise predicted opening; however, for the service conditions given, an 8 in. Design V250 valve installed in an 8 in. / 203 mm line will be approximately 75 degrees open.

Compressible Fluid Sizing Sample Problem No. 2

Assume steam is to be supplied to a process designed to operate at 250 psig / 17 bar. The supply source is a header maintained at 500 psig / 34.5 bar and 500°F / 260°C. A 6 in. / DN 150 line from the steam main to the process is being planned. Also, make the assumption that if the required valve size is less than 6 in. / DN 150, it will be installed using concentric reducers. Determine the appropriate Design ED valve with a linear cage.

1. *Specify the necessary variables required to size the valve:*

   a. Desired valve design—ASME CL300 Design ED valve with a linear cage. Assume valve size is 4 in.

   b. Process fluid—superheated steam

   c. Service conditions—

   w = 125,000 lbs/hr / 56,700 kg/hr

   P_1 = 500 psig / 34.5 bar = 514.7 psia / 35.5 bar a

   P_2 = 250 psig / 17 bar = 264.7 psia / 18.3 bar a

   ΔP = 250 psi / 17 bar

   $x = \Delta P/P_1 = 250/514.7 = 0.49$

   T_1 = 500°F / 260°C

   γ_1 = 1.0434 lb/ft³ / 16.71 kg/m³ (from Properties of Saturated Steam Table)

   k = 1.28 (from Properties of Saturated Steam Table)

2. Determine the appropriate equation constant, N, from the Equation Constants Table 2 in Liquid Valve Sizing Section.

Because the specified flow rate is in mass units, (lb/hr) and the specific weight of the steam is also specified, the only sizing equation that can be used is that which contains the N_6 constant. Therefore,

$N_6 = 63.3$

3. Determine F_p, the piping geometry factor.

$$F_p = \left[1 + \frac{\Sigma K}{N_2}\left(\frac{C_v}{d^2}\right)^2\right]^{-1/2}$$

where,

$N_2 = 890$, determined from Table 2. Equation Constants

$d = 4$ in.

$C_v = 236$, which is the value listed in the flow coefficient Table 5 for a 4 in. Design ED valve at 100% total travel.

$\Sigma K = K_1 + K_2$

$$= 1.5\left(1 - \frac{d^2}{D^2}\right)^2$$

$$= 1.5\left(1 - \frac{4^2}{6^2}\right)^2$$

$= 0.463$

Finally,

$$F_p = \left[1 + \frac{0.463}{890}\left(\frac{(1.0)(236)}{(4)^2}\right)^2\right]^{-1/2}$$

$= 0.95$

4. Determine Y, the expansion factor.

$$Y = 1 - \frac{x}{3F_k x_{TP}}$$

where,

$$F_k = \frac{k}{1.40}$$

$$= \frac{1.28}{1.40}$$

$= 0.91$

$x = 0.49$ (As calculated in step 1.)

Because the 4 in. valve is to be installed in a 6 in. line, the x_T term must be replaced by x_{TP}.

$$x_{TP} = \frac{x_T}{F_p^2}\left[1 + \frac{x_T K_i}{N_5}\left(\frac{C_v}{d^2}\right)^2\right]^{-1}$$

where,

$N_5 = 1000$, from Table 2. Equation Constants

$d = 4$ in.

$F_p = 0.95$, determined in step 3

$x_T = 0.688$, a value determined from the appropriate listing in the flow coefficient table

$C_v = 236$, from step 3

and

$K_i = K_1 + K_{B1}$

$$= 0.5\left(1 - \frac{d^2}{D^2}\right)^2 + \left[1 - \left(\frac{d}{D}\right)^4\right]$$

$$= 0.5\left(1 - \frac{4^2}{6^2}\right)^2 + \left[1 - \left(\frac{4}{6}\right)^4\right]$$

$= 0.96$

where D = 6 in.

so:

$$x_{TP} = \frac{0.69}{0.95^2}\left[1 + \frac{(0.69)(0.96)}{1000}\left(\frac{236}{4^2}\right)^2\right]^{-1} = 0.67$$

Finally:

$$Y = 1 - \frac{x}{3\,F_k\,x_{TP}}$$

$$= 1 - \frac{0.49}{(3)\,(0.91)\,(0.67)}$$

$= 0.73$

5. Solve for required C_v using the appropriate equation.

$$C_v = \frac{w}{N_6\,F_p\,Y\sqrt{x\,P_1\,\gamma_1}}$$

$$= \frac{125{,}000}{(63.3)(0.95)(0.73)\sqrt{(0.49)(514.7)(1.0434)}}$$

$= 176$

Table 3. Representative Sizing Coefficients for Type 1098-EGR Regulator

BODY SIZE		LINEAR CAGE						
		Line Size Equals Body Size		2:1 Line Size to Body Size		X_T	F_D	F_L
		C_v		C_v				
In.	DN	Regulating	Wide-Open	Regulating	Wide-Open			
1	25	16.8	17.7	17.2	18.1	0.806	0.43	
2	50	63.3	66.7	59.6	62.8	0.820	0.35	
3	80	132	139	128	135	0.779	0.30	0.84
4	100	202	213	198	209	0.829	0.28	
6	150	397	418	381	404	0.668	0.28	
BODY SIZE		WHISPER TRIM™ CAGE						
		Line Size Equals Body Size Piping		2:1 Line Size to Body Size Piping		X_T	F_D	F_L
		C_v		C_v				
In.	DN	Regulating	Wide-Open	Regulating	Wide-Open			
1	25	16.7	17.6	15.6	16.4	0.753	0.10	
2	50	54	57	52	55	0.820	0.07	
3	80	107	113	106	110	0.775	0.05	0.89
4	100	180	190	171	180	0.766	0.04	
6	150	295	310	291	306	0.648	0.03	

Table 4. Representative Sizing Coefficients for Rotary Shaft Valves

VALVE SIZE, IN.	VALVE STYLE	DEGREES OF VALVE OPENING	C_V	F_L	X_T	F_D
1	V-Notch Ball Valve	60 90	15.6 34.0	0.86 0.86	0.53 0.42	- - - - - - - -
1-1/2	V-Notch Ball Valve	60 90	28.5 77.3	0.85 0.74	0.50 0.27	- - - - - - - -
2	V-Notch Ball Valve	60 90	59.2 132	0.81 0.77	0.53 0.41	- - - - - - - -
	High Performance Butterfly Valve	60 90	58.9 80.2	0.76 0.71	0.50 0.44	0.49 0.70
3	V-Notch Ball Valve	60 90	120 321	0.80 0.74	0.50 0.30	0.92 0.99
	High Performance Butterfly Valve	60 90	115 237	0.81 0.64	0.46 0.28	0.49 0.70
4	V-Notch Ball Valve	60 90	195 596	0.80 0.62	0.52 0.22	0.92 0.99
	High Performance Butterfly Valve	60 90	270 499	0.69 0.53	0.32 0.19	0.49 0.70
6	V-Notch Ball Valve	60 90	340 1100	0.80 0.58	0.52 0.20	0.91 0.99
	High Performance Butterfly Valve	60 90	664 1260	0.66 0.55	0.33 0.20	0.49 0.70
8	V-Notch Ball Valve	60 90	518 1820	0.82 0.54	0.54 0.18	0.91 0.99
	High Performance Butterfly Valve	60 90	1160 2180	0.66 0.48	0.31 0.19	0.49 0.70
10	V-Notch Ball Valve	60 90	1000 3000	0.80 0.56	0.47 0.19	0.91 0.99
	High Performance Butterfly Valve	60 90	1670 3600	0.66 0.48	0.38 0.17	0.49 0.70
12	V-Notch Ball Valve	60 90	1530 3980	0.78 0.63	0.49 0.25	0.92 0.99
	High Performance Butterfly Valve	60 90	2500 5400	- - - - - - - -	- - - - - - - -	0.49 0.70
16	V-Notch Ball Valve	60 90	2380 8270	0.80 0.37	0.45 0.13	0.92 1.00
	High Performance Butterfly Valve	60 90	3870 8600	0.69 0.52	0.40 0.23	- - - - - - - -

Valve Sizing (Standardized Method)

Table 5. Representative Sizing Coefficients for Design ED Single-Ported Globe Style Valve Bodies

VALVE SIZE, IN.	VALVE PLUG STYLE	FLOW CHARACTERISTIC	PORT DIAMETER		RATED TRAVEL		C_v	F_L	X_T	F_D
			In.	mm	In.	mm				
1/2	Post Guided	Equal Percentage	0.38	9.7	0.50	12.7	2.41	0.90	0.54	0.61
3/4	Post Guided	Equal Percentage	0.56	14.2	0.50	12.7	5.92	0.84	0.61	0.61
1	Micro-Form™	Equal Percentage	3/8	9.5	3/4	19.1	3.07	0.89	0.66	0.72
			1/2	12.7	3/4	19.1	4.91	0.93	0.80	0.67
			3/4	19.1	3/4	19.1	8.84	0.97	0.92	0.62
	Cage Guided	Linear	1-5/16	33.3	3/4	19.1	20.6	0.84	0.64	0.34
		Equal Percentage	1-5/16	33.3	3/4	19.1	17.2	0.88	0.67	0.38
1-1/2	Micro-Form™	Equal Percentage	3/8	9.5	3/4	19.1	3.20	0.84	0.65	0.72
			1/2	12.7	3/4	19.1	5.18	0.91	0.71	0.67
			3/4	19.1	3/4	19.1	10.2	0.92	0.80	0.62
	Cage Guided	Linear	1-7/8	47.6	3/4	19.1	39.2	0.82	0.66	0.34
		Equal Percentage	1-7/8	47.6	3/4	19.1	35.8	0.84	0.68	0.38
2	Cage Guided	Linear	2-5/16	58.7	1-1/8	28.6	72.9	0.77	0.64	0.33
		Equal Percentage	2-5/16	58.7	1-1/8	28.6	59.7	0.85	0.69	0.31
3	Cage Guided	Linear	3-7/16	87.3	1-1/2	38.1	148	0.82	0.62	0.30
		Equal Percentage	----		----		136	0.82	0.68	0.32
4	Cage Guided	Linear	4-3/8	111	2	50.8	236	0.82	0.69	0.28
		Equal Percentage	----		----		224	0.82	0.72	0.28
6	Cage Guided	Linear	7	178	2	50.8	433	0.84	0.74	0.28
		Equal Percentage	----		----		394	0.85	0.78	0.26
8	Cage Guided	Linear	8	203	3	76.2	846	0.87	0.81	0.31
		Equal Percentage	----		----		818	0.86	0.81	0.26

6. *Select the valve size using flow coefficient tables and the calculated C_v value.*

Refer to the flow coefficient Table 5 for Design ED valves with linear cage. Because the assumed 4 in. valve has a C_v of 236 at 100% travel and the next smaller size (3 in.) has a C_v of only 148, it can be surmised that the assumed size is correct. In the event that the calculated required C_v had been small enough to have been handled by the next smaller size or if it had been larger than the rated C_v for the assumed size, it would have been necessary to rework the problem again using values for the new assumed size.

7. *Sizing equations for compressible fluids.*

The equations listed below identify the relationships between flow rates, flow coefficients, related installation factors and pertinent service conditions for control valves handling compressible fluids. Flow rates for compressible fluids may be encountered in either mass or volume units and thus equations are necessary to handle both situations. Flow coefficients may be calculated using the appropriate equations selected from the following. A sizing flow chart for compressible fluids is given in Annex B.

The flow rate of a compressible fluid varies as a function of the ratio of the pressure differential to the absolute inlet pressure ($\Delta P/P_1$), designated by the symbol x. At values of x near zero, the equations in this section can be traced to the basic Bernoulli equation for Newtonian incompressible fluids. However, increasing values of x result in expansion and compressibility effects that require the use of appropriate factors (see Buresh, Schuder and Driskell references).

7.1 Turbulent flow

7.1.1 Non-choked turbulent flow

7.1.1.1 Non-choked turbulent flow without attached fittings

[Applicable if $x < F_\gamma x_T$]

The flow coefficient shall be calculated using one of the following equations:

Eq. 6
$$C = \frac{W}{N_6 Y \sqrt{x P_1 \rho_1}}$$

Eq. 7
$$C = \frac{W}{N_8 P_1 Y} \sqrt{\frac{T_1 Z}{x M}}$$

Eq. 8a
$$C = \frac{Q}{N_9 P_1 Y} \sqrt{\frac{M T_1 Z}{x}}$$

Eq. 8b
$$C = \frac{Q}{N_7 P_1 Y} \sqrt{\frac{G_g T_1 Z}{x}}$$

NOTE 1 Refer to 8.5 for details of the expansion factor *Y*.

NOTE 2 See Annex C for values of *M*.

7.1.1.2 Non-choked turbulent flow with attached fittings

[Applicable if $x < F_\gamma x_{TP}$]

Regulators Rated for Low Temperatures

In some areas of the world, regulators periodically operate in temperatures below -20°F / -29°C. These cold temperatures require special construction materials to prevent regulator failure. Emerson offers regulator constructions that are RATED for use in service temperatures below -20°F / -29°C.

Selection Criteria

When selecting a regulator for extreme cold temperature service, the following guidelines should be considered:

- The body material should be 300 Series stainless steel, LCC or LCB due to low carbon content in the material makeup.
- Give attention to the bolts used. Generally, special stainless steel bolting is required.
- Gaskets and O-rings may need to be addressed if providing a seal between two parts exposed to the cold.
- Special springs may be required in order to prevent fracture when exposed to extreme cold.
- Soft parts in the regulator that are also being used as a seal gasket between two metal parts (such as a diaphragm) may need special consideration. Alternate diaphragm materials should be used to prevent leakage caused by hardening and stiffening of the standard materials.

Freezing

Introduction

Freezing has been a problem since the birth of the gas industry. This problem will likely continue, but there are ways to minimize the effects of the phenomenon.

There are two areas of freezing. The first is the formation of ice from water travelling within the gas stream. Ice will form when temperatures drop below 32°F / 0°C.

The second is hydrate formation. Hydrate is a frozen mixture of water and hydrocarbons. This bonding of water around the hydrocarbon molecule forms a compound which can freeze above 32°F / 0°C. Hydrates can be found in pipelines that are saturated with water vapor. It is also common to have hydrate formation in natural gas of high BTU content. Hydrate formation is dependent upon operating conditions and gas composition.

Reducing Freezing Problems

To minimize problems, we have several options.

1. Keep the fluid temperature above the freezing point by applying heat.
2. Feed an antifreeze solution into the flow stream.
3. Select equipment that is designed to be ice-free in the regions where there are moving parts.
4. Design systems that minimize freezing effects.
5. Remove the water from the flow stream.

Heat the Gas

Obviously, warm water does not freeze. What we need to know is when is it necessary to provide additional heat.

Gas temperature is reduced whenever pressure is reduced. This temperature drop is about 1°F / -17°C for each 15 psi / 1.03 bar pressure drop. Potential problems can be identified by calculating the temperature drop and subtracting from the initial temperature. Usually ground temperature, about 50°F / 10°C is the initial temperature. If a pressure reducing station dropped the pressure from 400 to 250 psi / 28 to 17 bar and the initial temperature is 50°F / 10°C, the final temperature would be 40°F / 4°C.

50°F - (400 to 250 psi) (1°F/15 psi) = 40°F

(10°C - (28 to 17 bar) (-17°C/1.03 bar) = 5°C)

In this case, a freezing problem is not expected. However, if the final pressure was 25 psi / 1.7 bar instead of 250 psi / 17 bar, the final temperature would be 25°F / -4°C. We should expect freezing in this example if there is any moisture in the gas stream.

We can heat the entire gas stream with line heaters where the situation warrants. However, this does involve some large equipment and considerable fuel requirements.

Many different types of large heaters are on the market today. Some involve boilers that heat a water/glycol solution which is circulated through a heat exchanger in the main gas line. Two important considerations are: (1) fuel efficiencies and (2) noise generation.

In many cases, it is more practical to build a box around the pressure reducing regulator and install a small catalytic heater to warm the regulator. When pilot-operated regulators are used, we may find that the ice passes through the regulator without difficulty but plugs the small ports in the pilot. A small heater can be used to heat the pilot supply gas or the pilot itself. A word of caution is appropriate. When a heater remains in use when it is not needed, it can overheat the rubber parts of the regulator. They are usually designed for 180°F / 82°C maximum. Using an automatic temperature control thermostat can prevent overheating.

Antifreeze Solution

An antifreeze solution can be introduced into the flow stream where it will combine with the water. The mixture can pass through the pressure reducing station without freezing. The antifreeze is dripped into the pipeline from a pressurized reservoir through a needle valve. This system is quite effective if one remembers to replenish the reservoir. There is a system that allows the antifreeze to enter the pipeline only when needed. We can install a small pressure regulator between the reservoir and the pipeline with the control line of the small regulator connected downstream of the pressure reducing regulator in the pipeline. The small regulator is set at a lower pressure than the regulator in the pipeline. When the controlled pressure is normal, the small regulator remains closed and conserves the antifreeze. When ice begins to block the regulator in the pipeline, downstream pressure will fall below the setpoint of the small regulator which causes it to open, admitting antifreeze into the pipeline as it is needed. When the ice is removed, the downstream pressure returns to normal and the small regulator closes until ice begins to re-form. This system is quite reliable as long as the supply of the antifreeze solution is maintained. It is usually used at low volume pressure reducing stations.

Equipment Selection

We can select equipment that is somewhat tolerant of freezing if we know how ice forms in a pressure reducing regulator. Since the pressure drop occurs at the orifice, this is the spot where we might expect the ice formation. However, this is not necessarily the case. Metal regulator bodies are good heat conductors. As a result, the body, not just the port, is cooled by the pressure drop. The moisture in the incoming gas strikes the cooled surface as it enters the body and freezes to the body wall before it reaches the orifice. If the valve plug is located upstream of the orifice, there is a good chance that it will become trapped in the ice and remain in the last position. This ice often contains worm holes which allow gas to continue to flow. In this case, the regulator will be unable to control downstream pressure when the flow requirement changes. If the valve plug is located downstream of the port, it is operating in an area that is frequently ice-free. It must be recognized that any regulator can be disabled by ice if there is sufficient moisture in the flow stream.

System Design

We can arrange station piping to reduce freezing if we know when to expect freezing. Many have noted that there are few reported instances of freezing when the weather is very cold (0°F / -18°C). They have observed that most freezing occurs when the atmospheric temperature is between 35 and 45°F / 2 and 7°C. When the atmospheric temperature is quite low, the moisture within the gas stream freezes to the pipe wall before it reaches the pressure reducing valve which leaves only dry gas to pass through the valve. We can take advantage of this concept by increasing the amount of piping that is exposed above ground upstream of the pressure reducing valve. This will assure ample opportunity for the moisture to contact the pipe wall and freeze to the wall.

When the atmospheric temperature rises enough to melt the ice from the pipe wall, it is found that the operating conditions are not favorable to ice formation in the pressure reducing valve. There may be sufficient solar heat gain to warm the regulator body or lower flow rates which reduces the refrigeration effect of the pressure drop.

Parallel pressure reducing valves make a practical antifreeze system for low flow stations such as farm taps. The two parallel regulators are set at slightly different pressures (maybe one at 50 psi / 3.4 bar and one at 60 psi / 4.1 bar). The flow will automatically go through the regulator with the higher setpoint. When this regulator freezes closed, the pressure will drop and the second regulator will open and carry the load. Since most freezing instances occur when the atmospheric temperature is between 35 and 45°F / 2 and 7°C, we expect the ice in the first regulator to begin thawing as soon as the flow stops. When the ice melts from the first regulator, it will resume flowing gas. These two regulators will continue to alternate between flowing and freezing until the atmospheric temperature decreases or increases, which will get the equipment out of the ice formation temperature range.

Water Removal

Removing the moisture from the flow stream solves the problem of freezing. However, this can be a difficult task. Where moisture is a significant problem, it may be beneficial to use a method of dehydration. Dehydration is a process that removes the water from the gas stream. Effective dehydration removes enough water to prevent reaching the dew point at the lowest temperature and highest pressure.

Two common methods of dehydration involve glycol absorption and desiccants. The glycol absorption process requires the gas stream to pass through glycol inside a contactor. Water vapor is absorbed by the glycol which in turn is passed through a regenerator that removes the water by distillation. The glycol is reused after being stripped of the water. The glycol system is continuous and fairly low in cost. It is important, however, that glycol is not pushed downstream with the dried gas.

The second method, solid absorption or desiccant, has the ability to produce much drier gas than glycol absorption. The solid process has the gas stream passing through a tower filled with desiccant. The water vapor clings to the desiccant, until it reaches saturation. Regeneration of the desiccant is done by passing hot gas through the tower to dry the absorption medium. After cooling, the system is ready to perform again. This is more of a batch process and will require two or more towers to keep a continuous flow of dry gas. The desiccant system is more expensive to install and operate than the glycol units.

Most pipeline gas does not have water content high enough to require these measures. Sometimes a desiccant dryer installed in the pilot gas supply lines of a pilot-operated regulator is quite effective. This is primarily true where water is present on an occasional basis.

Summary

It is ideal to design a pressure reducing station that will never freeze, but anyone who has spent time working on this problem will acknowledge that no system is foolproof. We can design systems that minimize the freezing potential by being aware of the conditions that favor freezing.

NACE Sulfide Stress Cracking

Details

NACE International is a technical society concerned with corrosion and corrosion-related issues. NACE is responsible for a large number of standards, but by far the most influential and well known is MR0175, formerly entitled “Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment”. MR0175 was issued by NACE in 1975 to provide guidelines for the selection of materials that are resistant to failure in hydrogen sulfide − containing oil and gas production environments. MR0175 has been so widely referenced that, throughout the process industry, the term “NACE” has become nearly synonymous with “MR0175”. However, the situation changed in 2003.

MR0175 was modified significantly in a 2003 revision to cover chloride stress corrosion cracking in addition to sulfide stress cracking. Then, in late 2003, the document was reformatted and released as a joint NACE/ISO document called NACE MR0175/ISO 15156, “Petroleum and Natural Gas Industries − Materials for Use in H_2S − Containing Environments in Oil and Gas Production”.

In April 2003, NACE also released a new standard, MR0103, which is entitled, “Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments.” This standard is essentially the refining industry’s “NACE MR0175”. MR0103 only addresses sulfide stress cracking, and as such is similar in many respects to the pre-2003 revisions of MR0175.

These NACE standards are applied to:

- MR0175-2002 (and prior)—Intended primarily for upstream *(Oil and gas production)* applications; has historically also been applied to downstream (refinery) applications
- MR0175/ISO 15156—Applies to upstream *(Oil and gas production)* applications only; does not apply to refineries; Includes stress corrosion cracking
- MR0103– Applies to downstream *(Refinery)* applications only
- MR0175-2003—Applies to upstream *(Oil and gas production)*; Replaced by MR0175/ISO 15156

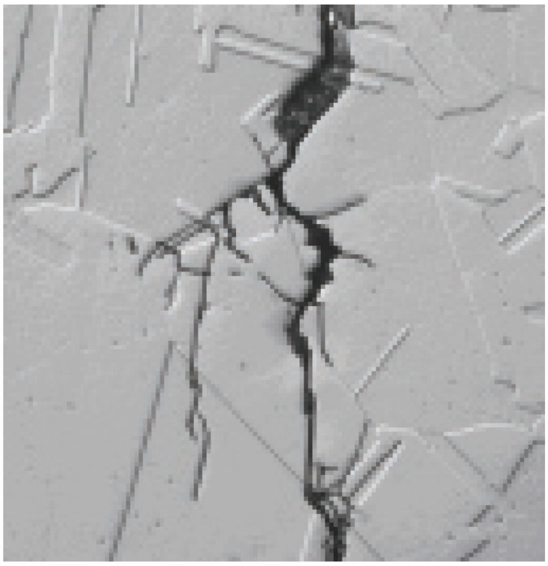

Figure 1. *Photomicrograph Showing Stress Corrosion Cracking*

NACE MR0175-2002 and Prior

The following statements, although based on information and requirements in the pre-2003 revisions of MR0175, cannot be presented in the detail furnished in the actual standard and do not guarantee suitability for any given material in hydrogen sulfide-containing sour environments. The reader is urged to refer to the actual standard before selecting equipment for sour service.

- Most ferrous metals can become susceptible to sulfide stress cracking (SSC) due to hardening by heat treatment and/or cold work. Conversely, many ferrous metals can be heat treated to improve resistance to SSC.
- Carbon and low-alloy steels must be properly heat treated to provide resistance to SSC. A maximum hardness limit of 22 HRC applies to carbon and low-alloy steels.
- Austenitic stainless steels are most resistant to SSC in the annealed condition; some specific grades and conditions of stainless steels are acceptable up to 35 HRC.

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- Copper-base alloys are inherently resistant to SSC, but are generally not used in critical parts of equipment without the approval of the purchaser due to concerns about general corrosion.

- Nickel alloys generally provide the best resistance to SSC. Some precipitation-hardenable nickel alloys are acceptable for use in applications requiring high strength and/or hardness up to 40 HRC.

- Chromium, nickel and other types of plating offer no protection against SSC. Their use is allowed in sour applications for wear resistance, but they cannot be used in an attempt to protect a non-resistant base material from SSC.

- Weld repairs and fabrication welds on carbon and low-alloy steels must be properly processed to ensure that they meet the 22 HRC maximum hardness requirement in the base metal, heat-affected zone (HAZ) and weld deposit. Alloy steels require post-weld heat treatment, and post- weld heat treatment is generally used for carbon steels as well.

- Conventional identification stamping is permissible in low stress areas, such as on the outside diameter of line flanges. Low-stress identification stamping must be used in other areas.

- The standard precludes using ASTM A193 Grade B7 bolting for applications that are considered “exposed”. Use of SSC-resistant bolting materials (such as ASTM A193 Grade B7M) sometimes necessitates to derating of valves designed originally to use B7 bolting.

NACE MR0175/ISO 15156

NACE MR0175/ISO 15156 introduced significant changes to the standard. However, many end users continue to specify NACE MR0175-2002, feeling that it adequately meets their needs in providing good service life. The most significant changes in NACE MR0175/ISO 15156 include:

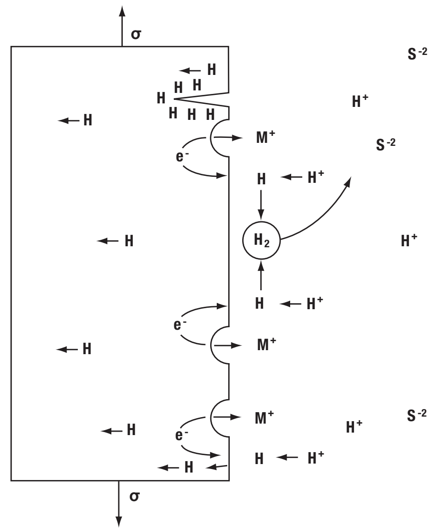

Figure 2. *Schematic Showing the Generation of Hydrogen Producing SSC*

- The revision addresses both sulfide stress cracking and chloride stress corrosion cracking. Prior versions simply listed most materials as acceptable or unacceptable. Because its scope was expanded to cover chloride stress corrosion cracking, the new standard lists all corrosion-resistant alloys as acceptable within limits, referred to as “environmental limits or environmental restrictions”. These are typically expressed in terms of H_2S partial pressure, maximum temperature, ppm chlorides and the presence of free sulfur.

- 316 stainless steel usage is still allowed but under very limited environmental conditions. The impact, if strictly followed, is that this material will find very little use.

- The standard applies only to petroleum production, drilling, gathering and flow line equipment and field processing facilities to be used in H_2S bearing hydrocarbon service. It does not apply to refineries.

- There is clear responsibility placed on the buyer to specify the correct materials. The manufacturer is responsible for meeting the metallurgical requirements of MR0175/ISO 15156.

NACE Sulfide Stress Cracking

NACE MR0103

As mentioned, NACE MR0103 is similar in many respects to the pre-2003 revisions of NACE MR0175. The following are some major differences:

- MR0103 utilizes different, refinery-based definitions for what constitutes a sour environment. The user is responsible for imposing the requirements of MR0103 when they are applicable. The manufacturer is responsible for meeting the metallurgical requirements of NACE MR0103.

- The 2002 and prior revisions of MR0175 included environmental restrictions on a few materials that were continued in the latter editions. MR0103 only deals with sulfide stress cracking. It does not impose environmental limits on any materials. Materials are either acceptable or not.

- Carbon steel base materials that are classified as P-No. 1, group 1 or 2 steels in the ASME Boiler and Pressure Vessel Code are acceptable per MR0103 without base metal hardness requirements. P-No. 1 groups 1 and 2 include WCC and LCC castings, A105 forgings, A516 Grade 70 plate and the other common carbon steel pressure vessel materials.

- MR0103 imposes welding controls on carbon steels that are more rigorous than those imposed by MR0175-2002. MR0103 requires that P-No. 1 carbon steels be welded per another NACE document called SP0472 “Methods and Controls to Prevent In-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments”. SP0472 imposes controls that ensure both the weld deposit and heat affected zone (HAZ) in a weldment will be soft enough to resist sulfide stress cracking. SP0472 invokes actual hardness testing of weld deposits in production, although hardness testing is waived if certain welding process/filler material combinations are employed. HAZ hardness may be controlled by either post-weld heat treatment (PWHT) or by a combination of cooling rate controls and base material chemistry restrictions such as imposing a maximum carbon equivalent (CE).

Exposed Bolting

It is the user’s responsibility to determine if the body-to-bonnet bolting is considered exposed. NACE defines exposed bolting as any bolting that is exposed to the sour service. However, the NACE documents also extend the definition to include external bolting (such as body-to-bonnet bolting) that is buried, insulated, equipped with flange protectors, or otherwise denied direct atmospheric exposure. The logic is that, in these situations, the sour environment might be trapped around the bolting in the event of a gasket leak, so the bolting is to be treated as if it were inside the pressure containment.

Coatings

NACE standards only address the base materials, and do not include restrictions on coatings or hard facing options. Coatings may be used provided the base metal is in a condition which is acceptable per the NACE standard. The coatings may not be used to protect a base metal which is susceptible to stress corrosion cracking.

Elastomers

NACE standards only limit metallic materials, since they were written to address corrosion induced wear. There are still possible limitations of certain elastomers based on your process fluid, temperature and pressures. Please consult product bulletins and literature for more information.

Reference: D101881X012Fisher Control Valve Handbook – Fourth Edition©Fisher Controls International LLC 2005

Chemical Compatibility of Elastomers and Metals

Introduction

This section explains the uses and compatibilities of elastomers commonly used in Fisher™ regulators. The following tables provide the compatibility of the most common elastomers and metals to a variety of chemicals and/or compounds.

The information contained herein is extracted from data we believe to be reliable. However, because of variable service conditions over which we have no control, we do not in any way make any warranty, either express or implied, as to the properties of any materials or as to the performance of any such materials in any particular application and we hereby expressly disclaim any responsibility for the accuracy of any of the information set forth herein.

Refer to the applicable process gas service code or standard to determine if a specific material found in the Process Gases Application Guide is allowed to be used in that service.

Elastomers: Chemical Names and Uses

NBR - Nitrile Rubber, also called Buna-N, is a copolymer of butadiene and acrylonitrile. Nitrile is recommended for: general purpose sealing, petroleum oils and fluids, water, silicone greases and oils, di-ester based lubricants (such as MIL-L-7808) and ethylene glycol based fluids (Hydrolubes). It is not recommended for: halogenated hydrocarbons, nitro hydrocarbons (such as nitrobenzene and aniline), phosphate ester hydraulic fluids (Skydrol, Cellulube, Pydraul), ketones (MEK, acetone), strong acids, ozone and automotive brake fluid. Its temperature range is -60 to 225°F / -51 to 107°C, although this would involve more than one compound and would depend upon the stress state of the component in service.

EPDM, EPM - Ethylenepropylene rubber is an elastomer prepared from ethylene and propylene monomers. EPM is a copolymer of ethylene and propylene, while EPDM contains a small amount of a third monomer (a diene) to aid in the curing process. EP is recommended for: phosphate ester based hydraulic fluids, steam to 400°F / 204°C, water, silicone oils and greases, dilute acids, dilute alkalis, ketones, alcohols and automotive brake fluids. It is not recommended for: petroleum oils and di-ester based lubricants. Its temperature range is -60 to 500°F / -51 to 260°C (the high limit would make use of a special high temperature formulation developed for geothermal applications).

FKM - This is a Fluorocarbon of the polymethylene type having substituent fluoro and perfluoroalkyl or perfluoroalkoxy groups on the polymer chain. Viton® and Fluorel® are the most common trade names. FKM is recommended for: petroleum oils, di-ester based lubricants, silicate ester based lubricants (such as MLO 8200, MLO 8515, OS-45), silicone fluids and greases, halogenated hydrocarbons, selected phosphate ester fluids and some acids. It is not recommended for: ketones, Skydrol 500, amines (UDMH), anhydrous ammonia, low molecular weight esters and ethers and hot hydrofluoric and chlorosulfonic acids. Its temperature range is -20 to 450°F / -29 to 232°C, (this extended range would require special grades and would limit use on each end of the range).

CR - This is chloroprene, commonly know as Neoprene, which is a homopolymer of chloroprene (chlorobutadiene). CR is recommended for: refrigerants (Freons, ammonia), high aniline point petroleum oils, mild acids and silicate ester fluids. It is not recommended for: phosphate ester fluids and ketones. Its temperature range is -60 to 200°F / -51 to 93°C, although this would involve more than one compound.

NR - This is natural rubber which is a natural polyisoprene, primarily from the tree, Hevea Brasiliensis. The synthetics have all but completely replaced natural rubber for seal use. NR is recommended for automotive brake fluid and it is not recommended for petroleum products. Its temperature range is -80 to 180°F / -62 to 82°C.

FXM - This is a copolymer of tetrafluoroethylene and propylene; hence, it is sometimes called PTFE/P rubber. Common trade names are Aflas® (Asahi Glass Co., Ltd) and Fluoraz® (Greene, Tweed & Co.). It is generally used where resistance to both hydrocarbons and hot water are required. Its temperature range is 20 to 400°F / -7 to 204°C.

ECO - This is commonly called Hydrin® rubber, although that is a trade name for a series of rubber materials by B.F. Goodrich. CO is the designation for the homopolymer of epichlorohydrin, ECO is the designation for a copolymer of ethylene oxide and chloromethyl oxirane (epichlorohydrin copolymer) and ETER is the designation for the terpolymer of epichlorohydrin, ethylene oxide and an unsaturated monomer. All the epichlorohydrin rubbers exhibit better heat resistance than nitrile rubbers, but corrosion with aluminum may limit applications. Normal temperature range is (-40 to 250°F / -40 to 121°C), while maximum temperature ranges are -40 to 275°F / -40 to 135°C (for homopolymer CO) and -65 to 275°F / -54 to 135°C (for copolymer ECO and terpolymer ETER).

FFKM - This is a perfluoroelastomer generally better known as Kalrez® (DuPont) and Chemraz® (Greene, Tweed). Perfluoro rubbers of the polymethylene type have all substituent groups on the polymer chain of fluoro, perfluoroalkyl or perfluoroalkoxy groups. The resulting polymer has superior chemical resistance and heat temperature resistance. This elastomer is extremely expensive and should be used only when all else fails. Its temperature range is 0 to 480°F / -18 to 249°C. Some materials, such as Kalrez® 1050LF is usable to 550°F / 288°C and Kalrez® 4079 can be used to 600°F / 316°C.

FVMQ - This is fluorosilicone rubber which is an elastomer that should be used for static seals because it has poor mechanical properties. It has good low and high temperature resistance and is reasonably resistant to oils and fuels because of its fluorination. Because of the cost, it only finds specialty use. Its temperature range is -80 to 400°F / -62 to 204°C.

VMQ - This is the most general term for silicone rubber. Silicone rubber can be designated MQ, PMQ and PVMQ, where the Q designates any rubber with silicon and oxygen in the polymer chain and M, P and V represent methyl, phenyl and vinyl substituent groups on the polymer chain. This elastomer is used only for static seals due to its poor mechanical properties. Its temperature range is -175 to 600°F / -115 to 316°C (extended temperature ranges require special compounds for high or low temperatures).

Chemical Compatibility of Elastomers and Metals

Table 1. General Properties of Elastomers

PROPERTY		NATURAL RUBBER	BUNA-S	NITRILE (NBR)	NEOPRENE (CR)	BUTYL	THIOKOL®	SILICONE	HYPALON®	FLUORO-CARBON[1,2] (FKM)	POLY-URETHANE[2]	POLY-ACRYLIC[1]	ETHYLENE-PROPYLENE[3] (EPDM)
Tensile Strength, psi / bar	Pure Gum	3000 / 207	400 / 28	600 / 41	3500 / 241	3000 / 207	300 / 21	200 to 450 / 14 to 31	4000 / 276	- - - -	- - - -	100 / 7	- - - -
	Reinforced	4500 / 310	3000 / 207	4000 / 276	3500 / 241	3000 / 207	1500 / 103	1100 / 76	4400 / 303	2300 / 159	6500 / 448	1800 / 124	2500 / 172
Tear Resistance		Excellent	Poor-Fair	Fair	Good	Good	Fair	Poor-Fair	Excellent	Good	Excellent	Fair	Poor
Abrasion Resistance		Excellent	Good	Good	Excellent	Fair	Poor	Poor	Excellent	Very Good	Excellent	Good	Good
Aging: Sunlight Oxidation		Poor Good	Poor Fair	Poor Fair	Excellent Good	Excellent Good	Good Good	Good Very Good	Excellent Very Good	Excellent Excellent	Excellent Excellent	Excellent Excellent	- - - - Good
Heat (Maximum Temperature)		200°F / 93°C	200°F / 93°C	250°F / 121°C	200°F / 93°C	200°F / 93°C	140°F / 60°C	450°F / 232°C	300°F / 149°C	400°F / 204°C	200°F / 93°C	350°F / 177°C	350°F / 177°C
Static (Shelf)		Good	Good	Good	Very Good	Good	Fair	Good	Good	- - - -	- - - -	Good	Good
Flex Cracking Resistance		Excellent	Good	Good	Excellent	Excellent	Fair	Fair	Excellent	- - - -	Excellent	Good	- - - -
Compression Set Resistance		Good	Good	Very Good	Excellent	Fair	Poor	Good	Poor	Poor	Good	Good	Fair
Solvent Resistance: Aliphatic Hydrocarbon Aromatic Hydrocarbon Oxygenated Solvent Halogenated Solvent		 Very Poor Very Poor Good Very Poor	 Very Poor Very Poor Good Very Poor	 Good Fair Poor Very Poor	 Fair Poor Fair Very Poor	 Poor Very Poor Good Poor	 Excellent Good Fair Poor	 Poor Very Poor Poor Very Poor	 Fair Poor Poor Very Poor	 Excellent Very Good Good - - - -	 Very Good Fair Poor - - - -	 Good Poor Poor Poor	 Poor Fair - - - - Poor
Oil Resistance: Low Aniline Mineral Oil High Aniline Mineral Oil Synthetic Lubricants Organic Phosphates		 Very Poor Very Poor Very Poor Very Poor	 Very Poor Very Poor Very Poor Very Poor	 Excellent Excellent Fair Very Poor	 Fair Good Very Poor Very Poor	 Very Poor Very Poor Poor Good	 Excellent Excellent Poor Poor	 Poor Good Fair Poor	 Fair Good Poor Poor	 Excellent Excellent - - - - Poor	 - - - - - - - - - - - - Poor	 Excellent Excellent Fair Poor	 Poor Poor Poor Very Good
Gasoline Resistance: Aromatic Non-Aromatic		 Very Poor Very Poor	 Very Poor Very Poor	 Good Excellent	 Poor Good	 Very Poor Very Poor	 Excellent Excellent	 Poor Good	 Poor Fair	 Good Very Good	 Fair Good	 Fair Poor	 Fair Poor
Acid Resistance: Diluted (Under 10%) Concentrated[4]		 Good Fair	 Good Poor	 Good Poor	 Fair Fair	 Good Fair	 Poor Very Poor	 Fair Poor	 Good Good	 Excellent Very Good	 Fair Poor	 Poor Poor	 Very Good Good
Low Temperature Flexibility (Maximum)		-65°F/ -54°C	-50°F/ -46°C	-40°F / -40°C	-40°F / -40°C	-40°F / -40°C	-40°F / -40°C	-100°F / -73°C	-20°F/ -29°C	-30°F/ -34°C	-40°F / -40°C	-10°F / -23°C	-50°F / -45°C
Permeability to Gases		Fair	Fair	Fair	Very Good	Very Good	Good	Fair	Very Good	Good	Good	Good	Good
Water Resistance		Good	Very Good	Very Good	Fair	Very Good	Fair	Fair	Fair	Excellent	Fair	Fair	Very Good
Alkali Resistance: Diluted (Under 10%) Concentrated		 Good Fair	 Good Fair	 Good Fair	 Good Good	 Very Good Very Good	 Poor Poor	 Fair Poor	 Good Good	 Excellent Very Good	 Fair Poor	 Poor Poor	 Excellent Good
Resilience		Very Good	Fair	Fair	Very Good	Very Good	Poor	Good	Good	Good	Fair	Very Poor	Very Good
Elongation (Maximum)		700%	500%	500%	500%	700%	400%	300%	300%	425%	625%	200%	500%

1. Do not use with steam.
2. Do not use with ammonia.
3. Do not use with petroleum based fluids. Use with ester based non-flammable hydraulic oils and low pressure steam applications to 300°F / 149°C.
4. Except for nitric and sulfuric acid.

Table 2. Fluid Compatibility of Elastomers

FLUID	MATERIAL				
	Neoprene (CR)	Nitrile (NBR)	Fluorocarbon (FKM)	Ethylenepropylene (EPDM)	Perfluoroelastomer (FFKM)
Acetic Acid (30%)	B	C	C	A	A
Acetone	C	C	C	A	A
Air, Ambient	A	A	A	A	A
Air, Hot (200°F / 93°C)	C	B	A	A	A
Alcohol (Ethyl)	A	C	C	A	A
Alcohol (Methyl)	A	A	C	A	A
Ammonia (Anhydrous) (Cold)	A	A	C	A	A
Ammonia (Gas, Hot)	B	C	C	B	A
Beer	A	A	A	A	A
Benzene	C	C	B	C	A
Brine (Calcium Chloride)	A	A	B	A	A
Butadiene Gas	C	C	B	C	A
Butane (Gas)	A	A	A	C	A
Butane (Liquid)	C	A	A	C	A
Carbon Tetrachloride	C	C	A	C	A
Chlorine (Dry)	C	C	A	C	A
Chlorine (Wet)	C	C	B	C	A
Coke Oven Gas	C	C	A	C	A
Ethyl Acetate	C	C	C	B	A
Ethylene Glycol	A	A	A	A	A
Freon 11	C	B	A	C	A
Freon 12	A	A	B	B	A
Freon 22	A	C	C	A	A
Freon 114	A	A	B	A	A
Gasoline (Automotive)	C	B	A	C	A
Hydrogen Gas	A	A	A	A	A
Hydrogen Sulfide (Dry)	A	A[1]	C	A	A
Hydrogen Sulfide (Wet)	B	C	C	A	A
Jet Fuel (JP-4)	B	A	A	C	A
Methyl Ethyl Ketone (MEK)	C	C	C	A	A
MTBE	C	C	C	C	A
Natural Gas	A	A	A	C	A
Nitric Acid (50 to 100%)	C	C	B	C	A
Nitrogen	A	A	A	A	A
Oil (Fuel)	C	A	A	C	A
Propane	B	A	A	C	A
Sulfur Dioxide	A	C	A	A	A
Sulfuric Acid (up to 50%)	B	C	A	B	A
Sulfuric Acid (50 to 100%)	C	C	A	B	A
Water (Ambient)	A	A	A	A	A
Water (at 200°F / 93°C)	C	B	B	A	A

1. Performance worsens with hot temperatures.
A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory
N/A - Information not available

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Chemical Compatibility of Elastomers and Metals

Table 3. Compatibility of Metals

CORROSION INFORMATION														
Fluid	Material													
	Carbon Steel	Cast Iron	S302 or S304 Stainless Steel	S316 Stainless Steel	Bronze	Monel®	Hastelloy® B	Hastelloy® C	Durimet® 20	Titanium	Cobalt-Base Alloy 6	S416 Stainless Steel	440C Stainless Steel	17-4PH Stainless Steel
Acetaldehyde	A	A	A	A	A	A	IL	A	A	IL	IL	A	A	A
Acetic Acid, Air Free	C	C	B	B	B	B	A	A	A	A	A	C	C	B
Acetic Acid, Aerated	C	C	A	A	A	A	A	A	A	A	A	C	C	B
Acetic Acid Vapors	C	C	A	A	B	B	IL	A	B	A	A	C	C	B
Acetone	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Acetylene	A	A	A	A	IL	A	A	A	A	IL	A	A	A	A
Alcohols	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Aluminum Sulfate	C	C	A	A	B	B	A	A	A	A	IL	C	C	IL
Ammonia	A	A	A	A	C	A	A	A	A	A	A	A	A	IL
Ammonium Chloride	C	C	B	B	B	B	A	A	A	A	B	C	C	IL
Ammonium Nitrate	A	C	A	A	C	C	A	A	A	A	A	C	B	IL
Ammonium Phosphate (Mono Basic)	C	C	A	A	B	B	A	A	B	A	A	B	B	IL
Ammonium Sulfate	C	C	B	A	B	A	A	A	A	A	A	C	C	IL
Ammonium Sulfite	C	C	A	A	C	C	IL	A	A	A	A	B	B	IL
Aniline	C	C	A	A	C	B	A	A	A	A	A	C	C	IL
Asphalt	A	A	A	A	A	A	A	A	A	IL	A	A	A	A
Beer	B	B	A	A	B	A	A	A	A	A	A	B	B	A
Benzene (Benzol)	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Benzoic Acid	C	C	A	A	A	A	IL	A	A	A	IL	A	A	A
Boric Acid	C	C	A	A	A	A	A	A	A	A	A	B	B	IL
Butane	A	A	A	A	A	A	A	A	A	IL	A	A	A	A
Calcium Chloride (Alkaline)	B	B	C	B	C	A	A	A	A	A	IL	C	C	IL
Calcium Hypochlorite	C	C	B	B	B	B	C	A	A	A	IL	C	C	IL
Carbolic Acid	B	B	A	A	A	A	A	A	A	A	A	IL	IL	IL
Carbon Dioxide, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Carbon Dioxide, Wet	C	C	A	A	B	A	A	A	A	A	A	A	A	A
Carbon Disulfide	A	A	A	A	C	B	A	A	A	A	A	B	B	IL
Carbon Tetrachloride	B	B	B	B	A	A	B	A	A	A	IL	C	A	IL
Carbonic Acid	C	C	B	B	B	A	A	A	A	IL	IL	A	A	A
Chlorine Gas, Dry	A	A	B	B	B	A	A	A	A	C	B	C	C	C
Chlorine Gas, Wet	C	C	C	C	C	C	C	B	C	A	B	C	C	C
Chlorine, Liquid	C	C	C	C	B	C	C	A	B	C	B	C	C	C
Chromic Acid	C	C	C	B	C	A	C	A	C	A	B	C	C	C
Citric Acid	IL	C	B	A	A	B	A	A	A	A	IL	B	B	B
Coke Oven Gas	A	A	A	A	B	B	A	A	A	A	A	A	A	A
Copper Sulfate	C	C	B	B	B	C	IL	A	A	A	IL	A	A	A
Cottonseed Oil	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Creosote	A	A	A	A	C	A	A	A	A	IL	A	A	A	A
Ethane	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ether	B	B	A	A	A	A	A	A	A	A	A	A	A	A
Ethyl Chloride	C	C	A	A	A	A	A	A	A	A	A	B	B	IL
Ethylene	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethylene Glycol	A	A	A	A	A	A	IL	IL	A	IL	A	A	A	A
Ferric Chloride	C	C	C	C	C	C	C	B	C	A	B	C	C	IL
Formaldehyde	B	B	A	A	A	A	A	A	A	A	A	A	A	A
Formic Acid	IL	C	B	B	A	A	A	A	A	C	B	C	C	B
Freon, Wet	B	B	B	A	A	A	A	A	A	A	A	IL	IL	IL
Freon, Dry	B	B	A	A	A	A	A	A	A	A	A	IL	IL	IL
Furfural	A	A	A	A	A	A	A	A	A	A	A	B	B	IL
Gasoline, Refine	A	A	A	A	A	A	A	A	A	A	A	A	A	A

A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory
IL - Information lacking

- continued -

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Table 3. Compatibility of Metals (continued)

Fluid	Carbon Steel	Cast Iron	S302 or S304 Stainless Steel	S316 Stainless Steel	Bronze	Monel®	Hastelloy® B	Hastelloy® C	Durimet® 20	Titanium	Cobalt-Base Alloy 6	S416 Stainless Steel	440C Stainless Steel	17-4PH Stainless Steel
	CORROSION INFORMATION — Material													
Glucose	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrochloric Acid, Aerated	C	C	C	C	C	C	A	B	C	C	B	C	C	C
Hydrochloric Acid, Air free	C	C	C	C	C	C	A	B	C	C	B	C	C	C
Hydrofluoric Acid, Aerated	B	C	C	B	C	C	A	A	B	C	B	C	C	C
Hydrofluoric Acid, Air free	A	C	C	B	C	A	A	A	B	C	IL	C	C	IL
Hydrogen	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrogen Peroxide	IL	A	A	A	C	A	B	B	A	A	IL	B	B	IL
Hydrogen Sufide, Liquid	C	C	A	A	C	C	A	A	B	A	A	C	C	IL
Magnesium Hydroxide	A	A	A	A	B	A	A	A	A	A	A	A	A	IL
Mercury	A	A	A	A	C	B	A	A	A	A	A	A	A	B
Methanol	A	A	A	A	A	A	A	A	A	A	A	A	B	A
Methyl Ethyl Ketone	A	A	A	A	A	A	A	A	A	IL	A	A	A	A
Milk	C	C	A	A	A	A	A	A	A	A	A	C	C	C
Natural Gas	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Nitric Acid	C	C	A	B	C	C	C	B	A	A	C	C	C	B
Oleic Acid	C	C	A	A	B	A	A	A	A	A	A	A	A	IL
Oxalic Acid	C	C	B	B	B	B	A	A	A	B	B	B	B	IL
Oxygen	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Petroleum Oils, Refined	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Phosphoric Acid, Aerated	C	C	A	A	C	C	A	A	A	B	A	C	C	IL
Phosphoric Acid, Air Free	C	C	A	A	C	B	A	A	A	B	A	C	C	IL
Phosphoric Acid Vapors	C	C	B	B	C	C	A	IL	A	B	C	C	C	IL
Picric Acid	C	C	A	A	C	C	A	A	A	IL	IL	B	B	IL
Potassium Chloride	B	B	A	A	B	B	A	A	A	A	IL	C	C	IL
Potassium Hydroxide	B	B	A	A	B	A	A	A	A	A	IL	B	B	IL
Propane	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Rosin	B	B	A	A	A	A	A	A	A	IL	A	A	A	A
Silver Nitrate	C	C	A	A	C	C	A	A	A	A	B	B	B	IL
Sodium Acetate	A	A	B	A	A	A	A	A	A	A	A	A	A	A
Sodium Carbonate	A	A	A	A	A	A	A	A	A	A	A	B	B	A
Sodium Chloride	C	C	B	B	A	A	A	A	A	A	A	B	B	B
Sodium Chromate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Hydroxide	A	A	C	C	C	A	A	A	A	A	A	B	B	A
Sodium Hypochloride	C	C	C	C	B-C	B-C	C	A	B	A	IL	C	C	IL
Sodium Thiosulfate	C	C	A	A	C	C	A	A	A	A	IL	B	B	IL
Stannous Chloride	B	B	C	A	C	B	A	A	A	A	IL	C	C	IL
Stearic Acid	A	C	A	A	B	B	A	A	A	A	B	B	B	IL
Sulfate Liquor (Black)	A	A	A	A	C	A	A	A	A	A	A	IL	IL	IL
Sulfur	A	A	A	A	C	A	A	A	A	A	A	A	A	A
Sulfur Dioxide, Dry	A	A	A	A	A	A	B	A	A	A	A	B	B	IL
Sulfur Trioxide, Dry	A	A	A	A	A	A	B	A	A	A	A	B	B	IL
Sufuric Acid (Aerated)	C	C	C	C	C	C	A	A	A	B	B	C	C	C
Sufuric Acid (Air Free)	C	C	C	C	B	B	A	A	A	B	B	C	C	C
Sulfurous Acid	C	C	B	B	B	C	A	A	A	A	B	C	C	IL
Tar	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Trichloroethylene	B	B	B	A	A	A	A	A	A	A	A	B	B	IL
Turpentine	B	B	A	A	A	B	A	A	A	A	A	A	A	A
Vinegar	C	C	A	A	B	A	A	A	A	IL	A	C	C	A
Water, Boiler Feed	B	C	A	A	C	A	A	A	A	A	A	B	A	A
Water, Distilled	A	A	A	A	A	A	A	A	A	A	A	B	B	IL
Water, Sea	B	B	B	B	A	A	A	A	A	A	A	C	C	A
Whiskey and Wines	C	C	A	A	A	B	A	A	A	A	A	C	C	IL
Zinc Chloride	C	C	C	C	C	C	A	A	A	A	B	C	C	IL
Zinc Sulfate	C	C	A	A	B	A	A	A	A	A	A	B	B	IL

A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory
IL - Information lacking

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Regulator Tips

1. All regulators should be installed and used in accordance with federal, state and local codes and regulations.

2. Adequate overpressure protection should be installed to protect the regulator from overpressure. Adequate overpressure protection should also be installed to protect all downstream equipment in the event of regulator failure.

3. Downstream pressures significantly higher than the regulator's pressure setting may damage soft seats and other internal parts.

4. If two or more available springs have published pressure ranges that include the desired pressure setting, use the spring with the lower range for better accuracy.

5. The recommended selection for orifice diameters is the smallest orifice that will handle the flow.

6. Most regulators shown in this application guide are generally suitable for temperatures to 180°F / 82°C. With high temperature Fluorocarbon (FKM) (if available), the regulators can be used for temperatures to 300°F / 149°C. Check the temperature capabilities to determine materials and temperature ranges available. Use stainless steel diaphragms and seats for higher temperatures, such as steam service.

7. The full advertised range of a spring can be utilized without sacrificing performance or spring life.

8. Regulator body size should not be larger than the pipe size. In many cases, the regulator body is one size smaller than the pipe size.

9. Do not oversize regulators. Pick the smallest orifice size or regulator that will work. Keep in mind when sizing a station that most restricted trims that do not reduce the main port size do not help with improved low flow control.

10. Speed of regulator response, in order:
    - Direct-operated
    - Two-path pilot-operated
    - Unloading pilot-operated
    - Control valve

    Note: Although direct-operated regulators give the fastest response, all types provide quick response.

11. When a regulator appears unable to pass the published flow rate, be sure to check the inlet pressure measured at the regulator body inlet connection. Piping up to and away from regulators can cause significant flowing pressure losses.

12. When adjusting setpoint, the regulator should be flowing at least five percent of the normal operating flow.

13. Direct-operated regulators generally have faster response to quick flow changes than pilot-operated regulators.

14. Droop is the reduction of outlet pressure experienced by pressure-reducing regulators as the flow rate increases. It is stated as a percent, in in. w.c. / mbar or in lbs/in^2 / bar and indicates the difference between the outlet pressure setting made at low flow rates and the actual outlet pressure at the published maximum flow rate. Droop is also called offset or proportional band.

15. Downstream pressure always changes to some extent when inlet pressure changes.

16. Most soft-seated regulators will maintain the pressure within reasonable limits down to zero flow. Therefore, a regulator sized for a high flow rate will usually have a turndown ratio sufficient to handle pilot-light loads during off cycles.

17. Do not undersize the monitor set. It is important to realize that the monitor regulator, even though it is wide-open, will require pressure drop for flow. Using two identical regulators in a monitor set will yield approximately 70 percent of the capacity of a single regulator.

18. Diaphragms leak a small amount due to migration of gas through the diaphragm material. To allow escape of this gas, be sure casing vents (where provided) remain open.

19. Use control lines of equal or greater size than the control tap on the regulator. If a long control line is required, make it bigger. A rule of thumb is to use the next nominal pipe size for every 20 ft. / 6.1 m of control line. Small control lines cause a delayed response of the regulator, leading to increased chance of instability. 3/8 in. / 9.5 mm OD tubing is the minimum recommended control line size.

20. For every 15 psid / 1.0 bar d pressure differential across the regulator, expect approximately a one degree drop in gas temperature due to the natural refrigeration effect. Freezing is often a problem when the ambient temperature is between 30 and 45°F / -1 and 7°C.

21. A disk with a cookie cut appearance probably means you had an overpressure situation. Thus, investigate further.

22. When using relief valves, be sure to remember that the reseat point is lower than the start-to-bubble point. To avoid seepage, keep the relief valve setpoint far enough above the regulator setpoint.

23. Vents should be pointed down to help avoid the accumulation of water condensation or other materials in the spring case.

24. Make control line connections in a straight run of pipe about 10 pipe diameters downstream of any area of turbulence, such as elbows, pipe swages or block valves.

25. When installing a working monitor station, get as much volume between the two regulators as possible. This will give the upstream regulator more room to control intermediate pressure.

26. Cutting the supply pressure to a pilot-operated regulator reduces the regulator gain or sensitivity and, thus, may improve regulator stability. (This can only be used with two path control.)

27. Regulators with high flows and large pressure drops generate noise. Noise can wear parts which can cause failure and/or inaccurate control. Keep regulator noise below 110 dBA.

28. Do not place control lines immediately downstream of rotary or turbine meters.

29. Keep vents open. Do not use small diameter, long vent lines. Use the rule of thumb of the next nominal pipe size every 10 ft. / 3.1 m of vent line and 3 ft. / 0.9 m of vent line for every elbow in the line.

30. Fixed factor measurement (or PFM) requires the regulator to maintain outlet pressure within ±1% of absolute pressure. For example: Setpoint of 2 psig + 14.7 psia = 16.7 psia x 0.01 = ±0.167 psi. (Setpoint of 0.14 bar + 1.01 bar = 1.15 bar x 0.01 = ±0.0115 bar.)

31. Regulating C_g (coefficient of flow) can only be used for calculating flow capacities on pilot-operated regulators. Use capacity tables or flow charts for determining a direct-operated regulator’s capacity.

32. Do not make the setpoints of the regulator/monitor too close together. The monitor can try to take over if the setpoints are too close, causing instability and reduction of capacity. Set them at least one proportional band apart.

33. Consider a butt-weld end regulator where available to lower costs and minimize flange leakages.

34. Do not use needle valves in control lines; use full-open valves. Needle valves can cause instability.

35. Burying regulators is not recommended. However, if you must, the vent should be protected from ground moisture and plugging.

Conversions, Equivalents and Physical Data

Table 1. Pressure Equivalents

TO OBTAIN / BY / MULTIPLY NUMBER OF	KG PER SQUARE CM	PSI	ATMOSPHERE	BAR	IN. OF MERCURY	KPA	IN. W.C.	FT. OF W.C.
Kg per square cm	1	14.22	0.9678	0.98067	28.96	98.067	394.05	32.84
Psi	0.07031	1	0.06804	0.06895	2.036	6.895	27.7	2.309
Atmosphere	1.0332	14.696	1	1.01325	29.92	101.325	407.14	33.93
Bar	1.01972	14.5038	0.98692	1	29.53	100	402.156	33.513
Inches of Mercury	0.03453	0.4912	0.03342	0.033864	1	3.3864	13.61	1.134
Kilopascals	0.0101972	0.145038	0.0098696	0.01	0.2953	1	4.02156	0.33513
In. of Water	0.002538	0.0361	0.002456	0.00249	0.07349	0.249	1	0.0833
Ft. of Water	0.3045	0.4332	0.02947	0.029839	0.8819	2.9839	12	1

1 ounce per square in. = 0.0625 psi

Table 2. Pressure Conversion - Psi to Bar(1)

PSI	0	1	2	3	4	5	6	7	8	9
	Bar									
0	0.000	0.069	0.138	0.207	0.276	0.345	0.414	0.482	0.552	0.621
10	0.689	0.758	0.827	0.896	0.965	1.034	1.103	1.172	1.241	1.310
20	1.379	1.448	1.517	1.586	1.655	1.724*	1.793	1.862	1.931	1.999
30	2.068	2.137	2.206	2.275	2.344	2.413	2.482	2.551	2.620	2.689
40	2.758	2.827	2.896	2.965	3.034	3.103	3.172	3.241	3.309	3.378
50	3.447	3.516	3.585	3.654	3.723	3.792	3.861	3.930	3.999	4.068
60	4.137	4.275	4.275	4.344	4.413	4.482	4.551	4.619	4.688	4.758
70	4.826	4.964	4.964	5.033	5.102	5.171	5.240	5.309	5.378	5.447
80	5.516	5.585	5.654	5.723	5.792	5.861	5.929	5.998	6.067	6.136
90	6.205	6.274	6.343	6.412	6.481	6.550	6.619	6.688	6.757	6.826
100	6.895	6.964	7.033	7.102	7.171	7.239	7.308	7.377	7.446	7.515

1. To convert to kilopascals, move decimal point two positions to the right; to convert to megapascals, move decimal point one position to the left.
*Note: Round off decimal points to provide no more than the desired degree of accuracy.
To use this table, see the shaded example.
25 psig (20 from the left column plus five from the top row) = 1.724 bar

Table 3. Volume Equivalents

TO OBTAIN / BY / MULTIPLY NUMBER OF	DM^3 (L)	IN^3	FT^3	U.S. QUART	U.S. GAL.	IMPERIAL GAL.	U.S. BARREL (PETROLEUM)
Dm^3 (L)	1	61.0234	0.03531	1.05668	0.264178	0.220083	0.00629
$In.^3$	0.01639	1	5.787×10^{-4}	1.01732	0.004329	0.003606	0.000103
$Ft.^3$	28.317	1728	1	29.9221	7.48055	6.22888	0.1781
U.S. Quart	0.94636	57.75	0.03342	1	0.25	0.2082	0.00595
U.S. Gal.	3.78543	231	0.13368	4	1	0.833	0.02381
Imperial Gal.	4.54374	277.274	0.16054	4.80128	1.20032	1	0.02877
U.S. Barrel (Petroleum)	158.98	9702	5.6146	168	42	34.973	1

1 m^3 = 1,000,000 cm^3
1 l = 1000 ml = 1000 cm^3

Table 4. Volume Rate Equivalents

MULTIPLY NUMBER OF / BY / TO OBTAIN	L/MIN	M^3/H	FT^3/H	L/H	U.S. GAL./MIN	U.S. BARRELS/DAY
l/m	1	0.06	2.1189	60	0.264178	9.057
m^3/h	16.667	1	35.314	1000	4.403	151
Ft^3/h	0.4719	0.028317	1	28.317	0.1247	4.2746
l/h	0.016667	0.001	0.035314	1	0.004403	0.151
U.S. Gal./Min	3.785	0.2273	8.0208	227.3	1	34.28
U.S. Barrels/Day	0.1104	0.006624	0.23394	6.624	0.02917	1

Table 5. Mass Conversion - Lbs to kg

LBS	0	1	2	3	4	5	6	7	8	9
	Kg									
0	0.00	0.45	0.91	1.36	1.81	2.27	2.72	3.18	3.63	4.08
10	4.54	4.99	5.44	5.90	6.35	6.80	7.26	7.71	8.16	8.62
20	9.07	9.53	9.98	10.43	10.89	11.34*	11.79	12.25	12.70	13.15
30	13.61	14.06	14.52	14.97	15.42	15.88	16.33	16.78	17.24	17.69
40	18.14	18.60	19.05	19.50	19.96	20.41	20.87	21.32	21.77	22.23
50	22.68	23.13	23.59	24.04	24.49	24.95	25.40	25.86	26.31	26.76
60	27.22	27.67	28.12	28.58	29.03	29.48	29.94	30.39	30.84	31.30
70	31.75	32.21	32.66	33.11	33.57	34.02	34.47	34.93	35.38	35.83
80	36.29	36.74	37.20	37.65	38.10	38.56	39.01	39.46	39.92	40.37
90	40.82	41.28	41.73	42.18	42.64	43.09	43.55	44.00	44.45	44.91

1 lb = 0.4536 kg
*NOTE: To use this table, see the shaded example.
25 lbs (20 from the left column plus five from the top row) = 11.34 kg

Table 6. Area Equivalents

MULTIPLY NUMBER OF / BY / TO OBTAIN	M^2	IN^2	FT^2	MI^2	KM^2
M^3	1	1549.99	10.7639	3.861×10^{-7}	1×10^{-6}
In^2	0.0006452	1	6.944×10^{-3}	2.491×10^{-10}	6.452×10^{-10}
Ft^2	0.0929	144	1	3.587×10^{-8}	9.29×10^{-8}
Mi^2	2,589,999	- - - -	27,878,400	1	2.59
Km^2	1,000,000	- - - -	10,763,867	0.3861	1

1 m^2 = 10,000 cm^2
1 ml^2 = 0.01 cm^2 = 0.00155 in^2

Table 7. Temperature Conversion Formulas

TO CONVERT FROM	TO	SUBSTITUTE IN FORMULA
Degrees Celsius	Degrees Fahrenheit	(°C x 9/5) + 32
Degrees Celsius	Kelvin	(°C + 273.16)
Degrees Fahrenheit	Degrees Celsius	(°F - 32) x 5/9
Degrees Fahrenheit	Degrees Rankine	(°F + 459.69)

Table 8. Kinematic-Viscosity Conversion Formulas

VISCOSITY SCALE	RANGE OF *t*, SEC	KINEMATIC VISCOSITY, STROKES
Saybolt Universal	$32 < t < 100$ $t > 100$	$0.00226t - 1.95/t$ $0.00220t - 1.35/t$
Saybolt Furol	$25 < t < 40$ $t > 40$	$0.0224t - 1.84/t$ $0.0216t - 0.60/t$
Redwood No. 1	$34 < t < 100$ $t > 100$	$0.00226t - 1.79/t$ $0.00247t - 0.50/t$
Redwood Admiralty	- - - -	$0.027t - 20/t$
Engler	- - - -	$0.00147t - 3.74/t$

Conversions, Equivalents and Physical Data

Table 9. Conversion Units

MULTIPLY	BY	TO OBTAIN
Volume		
cm^3	0.06103	In^3
Ft^3	7.4805	Gal. (US)
Ft^3	28.316	L
Ft^3	1728	In^3
Gal. (US)	0.1337	Ft^3
Gal. (US)	3.785	L
Gal. (US)	231	In^3
L	1.057	Quarts (US)
L	2.113	Pints (US)
Miscellaneous		
BTU	0.252	Calories
Decitherm	10,000	BTU
kg	2.205	lbs
kWh	3412	BTU
Oz	28.35	g
Lbs	0.4536	kg
Lbs	453.5924	g
Lbs	21,591	LPG BTU
Therm	100,000	BTU
API Bbls	42	Gal. (US)
Gal. of Propane	26.9	KWH
HP	746	KWH
HP (Steam)	42,418	BTU
Pressure		
g/cm^2	0.0142	Psi
in. of mercury	0.4912	Psi
in. of mercury	1.133	ft. of water
in. of water	0.0361	Psi
in. of water	0.0735	in. of mercury
in. of water	0.5781	oz/in^2
in. of water	5.204	lbs/ft
kPa	100	Bar
kg/cm^2	14.22	Psi
kg/m^2	0.2048	lbs/ft^2
Psi	0.06804	Atmospheres
Psi	0.07031	kg/cm^2
Psi	0.145	KPa
Psi	2.036	in. of mercury
Psi	2.307	ft. of water
Psi	14.5	Bar
Psi	27.67	in. of water
Length		
cm	0.3937	in.
ft.	0.3048	m
ft.	30.48	cm
ft.	304.8	mm
in.	2.540	cm
In.	25.40	mm
km	0.6214	mi
m	1.094	Yards
m	3.281	ft
m	39.37	in.
mi (nautical)	1853	m
mi (statute)	1609	m
Yards	0.9144	m
Yards	91.44	cm

Table 10. Other Useful Conversions

TO CONVERT FROM	TO	MULTIPLY BY
ft^3 of methane	BTU	1000 (approximate)
ft^3 of water	lbs. of water	62.4
Degrees	Radians	0.01745
Gal.	lbs. of water	8.336
g	oz.	0.0352
hp (mechanical)	ft. lbs./min	33,000
hp (electrical)	Watts	746
kg	lbs.	2.205
kg/m^3	lbs/ft^3	0.06243
kW	hp	1.341
Lbs	kg	0.4536
lbs. of Air (14.7 psia and 60°F)	ft^3 of air	13.1
lbs/ft^3	kg/m^3	16.0184
lbs/hr (gas)	SCFH	13.1 ÷ Specific Gravity
lbs/hr (water)	Gal./min	0.002
lbs/sec (gas)	SCFH	46,160 ÷ Specific Gravity
Radians	Degrees	57.3
SCFH Air	SCFH Propane	0.81
SCFH Air	SCFH Butane	0.71
SCFH Air	SCFH 0.6 Natural Gas	1.29
SCFH	m^3/hr	0.028317

Table 11. Converting Volumes of Gas

CFH TO CFH OR CFM TO CFM		
Multiply Flow of	**By**	**To Obtain Flow of**
Air	0.707	Butane
	1.290	Natural Gas
	0.808	Propane
Butane	1.414	Air
	1.826	Natural Gas
	1.140	Propane
Natural Gas	0.775	Air
	0.547	Butane
	0.625	Propane
Propane	1.237	Air
	0.874	Butane
	1.598	Natural Gas

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Conversions, Equivalents and Physical Data

Table 12. Fractional In. to mm

IN.	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
	mm															
0	0.0	1.6	3.2	4.8	6.4	7.9	9.5	11.1	12.7	14.3	15.9	17.5	19.1	20.6	22.2	23.8
1	25.4	27.0	28.6	30.2	31.8	33.3	34.9	36.5	38.1	39.7	41.3	42.9	44.5	46.0	47.6	49.2
2	50.8	52.4	54.0	55.6	57.2	58.7	60.3	61.9	63.5	65.1	66.7	68.3	69.9	71.4	73.0	74.6
3	76.2	77.8	79.4	81.0	82.6	84.1	85.7	87.3	88.9	90.5	92.1	93.7	95.3	96.8	98.4	100.0
4	101.6	103.2	104.8	106.4	108.0	109.5	111.1	112.7	114.3	115.9	117.5	119.1	120.7	122.2	123.8	125.4
5	127.0	128.6	130.2	131.8	133.4	134.9	136.5	138.1	139.7	141.3	142.9	144.5	146.1	147.6	149.2	150.8
6	152.4	154.0	155.6	157.2	158.8	160.3	161.9	163.5	165.1	166.7	168.3	169.9	171.5	173.0	174.6	176.2
7	177.8	179.4	181.0	182.6	184.2	185.7	187.3	188.9	190.5	192.1	193.7	195.3	196.9	198.4	200.0	201.6
8	203.2	204.8	206.4	208.0	209.6	211.1	212.7	214.3	215.9	217.5	219.1	220.7	222.3	223.8	225.4	227.0
9	228.6	230.2	231.8	233.4	235.0	236.5	238.1	239.7	241.3	242.9	244.5	246.1	247.7	249.2	250.8	252.4
10	254.0	255.6	257.2	258.8	260.4	261.9	263.5	265.1	266.7	268.3	269.9	271.5	273.1	274.6	276.2	277.8

1 in. = 25.4 mm
NOTE: To use this table, see the shaded example.
2-1/2 in. (2 from the left column plus 1/2 from the top row) = 63.5 mm

Table 13. Length Equivalents

MULTIPLY NUMBER OF / BY / TO OBTAIN	M	IN.	FT.	MM	MI.	KM
m	1	39.37	3.2808	1000	0.0006214	0.001
In.	0.0254	1	0.0833	25.4	0.00001578	0.0000254
Ft.	0.3048	12	1	304.8	0.0001894	0.0003048
mm	0.001	0.03937	0.0032808	1	0.0000006214	0.000001
Mi.	1609.35	63.360	5.280	1,609,350	1	1.60935
Km	1000	39.370	3280.83	1,000,000	0.62137	1

1 m = 100 cm = 1000 mm = 0.001 km = 1,000,000 micrometers

Table 14. Whole In.-mm Equivalents

IN.	0	1	2	3	4	5	6	7	8	9
	mm									
0	0.00	25.4	50.8	76.2	101.6	127.0	152.4	177.8	203.2	228.6
10	254.0	279.4	304.8	330.2	355.6	381.0	406.4	431.8	457.2	482.6
20	508.0	533.4	558.8	584.2	609.6	635.0	660.4	685.8	711.2	736.6
30	762.0	787.4	812.8	838.2	863.6	889.0	914.4	939.8	965.2	990.6
40	1016.0	1041.4	1066.8	1092.2	1117.6	1143.0	1168.4	1193.8	1219.2	1244.6
50	1270.0	1295.4	1320.8	1346.2	1371.6	1397.0	1422.4	1447.8	1473.2	1498.6
60	1524.0	1549.4	1574.8	1600.2	1625.6	1651.0	1676.4	1701.8	1727.2	1752.6
70	1778.0	1803.4	1828.8	1854.2	1879.6	1905.0	1930.4	1955.8	1981.2	2006.6
80	2032.0	2057.4	2082.8	2108.2	2133.6	2159.0	2184.4	2209.8	2235.2	2260.6
90	2286.0	2311.4	2336.8	2362.2	2387.6	2413.0	2438.4	2463.8	2489.2	2514.6
100	2540.0	2565.4	2590.8	2616.2	2641.6	2667.0	2692.4	2717.8	2743.2	2768.6

Note: All values in this table are exact, based on the relation 1 in. = 25.4 mm.
To use this table, see the shaded example.
25 in. (20 from the left column plus five from the top row) = 635 mm

Table 15. Metric Prefixes and Symbols

MULTIPLICATION FACTOR	PREFIX	SYMBOL
1,000,000,000,000,000,000 = 10^{18}	exa	E
1,000,000,000,000,000 = 10^{15}	peta	P
1,000,000,000,000 = 10^{12}	tera	T
1,000,000,000 = 10^{9}	giga	G
1,000,000 = 10^{6}	mega	M
1,000 = 10^{3}	kilo	k
100 = 10^{2}	hecto	h
10 = 10^{1}	deka	da
0.1 = 10^{-1}	deci	d
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 01 = 10^{-6}	micro	m
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

Table 16. Greek Alphabet

CAPS	LOWER CASE	GREEK NAME	CAPS	LOWER CASE	GREEK NAME	CAPS	LOWER CASE	GREEK NAME
Α	α	Alpha	Ι	ι	Iota	Ρ	ρ	Rho
Β	β	Beta	Κ	κ	Kappa	Σ	σ	Sigma
Γ	γ	Gamma	Λ	λ	Lambda	Τ	τ	Tau
Δ	δ	Delta	Μ	μ	Mu	Υ	υ	Upsilon
Ε	ε	Epsilon	Ν	ν	Nu	Φ	φ	Phi
Ζ	ζ	Zeta	Ξ	ξ	Xi	Χ	χ	Chi
Η	η	Eta	Ο	ο	Omicron	Ψ	ψ	Psi
Θ	θ	Theta	Π	π	Pi	Ω	ω	Omega

Conversions, Equivalents and Physical Data

Table 17. Length Equivalents - Fractional and Decimal In. to mm

IN.		mm	IN.		mm	IN.		mm	IN.		mm
Fractions	Decimals		Fractions	Decimals		Fractions	Decimals		Fractions	Decimals	
	0.00394	0.1		0.23	5.842	1/2	0.50	12.7		0.77	19.558
	0.00787	0.2	15/64	0.234375	5.9531		0.51	12.954		0.78	19.812
	0.01	0.254		0.23622	6.0		0.51181	13.0	25/32	0.78125	19.8438
	0.01181	0.3		0.24	6.096	33/64	0.515625	13.0969		0.78740	20.0
1/64	0.015625	0.3969	1/4	0.25	6.35		0.52	13.208		0.79	20.066
	0.01575	0.4		0.26	6.604		0.53	13.462	51/64	0.796875	20.2406
	0.01969	0.5	17/64	0.265625	6.7469	17/32	0.53125	13.4938		0.80	20.320
	0.02	0.508		0.27	6.858		0.54	13.716		0.81	20.574
	0.02362	0.6		0.27559	7.0	35/64	0.546875	13.8906	13/64	0.8125	20.6375
	0.02756	0.7		0.28	7.112		0.55	13.970		0.82	20.828
	0.03	0.762	9/32	0.28125	7.1438		0.55118	14.0		0.82677	21.0
1/32	0.03125	0.7938		0.29	7.366		0.56	14.224	53/64	0.828125	21.0344
	0.0315	0.8	19/64	0.296875	7.5406	9/16	0.5625	14.2875		0.83	21.082
	0.13543	0.9		0.30	7.62		0.57	14.478		0.84	21.336
	0.03937	1.0		0.31	7.874	37/64	0.578125	14.6844	27/32	0.84375	21.4312
	0.04	1.016	5/16	0.3125	7.9375		0.58	14.732		0.85	21.590
3/64	0.046875	1.1906		0.31496	8.0		0.59	14.986	55/64	0.859375	21.8281
	0.05	1.27		0.32	8.128		0.5905	15.0		0.86	21.844
	0.06	1.524	21/64	0.328125	8.3344	19/32	0.59375	15.0812		0.86614	22.0
1/16	0.0625	1.5875		0.33	8.382		0.60	15.24		0.87	22.098
	0.07	1.778		0.34	8.636	39/64	0.609375	15.4781	7/8	0.875	22.225
5/64	0.078125	1.9844	11/32	0.34375	8.7312		0.61	15.494		0.88	22.352
	0.07874	2.0		0.35	8.89		0.62	15.748		0.89	22.606
	0.08	2.032		0.35433	9.0	5/8	0.625	15.875	57/64	0.890625	22.6219
	0.09	2.286	23/64	0.359375	9.1281		0.62992	16.0		0.90	22.860
3/32	0.09375	2.3812		0.36	9.144		0.63	16.002		0.90551	23.0
	0.1	2.54		0.37	9.398		0.64	16.256	29/32	0.90625	23.0188
7/64	0.109375	2.7781	3/8	0.375	9.525	41/64	0.640625	16.2719		0.91	23.114
	0.11	2.794		0.38	9.652		0.65	16.510		0.92	23.368
	0.11811	3.0		0.39	9.906	21/32	0.65625	16.6688	59/64	0.921875	23.1456
	0.12	3.048	25/64	0.390625	9.9219		0.66	16.764		0.93	23.622
1/8	0.125	3.175		0.39370	10.0		0.66929	17.0	15/16	0.9375	23.8125
	0.13	3.302		0.40	10.16		0.67	17.018		0.94	23.876
	0.14	3.556	13/32	0.40625	10.3188	43/64	0.671875	17.0656		0.94488	24.0
9/64	0.140625	3.5719		0.41	10.414		0.68	17.272		0.95	24.130
	0.15	3.810		0.42	10.668	11/16	0.6875	17.4625	61/64	0.953125	24.2094
5/32	0.15625	3.9688	27/64	0.421875	10.7156		0.69	17.526		0.96	24.384
	0.15748	4.0		0.43	10.922		0.70	17.78	31/32	0.96875	24.6062
	0.16	4.064		0.43307	11.0	45/64	0.703125	17.8594		0.97	24.638
	0.17	4.318	7/16	0.4375	11.1125		0.70866	18.0		0.98	24.892
11/64	0.171875	4.3656		0.44	11.176		0.71	18.034		0.98425	25.0
	0.18	4.572		0.45	11.430	23/32	0.71875	18.2562	63/64	0.984375	25.0031
3/16	0.1875	4.7625	29/64	0.453125	11.5094		0.72	18.288		0.99	25.146
	0.19	4.826		0.46	11.684		0.73	18.542	1	1.00000	25.4000
	0.19685	5.0	15/32	0.46875	11.9062	47/64	0.734375	18.6531			
	0.2	5.08		0.47	11.938		0.74	18.796			
13/64	0.203125	5.1594		0.47244	12.0		0.74803	19.0			
	0.21	5.334		0.48	12.192	3/4	0.75	19.050			
7/32	0.21875	5.5562	31/64	0.484375	12.3031		0.76	19.304			
	0.22	5.588		0.49	12.446	49/64	0.765625	19.4469			

Note: Round off decimal points to provide no more than the desired degree of accuracy.

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Table 18. Temperature Conversions

°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F
-273.16	-460	-796	-90.00	-130	-202.0	-17.8	0	32.0	21.1	70	158.0
-267.78	-450	-778	-84.44	-120	-184.0	-16.7	2	35.6	22.2	72	161.6
-262.22	-440	-760	-78.89	-110	-166.0	-15.6	4	39.2	23.3	74	165.2
-256.67	-430	-742	-73.33	-100	-148.0	-14.4	6	42.8	24.4	76	168.8
-251.11	-420	-724	-70.56	-95	-139.0	-13.3	8	46.4	25.6	78	172.4
-245.56	-410	-706	-67.78	-90	-130.0	-12.2	10	50.0	26.7	80	176.0
-240.00	-400	-688	-65.00	-85	-121.0	-11.1	12	53.6	27.8	82	179.6
-234.44	-390	-670	-62.22	-80	-112.0	-10.0	14	57.2	28.9	84	183.2
-228.89	-380	-652	-59.45	-75	-103.0	-8.89	16	60.8	30.0	86	186.8
-223.33	-370	-634	-56.67	-70	-94.0	-7.78	18	64.4	31.1	88	190.4
-217.78	-360	-616	-53.89	-65	-85	-6.67	20	68.0	32.2	90	194.0
-212.22	-350	-598	-51.11	-60	-76.0	-5.56	22	71.6	33.3	92	197.6
-206.67	-340	-580	-48.34	-55	-67.0	-4.44	24	75.2	34.4	94	201.2
-201.11	-330	-562	-45.56	-50	-58.0	-3.33	26	78.8	35.6	96	204.8
-195.56	-320	-544	-42.78	-45	-49.0	-2.22	28	82.4	36.7	98	208.4
-190.00	-310	-526	-40.00	-40	-40.0	-1.11	30	86.0	37.8	100	212.0
-184.44	-300	-508	-38.89	-38	-36.4	0	32	89.6	43.3	110	230.0
-178.89	-290	-490	-37.78	-36	-32.8	1.11	34	93.2	48.9	120	248.0
-173.33	-280	-472	-36.67	-34	-29.2	2.22	36	96.8	54.4	130	266.0
-169.53	-273	-459.4	-35.56	-32	-25.6	3.33	38	100.4	60.0	140	284.0
-168.89	-272	-457.6	-34.44	-30	-22.0	4.44	40	104.0	65.6	150	302.0
-167.78	-270	-454.0	-33.33	-28	-18.4	5.56	42	107.6	71.1	160	320.0
-162.22	-260	-436.0	-32.22	-26	-14.8	6.67	44	111.2	76.7	170	338.0
-156.67	-250	-418.0	-31.11	-24	-11.2	7.78	46	114.8	82.2	180	356.0
-151.11	-240	-400.0	-30.00	-22	-7.6	8.89	48	118.4	87.8	190	374.0
-145.56	-230	-382.0	-28.89	-20	-4.0	10.0	50	122.0	93.3	200	392.0
-140.00	-220	-364.0	-27.78	-18	-0.4	11.1	52	125.6	98.9	210	410.0
-134.44	-210	-356.0	-26.67	-16	3.2	12.2	54	129.2	104.4	220	428.0
-128.89	-200	-328.0	-25.56	-14	6.8	13.3	56	132.8	110.0	230	446.0
-123.33	-190	-310.0	-24.44	-12	10.4	14.4	58	136.4	115.6	240	464.0
-117.78	-180	-292.0	-23.33	-10	14.0	15.6	60	140.0	121.1	250	482.0
-112.22	-170	-274.0	-22.22	-8	17.6	16.7	62	143.6	126.7	260	500.0
-106.67	-160	-256.0	-21.11	-6	21.2	17.8	64	147.2	132.2	270	518.0
-101.11	-150	-238.0	-20.00	-4	24.8	18.9	66	150.8	137.8	280	536.0
-95.56	-140	-220.0	-18.89	-2	28.4	20.0	68	154.4	143.3	290	665.0

- continued -

Table 18. Temperature Conversions (continued)

°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F
21.1	70	158.0	204.4	400	752.0	454.0	850	1562.0
22.2	72	161.6	210.0	410	770.0	460.0	860	1580.0
23.3	74	165.2	215.6	420	788.0	465.6	870	1598.0
24.4	76	168.8	221.1	430	806.0	471.1	880	1616.0
25.6	78	172.4	226.7	440	824.0	476.7	890	1634.0
26.7	80	176.0	232.2	450	842.0	482.2	900	1652.0
27.8	82	179.6	237.8	460	860.0	487.8	910	1670.0
28.9	84	183.2	243.3	470	878.0	493.3	920	1688.0
30.0	86	186.8	248.9	480	896.0	498.9	930	1706.0
31.1	88	190.4	254.4	490	914.0	504.4	940	1724.0
32.2	90	194.0	260.0	500	932.0	510.0	950	1742.0
33.3	92	197.6	265.6	510	950.0	515.6	960	1760.0
34.4	94	201.2	271.1	520	968.0	521.1	970	1778.0
35.6	96	204.8	276.7	530	986.0	526.7	980	1796.0
36.7	98	208.4	282.2	540	1004.0	532.2	990	1814.0
37.8	100	212.0	287.8	550	1022.0	537.8	1000	1832.0
43.3	110	230.0	293.3	560	1040.0	543.3	1010	1850.0
48.9	120	248.0	298.9	570	1058.0	548.9	1020	1868.0
54.4	130	266.0	304.4	580	1076.0	554.4	1030	1886.0
60.0	140	284.0	310.0	590	1094.0	560.0	1040	1904.0
65.6	150	302.0	315.6	600	1112.0	565.6	1050	1922.0
71.1	160	320.0	321.1	610	1130.0	571.1	1060	1940.0
76.7	170	338.0	326.7	620	1148.0	576.7	1070	1958.0
82.2	180	356.0	332.2	630	1166.0	582.2	1080	1976.0
87.8	190	374.0	337.8	640	1184.0	587.8	1090	1994.0
93.3	200	392.0	343.3	650	1202.0	593.3	1100	2012.0
98.9	210	410.0	348.9	660	1220.0	598.9	1110	2030.0
104.4	220	428.0	354.4	670	1238.0	604.4	1120	2048.0
110.0	230	446.0	360.0	680	1256.0	610.0	1130	2066.0
115.6	240	464.0	365.6	690	1274.0	615.6	1140	2084.0
121.1	250	482.0	371.1	700	1292.0	621.1	1150	2102.0
126.7	260	500.0	376.7	710	1310.0	626.7	1160	2120.0
132.2	270	518.0	382.2	720	1328.0	632.2	1170	2138.0
137.8	280	536.0	287.8	730	1346.0	637.8	1180	2156.0
143.3	290	665.0	393.3	740	1364.0	643.3	1190	2174.0

- continued -

Table 18. Temperature Conversions (continued)

°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F	°C	TEMP. IN °C OR °F TO BE CONVERTED	°F
148.9	300	572.0	315.6	600	1112.0	482.2	900	1652.0	648.9	1200	2192.0
154.4	310	590.0	321.1	610	1130.0	487.8	910	1670.0	654.4	1210	2210.0
160.0	320	608.0	326.7	620	1148.0	493.3	920	1688.0	660.0	1220	2228.0
165.6	330	626.0	332.2	630	1166.0	498.9	930	1706.0	665.6	1230	2246.0
171.1	340	644.0	337.8	640	1184.0	504.4	940	1724.0	671.1	1240	2264.0
176.7	350	662.0	343.3	650	1202.0	510.0	950	1742.0	676.7	1250	2282.0
182.2	360	680.0	348.9	660	1220.0	515.6	960	1760.0	682.2	1260	2300.0
187.8	370	698.0	354.4	670	1238.0	521.1	970	1778.0	687.8	1270	2318.0
189.9	380	716.0	360.0	680	1256.0	526.7	980	1796.0	693.3	1280	2336.0
193.3	390	734.0	365.6	690	1274.0	532.2	990	1814.0	698.9	1290	2354.0
204.4	400	752.0	371.1	700	1292.0	537.8	1000	1832.0	704.4	1300	2372.0
210.0	410	770.0	376.7	710	1310.0	543.3	1010	1850.0	710.0	1310	2390.0
215.6	420	788.0	382.2	720	1328.0	548.9	1020	1868.0	715.6	1320	2408.0
221.1	430	806.0	287.8	730	1346.0	554.4	1030	1886.0	721.1	1330	2426.0
226.7	440	824.0	393.3	740	1364.0	560.0	1040	1904.0	726.7	1340	2444.0
232.2	450	842.0	398.9	750	1382.0	565.6	1050	1922.0	732.2	1350	2462.0
237.8	460	860.0	404.4	760	1400.0	571.1	1060	1940.0	737.8	1360	2480.0
243.3	470	878.0	410.0	770	1418.0	576.7	1070	1958.0	743.3	1370	2498.0
248.9	480	896.0	415.6	780	1436.0	582.2	1080	1976.0	748.9	1380	2516.0
254.4	490	914.0	421.1	790	1454.0	587.8	1090	1994.0	754.4	1390	2534.0
260.0	500	932.0	426.7	800	1472.0	593.3	1100	2012.0	760.0	1400	2552.0
265.6	510	950.0	432.2	810	1490.0	598.9	1110	2030.0	765.6	1410	2570.0
271.1	520	968.0	437.8	820	1508.0	604.4	1120	2048.0	771.1	1420	2588.0
276.7	530	986.0	443.3	830	1526.0	610.0	1130	2066.0	776.7	1430	2606.0
282.2	540	1004.0	448.9	840	1544.0	615.6	1140	2084.0	782.2	1440	2624.0
287.8	550	1022.0	454.4	850	1562.0	621.1	1150	2102.0	787.0	1450	2642.0
293.3	560	1040.0	460.0	860	1580.0	626.7	1160	2120.0	793.3	1460	2660.0
298.9	570	1058.0	465.6	870	1598.0	632.2	1170	2138.0	798.9	1470	2678.0
304.4	580	1076.0	471.1	880	1616.0	637.8	1180	2156.0	804.4	1480	2696.0
310.0	590	1094.0	476.7	890	1634.0	643.3	1190	2174.0	810.0	1490	2714.0

Table 19. A.P.I. and Baumé Gravity Tables and Weight Factors

A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lbs/U.S. Gal.	U.S. Gal/ Lb	A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lbs/U.S. Gal.	U.S. Gal/ Lb	A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lbs/U.S. Gal.	U.S. Gal/ Lb	A.P.I. Gravity	Baumé Gravity	Specific Gravity	Lbs/U.S. Gal.	U.S. Gal/ Lb
0	10.247	1.0760	8.962	0.1116	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1	9.223	1.0679	8.895	0.1124	31	30.78	0.9808	7.251	0.1379	61	60.46	0.7351	6.119	0.1634	81	80.25	0.6659	5.542	0.1804
2	8.198	1.0599	8.828	0.1133	32	31.77	0.8654	7.206	0.1388	62	61.45	0.7313	6.087	0.1643	82	81.24	0.6628	5.516	0.1813
3	7.173	1.0520	8.762	0.1141	33	32.76	0.8602	7.163	0.1396	63	62.44	0.7275	6.056	0.1651	83	82.23	0.6597	5.491	0.1821
4	6.148	1.0443	8.698	0.1150	34	33.75	0.8550	7.119	0.1405	64	63.43	0.7238	6.025	0.1660	84	83.22	0.6566	5.465	0.1830
5	5.124	1.0366	8.634	0.1158	35	34.73	0.8498	7.075	0.1413	65	64.42	0.7201	6.994	0.1668	85	84.20	0.6536	5.440	0.1838
6	4.099	1.0291	8.571	0.1167	36	35.72	0.8448	7.034	0.1422	66	65.41	0.7165	5.964	0.1677	86	85.19	0.6506	5.415	0.1847
7	3.074	1.0217	8.509	0.1175	37	36.71	0.8398	6.993	0.1430	67	66.40	0.7128	5.934	0.1685	87	86.18	0.6476	5.390	0.1855
8	2.049	1.0143	8.448	0.1184	38	37.70	0.8348	6.951	0.1439	68	67.39	0.7093	5.904	0.1694	88	87.17	0.6446	5.365	0.1864
9	1.025	1.0071	8.388	0.1192	39	38.69	0.8299	6.910	0.1447	69	68.37	0.7057	5.874	0.1702	89	88.16	0.6417	5.341	0.1872
10	10.00	1.0000	8.328	0.1201	40	39.68	0.8251	6.870	0.1456	70	69.36	0.7022	5.845	0.1711	90	89.15	0.6388	5.316	0.1881
11	10.99	0.9930	8.270	0.1209	41	40.67	0.8203	6.830	0.1464	71	70.35	0.6988	5.817	0.1719	91	90.14	0.6360	5.293	0.1889
12	11.98	0.9861	8.212	0.1218	42	41.66	0.8155	6.790	0.1473	72	71.34	0.6953	5.788	0.1728	92	91.13	0.6331	5.269	0.1898
13	12.97	0.9792	8.155	0.1226	43	42.65	0.8109	6.752	0.1481	73	72.33	0.6919	5.759	0.1736	93	92.12	0.6303	5.246	0.1906
14	13.96	0.9725	8.099	0.1235	44	43.64	0.8063	6.713	0.1490	74	73.32	0.6886	5.731	0.1745	94	93.11	0.6275	5.222	0.1915
15	14.95	0.9659	8.044	0.1243	45	44.63	0.8017	6.675	0.1498	75	74.31	0.6852	5.703	0.1753	95	94.10	0.6247	5.199	0.1924
16	15.94	0.9593	7.989	0.1252	46	45.62	0.7972	6.637	0.1507	76	75.30	0.6819	5.676	0.1762	96	95.09	0.6220	5.176	0.1932
17	16.93	0.9529	7.935	0.1260	47	50.61	0.7927	6.600	0.1515	77	76.29	0.6787	5.649	0.1770	97	96.08	0.6193	5.154	0.1940
18	17.92	0.9465	7.882	0.1269	48	50.60	0.7883	6.563	0.1524	78	77.28	0.6754	5.622	0.1779	98	97.07	0.6166	5.131	0.1949
19	18.90	0.9402	7.930	0.1277	49	50.59	0.7839	6.526	0.1532	79	78.27	0.6722	5.595	0.1787	99	98.06	0.6139	5.109	0.1957
20	19.89	0.9340	7.778	0.1286	50	50.58	0.7796	6.490	0.1541	80	79.26	0.6690	5.568	0.1796	100	99.05	0.6112	5.086	0.1966
21	20.88	0.9279	7.727	0.1294	51	50.57	0.7753	6.455	0.1549										
22	21.87	0.9218	7.676	0.1303	52	51.55	0.7711	6.420	0.1558										
23	22.86	0.9159	7.627	0.1311	53	52.54	0.7669	6.385	0.1566										
24	23.85	0.9100	7.578	0.1320	54	53.53	0.7628	6.350	0.1575										
25	24.84	0.9042	7.529	0.1328	55	54.52	0.7587	6.136	0.1583										
26	25.83	0.8984	7.481	0.1337	56	55.51	0.7547	6.283	0.1592										
27	26.82	0.8927	7.434	0.1345	57	56.50	0.7507	6.249	0.1600										
28	27.81	0.8871	7.387	0.1354	58	57.49	0.7467	6.216	0.1609										
29	28.80	0.8816	7.341	0.1362	59	58.48	0.7428	6.184	0.1617										
30	29.79	0.8762	7.296	0.1371	60	59.47	0.7389	6.151	0.1626										

The relation of degrees Baume or A.P.I. to Specific Gravity is expressed by these formulas:

For liquids lighter than water:

Degrees Baume = $\frac{140}{G} - 130$ $G = \frac{140}{130 + \text{Degrees Baume}}$

Degrees A.P.I. = $\frac{141}{5} - 131.5$ $G = \frac{141.5}{131.5 + \text{Degrees A.P.I.}}$

For liquids heavier than water:

Degrees Baume = $145 - \frac{145}{5}$ $G = \frac{145}{145 - \text{Degrees Baume}}$

G = Specific Gravity = ratio of weight of a given volume of oil at 60°F to the weight of the same volume of water at 60°F.

The above tables are based on the weight of 1 gal. (U.S.) of oil with a volume of 231 in^3 at 60°F in air at 760 mm pressure and 50% relative humidity. Assumed weight of 1 gal. of water at 60°F in air is 8.32828 lbs.

To determine the resulting gravity by mixing oils of different gravities:

$$D = \frac{md_1 + md_2}{m + n}$$

D = Density or Specific Gravity of mixture
m = Proportion of oil of d_1 density
n = Proportion of oil of d_2 density
d_1 = Specific gravity of m oil
d_2 = Specific gravity of n oil

EMERSON.

Table 20. Characteristics of the Elements

ELEMENT	SYMBOL	ATOMIC NUMBER	MASS NUMBER[1]	MELTING POINT (°C)	BOILING POINT (°C)	ELEMENT	SYMBOL	ATOMIC NUMBER	MASS NUMBER[1]	MELTING POINT (°C)	BOILING POINT (°C)
Actinium	Ac	89	(227)	1600†		Neon	Ne	10	20	-248.67	-245.9
Aluminum	Al	13	27	659.7	2057	Neptunium	Np	93	(237)		
Americum	Am	95	(243)			Nickel	Ni	28	58	1455	2900
Antimony (Stibium)	Sb	51	121	630.5	1380	Niobium	Nb	41	93	2500±50	3700
Argon	Ar	18	40	-189.2	-185.7	Nitrogen	N	7	14	-209.86	-195.8
Arsenic	As	33	75	sublimes at 615	sublimes at 615	Nobelium	No	102	(253)		
Astatine	At	85	(210)			Osmium	Os	76	192	2700	>5300
Barium	Ba	56	138	850	1140	Oxygen	O	8	16	-218.4	-182.86
Berkelium	Bk	97	(247)			Palladium	Pd	46	106	1549.4	2000
Beryllium	Be	4	9	1278±5	2970	Phosphorus	P	15	31		
Bismuth	Bi	83	209	271.3	1560±5	Platinum	Pt	78	195	1773.5	4300
Boron	B	5	11	2300	2550	Plutonium	Pu	94	(242)		
Bromine	Br	35	79	-7.2	58.78	Polonium	Po	84	(209)		
Cadmium	Cd	48	114	320.9	767±2	Potassium	K	19	39	53.3	760
Calcium	Ca	20	40	842±8	1240	Praseodymium	Pr	59	141	940	
Californium	Cf	98	(249)			Promethium	Pm	61	(145)		
Carbon	C	6	12	>3550	4200	Protactinium	Pa	91	(231)		
Cerium	Ce	58	140	804	1400	Radium	Ra	88	(226)	700	
Cesium	Cs	55	133	28.5	670	Radon	Rn	86	(222)	-71	1140
Chlorine	Cl	17	35	-103±5	-34.6	Rhenium	Re	75	187	3167±60	-61.8
Chromium	Cr	24	52	1890	2480	Rhodium	Rh	45	103	1966±3	>2500
Cobalt	Co	27	59	1495	2900	Rubidium	Rb	37	85	38.5	700
Copper	Cu	29	63	1083	2336	Ruthenium	Ru	44	102	2450	2700
Curium	Cm	96	(248)			Samarium	Sm	62	152	>1300	
Dysprosium	Dy	66	164			Scandium	Sc	21	45	1200	2400
Einsteinium	Es	99	(254)			Selenium	Se	34	80	217	688
Erbium	Er	68	166			Silicon	Si	14	28	1420	2355
Europium	Eu	63	153	1150±50		Silver	Ag	47	107	960.8	1950
Fermium	Fm	100	(252)			Sodium	Na	11	23	97.5	880
Fluourine	F	9	19	-223	-188	Strontium	Sr	38	88	800	1150
Francium	Fr	87	(223)			Sulfur	S	16	32		
Gadolinium	Gd	64	158			Tantalum	Ta	73	180	2996±50	c.4100
Gallium	Ga	31	69	29.78	1983	Technetium	Tc	43	(99)		
Germanium	Ge	32	74	958.5	2700	Tellurium	Te	52	130	452	1390
Gold	Au	79	197	1063	2600	Terbium	Tb	65	159	327±5	
Hafnium	Hf	72	180	1700[2]	>3200	Thallium	Tl	81	205	302	1457±10
Helium	He	2	4	-272	-268.9	Thorium	Th	90	232	1845	4500
Holmium	Ho	67	165			Thulium	Tm	69	169		
Hydrogen	H	1	1	-259.14	-252.8	Tin	Sn	50	120	231.89	2270
Indium	In	49	115	156.4	2000±10	Titanium	Ti	22	48	1800	>3000
Iodine	I	53	127	113.7	184.35	Tungsten (Wolfram)	W	74	184	3370	5900
Iridium	Ir	77	193	2454	>4800	Uranium	U	92	238	c.1133	
Iron	Fe	26	56	1535	3000	Vanadium	V	23	51	1710	3000
Krypton	Kr	36	84	-156.6	-152.9	Xenon	Xe	54	132	-112	-107.1
Lanthanum	La	57	139	826		Ytterbium	Yb	70	174	1800	
Lawrencium	Lw	103	(257)			Yttrium	Y	39	89	1490	2500
Lead	Pb	82	208	327.43	1620	Zinc	Zn	30	64	419.47	907
Lithium	Li	3	7	186	1336±5	Zirconium	Zr	40	90	1857	>2900
Lutetium	Lu	71	175								
Magnesium	Mg	12	24	651	1107						
Manganese	Mn	25	55	1260	1900						
Mendelevium	Mv	101	(256)								
Mercury	Hg	80	202	-38.87	356.58						
Molybdenum	Mo	42	98	2620±10	4800						
Neodymium	Nd	60	142	840							

1. Mass number shown is that of stable isotope most common in nature. Mass numbers shown in parentheses designate the isotope with the longest half-life (slowest rate of radioactive decay) for those elements having an unstable isotope.
2. Calculated

> Greater than

Table 21. Recommended Standard Specifications for Valve Materials Pressure-Containing Castings

1 Carbon Steel ASTM A216 Grade WCC Temperature Range = -20 to 800°F Composition (Percent) C 0.25 maximum Mn 1.20 maximum P 0.04 maximum S 0.04 maximum Si 0.60 maximum	2 Carbon Steel ASTM A216 Grade WCB Temperature Range = -20 to 1000°F Composition (Percent) C 0.30 maximum Mn 1.00 maximum P 0.05 maximum S 0.06 maximum Si 0.60 maximum	11 Type 304 Stainless Steel ASTM A351 Grade CF-8 Temperature Range = -425 to 1500°F Composition (Percent) C 0.08 maximum Mn 1.50 maximum Si 2.00 maximum S 0.04 maximum P 0.04 maximum Cr 18.00 to 21.00 Ni 8.00 to 11.00	12 Type 316 Stainless Steel ASTM A351 Grade CF-8M Temperature Range = -425 to 1500°F Composition (Percent) C 0.08 maximum Mn 1.50 maximum Si 2.00 maximum P 0.04 maximum S 0.04 maximum Cr 18.00 to 21.00 Ni 9.00 to 12.00 Mo 2.00 to 3.00
3 Carbon Steel ASTM A352 Grade LCC Temperature Range = -50 to 650°F Composition: same as ASTM A216 Grade WCC	4 Carbon Steel ASTM A352 Grade LCB Temperature Range = -50 to 650°F Composition: same as ASTM A216 Grade WCB	13 Cast Iron ASTM A126 Class B Temperature Range = -150 to 450°F Composition (Percent) P 0.75 maximum S 0.12 maximum	14 Cast Iron ASTM A126 Class C Temperature Range = -150 to 450°F Composition (Percent) P 0.75 maximum S 0.12 maximum
5 Chrome Moly Steel ASTM A217 Grade C5 Temperature Range = -20 to 1100°F Composition (Percent) C 0.20 maximum Mn 0.40 to 0.70 P 0.05 maximum S 0.06 maximum Si 0.75 maximum Cr 4.00 to 6.50 Mo 0.45 to 0.65	6 Carbon Moly Steel ASTM A217 Grade WC1 Temperature Range = -20 to 850°F Composition (Percent) C 0.25 Mn 0.50 to 0.80 P 0.05 maximum S 0.06 maximum Si 0.60 maximum Mo 0.45 to 0.65	15 Ductile Iron ASTM A395 Type 60-45-15 Temperature Range = -20 to 650°F Composition (Percent) C 3.00 minimum Si 2.75 maximum P 0.80 maximum	16 Ductile Ni-Resist* Iron ASTM A439 Type D-2B Temperature Range = -20 to 750°F Composition (Percent) C 3.00 maximum Si 1.50 to 3.00 Mn 0.70 to 1.25 P 0.08 maximum Ni 18.00 to 22.00 Cr 2.75 to 4.00
7 Chrome Moly Steel ASTM A217 Grade WC6 Temperature Range = -20 to 1000°F Composition (Percent) C 0.20 maximum Mn 0.50 to 0.80 P 0.05 maximum S 0.06 maximum Si 0.60 maximum Cr 1.00 to 1.50 Mo 0.45 to 0.65	8 Chrome Moly Steel ASTM A217 Grade WC9 Temperature Range = -20 to 1050°F Composition (Percent) C 0.18 maximum Mn 0.40 to 0.70 P 0.05 maximum Si 0.60 maximum Cr 2.00 to 2.75 Mo 0.90 to 1.20	17 Standard Valve Bronze ASTM B62 Temperature Range = -325 to 450°F Composition (Percent) Cu 84.00 to 86.00 Sn 4.00 to 6.00 Pb 4.00 to 6.00 Zn 4.00 to 6.00 Ni 1.00 maximum Fe 0.30 maximum P 0.05 maximum	18 Tin Bronze ASTM B143 Alloy 1A Temperature Range = -325 to 400°F Composition (Percent) Cu 86.00 to 89.00 Sn 9.00 to 11.00 Pb 0.30 maximum Zn 1.00 to 3.00 Ni 1.00 maximum Fe 0.15 maximum P 0.05 maximum
9 3.5% Nickel Steel ASTM A352 Grade LC3 Temperature Range = -150 to 650°F Composition (Percent) C 0.15 maximum Mn 0.50 to 0.80 P 0.05 maximum S 0.05 maximum Si 0.60 maximum Ni 3.00 to 4.00	10 Chrome Moly Steel ASTM A217 Grade C12 Temperature Range = -20 to 1100°F Composition (Percent) C 0.20 maximum Si 1.00 maximum Mn 0.35 to 0.65 Cr 8.00 to 10.00 Mo 0.90 to 1.20 P 0.05 maximum S 0.06 maximum	19 Manganese Bronze ASTM B147 Alloy 8A Temperature Range = -325 to 350°F Composition (Percent) Cu 55.00 to 60.00 Sn 1.00 maximum Pb 0.40 maximum Ni 0.50 maximum Fe 0.40 to 2.00 Al 0.50 to 1.50 Mn 1.50 maximum Zn Remainder	20 Aluminum Bronze ASTM B148 Alloy 9C Temperature Range = -325 to 500°F Composition (Percent) Cu 83.00 minimum Al 10.00 to 11.50 Fe 3.00 to 5.00 Mn 0.50 Ni 2.50 maximum Minimum total named elements = 99.5

- continued -

Table 21. Recommended Standard Specifications for Valve Materials Pressure-Containing Castings (continued)

21 Mondel* Alloy 411 (Weldable Grade) Temperature Range = -325 to 900°F Composition (Percent) Ni 60.00 minimum Cu 26.00 to 33.00 C 0.30 maximum Mn 1.50 maximum Fe 3.50 maximum S 0.015 maximum Si 1.00 to 2.00 Nb 1.00 to 3.00	22 Nickel-Moly Alloy "B" ASTM A494 (Hastelloy® "B" †) Temperature Range = -325 to 700°F Composition (Percent) Cr 1.00 maximum Fe 4.00 to 6.00 C 0.12 maximum Si 1.00 maximum Co 2.50 maximum Mn 1.00 maximum V 0.20 to 0.60 Mo 26.00 to 30.00 P 0.04 maximum S 0.03 maximum Ni Remainder	31 Type 302 Stainless Steel ASTM A276 Type 302 Composition (Percent) C 0.15 maximum Mn 2.00 maximum P 0.045 maximum S 0.030 maximum Si 1.00 maximum Cr 17.00 to 19.00 Ni 8.00 to 10.00	32 Type 304 Stainless Steel ASTM A276 Type 304 Composition (Percent) C 0.08 maximum Mn 2.00 maximum P 0.045 maximum S 0.030 maximum Si 1.00 maximum Cr 18.00 to 20.00 Ni 8.00 to 12.00
23 Nickel-Moly-Chrome Alloy "C" ASTM A494 (Hastelloy® "C" †) Temperature Range = -325 to 1000°F Composition (Percent) Cr 15.50 to 17.50 Fe 4.50 to 7.50 W 3.75 to 5.25 C 0.12 maximum Si 1.00 maximum Co 2.50 maximum Mn 1.00 maximum V 0.20 to 0.40 Mo 16.00 to 18.00 P 0.04 S 0.03 Ni Remainder	24 Cobalt-based Alloy No.6 Stellite † No. 6 Composition (Percent) C 0.90 to 1.40 Mn 1.00 W 3.00 to 6.00 Ni 3.00 Cr 26.00 to 32.00 Mo 1.00 Fe 3.00 Se 0.40 to 2.00 Co Remainder	33 Type 316 Stainless Steel ASTM A276 Type 316 Composition (Percent) C 0.08 maximum Mn 2.00 maximum P 0.045 maximum S 0.030 maximum Si 1.00 maximum Cr 16.00 to 18.00 Ni 10.00 to 14.00 Mo 2.00 to 3.00	34 Type 316L Stainless Steel ASTM A276 Type 316L Composition (Percent) C 0.03 maximum Mn 2.00 maximum P 0.045 maximum S 0.030 maximum Si 1.00 maximum Cr 16.00 to 18.00 Ni 10.00 to 14.00 Mo 2.00 to 3.00
25 Aluminum Bar ASTM B211 Alloy 20911-T3 Composition (Percent) Si 0.40 maximum Fe 0.70 maximum Cu 5.00 to 6.00 Zn 0.30 maximum Bi 0.20 to 0.60 Pb 0.20 to 0.60 Other Elements 0.15 maximum Al Remainder	26 Yellow Brass Bar ASTM B16 1/2 Hard Composition (Percent) Cu 60.00 to 63.00 Pb 2.50 to 3.70 Fe 0.35 maximum Zn Remainder	35 Type 410 Stainless Steel ASTM A276 Type 410 Composition (Percent) C 0.15 maximum Mn 1.00 maximum P 0.040 maximum S 0.030 maximum Si 1.00 maximum Cr 11.50 to 13.50 Al 0.10 to 0.30	36 Type 17-4PH Stainless Steel ASTM A461 Grade 630 Composition (Percent) C 0.07 maximum Mn 1.00 maximum Si 1.00 maximum P 0.04 maximum S 0.03 maximum Cr 15.50 to 17.50 Nb 0.05 to 0.45 Cu 3.00 to 5.00 Ni 3.00 to 5.00 Fe Remainder
27 Naval Brass Bar ASTM B21 Allow 464 Composition (Percent) Cu 59.00 to 62.00 Sn 0.50 to 1.00 Pb 0.20 maximum Zn Remainder	28 Leaded Steel Bar AISI 12L14 Composition (Percent) C 0.15 maximum Mn 0.80 to 1.20 P 0.04 to 0.09 S 0.25 to 0.35 Pb 0.15 to 0.35	37 Nickel-Copper Alloy Bar Alloy K500 (K Monel®*) Composition (Percent) Ni 63.00 to 70.00 Fe 2.00 maximum Mn 1.50 maximum Si 1.00 maximum C 0.25 maximum S 0.01 maximum Al 2.00 to 4.00 Ti 0.25 to 1.00 Cu Remainder	38 Nickel-Moly Alloy "B" Bar ASTM B335 (Hastelloy® "B" †) Composition (Percent) Cr 1.00 maximum Fe 4.00 to 6.00 C 0.04 maximum Si 1.00 maximum Co 2.50 maximum Mn 1.00 maximum V 0.20 to 0.40 Mo 26.00 to 30.00 P 0.025 maximum S 0.030 maximum Ni Remainder
29 Carbon Steel Bar ASTM A108 Grade 1018 Composition (Percent) C 0.15 to 0.20 Mn 0.60 to 0.90 P 0.04 maximum S 0.05 maximum	30 AISI 4140 Chrome-Moly Steel (Suitable for ASTM A193 Grade B7 bolt material) Composition (Percent) C 0.38 to 0.43 Mn 0.75 to 1.00 P 0.035 maximum S 0.04 maximum Si 0.20 to 0.35 Cr 0.80 to 1.10 Mo 0.15 to 0.25 Fe Remainder	39 Nickel-Moly-Chrome Alloy "C" Bar ASTM B336 (Hastelloy® "C" †) Composition (Percent) Cr 14.50 to 16.50 Fe 4.00 to 7.00 W 3.00 to 4.50 C 0.08 maximum Si 1.00 maximum Co 2.50 maximum Mn 1.00 maximum Va 0.35 maximum Mo 15.00 to 17.00 P 0.04 S 0.03 Ni Remainder	

Table 22. Recommended Standard Specifications for Valve Materials Pressure-Containing Castings

MATERIAL CODE AND DESCRIPTION			MINIMUM PHYSICAL PROPERTIES				MODULUS OF ELASTICITY AT 70°F (psi x 10^6)	APPROXIMATE BRINELL HARDNESS
			Tensile (psi)	Yield Point (psi)	Elong. in 2 in. (%)	Reduction of Area (%)		
1	Carbon Steel	ASTM A 216 Grade WCC	70,000	40,000	22	35	30.4	137 to 187
2	Carbon Steel	ASTM A 216 Grade WCB	70,000	36,000	22	35	27.9	137 to 187
3	Carbon Steel	ASTM A 352 Grade LCC	70,000	40,000	22	35	29.9	137 to 187
4	Carbon Steel	ASTM A 352 Grade LCB	65,000	35,000	24	35	27.9	137 to 187
5	Chrome Moly Steel	ASTM A217 Grade C5	90,000	60,000	18	35	27.4	241 Maximum
6	Carbon Moly Steel	ASTM A217 Grade WC1	65,000	35,000	24	35	29.9	215 Maximum
7	Chrome Moly Steel	ASTM A217 Grade WC6	70,000	40,000	20	35	29.9	215 Maximum
8	Chrome Moly Steel	ASTM A217 Grade WC9	70,000	40,000	20	35	29.9	241 Maximum
9	3.5% Nickel Steel	ASTM A352 Grade LC3	65,000	40,000	24	35	27.9	137
10	Chrome Moly Steel	ASTM A217 Grade C12	90,000	60,000	18	35	27.4	180 to 240
11	Type 304 Stainless Steel	ASTM A351 Grade CF8	65,000	28,000	35	----	28.0	140
12	Type 316 Stainless Steel	ASTM A351 Grade CF8M	70,000	30,000	30	----	28.3	156 to 170
13	Cast Iron	ASTM A126 Class B	31,000	----	----	----	----	160 to 220
14	Cast Iron	ASTM A126 Class C	41,000	----	----	----	----	160 to 220
15	Ductile Iron	ASTM A395 Type 60-45-15	60,000	45,000	15	----	23-26	143 to 207
16	Ductile Ni-Resist Iron(1)	ASTM A439 Type D-2B	58,000	30,000	7	----	----	148 to 211
17	Standard Valve Bronze	ASTM B62	30,000	14,000	20	17	13.5	55 to 65*
18	Tin Bronze	ASTM B143 Alloy 1A	40,000	18,000	20	20	15	75 to 85*
19	Manganese Bronze	ASTM B147 Alloy 8A	65,000	25,000	20	20	15.4	98*
20	Aluminum Bronze	ASTM B148 Alloy 9C	75,000	30,000	12 minimum	12	17	150
21	Mondel Alloy 411	(Weldable Grade)	65,000	32,500	25	----	23	120 to 170
22	Nickel-Moly Alloy “B”	ASTM A494 (Hastelloy® “B”)	72,000	46,000	6	----	----	----
23	Nickel-Moly-Chrome Alloy “C”	ASTM A494 (Hastelloy® “C”)	72,000	46,000	4	----	----	----
24	Cobalt-base Alloy No.6	Stellite No. 6	121,000	64,000	1 to 2	----	30.4	----
25	Aluminum Bar	ASTM B211 Alloy 20911-T3	44,000	36,000	15	----	10.2	95
26	Yellow Brass Bar	ASTM B16-1/2 Hard	45,000	15,000	7	50	14	----
27	Naval Brass Bar	ASTM B21 Alloy 464	60,000	27,000	22	55	----	----
28	Leaded Steel Bar	AISI 12L14	79,000	71,000	16	52	----	163
29	Carbon Steel Bar	ASTM A108 Grade 1018	69,000	48,000	38	62	----	143
30	AISI 4140 Chrome-Moly Steel	(Suitable for ASTM A193 Grade B7 bolt material)	135,000	115,000	22	63	29.9	255
31	Type 302 Stainless Steel	ASTM A276 Type 302	85,000	35,000	60	70	28	150
32	Type 304 Stainless Steel	ASTM A276 Type 304	85,000	35,000	60	70	----	149
33	Type 316 Stainless Steel	ASTM A276 Type 316	80,000	30,000	60	70	28	149
34	Type 316L Stainless Steel	ASTM A276 Type 316L	81,000	34,000	55	----	----	146
35	Type 410 Stainless Steel	ASTM A276 Type 410	75,000	40,000	35	70	29	155
36	Type 17-4PH Stainless Steel	ASTM A461 Grade 630	135,000	105,000	16	50	29	275 to 345
37	Nickel-Copper Alloy Bar	Alloy K500 (K Monel®)	100,000	70,000	35	----	26	175 to 260
38	Nickel-Moly Alloy “B” Bar	ASTM B335 (Hastelloy® “B”)	100,000	46,000	30	----	----	----
39	Nickel-Moly Alloy “C” Bar	ASTM B336 (Hastelloy® “C”)	100,000	46,000	20	----	----	----

1. 500 kg load.

Table 23. Physical Constants of Hydrocarbons

NO.	COMPOUND	FORMULA	MOLECULAR WEIGHT	BOILING POINT AT 14.696 psia (°F)	VAPOR PRESSURE AT 100°F (psia)	FREEZING POINT AT 14.696 PSIA (°F)	CRITICAL CONSTANTS		SPECIFIC GRAVITY AT 14.696 PSIA	
							Critical Temperature (°F)	Critical Pressure (psia)	Liquid[3][4], 60°F/60°F	Gas at 60°F (Air = 1)[1]
1	Methane	CH_4	16.043	-258.69	5000[2]	-296.46[5]	-116.63	667.8	0.3000[8]	0.5539
2	Ethane	C_2H_6	30.070	-127.48	800[2]	-297.89[5]	90.09	707.8	0.3564[7]	1.0382
3	Propane	C_3H_8	44.097	-43.67	190	-305.84[5]	206.01	616.3	0.5077[7]	1.5225
4	n-Butane	C_4H_{10}	58.124	31.10	51.6	-217.05	305.65	550.7	0.5844[7]	2.0068
5	Isobutane	C_4H_{10}	58.124	10.90	72.2	-255.29	274.98	529.1	0.5631[7]	2.0068
6	n-Pentane	C_5H_{12}	72.151	96.92	15.570	-201.51	385.7	488.6	0.6310	2.4911
7	Isopentane	C_5H_{12}	72.151	82.12	20.44	-255.83	369.10	490.4	0.6247	2.4911
8	Neopentane	C_5H_{12}	72.151	49.10	35.9	2.17	321.13	464.0	0.5967[7]	2.4911
9	n-Hexane	C_6H_{14}	86.178	155.72	4.956	-139.58	453.7	436.9	0.6640	2.9753
10	2-Methylpentane	C_6H_{14}	86.178	140.47	6.767	-244.63	435.83	436.6	0.6579	2.9753
11	3-Methylpentane	C_6H_{14}	86.178	145.89	6.098	- - - -	448.3	453.1	0.6689	2.9753
12	Neohexane	C_6H_{14}	86.178	121.52	9.856	-147.72	420.13	446.8	0.6540	2.9753
13	2,3-Dimethylbutane	C_6H_{14}	86.178	136.36	7.404	-199.38	440.29	453.5	0.6664	2.9753
14	n-Heptane	C_7H_{16}	100.205	209.17	1.620	-131.05	512.8	396.8	0.6882	3.4596
15	2-Methylhexane	C_7H_{16}	100.205	194.09	2.271	-180.89	495.00	396.5	0.6830	3.4596
16	3-Methylhexane	C_7H_{16}	100.205	197.32	2.130	- - - -	503.78	408.1	0.6917	3.4596
17	3-Ethylpentane	C_7H_{16}	100.205	200.25	2.012	-181.48	513.48	419.3	0.7028	3.4596
18	2,2-Dimethylpentane	C_7H_{16}	100.205	174.54	3.492	-190.86	477.23	402.2	0.6782	3.4596
19	2,4-Dimethylpentane	C_7H_{16}	100.205	176.89	3.292	-182.63	475.95	396.9	0.6773	3.4596
20	3,3-Dimethylpentane	C_7H_{16}	100.205	186.91	2.773	-210.01	505.85	427.2	0.6976	3.4596
21	Triptane	C_7H_{16}	100.205	177.58	3.374	-12.82	496.44	428.4	0.6946	3.4596
22	n-Octane	C_8H_{18}	114.232	258.22	0.537	-70.18	564.22	360.6	0.7068	3.9439
23	Disobutyl	C_8H_{18}	114.232	228.39	1.101	-132.07	530.44	360.6	0.6979	3.9439
24	Isooctane	C_8H_{18}	114.232	210.63	1.708	-161.27	519.46	372.4	0.6962	3.9439
25	n-Nonane	C_9H_{20}	128.259	303.47	0.179	-64.28	610.68	332	0.7217	4.4282
26	n-Decane	$C_{10}H_{22}$	142.286	345.48	0.0597	-21.36	652.1	304	0.7342	4.9125
27	Cyclopentane	C_5H_{10}	70.135	120.65	9.914	-136.91	461.5	653.8	0.7504	2.4215
28	Methylcyclopentane	C_6H_{12}	84.162	161.25	4.503	-224.44	499.35	548.9	0.7536	2.9057
29	Cyclohexane	C_6H_{12}	84.162	177.29	3.264	43.77	536.7	591	0.7834	2.9057
30	Methylcyclohexane	C_7H_{14}	98.189	213.68	1.609	-195.98	570.27	503.5	0.7740	3.3900
31	Ethylene	C_2H_4	28.054	-154.62	- - - -	-272.45[5]	48.58	729.8	- - - -	0.9686
32	Propene	C_3H_6	42.081	-53.90	226.4	-301.45[5]	196.9	669	0.5220[7]	1.4529
33	1-Butene	C_4H_8	56.108	20.75	63.05	-301.63[5]	295.6	583	0.6013[7]	1.9372
34	Cis-2-Butene	C_4H_8	56.108	38.69	45.54	-218.06	324.37	610	0.6271[7]	1.9372
35	Trans-2-Butene	C_4H_8	56.108	33.58	49.80	-157.96	311.86	595	0.6100[7]	1.9372
36	Isobutene	C_4H_8	56.108	19.59	63.40	-220.61	292.55	580	0.6004[7]	1.9372
37	1-Pentene	C_5H_{10}	70.135	85.93	19.115	-265.39	376.93	590	0.645[7]	2.4215
38	1,2-Butadiene	C_4H_6	54.092	51.56	20[2]	-213.16	339[2]	653[2]	0.658[7]	1.8676
39	1,3-Butadiene	C_4H_6	54.092	24.06	60[2]	-164.02	306	628	0.6272[7]	1.8676
40	Isoprene	C_5H_8	68.119	93.30	16.672	-230.74	412[2]	558.4[2]	0.6861	2.3519
41	Acetylene	C_2H_2	26.038	-119[6]	- - - -	-114[5]	95.31	890.4	0.615[9]	0.8990
42	Benzene	C_6H_6	78.114	176.17	3.224	41.96	552.22	710.4	0.8844	2.6969
43	Toluene	C_7H_8	92.141	231.13	1.032	-138.94	605.55	595.9	0.8718	3.1812
44	Ethylbenzene	C_8H_{10}	106.168	277.16	0.371	-138.91	651.24	523.5	0.8718	3.6655
45	o-Xylene	C_8H_{10}	106.168	291.97	0.264	-13.30	675.0	541.4	0.8848	3.6655
46	m-Xylene	C_8H_{10}	106.168	282.41	0.326	-54.12	651.02	513.6	0.8687	3.6655
47	p-Xylene	C_8H_{10}	106.168	281.05	0.342	55.86	649.6	509.2	0.8657	3.6655
48	Styrene	C_8H_8	104.152	293.29	0.24[2]	-23.10	706.0	580	0.9110	3.5959
49	Isopropylbenzane	C_9H_{12}	120.195	306.34	0.188	-140.82	676.4	465.4	0.8663	4.1498

1. Calculated values.
2. ( ) - Estimated values.
3. Air saturated hydrocarbons.
4. Absolute values from weights in vacuum.
5. At saturation pressure (- - - -).
6. Sublimation point.
7. Saturation pressure at 60°F.
8. Apparent value for methane at 60°F.
9. Specific gravity, 119°F/60°F (sublimation point).

Conversions, Equivalents and Physical Data

Table 24. Physical Constants of Various Fluids

FLUID	FORMULA	MOLECULAR WEIGHT	BOILING POINT (°F AT 14.696 psia)	VAPOR PRESSURE AT 70°F (psig)	CRITICAL TEMPERATURE (°F)	CRITICAL PRESSURE (psia)	SPECIFIC GRAVITY	
							Liquid 60°F/60°F	Gas
Acetic Acid	$HC_2H_3O_3$	60.06	245	----	----	----	1.05	----
Acetone	C_3H_6O	58.08	133	----	455	691	0.79	2.01
Air	N_2O_2	28.97	-317	----	-221	547	0.86‡	1.0
Alcohol, Ethyl	C_2H_6O	46.07	173	2.3(2)	470	925	0.794	1.59
Alcohol, Methyl	CH_4O	32.04	148	4.63(2)	463	1174	0.796	1.11
Ammonia	NH_3	17.03	-28	114	270	1636	0.62	0.59
Ammonium Chloride(1)	NH_4Cl	----	----	----	----	----	1.07	----
Ammonium Hydroxide(1)	NH_4OH	----	----	----	----	----	0.91	----
Ammonium Sulfate(1)	$(NH_4)_2SO_4$	----	----	----	----	----	1.15	----
Aniline	C_6H_7N	93.12	365	----	798	770	1.02	----
Argon	A	39.94	-302	----	-188	705	1.65	1.38
Bromine	Br_2	159.84	138	----	575	----	2.93	5.52
Calcium Chloride(1)	$CaCl_2$	----	----	----	----	----	1.23	----
Carbon Dioxide	CO_2	44.01	-109	839	88	1072	0.801(3)	1.52
Carbon Disulfide	CS_2	76.1	115	----	----	----	1.29	2.63
Carbon Monoxide	CO	28.01	-314	----	-220	507	0.80	0.97
Carbon Tetrachloride	CCl_4	153.84	170	----	542	661	1.59	5.31
Chlorine	Cl_2	70.91	-30	85	291	1119	1.42	2.45
Chromic Acid	H_2CrO_4	118.03	----	----	----	----	1.21	----
Citric Acid	$C_6H_8O_7$	192.12	----	----	----	----	1.54	----
Copper Sulfate(1)	$CuSO_4$	----	----	----	----	----	1.17	----
Ether	$(C_2H_5)_2O$	74.12	34	----	----	----	0.74	2.55
Ferric Chloride(1)	$FeCl_3$	----	----	----	----	----	1.23	----
Fluorine	F_2	38.00	-305	300	-200	809	1.11	1.31
Formaldehyde	H_2CO	30.03	-6	----	----	----	0.82	1.08
Formic Acid	HCO_2H	46.03	214	----	----	----	1.23	----
Furfural	$C_5H_4O_2$	96.08	324	----	----	----	1.16	----
Glycerine	$C_3H_8O_3$	92.09	554	----	----	----	1.26	----
Glycol	$C_2H_6O_2$	62.07	387	----	----	----	1.11	----
Helium	He	4.003	-454	----	-450	33	0.18	0.14
Hydrochloric Acid	HCl	36.47	-115	----	----	----	1.64	----
Hydrofluoric Acid	HF	20.01	66	0.9	446	----	0.92	----
Hydrogen	H_2	2.016	-422	----	-400	188	0.07(3)	0.07
Hydrogen Chloride	HCl	36.47	-115	613	125	1198	0.86	1.26
Hydrogen Sulfide	H_2S	34.07	-76	252	213	1307	0.79	1.17
Isopropyl Alcohol	C_3H_8O	60.09	180	----	----	----	0.78	2.08
Linseed Oil	----	----	538	----	----	----	0.93	----

1. Aqueous Solution - 25% by weight of compound.
2. Vapor pressure in psia at 100°F.
3. Density of liquid, gm/ml at normal boiling point.

- continued -

Table 24. Physical Constants of Various Fluids (continued)

FLUID	FORMULA	MOLECULAR WEIGHT	BOILING POINT (°F AT 14.696 psia)	VAPOR PRESSURE AT 70°F (psig)	CRITICAL TEMPERATURE (°F)	CRITICAL PRESSURE (psia)	SPECIFIC GRAVITY	
							Liquid 60°F/60°F	Gas
Magnesium Chloride(1)	$MgCl_2$	- - - -	- - - -	- - - -	- - - -	- - - -	1.22	- - - -
Mercury	Hg	200.61	670	- - - -	- - - -	- - - -	13.6	6.93
Methyl Bromide	CH_3Br	94.95	38	13	376	- - - -	1.73	3.27
Methyl Chloride	CH_3Cl	50.49	-11	59	290	969	0.99	1.74
Naphthalene	$C_{10}H_8$	128.16	424	- - - -	- - - -	- - - -	1.14	4.43
Nitric Acid	HNO_3	63.02	187	- - - -	- - - -	- - - -	1.5	- - - -
Nitrogen	N_2	28.02	-320	- - - -	-233	493	0.81(3)	0.97
Oil, Vegetable	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	0.91 to 0.94	- - - -
Oxygen	O_2	32	-297	- - - -	-181	737	1.14(3)	1.105
Phosgene	$COCl_2$	98.92	47	10.7	360	823	1.39	3.42
Phosphoric Acid	H_3PO_4	98.00	415	- - - -	- - - -	- - - -	1.83	- - - -
Potassium Carbonate(1)	K_2CO_3	- - - -	- - - -	- - - -	- - - -	- - - -	1.24	- - - -
Potassium Chloride(1)	KCl	- - - -	- - - -	- - - -	- - - -	- - - -	1.16	- - - -
Potassium Hydroxide(1)	KOH	- - - -	- - - -	- - - -	- - - -	- - - -	1.24	- - - -
Refrigerant 11	CCl_3F	137.38	75	13.4	388	635	- - - -	5.04
Refrigerant 12	CCl_2F_2	120.93	-22	70.2	234	597	- - - -	4.2
Refrigerant 13	$CClF_3$	104.47	-115	458.7	84	561	- - - -	- - - -
Refrigerant 21	$CHCl_2F$	102.93	48	8.4	353	750	- - - -	3.82
Refrigerant 22	$CHClF_2$	86.48	-41	122.5	205	716	- - - -	- - - -
Refrigerant 23	CHF_3	70.02	-119	635	91	691	- - - -	- - - -
Sodium Chloride(1)	NaCl	- - - -	- - - -	- - - -	- - - -	- - - -	1.19	- - - -
Sodium Hydroxide(1)	NaOH	- - - -	- - - -	- - - -	- - - -	- - - -	1.27	- - - -
Sodium Sulfate(1)	Na_2SO_4	- - - -	- - - -	- - - -	- - - -	- - - -	1.24	- - - -
Sodium Thiosulfate(1)	Na_2SO_3	- - - -	- - - -	- - - -	- - - -	- - - -	1.23	- - - -
Starch	$(C_6H_{10}O_5)x$	- - - -	- - - -	- - - -	- - - -	- - - -	1.50	- - - -
Sugar Solutions(1)	$C_{12}H_{22}O_{11}$	- - - -	- - - -	- - - -	- - - -	- - - -	1.10	- - - -
Sulfuric Acid	H_2SO_4	98.08	626	- - - -	- - - -	- - - -	1.83	- - - -
Sulfer Dioxide	SO_2	64.6	14	34.4	316	1145	1.39	2.21
Turpentine	- - - -	- - - -	320	- - - -	- - - -	- - - -	0.87	- - - -
Water	H_2O	18.016	212	0.9492(2)	706	3208	1.00	0.62
Zinc Chloride(1)	$ZnCl_2$	- - - -	- - - -	- - - -	- - - -	- - - -	1.24	- - - -
Zinc Sulfate(1)	$ZnSO_4$	- - - -	- - - -	- - - -	- - - -	- - - -	1.31	- - - -

1. Aqueous Solution - 25% by weight of compound.
2. Vapor pressure in psia at 100°F.
3. Density of liquid, gm/ml at normal boiling point.

Conversions, Equivalents and Physical Data

Table 25. Properties of Water

TEMPERATURE OF WATER (°F)	SATURATION PRESSURE (POUNDS PER SQUARE INCH ABSOLUTE)	WEIGHT (POUNDS PER GALLON)	SPECIFIC GRAVITY 60°F/60°F	CONVERSION FACTOR[1], LBS/HR TO GPM
32	0.0885	8.345	1.0013	0.00199
40	0.1217	8.345	1.0013	0.00199
50	0.1781	8.340	1.0007	0.00199
60	0.2653	8.334	1.0000	0.00199
70	0.3631	8.325	0.9989	0.00200
80	0.5069	8.314	0.9976	0.00200
90	0.6982	8.303	0.9963	0.00200
100	0.9492	8.289	0.9946	0.00201
110	1.2748	8.267	0.9919	0.00201
120	1.6924	8.253	0.9901	0.00200
130	2.2225	8.227	0.9872	0.00202
140	2.8886	8.207	0.9848	0.00203
150	3.718	8.182	0.9818	0.00203
160	4.741	8.156	0.9786	0.00204
170	5.992	8.127	0.9752	0.00205
180	7.510	8.098	0.9717	0.00205
190	9.339	8.068	0.9681	0.00206
200	11.526	8.039	0.9646	0.00207
210	14.123	8.005	0.9605	0.00208
212	14.696	7.996	0.9594	0.00208
220	17.186	7.972	0.9566	0.00209
240	24.969	7.901	0.9480	0.00210
260	35.429	7.822	0.9386	0.00211
280	49.203	7.746	0.9294	0.00215
300	67.013	7.662	0.9194	0.00217
350	134.63	7.432	0.8918	0.00224
400	247.31	7.172	0.8606	0.00232
450	422.6	6.892	0.8270	0.00241
500	680.8	6.553	0.7863	0.00254
550	1045.2	6.132	0.7358	0.00271
600	1542.9	5.664	0.6796	0.00294
700	3093.7	3.623	0.4347	0.00460

1. Multiply flow in pounds per hour by the factor to get equivalent flow in gallons per minute. Weight per gallon is based on 7.48 gal/ft^3.

Table 26. Properties of Saturated Steam

ABSOLUTE PRESSURE		VACUUM (IN. OF HG)	TEMP. (°F)	HEAT OF THE LIQUID (BTU/LB.)	LATENT HEAT OF EVAPORATION (BTU/LB.)	TOTAL HEAT OF STEAM HG (BTU/LB.)	SPECIFIC VOLUME (CUBIC FT./LB.)
psia	In. of Hg						
0.20	0.41	29.51	53.14	21.21	1063.8	1085.0	1526.0
0.25	0.51	29.41	59.30	27.36	1060.3	1087.7	1235.3
0.30	0.61	29.31	64.47	32.52	1057.4	1090.0	1039.5
0.35	0.71	29.21	68.93	36.97	1054.9	1091.9	898.5
0.40	0.81	29.11	72.86	40.89	1052.7	1093.6	791.9
0.45	0.92	29.00	76.38	44.41	1050.7	1095.1	708.5
0.50	1.02	28.90	79.58	47.60	1048.8	1096.4	641.4
0.60	1.22	28.70	85.21	53.21	1045.7	1098.9	540.0
0.70	1.43	28.49	90.08	58.07	1042.9	1101.0	466.9
0.80	1.63	28.29	94.38	62.36	1040.4	1102.8	411.7
0.90	1.83	28.09	98.24	66.21	1038.3	1104.5	368.4
1.0	2.04	27.88	101.74	69.70	1036.3	1106.0	333.6
1.2	2.44	27.48	107.92	75.87	1032.7	1108.6	280.9
1.4	2.85	27.07	113.26	81.20	1029.6	1110.8	243.0
1.6	3.26	26.66	117.99	85.91	1026.9	1112.8	214.3
1.8	3.66	26.26	122.23	90.14	1024.5	1114.6	191.8
2.0	4.07	25.85	126.08	93.99	1022.2	1116.2	173.73
2.2	4.48	25.44	129.62	97.52	1020.2	1117.7	158.85
2.4	4.89	25.03	132.89	100.79	1018.3	1119.1	146.38
2.6	5.29	24.63	135.94	103.83	1016.5	1120.3	135.78
2.8	5.70	24.22	138.79	106.68	1014.8	1121.5	126.65
3.0	6.11	23.81	141.48	109.37	1013.2	1122.6	67.24
3.5	7.13	22.79	147.57	115.46	1009.6	1125.1	61.98
4.0	8.14	21.78	152.97	120.86	1006.4	1127.3	57.50
4.5	9.16	20.76	157.83	125.71	1003.6	1129.3	53.64
5.0	10.18	19.74	162.24	130.13	1001.0	1131.1	50.29
5.5	11.20	18.72	166.30	134.19	998.5	1132.7	67.24
6.0	12.22	17.70	170.06	137.96	996.2	1134.2	61.98
6.5	13.23	16.69	173.56	141.47	994.1	1135.6	57.50
7.0	14.25	15.67	176.85	144.76	992.1	1136.9	53.64
7.5	15.27	14.65	179.94	147.86	990.2	1138.1	50.29
8.0	16.29	13.63	182.86	150.79	988.5	1139.3	47.34
8.5	17.31	12.61	185.64	153.57	986.8	1140.4	44.73
9.0	18.32	11.60	188.28	156.22	985.2	1141.4	42.40
9.5	19.34	10.58	190.80	158.75	983.6	1142.3	40.31
10.0	20.36	9.56	193.21	161.17	982.1	1143.3	38.42
11.0	22.40	7.52	197.75	165.73	979.3	1145.0	35.14
12.0	24.43	5.49	201.96	169.96	976.6	1146.6	32.40
13.0	26.47	3.45	205.88	173.91	974.2	1148.1	30.06
14.0	28.50	1.42	209.56	177.61	971.9	1149.5	28.04

- continued -

Table 26. Properties of Saturated Steam (continued)

PRESSURE (psi)		TEMP. (°F)	HEAT OF THE LIQUID (BTU/LB)	LATENT HEAT OF EVAPORATION (BTU/LB)	TOTAL HEAT OF STEAM H_g (BTU/LB)	SPECIFIC VOLUME ∇ (FT^3/LB)	PRESSURE (psi)		TEMP. (°F)	HEAT OF THE LIQUID (BTU/LB)	LATENT HEAT OF EVAPORATION (BTU/LB)	TOTAL HEAT OF STEAM H_g (BTU/LB)	SPECIFIC VOLUME ∇ (FT^3/LB)
Absolute P'	Gauge P						Absolute P'	Gauge P					
14.696	0.0	212.00	180.07	970.3	1150.4	26.80	- - - -	- - - -	- - -	- - - -	- - - -	- - - -	- - - -
15.0	0.3	213.03	181.11	969.7	1150.8	26.29	75.0	60.3	-307.60	277.43	904.5	1181.9	5.816
16.0	1.3	216.32	184.42	967.6	1152.0	24.72	76.0	61.3	308.50	278.37	903.7	1182.1	5.743
17.0	2.3	219.44	187.56	965.5	1153.1	23.39	77.0	62.3	309.40	279.30	903.1	1182.4	5.673
18.0	3.3	222.41	190.56	963.6	1154.2	22.17	78.0	63.3	310.29	280.21	902.4	1182.6	5.604
19.0	4.3	225.24	193.42	961.9	1155.3	21.08	79.0	64.3	311.16	281.12	901.7	1182.8	5.537
20.0	5.3	227.96	196.16	960.1	1156.3	20.089	80.0	65.3	312.03	282.02	901.1	1183.1	5.472
21.0	6.3	230.57	198.79	958.4	1157.2	19.192	81.0	66.3	312.89	282.91	900.4	1183.3	5.408
22.0	7.3	233.07	201.33	956.8	1158.1	18.375	82.0	67.3	313.74	283.79	899.7	1183.5	5.346
23.0	8.3	235.49	203.78	955.2	1159.0	17.627	83.0	68.3	314.59	284.66	899.1	1183.8	5.285
24.0	9.3	237.82	206.14	953.7	1159.8	16.938	84.0	69.3	315.42	285.53	898.5	1184.0	5.226
25.0	10.3	240.07	208.42	952.1	1160.6	16.303	85.0	70.3	316.25	286.39	897.8	1184.2	5.168
26.0	11.3	242.25	210.62	950.7	1161.3	15.715	86.0	71.3	317.07	287.24	897.2	1184.4	5.111
27.0	12.3	244.36	212.75	949.3	1162.0	15.170	87.0	72.3	317.88	288.08	896.5	1184.6	5.055
28.0	13.3	246.41	214.83	947.9	1162.7	14.663	88.0	73.3	318.68	288.91	895.9	1184.8	5.001
29.0	14.3	248.40	216.86	946.5	1163.4	14.189	89.0	74.3	319.48	289.74	895.3	1185.1	4.948
30.0	15.3	250.33	218.82	945.3	1164.1	13.746	90.0	75.3	320.27	290.56	894.7	1185.3	4.896
31.0	16.3	252.22	220.73	944.0	1164.7	13.330	91.0	76.3	321.06	291.38	894.1	1185.5	4.845
32.0	17.3	254.05	222.59	942.8	1165.4	12.940	92.0	77.3	321.83	292.18	893.5	1185.7	4.796
33.0	18.3	255.84	224.41	941.6	1166.0	12.572	93.0	78.3	322.60	292.98	892.9	1185.9	4.747
34.0	19.3	257.58	226.18	940.3	1166.5	12.226	94.0	79.3	323.36	293.78	892.3	1186.1	4.699
35.0	20.3	259.28	227.91	939.2	1167.1	11.898	95.0	80.3	324.12	294.56	891.7	1186.2	4.652
36.0	21.3	260.95	229.60	938.0	1167.6	11.588	96.0	81.3	324.87	295.34	891.1	1186.4	4.606
37.0	22.3	262.57	231.26	936.9	1168.2	11.294	97.0	82.3	325.61	296.12	890.5	1186.6	4.561
38.0	23.3	264.16	232.89	935.8	1168.7	11.150	98.0	83.3	326.35	296.89	889.9	1186.8	4.517
39.0	24.3	265.72	234.48	934.7	1169.2	10.750	99.0	84.3	327.08	297.65	889.4	1187.0	4.474
40.0	25.3	267.25	236.03	933.7	1169.7	10.498	100.0	85.3	327.81	298.40	888.8	1187.2	4.432
41.0	26.3	268.74	237.55	932.6	1170.2	10.258	101.0	86.3	328.53	299.15	888.2	1187.4	4.391
42.0	27.3	270.21	239.04	931.6	1170.7	10.029	102.0	87.3	329.25	299.90	887.6	1187.5	4.350
43.0	28.3	271.64	240.51	930.6	1171.1	9.810	103.0	88.3	329.96	300.64	887.1	1187.7	4.310
44.0	29.3	273.05	241.95	929.6	1171.6	9.601	104.0	89.3	330.66	301.37	886.5	1187.9	4.271
45.0	30.3	274.44	243.36	928.6	1172.0	9.401	105.0	90.3	331.36	302.10	886.0	1188.1	4.232
46.0	31.3	275.80	244.75	927.7	1172.4	9.209	106.0	91.3	332.05	302.82	885.4	1188.2	4.194
47.0	32.3	277.13	246.12	926.7	1172.9	9.025	107.0	92.3	332.74	303.54	884.9	1188.4	4.157
48.0	33.3	278.45	247.47	925.8	1173.3	8.848	108.0	93.3	333.42	304.26	884.3	1188.6	4.120
49.0	34.3	279.74	248.79	924.9	1173.7	8.678	109.0	94.3	334.10	304.97	883.7	1188.7	4.084
50.0	35.3	281.01	250.09	924.0	1174.1	8.515	110.0	95.3	334.77	305.66	883.2	1188.9	4.049
51.0	36.3	282.26	251.37	923.0	1174.4	8.359	111.0	96.3	335.44	306.37	882.6	1189.0	4.015
52.0	37.3	283.49	252.63	922.2	1174.8	8.208	112.0	97.3	336.11	307.06	882.1	1189.2	3.981
53.0	38.3	284.70	253.87	921.3	1175.2	8.062	113.0	98.3	336.77	307.75	881.6	1189.4	3.947
54.0	39.3	285.90	255.09	920.5	1175.6	7.922	114.0	99.3	337.42	308.43	881.1	1189.5	3.914
55.0	40.3	287.07	256.30	919.6	1175.9	7.787	115.0	100.3	338.07	309.11	880.6	1189.7	3.882
56.0	41.3	288.28	257.50	918.8	1176.3	7.656	116.0	101.3	338.72	309.79	880.0	1189.8	3.850
57.0	42.3	289.37	258.67	917.9	1176.6	7.529	117.0	102.3	339.36	310.46	879.5	1190.0	3.819
58.0	43.3	290.50	259.82	917.1	1176.9	7.407	118.0	103.3	339.99	311.12	879.0	1190.1	3.788
59.0	44.3	291.61	260.96	916.3	1177.3	7.289	119.0	104.3	340.62	311.78	878.4	1190.2	3.758
60.0	45.3	292.71	262.09	915.5	1177.6	7.175	120.0	105.3	341.25	312.44	877.9	1190.4	3.728
61.0	46.3	293.79	263.20	914.7	1177.9	7.064	121.0	106.3	341.88	313.10	877.4	1190.5	3.699
62.0	47.3	294.85	264.30	913.9	1178.2	6.957	122.0	107.3	342.50	313.75	876.9	1190.7	3.670
63.0	48.3	295.90	265.38	913.1	1178.5	6.853	123.0	108.3	343.11	314.40	876.4	1190.8	3.642
64.0	49.3	296.94	266.45	912.3	1178.8	6.752	124.0	109.3	343.72	315.04	875.9	1190.9	3.614
65.0	50.3	297.97	267.50	911.6	1179.1	6.655	125.0	110.3	344.33	315.68	875.4	1191.1	3.587
66.0	51.3	298.99	268.55	910.8	1179.4	6.560	126.0	111.3	344.94	316.31	874.9	1191.2	3.560
67.0	52.3	299.99	269.58	910.1	1179.7	6.468	127.0	112.3	345.54	316.94	874.4	1191.3	3.533
68.0	53.3	300.98	270.60	909.4	1180.0	6.378	128.0	113.3	346.13	317.57	873.9	1191.5	3.507
69.0	54.3	301.96	291.61	908.7	1180.3	6.291	129.0	114.3	346.73	318.19	873.4	1191.6	3.481
70.0	55.3	302.92	272.61	907.9	1180.6	6.206	130.0	115.3	347.32	318.81	872.9	1191.7	3.455
71.0	56.3	303.88	273.60	907.2	1180.8	6.124	131.0	116.3	347.90	319.43	872.5	1191.9	3.430
72.0	57.3	304.83	274.57	906.5	1181.1	6.044	132.0	117.3	348.48	320.04	872.0	1192.0	3.405
73.0	58.3	305.76	275.54	905.8	1181.3	5.966	133.0	118.3	349.06	320.65	871.5	1192.1	3.381
74.0	59.3	306.68	276.49	905.1	1181.6	5.890	134.0	119.3	349.64	321.25	871.0	1192.2	3.357

- continued -

Table 26. Properties of Saturated Steam (continued)

PRESSURE (psi)		TEMP. (°F)	HEAT OF THE LIQUID (BTU/LB)	LATENT HEAT OF EVAPORATION (BTU/LB)	TOTAL HEAT OF STEAM H_g (BTU/LB)	SPECIFIC VOLUME ∇ (FT^3/LB)	PRESSURE (psi)		TEMP. (°F)	HEAT OF THE LIQUID (BTU/LB)	LATENT HEAT OF EVAPORATION (BTU/LB)	TOTAL HEAT OF STEAM H_g (BTU/LB.)	SPECIFIC VOLUME ∇ (CU. FT./LB.)
Absolute P'	Gauge P						Absolute P'	Gauge P					
135.0	120.3	350.21	321.85	870.6	1192.4	3.333	400.0	385.3	444.59	424.0	780.5	1204.5	1.1613
136.0	121.3	350.78	322.45	870.1	1192.5	3.310	420.0	405.3	449.39	429.4	775.2	1204.6	1.1061
137.0	122.3	351.35	323.05	869.6	1192.6	3.287	440.0	425.3	454.02	434.6	770.0	1204.6	1.0556
138.0	123.3	351.91	323.64	869.1	1192.7	3.264	460.0	445.3	458.50	439.7	764.9	1204.6	1.0094
139.0	124.3	352.47	324.23	868.7	1192.9	3.242	480.0	465.3	462.82	444.6	759.9	1204.5	0.9670
140.0	125.3	353.02	324.82	868.2	1193.0	3.220	500.0	485.3	467.01	449.4	755.0	1204.4	0.9278
141.0	126.3	353.57	325.40	867.7	1193.1	3.198	520.0	505.3	471.07	454.1	750.1	1204.2	0.7815
142.0	127.3	354.12	325.98	867.2	1193.2	3.177	540.0	525.3	475.01	458.6	745.4	1204.0	0.8578
143.0	128.3	354.67	326.56	866.7	1193.3	3.155	560.0	545.3	478.85	463.0	740.8	1203.8	0.8265
144.0	129.3	355.21	327.13	866.3	1193.4	3.134	580.0	565.3	482.58	467.4	736.1	1203.5	0.7973
145.0	130.3	355.76	327.70	865.8	1193.5	3.114	600.0	585.3	486.21	471.6	731.6	1203.2	0.7698
146.0	131.3	356.29	328.27	865.3	1193.6	3.094	620.0	605.3	489.75	475.7	727.2	1202.9	0.7440
147.0	132.3	356.83	328.83	864.9	1193.8	3.074	640.0	625.3	493.21	479.8	722.7	1202.5	0.7198
148.0	133.3	357.36	329.39	864.5	1193.9	3.054	660.0	645.3	496.58	483.8	718.3	1202.1	0.6971
149.0	134.3	357.89	329.95	864.0	1194.0	3.034	680.0	665.3	499.88	487.7	714.0	1201.7	0.6757
150.0	135.3	358.42	330.51	863.6	1194.1	3.015	700.0	685.3	503.10	491.5	709.7	1201.2	0.6554
152.0	137.3	359.46	331.61	862.7	1194.3	2.977	720.0	705.3	506.25	495.3	705.4	1200.7	0.6362
154.0	139.3	360.49	332.70	851.8	1194.5	2.940	740.0	725.3	509.34	499.0	701.2	1200.2	0.6180
156.0	141.3	361.52	333.79	860.9	1194.7	2.904	760.0	745.3	512.36	502.6	697.1	1199.7	0.6007
158.0	143.3	362.53	334.86	860.0	1194.9	2.869	780.0	765.3	505.33	506.2	692.9	1199.1	0.5843
160.0	145.3	363.53	335.93	859.2	1195.1	2.834	800.0	785.3	518.23	509.7	688.9	1198.6	0.5687
162.0	147.3	364.53	336.98	858.3	1195.3	2.801	820.0	805.3	521.08	513.2	684.8	1198.0	0.5538
164.0	149.3	365.51	338.02	857.5	1195.5	2.768	840.0	825.3	523.88	516.6	680.8	1197.4	0.5396
166.0	151.3	366.48	339.05	856.6	1195.7	2.736	860.0	845.3	526.63	520.0	676.8	1196.8	0.5260
168.0	153.3	367.45	340.07	855.7	1195.8	2.705	880.0	865.3	529.33	523.3	672.8	1196.1	0.5130
170.0	155.3	368.41	341.09	854.9	1196.0	2.675	900.0	885.3	531.98	526.6	668.8	1195.4	0.5006
172.0	157.3	369.35	342.10	854.1	1196.2	2.645	920.0	905.3	534.59	529.8	664.9	1194.7	0.4886
174.0	159.3	370.29	343.10	853.3	1196.4	2.616	940.0	925.3	537.16	533.0	661.0	1194.0	0.4772
176.0	161.3	371.22	344.09	852.4	1196.5	2.587	960.0	945.3	539.68	536.2	657.1	1193.3	0.4663
178.0	163.3	372.14	345.06	851.6	1196.7	2.559	980.0	965.3	542.17	539.3	653.3	1192.6	0.4557
180.0	165.3	373.06	346.03	850.8	1196.9	2.532	1000.0	985.3	544.61	542.4	649.4	1191.8	0.4456
182.0	167.3	373.96	347.00	850.0	1197.0	2.505	1050.0	1035.3	550.57	550.0	639.9	1189.9	0.4218
184.0	169.3	374.86	347.96	849.2	1197.2	2.479	1100.0	1085.3	556.31	557.4	630.4	1187.8	0.4001
186.0	171.3	375.75	348.92	848.4	1197.3	2.454	1150.0	1135.3	561.86	565.6	621.0	1185.6	0.3802
188.0	173.3	376.64	349.86	847.6	1197.5	2.429	1200.0	1185.3	567.22	571.7	611.7	1183.4	0.619
190.0	175.3	377.51	350.79	846.8	1197.6	2.404	1250.0	1235.3	572.42	578.6	602.4	1181.0	0.3450
192.0	177.3	378.38	351.72	846.1	1197.8	2.380	1300.0	1285.3	577.46	585.4	593.2	1178.6	0.3293
194.0	179.3	379.24	352.64	845.3	1197.9	2.356	1350.0	1335.3	582.35	592.1	584.0	1176.1	0.3148
196.0	181.3	380.10	353.55	844.5	1198.1	2.333	1400.0	1385.3	587.10	598.7	574.7	1173.4	0.3012
198.0	183.3	380.95	354.46	843.7	1198.2	2.310	1450.0	1435.3	591.73	605.2	565.5	1170.7	0.2884
200.0	185.3	381.79	355.36	843.0	1198.4	2.288	1500.0	1485.3	596.23	611.6	556.3	1167.9	0.2765
205.0	190.3	383.86	357.58	841.0	1198.7	2.234	1600.0	1585.3	604.90	624.1	538.0	1162.1	0.2548
210.0	195.3	385.90	359.77	839.2	1199.0	2.183	1700.0	1685.3	613.15	636.3	519.6	1155.9	0.2354
215.0	200.3	387.89	361.91	837.4	1199.3	2.134	1800.0	1785.3	621.03	648.3	501.1	1149.4	0.2179
220.0	205.3	389.86	364.02	835.6	1199.6	2.087	1900.0	1885.3	628.58	660.1	482.4	1142.4	0.2021
225.0	210.3	391.79	366.09	833.8	1199.9	2.0422	2000.0	1985.3	635.82	671.7	463.4	1135.1	0.1878
230.0	215.3	393.68	368.13	832.0	1200.1	1.9992	2100.0	2085.3	642.77	683.3	444.1	1127.4	0.1746
235.0	220.3	395.54	370.14	830.3	1200.4	1.9579	2200.0	2185.3	649.46	694.8	424.4	1119.2	0.1625
240.0	225.3	397.37	372.12	828.5	1200.6	1.9183	2300.0	2285.3	655.91	706.5	403.9	1110.4	0.1513
245.0	230.3	399.18	374.08	826.8	1200.9	1.8803	2400.0	2385.3	662.12	718.4	382.7	1101.1	0.1407
250.0	235.3	400.95	376.00	825.1	1201.1	1.8438	2500.0	2485.3	668.13	730.6	360.5	1091.1	0.1307
255.0	240.3	402.70	377.89	823.4	1201.3	1.8086	2600.0	2585.3	673.94	743.0	337.2	1080.2	0.1213
260.0	245.3	404.42	379.76	821.8	1201.5	1.7748	2700.0	2685.3	679.55	756.2	312.1	1068.3	0.1123
265.0	250.3	406.11	381.60	820.1	1201.7	1.7422	2800.0	2785.3	684.99	770.1	284.7	1054.8	0.1035
270.0	255.3	407.78	383.42	818.5	1201.9	1.7107	2900.0	2885.3	690.26	785.4	253.6	1039.0	0.0947
275.0	260.3	409.43	385.21	816.9	1202.1	1.6804	3000.0	2985.3	695.36	802.5	217.8	1020.3	0.0858
280.0	265.3	411.05	386.98	815.3	1202.3	1.6511	3100.0	3085.3	700.31	825.0	168.1	993.1	0.0753
285.0	270.3	412.65	388.73	813.7	1202.4	1.6228	3200.0	3185.3	705.11	872.4	62.0	934.4	0.0580
290.0	275.3	414.23	390.46	812.1	1202.6	1.5954	3206.2	3191.5	705.40	902.7	0.0	902.7	0.0503
295.0	280.3	415.79	392.16	810.5	1202.7	1.5689	----	----	----	----	----	----	----
300.0	285.3	417.33	393.84	809.0	1202.8	1.5433	----	----	----	----	----	----	----
320.0	305.3	423.29	400.39	803.0	1203.4	1.4485	----	----	----	----	----	----	----
340.0	325.3	428.97	406.66	797.1	1203.7	1.3645	----	----	----	----	----	----	----
360.0	345.3	434.40	412.67	797.4	1204.1	1.2895	----	----	----	----	----	----	----
380.0	365.3	439.60	418.45	785.8	1204.3	1.2222	----	----	----	----	----	----	----

Table 27. Properties of Saturated Steam (Metric)

TEMPERATURE, °K	PRESSURE, BAR	VOLUME, m/kg		ENTHALPY, kJ/kg		ENTROPY, kJ/(kg x °K)	
		Condensed	Vapor	Condensed	Vapor	Condensed	Vapor
150	6.30 to 11	1.073 to 3	9.55 + 9	- 539.6	2273	- 2.187	16.54
160	7.72 to 10	1.074 to 3	9.62 + 8	- 525.7	2291	- 2.106	15.49
170	7.29 to 9	1.076 to 3	1.08 + 8	- 511.7	2310	- 2.026	14.57
180	5.38 to 8	1.077 to 3	1.55 + 7	- 497.8	2328	- 1.947	13.76
190	3.23 to 7	1.078 to 3	2.72 + 6	- 483.8	2347	- 1.868	16.03
200	1.62 to 6	1.079 to 3	5.69 + 5	- 467.5	2366	- 1.789	12.38
210	7.01 to 6	1.081 to 3	1.39 + 5	- 451.2	2384	- 1.711	11.79
220	2.65 to 5	1.082 to 3	3.83 + 4	- 435.0	2403	- 1.633	11.20
230	8.91 to 5	1.084 to 3	1.18 + 4	- 416.3	2421	- 1.555	10.79
240	3.72 to 4	1.085 to 3	4.07 + 3	- 400.1	2440	- 1.478	10.35
250	7.59 to 4	1.087 to 3	1.52 + 3	- 318.5	2459	- 1.400	9.954
255	1.23 to 3	1.087 to 3	956.4	- 369.8	2468	- 1.361	9.768
260	1.96 to 3	1.088 to 3	612.2	- 360.5	2477	- 1.323	9.590
265	3.06 to 3	1.089 to 3	400.4	- 351.2	2486	- 1.281	9.461
270	4.69 to 3	1.090 to 3	265.4	- 339.6	2496	- 1.296	9.255
273.15	6.11 to 3	1.091 to 3	206.3	- 333.5	2502	- 1.221	9.158
273.15	0.00611	1.000 to 3	206.3	0.00	2502	0.000	9.158
275	0.00697	1.000 to 3	181.7	7.80	2505	0.028	9.109
280	0.00990	1.000 to 3	130.4	28.8	2514	0.104	8.890
285	0.01387	1.000 to 3	99.4	49.8	2523	0.178	8.857
290	0.01917	1.001 to 3	69.7	70.7	2532	0.251	8.740
295	0.02617	1.002 to 3	51.94	91.6	2541	0.323	8.627
300	0.03531	1.003 to 3	39.13	112.5	2550	0.393	8.520
305	0.04712	1.005 to 3	27.90	133.4	2559	0.462	8.417
310	0.06221	1.007 to 3	22.93	154.3	2568	0.530	8.318
315	0.08132	1.009 to 3	17.82	175.2	2577	0.597	8.224
320	0.01053	1.011 to 3	13.98	196.1	2586	0.649	8.151
325	0.01351	1.013 to 3	11.06	217.0	2595	0.727	8.046
330	0.01719	1.016 to 3	8.82	237.9	2604	0.791	7.962
335	0.02167	1.018 to 3	7.09	258.8	2613	0.854	7.881
340	0.02713	1.021 to 3	5.74	279.8	2622	0.916	7.804
345	0.3372	1.024 to 3	4.683	300.7	2630	0.977	7.729
350	0.4163	1.027 to 3	3.846	321.7	2639	1.038	7.657
355	0.5100	1.030 to 3	3.180	342.7	2647	1.097	7.588
360	0.6209	1.034 to 3	2.645	363.7	2655	1.156	7.521
365	0.7514	1.038 to 3	2.212	384.7	2663	1.214	7.456
370	0.9040	1.041 to 3	1.861	405.8	2671	1.271	7.394
373.15	1.0133	1.044 to 3	1.679	419.1	2676	1.307	7.356
375	1.0815	1.045 to 3	1.574	426.8	2679	1.328	7.333
380	1.2869	1.049 to 3	1.337	448.0	2687	1.384	7.275
385	1.5233	1.053 to 3	1.142	469.2	2694	1.439	7.210
390	1.794	1.058 to 3	0.980	490.4	2702	1.494	7.163
400	2.455	1.067 to 3	0.731	532.9	2716	1.605	7.058
410	3.302	1.077 to 3	0.553	575.6	2729	1.708	6.959
420	4.370	1.088 to 3	0.425	618.6	2742	1.810	6.865
430	5.699	1.099 to 3	0.331	661.8	2753	1.911	6.775
440	7.333	1.110 to 3	0.261	705.3	2764	2.011	6.689
450	9.319	1.123 to 3	0.208	749.2	2773	2.109	6.607
460	11.71	1.137 to 3	0.167	793.5	2782	2.205	6.528
470	14.55	1.152 to 3	0.136	838.2	2789	2.301	6.451
480	17.90	1.167 to 3	0.111	883.4	2795	2.395	6.377
490	21.83	1.184 to 3	0.0922	929.1	2799	2.479	6.312
500	26.40	1.203 to 3	0.0776	975.6	2801	2.581	6.233
510	31.66	1.222 to 3	0.0631	1023	2802	2.673	6.163
520	37.70	1.244 to 3	0.0525	1071	2801	2.765	6.093
530	44.58	1.268 to 3	0.0445	1119	2798	2.856	6.023
540	52.38	1.294 to 3	0.0375	1170	2792	2.948	5.953
550	61.19	1.323 to 3	0.0317	1220	2784	3.039	5.882
560	71.08	1.355 to 3	0.0269	1273	2772	3.132	5.808
570	82.16	1.392 to 3	0.0228	1328	2757	3.225	5.733
580	94.51	1.433 to 3	0.0193	1384	2737	3.321	5.654
590	108.3	1.482 to 3	0.0163	1443	2717	3.419	5.569
600	123.5	1.541 to 3	0.0137	1506	2682	3.520	5.480
610	137.3	1.612 to 3	0.0115	1573	2641	3.627	5.318
620	159.1	1.705 to 3	0.0094	1647	2588	3.741	5.259
625	169.1	1.778 to 3	0.0085	1697	2555	3.805	5.191
630	179.1	1.856 to 3	0.0075	1734	2515	3.875	5.115
635	190.9	1.935 to 3	0.0066	1783	2466	3.950	5.025
640	202.7	2.075 to 3	0.0057	1841	2401	4.037	4.912
645	215.2	2.351 to 3	0.0045	1931	2292	4.223	4.732
647.31	221.2	3.170 to 3	0.0032	2107	2107	4.443	4.443

Table 28. Properties of Superheated Steam

PRESSURE (psi)		SAT. TEMP. (°F)		TOTAL TEMPERATURE — °F (t)										
Absolute P'	Gauge P			360°F	400°F	440°F	480°F	500°F	600°F	700°F	800°F	900°F	1000°F	1200°F
14.696	0.0	212.00	∇	33.03	34.68	36.32	37.96	38.78	42.86	46.94	51.00	55.07	59.13	67.25
			h_g	1221.1	1239.9	1258.8	1277.6	1287.1	1334.8	1383.2	1432.3	1482.3	1533.1	1637.5
20.0	5.3	227.96	∇	24.21	25.43	26.65	27.86	28.46	31.47	34.47	37.46	40.45	43.44	49.41
			h_g	1220.3	1239.2	1258.2	1277.1	1286.6	1334.4	1382.9	1432.1	1482.1	1533.0	1637.4
30.0	15.3	250.33	∇	16.072	16.897	17.714	18.528	18.933	20.95	22.96	24.96	26.95	28.95	32.93
			h_g	1218.6	1237.9	1257.0	1276.2	1285.7	1333.8	1382.4	1431.17	1481.8	1532.7	1637.2
40.0	25.3	267.25	∇	12.001	12.628	13.247	13.962	14.168	15.688	17.198	18.702	20.20	21.70	24.69
			h_g	1216.9	1236.5	1255.9	1275.2	1284.8	1333.1	1381.9	1431.3	1481.4	1532.4	1637.0
50.0	35.3	281.01	∇	9.557	10.065	10.567	11.062	11.309	12.532	13.744	14.950	16.152	17.352	19.747
			h_g	1215.2	1235.1	1254.7	1274.2	1283.9	1332.5	1381.4	1430.9	1481.1	1532.1	1636.8
60.0	45.3	292.71	∇	7.927	8.357	8.779	9.196	9.403	10.427	11.441	12.449	13.452	14.454	16.451
			h_g	1213.4	1233.6	1253.5	1273.2	1283.0	1331.8	1380.9	1430.5	1480.8	1531.9	1636.6
70.0	55.3	302.92	∇	6.762	7.136	7.502	7.863	8.041	8.924	9.796	10.662	11.524	12.383	14.097
			h_g	1211.5	1232.1	1252.3	1272.2	1282.0	1331.1	1380.4	1430.1	1480.5	1531.6	1636.3
80.0	65.3	312.03	∇	5.888	6.220	6.544	6.862	7.020	7.797	8.562	9.322	10.077	10.830	12.332
			h_g	1209.7	1230.7	1251.1	1271.1	1281.1	1330.5	1379.9	1429.7	1480.1	1531.3	1636.2
90.0	75.3	320.27	∇	5.208	5.508	5.799	6.084	6.225	6.920	7.603	8.279	8.952	9.623	10.959
			h_g	1207.7	1229.1	1249.8	1270.1	1280.1	1329.8	1379.4	1429.3	1479.8	1531.0	1635.9
100.0	85.3	327.81	∇	4.663	4.937	5.202	5.462	5.589	6.218	6.835	7.446	8.052	8.656	9.860
			h_g	1205.7	1227.6	1248.6	1269.0	1279.1	1329.1	1378.9	1428.9	1479.5	1530.8	1635.7
120.0	105.3	341.25	∇	3.844	4.081	4.307	4.527	4.636	5.165	5.683	6.195	6.702	7.207	8.212
			h_g	1201.6	1224.4	1246.0	1266.9	1277.2	1327.7	1377.8	1428.1	1478.8	1530.2	1635.3
140.0	125.3	353.02	∇	3.258	3.468	3.667	3.860	3.954	4.413	4.861	5.301	5.738	6.172	7.035
			h_g	1197.3	1221.1	1243.3	1264.7	1275.2	1326.4	1376.8	1427.2	1478.2	1529.7	1634.9
160.0	145.3	363.53	∇	----	3.008	3.187	3.359	3.443	3.849	4.244	4.631	5.015	5.396	6.152
			h_g	----	1217.6	1240.6	1262.4	1273.1	1325.0	1375.7	1426.4	1477.5	1529.1	1634.5
180.0	165.3	373.06	∇	----	2.649	2.813	2.969	3.044	3.411	3.964	4.110	4.452	4.792	5.466
			h_g	----	1214.0	1237.8	1260.2	1271.0	1323.5	1374.7	1425.6	1476.8	1528.6	1634.1
200.0	185.3	381.79	∇	----	2.361	2.513	2.656	2.726	3.060	3.380	3.693	4.002	4.309	4.917
			h_g	----	1210.3	1234.9	1257.8	1268.9	1322.1	1373.6	1424.8	1476.2	1528.0	1633.7
220.0	205.3	389.86	∇	----	2.125	2.267	2.400	2.465	2.772	3.066	3.352	3.634	3.913	4.467
			h_g	----	1206.5	1231.9	1255.4	1266.7	1320.7	1372.6	1424.0	1475.5	1527.5	1633.3
240.0	225.3	397.37	∇	----	1.9276	2.062	2.187	2.247	2.533	2.804	3.068	3.327	3.584	4.093
			h_g	----	1202.5	1228.8	1253.0	1264.5	1319.2	1371.5	1432.2	1474.8	1526.9	1632.9
260.0	245.3	404.42	∇	----	----	1.8882	2.006	2.063	2.330	2.582	2.827	3.067	3.305	3.776
			h_g	----	----	1225.7	1250.5	1262.3	1317.7	1370.4	1422.3	1474.2	1526.3	1632.5
280.0	265.3	411.05	∇	----	----	1.7388	1.8512	1.9047	2.156	2.392	2.621	2.845	3.066	3.504
			h_g	----	----	1222.4	1247.9	1260.0	1316.2	1369.4	1421.5	1473.5	1525.8	1632.1
300.0	285.3	417.33	∇	----	----	1.6090	1.7165	1.7675	2.005	2.227	2.442	2.652	2.859	3.269
			h_g	----	----	1219.1	1245.3	1257.6	1314.7	1368.3	1420.6	1472.8	1525.2	1631.7
320.0	305.3	423.29	∇	----	----	1.4950	1.5985	1.6472	1.8734	2.083	2.285	2.483	2.678	3.063
			h_g	----	----	1215.6	1242.6	1255.2	1313.2	1367.2	1419.8	1472.1	1524.7	1631.3
340.0	325.3	428.97	∇	----	----	1.3941	1.4941	1.5410	1.7569	1.9562	2.147	2.334	2.518	2.881
			h_g	----	----	1212.1	1239.9	1252.8	1311.6	1366.1	1419.0	1471.5	1524.1	1630.9
360.0	345.3	343.40	∇	----	----	1.3041	1.4012	1.4464	1.6533	1.8431	2.025	2.202	2.376	2.719
			h_g	----	----	1208.4	1237.1	1250.3	1310.1	1365.0	1418.1	1470.8	1523.5	1630.5

∇ = specific volume, cubic feet per pound
h_g = total heat of steam, BTU per pound

- continued -

Table 28. Properties of Superheated Steam (continued)

PRESSURE (psi) Absolute P'	PRESSURE (psi) Gauge P	SAT. TEMP. °F		TOTAL TEMPERATURE — °F (t) 500°F	540°F	600°F	640°F	660°F	700°F	740°F	800°F	900°F	1000°F	1200°F
380.0	365.3	439.60	∇ ηγ	1.3616 1247.7	1.4444 1273.1	1.5605 1308.5	1.6345 1331.0	1.6707 1342.0	1.7419 1363.8	1.8118 1385.3	1.9149 1417.3	2.083 1470.1	2.249 1523.0	2.575 1630.0
400.0	385.3	444.59	∇ h_g	1.2851 1245.1	1.3652 1271.0	1.4770 1306.9	1.5480 1329.6	1.5827 1340.8	1.6508 1362.7	1.7177 1384.3	1.8161 1416.4	1.9767 1469.4	2.134 1522.4	2.445 1629.6
420.0	405.3	449.39	∇ h_g	1.2158 1242.5	1.2935 1268.9	1.4014 1305.3	1.4697 1328.3	1.5030 1339.5	1.5684 1361.6	1.6324 1383.3	1.7267 1415.5	1.8802 1468.7	2.031 1521.9	2.327 1629.2
440.0	425.3	454.02	∇ h_g	1.1526 1239.8	1.2282 1266.7	1.3327 1303.6	1.3984 1326.9	1.4306 1338.2	1.4934 1360.4	1.5549 1382.3	1.6454 1414.7	1.7925 1468.1	1.9368 1521.3	2.220 1628.8
460.0	445.3	458.5	∇ h_g	1.0948 1237.0	1.1685 1264.5	1.2698 1302.0	1.3334 1325.4	1.3644 1336.9	1.4250 1359.3	1.4842 1381.3	1.5711 1413.8	1.7124 1467.4	1.8508 1520.7	2.122 1628.4
480.0	465.3	462.82	∇ h_g	1.0417 1234.2	1.1138 1262.3	1.2122 1300.3	1.2737 1324.0	1.3038 1335.6	1.3622 1358.2	1.4193 1380.3	1.5031 1412.9	1.6390 1466.7	1.7720 1520.2	2.033 1628.0
500.0	485.3	467.01	∇ h_g	0.9927 1231.3	1.0633 1260.0	1.1591 1298.6	1.2188 1322.6	1.2478 1334.2	1.3044 1357.0	1.3596 1379.3	1.4405 1412.1	1.5715 1466.0	1.6996 1519.6	1.9504 1627.6
520.0	505.3	471.07	∇ h_g	0.9473 1228.3	1.0166 1257.7	1.1101 1296.9	1.1681 1321.1	1.1962 1332.9	1.2511 1355.8	1.3045 1378.2	1.3826 1411.2	1.5091 1465.3	1.636 1519.0	1.8743 1627.2
540.0	525.3	475.01	∇ h_g	0.9052 1225.3	0.9733 1255.4	1.0646 1295.2	1.1211 1319.7	1.1485 1331.5	1.2017 1354.6	1.2535 1377.2	1.3291 1410.3	1.4514 1464.6	1.5707 1518.5	1.8039 1626.8
560.0	545.3	478.85	∇ h_g	0.8659 1222.2	0.9330 1253.0	1.0224 1293.4	1.0775 1318.2	1.1041 1330.2	1.1558 1353.5	1.2060 1376.1	1.2794 1409.4	1.3978 1463.9	1.5132 1517.9	1.7385 1626.4
580.0	565.3	482.58	∇ h_g	0.8291 1219.0	0.8954 1250.5	0.9830 1291.7	1.0368 1316.7	1.0627 1328.8	1.1331 1352.3	1.1619 1375.1	1.2331 1408.6	1.3479 1463.2	1.4596 1517.3	1.6776 1626.0
600.0	585.3	486.21	∇ h_g	0.7947 1215.7	0.8602 1248.1	0.9463 1289.9	0.9988 1315.2	1.0241 1327.4	1.0732 1351.1	1.1207 1374.0	1.1899 1407.7	1.3013 1462.5	1.4096 1516.7	1.6208 1625.5
620.0	605.0	489.75	∇ h_g	0.7624 1212.4	0.8272 1245.5	0.9118 1288.1	0.9633 1313.7	0.9880 1326.0	1.0358 1349.9	1.0821 1373.0	1.1494 1406.8	1.2577 1461.8	1.3628 1516.2	1.5676 1625.1
640.0	625.3	493.21	∇ h_g	0.7319 1209.0	0.7963 1243.0	0.8795 1296.2	0.9299 1312.2	0.9541 1324.6	1.0008 1348.6	1.0459 1371.9	1.1115 1405.9	1.2168 1461.1	1.3190 1515.6	1.5178 1624.7
660.0	645.3	496.58	∇ h_g	0.7032 1205.4	0.7670 1240.4	0.8491 1284.4	0.8985 1310.6	0.9222 1323.2	0.9679 1347.4	1.0119 1370.8	1.0759 1405.0	1.1784 1460.4	1.2778 1515.0	1.4709 1624.3
680.0	665.3	499.88	∇ h_g	0.6759 1201.8	0.7395 1237.7	0.8205 1282.5	0.8690 1309.1	0.8922 1321.7	0.9369 1346.2	0.9800 1369.8	1.0424 1404.1	1.1423 1459.7	1.2390 1514.5	1.4269 1623.9
700.0	685.3	503.10	∇ h_g	- - - - - - - -	0.7134 1235.0	0.7934 1280.6	0.8411 1307.5	0.8639 1320.3	0.9077 1345.0	0.9498 1368.7	1.0108 1403.2	1.1082 1459.0	1.2024 1513.9	1.3853 1623.5
750.	735.3	510.86	∇ h_g	- - - - - - - -	0.6540 1227.9	0.7319 1275.7	0.7778 1303.5	0.7996 1316.6	0.8414 1341.8	0.8813 1366.0	0.9391 1400.9	1.0310 1457.2	1.1196 1512.4	1.2912 1622.4
800.0	785.3	518.23	∇ h_g	- - - - - - - -	0.6015 1220.5	0.6779 1270.7	0.7223 1299.4	0.7433 1312.9	0.7833 1338.6	0.8215 1363.2	0.8763 1398.6	0.9633 1455.4	1.0470 1511.0	1.2088 1621.4
850.0	835.3	525.26	∇ h_g	- - - - - - - -	0.5546 1212.7	0.6301 1265.5	0.6732 1295.2	0.6934 1309.0	0.7320 1335.4	0.7685 1360.4	0.8209 1396.3	0.9037 1453.6	0.9830 1509.5	1.1360 1620.4
90.0	885.3	531.98	∇ h_g	- - - - - - - -	0.5124 1204.4	0.5873 1260.1	0.6294 1290.9	0.6491 1305.1	0.6863 1332.1	0.7215 1357.5	0.7716 1393.9	0.8506 1451.8	0.9262 1508.1	1.0714 1619.3
950.0	935.3	538.42	∇ h_g	- - - - - - - -	0.4740 1195.5	0.5489 1254.6	0.5901 1286.4	0.6092 1301.1	0.6453 1328.7	0.6793 1354.7	0.7275 1391.6	0.8031 1450.0	0.8753 1506.6	1.0136 1618.3
1000.0	985.3	544.61	∇ h_g	- - - - - - - -	- - - - - - - -	0.5140 1248.8	0.5546 1281.9	0.5733 1297.0	0.6084 1325.3	0.6413 1351.7	0.6878 1389.2	0.7604 1448.2	0.8294 1505.1	0.9615 1617.3

∇ = specific volume, cubic feet per pound
h_g = total heat of steam, BTU per pound

- continued -

Table 28. Properties of Superheated Steam (continued)

PRESSURE (psi) Absolute P'	PRESSURE (psi) Gauge	SAT. TEMP. °F		TOTAL TEMPERATURE — °F (t) 660°F	700°F	740°F	760°F	780°F	800°F	860°F	900°F	1000°F	1100°F	1200°F
1100.0	1085.3	556.31	∇	0.5110	0.5445	0.5755	0.5904	0.6049	0.6191	0.6601	0.6866	0.7503	0.8117	0.8716
			h_g	1288.5	1318.3	1345.8	1358.9	1371.7	1384.3	1420.8	1444.5	1502.2	1558.8	1615.2
1200.0	1185.3	567.22	∇	0.4586	0.4909	0.5206	0.5347	0.5484	0.5617	0.6003	0.6250	0.6843	0.7412	0.7967
			h_g	1279.6	1311.0	1339.6	1353.2	1366.4	1379.3	1416.7	1440.7	1499.2	1556.4	1613.1
1300.0	1285.3	577.46	∇	0.4139	0.4454	0.4739	0.4874	0.5004	0.5131	0.5496	0.5728	0.6284	0.6816	0.7333
			h_g	1270.2	1303.4	1333.3	1347.3	1361.0	1374.3	1412.5	1437.0	1496.2	1553.9	1611.0
1400.0	1385.3	587.10	∇	0.3753	0.4062	0.4338	0.4468	0.4593	0.4714	0.5061	0.5281	0.5805	0.6305	0.6789
			h_g	1260.3	1295.5	1326.7	1341.3	1355.4	1369.1	1408.2	1433.1	1493.2	1551.4	1608.9
1500.0	1485.3	596.23	∇	0.3413	0.3719	0.3989	0.4114	0.4235	0.4352	0.4684	0.4893	0.5390	0.5862	0.6318
			h_g	1249.8	1287.2	1320.0	1335.2	1349.7	1363.8	1403.9	1429.3	1490.1	1548.9	1606.8
1600.0	1585.3	604.90	∇	0.3112	0.3417	0.3682	0.3804	0.3921	0.4034	0.4353	0.4553	0.5027	0.5474	0.5906
			h_g	1238.7	1278.7	1313.0	1328.8	1343.9	1358.4	1399.5	1425.3	1487.0	1546.4	1604.6
1700.0	1685.3	613.15	∇	0.2842	0.3148	0.3410	0.3529	0.3643	0.3753	0.4061	0.4253	0.4706	0.5132	0.5542
			h_g	1226.8	1269.7	1305.8	1322.3	1337.9	1352.9	1395.0	1421.4	1484.0	1543.8	1602.5
1800.0	1785.3	621.03	∇	0.2597	0.2907	0.3166	0.3284	0.3395	0.3502	0.3801	0.3986	0.4421	0.4828	0.5218
			h_g	1214.0	1260.3	1298.4	1315.5	1331.8	1347.2	1390.4	1417.4	1480.8	1541.3	1600.4
1900.0	1885.3	628.58	∇	0.2371	0.2688	0.2947	0.3063	0.3171	0.3277	0.3568	0.3747	0.4165	0.4556	0.4929
			h_g	1200.2	1250.4	1290.6	1308.6	1325.4	1341.5	1385.8	1413.3	1477.7	1538.8	1598.2
2000.0	1985.3	635.82	∇	0.2161	0.2489	0.2748	0.2863	0.2972	0.3074	0.3358	0.3532	0.3935	0.4311	0.4668
			h_g	1184.9	1240.0	1282.6	1301.4	1319.0	1335.5	1381.2	1409.2	1474.5	1536.2	1596.1
2100.0	2085.3	642.77	∇	0.1962	0.2306	0.2567	0.2682	0.2789	0.2890	0.3167	0.3337	0.3727	0.4089	0.4433
			h_g	1167.7	1229.0	1274.3	1294.0	1312.3	1329.5	1376.4	1405.0	1471.4	1533.6	1593.9
2200.0	2185.3	649.46	∇	0.1768	0.2135	0.2400	0.2514	0.2621	0.2721	0.2994	0.3159	0.3538	0.3887	0.4218
			h_g	1147.8	1217.4	1265.7	1286.3	1305.4	1323.3	1371.5	1400.8	1468.2	1531.1	1591.8
2300.0	2285.3	655.91	∇	0.1575	0.1978	0.2247	0.2362	0.2468	0.2567	0.2835	0.2997	0.3365	0.3703	0.4023
			h_g	1123.8	1204.9	1256.7	1278.4	1298.4	1316.9	1366.6	1396.5	1464.9	1528.5	1589.6
2400.0	2385.3	662.12	∇	----	0.1828	0.2105	0.2221	0.2327	0.2425	0.2689	0.2848	0.3207	0.3534	0.3843
			h_g	----	1191.5	1247.3	1270.2	1291.1	1310.3	1361.6	1392.2	1461.7	1525.9	1587.4
2500.0	2485.3	668.13	∇	----	0.1686	0.1973	0.2090	0.2196	0.2294	0.2555	0.2710	0.3061	0.3379	0.3678
			h_g	----	1176.8	1207.6	1261.8	1283.6	1303.6	1356.5	1387.8	1458.4	1523.2	1585.3
2600.0	2585.3	673.94	∇	----	0.1549	0.1849	0.1967	0.2074	0.2172	0.2431	0.2584	0.2926	0.3236	0.3526
			h_g	----	1160.6	1227.3	1252.9	1275.8	1296.8	1351.4	1383.4	1455.1	1520.6	1583.1
2700.0	2685.3	679.55	∇	----	0.1415	0.1732	0.1853	0.1960	0.2059	0.2315	0.2466	0.2801	0.3103	0.3385
			h_g	----	1142.5	1216.5	1243.8	1267.9	1289.7	1346.1	1378.9	1451.8	1518.0	1580.9
2800.0	2785.3	684.99	∇	----	0.1281	0.1622	0.1745	0.1854	0.1953	0.2208	0.2356	0.2685	0.2979	0.3254
			h_g	----	1121.4	1205.1	1234.2	1259.6	1282.4	1340.8	1374.3	1448.5	1515.4	1578.7
2900.0	2885.3	690.26	∇	----	0.1143	0.1517	0.1644	0.1754	0.1853	0.2108	0.2254	0.2577	0.2864	0.3132
			h_g	----	1095.9	1193.0	1224.3	1251.1	1274.9	1335.3	1369.7	1445.1	1512.7	1576.5
3000.0	2985.3	695.36	∇	----	0.0984	0.1416	0.1548	0.1660	0.1760	0.2014	0.2159	0.2476	0.2757	0.3018
			h_g	----	1060.7	1180.1	1213.8	1242.2	1267.2	1329.7	1365.0	1441.8	1510.0	1574.3
3100.0	3085.3	700.31	∇	----	----	0.1320	0.1456	0.1571	0.1672	0.1926	0.2070	0.2382	0.2657	0.2911
			h_g	----	----	1166.2	1202.9	1233.0	1259.3	1324.1	1360.3	1438.4	1507.4	1572.1
3200.0	3185.3	705.11	∇	----	----	0.1226	0.1369	0.1486	0.1589	0.1843	0.1986	0.2293	0.2563	0.2811
			h_g	----	----	1151.1	1191.4	1223.5	1251.1	1318.3	1355.5	1434.9	1504.7	1569.9
3206.2	3191.5	705.40	∇	----	----	0.1220	0.1363	0.1480	0.1583	0.1838	0.1981	0.2288	0.2557	0.2806
			h_g	----	----	1150.2	1190.6	1222.9	1250.5	1317.9	1355.2	1434.7	1504.5	1569.8

∇ = specific volume, cubic feet per pound
h_g = total heat of steam, BTU per pound

EMERSON

Determine Velocity of Steam in Pipes:

$$\text{Velocity (ft/s)} = \frac{(25)\,(A)}{(V)}$$

Where: A = Nominal pipe section area = $\frac{\pi\,(d)^2}{4}$

d = Diameter

V = Specific volume from steam tables in ft^3/lb (m^3/kg)

Note: Specific volume changes with steam pressure and temperature. Make sure to calculate velocities of inlet and outlet piping of the regulator.

Table 29. Recommended Steam Pipe Line Velocities

STEAM CONDITION	VELOCITY, FT/SEC / M/SEC
0 to 15 psig / 0 to 1.0 bar, Dry and saturated	100 / 30.5
15 psig / 1.0 bar, Dry and saturated and up	175 / 53.3
200 psig / 13.8 bar, Superheated and up	250 / 76.2

Table 30. Typical Condensation Rates In Insulated Steam Pipes

PRESSURE		RATES IN LBS/HR / KG/HR PER FOOT OF PIPE WITH 2 IN. OF INSULATION											
		Pipe Diameter in In.											
		3/4		1		1-1/2		2		3		4	
psig	bar	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr
1	0.069	0.02	0.009	0.03	0.014	0.03	0.014	0.04	0.018	0.05	0.023	0.06	0.027
5	0.34	0.03	0.014	0.03	0.014	0.04	0.018	0.04	0.018	0.05	0.023	0.06	0.027
10	0.69	0.03	0.014	0.03	0.014	0.04	0.018	0.04	0.018	0.05	0.023	0.07	0.032
25	1.7	0.03	0.014	0.04	0.018	0.05	0.023	0.05	0.023	0.06	0.027	0.08	0.036
50	3.4	0.04	0.018	0.04	0.018	0.05	0.023	0.06	0.027	0.09	0.041	0.11	0.05
75	5.2	0.04	0.018	0.05	0.023	0.06	0.027	0.07	0.032	0.11	0.05	0.14	0.064
100	6.9	0.05	0.023	0.05	0.023	0.07	0.032	0.08	0.036	0.12	0.054	0.15	0.068
125	8.6	0.05	0.023	0.06	0.027	0.07	0.032	0.08	0.036	0.13	0.059	0.16	0.073
150	10.3	0.06	0.027	0.06	0.027	0.08	0.036	0.09	0.041	0.14	0.064	0.17	0.077
200	13,8	0.06	0.027	0.07	0.032	0.08	0.036	0.09	0.041	0.15	0.068	0.19	0.086

Table 31. Typical Condensation Rates In Steam Pipes Without Insulation

PRESSURE		RATES IN LBS/HR / KG/HR PER FOOT OF BARE PIPE AT 72°F / 22°C AMBIENT AIR											
		Pipe Diameter in In.											
		3/4		1		1-1/2		2		3		4	
psig	bar	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr	lbs/hr	kg/hr
1	0.069	0.11	0.05	0.15	0.068	0.21	0.095	0.25	0.113	0.38	0.172	0.46	0.209
5	0.34	0.14	0.064	0.16	0.073	0.22	0.1	0.26	0.118	0.41	0.186	0.50	0.227
10	0.69	0.15	0.068	0.18	0.082	0.24	0.109	0.29	0.132	0.44	0.2	0.53	0.24
25	1.7	0.17	0.077	0.22	0.1	0.31	0.141	0.36	0.163	0.53	0.24	0.65	0.295
50	3.4	0.22	0.1	0.27	0.122	0.39	0.177	0.46	0.209	0.66	0.299	0.83	0.376
75	5.2	0.26	0.118	0.31	0.141	0.45	0.204	0.54	0.245	0.77	0.349	1.04	0.472
100	6.9	0.29	0.132	0.35	0.159	0.50	0.227	0.61	0.277	0.86	0.39	1.11	0.503
125	8.6	0.32	0.145	0.39	0.177	0.55	0.249	0.68	0.308	0.94	0.426	1.23	0.558
150	10.3	0.35	0.159	0.42	0.191	0.60	0.272	0.74	0.336	1.03	0.467	1.33	0.603
200	13.8	0.40	0.181	0.49	0.222	0.69	0.313	0.81	0.367	1.19	0.54	1.50	0.68

Table 32. Flow of Water Through Schedule 40 Steel Pipes

DISCHARGE		PRESSURE DROP PER 100 FT AND VELOCITY IN SCHEDULE 40 PIPE FOR WATER AT 60°F															
Gal/min	Ft^3/Sec	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)
		1/8 In.		**1/4 In.**													
0.2	0.000446	1.13	1.86	0.616	0.359	**3/8 In.**		**1/2 In.**									
0.3	0.000668	1.69	4.22	0.924	0.903	0.504	0.159	0.317	0.061	**3/4 In.**							
0.4	0.000891	2.26	6.98	1.23	1.61	0.672	0.345	0.422	0.086								
0.5	0.00111	2.82	10.5	1.54	2.39	0.840	0.539	0.528	0.167	0.301	0.033						
0.6	0.00134	3.39	14.7	1.85	3.29	1.01	0.751	0.633	0.240	0.361	0.041						
0.8	0.00178	4.52	25.0	2.46	5.44	1.34	1.25	0.844	0.408	0.481	0.102	**1 In.**					
1	0.00223	5.65	37.2	3.08	8.28	1.68	1.85	1.06	0.600	0.602	0.155	0.371	0.048	**1-1/4 In.**			
2	0.00446	11.29	134.4	6.16	30.1	3.36	6.58	2.11	2.10	1.20	0.526	0.743	0.164	0.429	0.044	**1-1/2 In.**	
3	0.00668			9.25	64.1	5.04	13.9	3.17	4.33	1.81	1.09	1.114	0.336	0.644	0.090	0.473	0.043
4	0.00891			12.33	111.2	6.72	23.9	4.22	7.42	2.41	1.83	1.49	0.565	0.858	0.150	0.630	0.071
5	0.01114	**2 In.**				8.40	36.7	5.28	11.2	3.01	2.75	1.86	0.835	1.073	0.223	0.788	0.104
6	0.01337	0.574	0.044	**2-1/2 In.**		10.08	51.9	6.33	15.8	3.61	3.84	2.23	1.17	1.29	0.309	0.943	0.145
8	0.01782	0.765	0.073			13.44	91.1	8.45	27.7	4.81	6.60	2.97	1.99	1.72	0.518	1.26	0.241
10	0.02228	0.956	0.108	0.670	0.046	**3 In.**		10.56	42.4	6.02	9.99	3.71	2.99	2.15	0.774	1.58	0.361
15	0.03342	1.43	0.224	1.01	0.094					9.03	21.6	5.57	6.36	3.22	1.63	2.37	0.755
20	0.04456	1.91	3.375	1.34	0.158	0.868	0.056	**3-1/2 In.**		12.03	37.8	7.43	10.9	4.29	2.78	3.16	1.28
25	0.05570	2.39	0.561	1.68	0.234	1.09	0.083	0.812	0.041	**4 In.**		9.28	16.7	5.37	4.22	3.94	1.93
30	0.06684	2.87	0.786	2.01	0.327	1.30	0.114	0.974	0.056			11.14	23.8	6.44	5.92	4.73	2.72
35	0.07798	3.35	1.05	2.35	0.436	1.52	0.151	1.14	0.071	0.882	0.041	12.99	32.2	7.51	7.90	5.52	3.64
40	0.08912	3.83	1.35	2.68	0.556	1.74	0.192	1.30	0.095	1.01	0.052	14.85	41.5	8.59	10.24	6.30	4.65
45	0.1003	4.30	1.67	3.02	0.668	1.95	0.239	1.46	0.117	1.13	0.064			9.67	12.80	7.09	5.85
50	0.1114	4.78	2.03	3.35	0.839	2.17	0.288	1.62	0.142	1.26	0.076			10.74	15.66	7.88	7.15
60	0.1337	5.74	2.87	4.02	1.18	2.60	0.46	1.95	0.204	1.51	0.107	**5 In.**		12.89	22.2	9.47	10.21
70	0.1560	6.70	3.84	4.69	1.59	3.04	0.540	2.27	0.261	1.76	0.143	1.12	0.047			11.05	13.71
80	0.1782	7.65	4.97	5.36	2.03	3.47	0.687	2.60	0.334	2.02	0.180	1.28	0.060			12.62	17.59
90	0.2005	8.60	6.20	6.03	2.53	3.91	0.861	2.92	0.416	2.27	0.224	1.44	0.074	**6 In.**		14.20	22.0
100	0.2228	9.56	7.59	6.70	3.09	4.34	1.05	3.25	0.509	2.52	0.272	1.60	0.090	1.11	0.036	15.778	26.9
125	0.2785	11.97	11.76	8.38	4.71	5.43	1.61	4.06	0.769	3.15	0.415	2.01	0.135	1.39	0.055	19.72	41.4
150	0.3342	14.36	16.70	10.05	6.69	6.51	2.24	4.87	1.08	3.78	0.580	2.41	0.190	1.67	0.077		
175	0.3899	16.75	22.3	11.73	8.97	7.60	3.00	5.68	1.44	4.41	0.774	2.81	0.253	1.94	0.102		
200	0.4456	19.14	28.8	13.42	11.68	8.68	3.87	6.49	1.85	5.04	0.985	3.21	0.323	2.22	0.130	**8 In.**	
225	0.5013	----	----	15.09	14.63	9.77	4.83	7.30	2.32	5.67	1.23	3.61	0.401	2.50	0.162	1.44	0.043
250	0.557	----	----	----	----	10.85	5.93	8.12	2.84	6.30	1.46	4.01	0.495	2.78	0.195	1.60	0.051
275	0.6127	----	----	----	----	11.94	7.14	8.93	3.40	6.93	1.79	4.41	0.583	3.05	0.234	1.76	0.061
300	0.6684	----	----	----	----	13.00	8.36	9.74	4.02	7.56	2.11	4.81	0.683	3.33	0.275	1.92	0.072
325	0.7241	----	----	----	----	14.12	9.89	10.53	4.09	8.19	2.47	5.21	0.797	3.61	0.320	2.08	0.083
350	0.7798			----	----	----	----	11.36	5.51	8.82	2.84	5.62	0.919	3.89	0.367	2.24	0.095
375	0.8355			----	----	----	----	12.17	6.18	9.45	3.25	6.02	10.5	4.16	0.416	2.40	0.108
400	0.8912			----	----	----	----	12.98	7.03	10.08	3.68	6.42	1.19	4.44	0.471	2.56	0.121
425	0.9469			----	----	----	----	13.80	7.89	10.71	4.12	6.82	1.33	4.72	0.529	2.73	0.136
450	1.003	**10 In.**		----	----	----	----	14.61	8.80	11.34	4.60	7.22	1.48	5.00	0.590	2.89	0.151
475	1.059	1.93	0.054			----	----	----	----	11.97	5.12	7.62	1.64	5.27	0.653	3.04	0.166
500	1.114	2.03	0.059			----	----	----	----	12.60	5.65	8.02	1.81	5.55	0.720	3.21	0.182
550	1.225	2.24	0.071			----	----	----	----	13.85	6.79	8.82	2.17	6.11	0.861	3.53	0.219
600	1.337	2.44	0.083			----	----	----	----	15.12	8.04	9.63	2.55	6.66	1.02	3.85	0.258
650	1.448	2.64	0.097			----	----	----	----	----	----	10.43	2.98	7.22	1.18	4.17	0.301

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Table 32. Flow of Water Through Schedule 40 Steel Pipes (continued)

DISCHARGE		PRESSURE DROP PER 100 FT AND VELOCITY IN SCHEDULE 40 PIPE FOR WATER AT 60°F															
Gal/min	Ft^3/Sec	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)	Velocity (Ft/Sec)	Pressure Drop (psi)
		10 In.		12 In.								5 In.		6 In.		8 In.	
700	1.560	2.85	0.112	2.01	0.047			- - - -	- - - -	- - - -	- - - -	11.23	3.43	7.78	1.35	4.49	0.343
750	1.671	3.05	0.127	2.15	0.054			- - - -	- - - -	- - - -	- - - -	12.03	3.92	8.33	1.55	4.81	0.392
800	1.782	3.25	0.143	2.29	0.061	14 In.		- - - -	- - - -	- - - -	- - - -	12.83	4.43	8.88	1.75	5.13	0.443
850	1.894	3.46	0.160	2.44	0.068	2.02	0.042	- - - -	- - - -	- - - -	- - - -	13.64	5.00	9.44	1.96	5.45	0.497
900	2.005	3.66	0.179	2.58	0.075	2.13	0.047	- - - -	- - - -	- - - -	- - - -	14.44	5.58	9.99	2.18	5.77	0.554
950	2.117	3.86	0.198	2.72	0.083	2.25	0.052	- - - -	- - - -	- - - -	- - - -	15.24	6.21	10.55	2.42	6.09	0.613
1000	2.228	4.07	0.218	2.87	0.091	2.37	0.057	16 In.		- - - -	- - - -	16.04	6.84	11.10	2.68	6.41	0.675
1100	2.451	4.48	0.260	3.15	0.110	2.61	0.068			- - - -	- - - -	17.65	8.23	12.22	3.22	7.05	0.807
1200	2.674	4.88	0.306	3.44	0.128	2.85	0.800	2.18	0.042	- - - -	- - - -	- - - -	- - - -	13.33	3.81	7.70	0.948
1300	2.896	5.29	0.355	3.73	0.150	3.08	0.093	2.36	0.048	- - - -	- - - -	- - - -	- - - -	14.43	4.45	8.33	1.11
1400	3.119	5.70	0.409	4.01	0.171	3.32	0.107	2.54	0.055	- - - -	- - - -	- - - -	- - - -	15.55	5.13	8.98	1.28
1500	3.342	6.10	0.466	4.30	0.195	3.56	0.122	2.72	0.063	18 In.				16.66	5.85	9.62	1.46
1600	3.565	6.51	0.527	4.59	0.219	3.79	0.138	2.90	0.071					17.77	6.61	10.26	1.65
1800	4.010	7.32	0.663	5.16	0.276	4.27	0.172	3.27	0.088	2.58	0.050			19.99	8.37	11.54	2.08
2000	4.456	8.14	0.808	5.73	0.339	4.74	0.209	3.63	0.107	2.87	0.060			22.21	10.3	12.82	2.55
2500	5.570	10.17	1.24	7.17	0.515	5.93	0.321	4.54	0.163	3.59	0.091	20 In.				16.03	3.94
3000	6.684	12.20	1.76	8.60	0.731	7.11	0.451	5.45	0.232	4.30	0.129	3.46	0.075	24 In.		19.24	5.59
3500	7.798	14.24	2.38	10.03	0.982	8.30	0.607	6.35	0.312	5.02	0.173	4.04	0.101			22.44	7.56
4000	8.912	16.27	3.08	11.47	1.27	9.48	0.787	7.26	0.401	5.74	0.222	4.62	0.129	3.19	0.052	25.65	9.80
4500	10.03	18.31	3.87	12.90	1.60	10.67	0.990	8.17	0.503	6.46	0.280	5.20	0.162	3.59	0.065	28.87	12.2
5000	11.14	20.35	7.71	14.33	1.95	11.85	1.21	9.08	0.617	7.17	0.340	5.77	0.199	3.99	0.079	- - - -	- - - -
6000	13.37	24.41	6.74	17.20	2.77	14.23	1.71	10.89	0.877	8.61	0.483	6.93	0.280	4.79	0.111	- - - -	- - - -
7000	15.60	28.49	9.11	20.07	3.74	16.60	2.31	12.71	1.18	10.04	0.652	8.08	0.376	5.59	0.150	- - - -	- - - -
8000	17.82	- - - -	- - - -	22.93	4.84	18.96	2.99	14.52	1.51	11.47	0.839	9.23	0.488	6.38	0.192	- - - -	- - - -
9000	20.05	- - - -	- - - -	25.79	6.09	21.34	3.76	16.34	1.90	12.91	1.05	10.39	0.608	7.18	0.242	- - - -	- - - -
10,000	22.28	- - - -	- - - -	28.66	7.46	23.71	4.61	18.15	2.34	14.34	1.28	11.54	0.739	7.98	0.294	- - - -	- - - -
12,000	26.74	- - - -	- - - -	34.40	10.7	28.45	6.59	21.79	3.33	17.21	1.83	13.85	1.06	9.58	0.416	- - - -	- - - -
14,000	31.19	- - - -	- - - -	- - - -	- - - -	33.19	8.89	25.42	4.49	20.08	2.45	16.16	1.43	11.17	0.562	- - - -	- - - -
16,000	35.65	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	29.05	5.83	22.95	3.18	18.47	1.85	12.77	0.723	- - - -	- - - -
18,000	40.10	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	32.68	7.31	25.82	4.03	20.77	2.32	14.36	0.907	- - - -	- - - -
20,000	44.56	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	36.31	9.03	28.69	4.93	23.08	2.86	15.96	1.12	- - - -	- - - -

For pipe lengths other than 100 ft., the pressure drop is proportional to the length. Thus, for 50 ft. of pipe, the pressure drop is approximately one half the value given in the table or 300 ft., three times the given value, etc.
Velocity is a function of the cross sectional flow area; thus, it is constant for a given flow rate and is independent of pipe length.
Extracted from Technical Paper No. 410, Flow of Fluids, with permission of Crane Co.

Table 33. Flow of Air Through Schedule 40 Steel Pipes

FREE AIR Q^{TM}	COMPRESSED AIR	PRESSURE DROP OF AIR IN PSI PER 100 FT OF SCHEDULE 40 PIPE FOR AIR AT 100 PSIG PRESSURE AND 60°F TEMPERATURE								
Ft^3/min at 60°F and 14.7 psia	Ft^3/min at 60°F and 100 psig	1/8 In.	1/4 In.	3/8 In.	1/2 In.	3/4 In.	1 In.	1-1/4 In.	1-1/2 In.	2 In.
1	0.128	0.361	0.083	0.018						
2	0.256	1.31	0.285	0.064	0.020					
3	0.384	3.06	0.605	0.133	0.042					
4	0.513	4.83	1.04	0.226	0.071					
5	0.641	7.45	1.58	0.343	0.106	0.027				
6	0.769	10.6	2.23	0.408	0.148	0.037				
8	1.025	18.6	3.89	0.848	0.255	0.062	0.019			
10	0.282	28.7	5.96	1.26	0.356	0.094	0.029			
15	1.922	----	13.0	2.73	0.834	0.201	0.062			
20	2.563	----	22.8	4.76	1.43	0.345	0.102	0.026		
25	3.204	----	35.6	7.34	2.21	0.526	0.156	0.039	0.019	
30	3.845	----	----	10.5	3.15	0.748	0.219	0.055	0.026	
35	4.486	----	----	14.2	4.24	1.00	0.293	0.073	0.035	
40	5.126	----	----	18.4	5.49	1.30	0.379	0.095	0.044	
45	5.767	----	----	23.1	6.90	1.62	0.474	0.116	0.055	
50	6.408			28.5	8.49	1.99	0.578	0.149	0.067	0.019
60	7.690	**2-1/2 In.**		40.7	12.2	2.85	0.819	0.200	0.094	0.027
70	8.971			----	16.5	3.83	1.10	0.270	0.126	0.036
80	10.25	0.019		----	21.4	4.96	1.43	0.350	0.162	0.046
90	11.53	0.023		----	27.0	6.25	1.80	0.437	0.203	0.058
100	12.82	0.029	**3 In.**		33.2	7.69	2.21	0.534	0.247	0.070
125	16.02	0.044			----	11.9	3.39	0.825	0.380	0.107
150	19.22	0.062	0.021		----	17.0	4.87	1.17	0.537	0.151
175	22.43	0.083	0.028	**3-1/2 In.**	----	23.1	6.60	1.58	0.727	0.205
200	25.63	0.107	0.036		----	30.0	8.54	2.05	0.937	0.264
225	28.84	0.134	0.045	0.022		37.9	10.8	2.59	1.19	0.331
250	32.04	0.164	0.055	0.027		----	13.3	3.18	1.45	0.404
275	35.24	0.191	0.066	0.032		----	16.0	3.83	1.75	0.484
300	38.45	0.232	0.078	0.037		----	19.0	4.56	2.07	0.573
325	41.65	0.270	0.090	0.043	**4 In.**	----	22.3	5.32	2.42	0.673
350	44.87	0.313	0.104	0.050		----	25.8	6.17	2.80	0.776
375	48.06	0.356	0.119	0.057	0.030	----	29.6	7.05	3.20	0.887
400	51.26	0.402	0.134	0.064	0.034	----	33.6	8.02	3.64	1.00
425	54.47	0.452	0.151	0.072	0.038	----	37.9	9.01	4.09	1.13
450	57.67	0.507	0.168	0.081	0.042	----	----	10.2	4.59	1.26
475	60.88	0.562	0.187	0.089	0.047		----	11.3	5.09	1.40
500	64.08	0.623	0.206	0.099	0.052		----	12.5	5.61	1.55
550	70.49	0.749	0.248	0.118	0.062		----	15.1	6.79	1.87
600	76.90	0.887	0.293	0.139	0.073	**5 In.**	----	18.0	8.04	2.21
650	83.30	1.04	0.342	0.163	0.086		----	21.1	9.43	2.60
700	89.71	1.19	0.395	0.188	0.099	0.032		24.3	10.9	3.00
750	96.12	1.36	0.451	0.214	0.113	0.036		27.9	12.6	3.44
800	102.5	1.55	0.513	0.244	0.127	0.041		31.8	14.2	3.90
850	108.9	1.74	0.576	0.274	0.144	0.046	**6 In.**	35.9	16.0	4.40
900	115.3	1.95	0.642	0.305	0.160	0.051		40.2	18.0	4.91
950	121.8	2.18	0.715	0.340	0.178	0.057	0.023	----	20.0	5.47
1000	128.2	2.40	0.788	0.375	0.197	0.063	0.025	----	22.1	6.06
1100	141.0	2.89	0.948	0.451	0.236	0.075	0.030	----	26.7	7.29
1200	153.8	3.44	1.13	0.533	0.279	0.089	0.035	----	31.8	8.63
1300	166.6	4.01	1.32	0.626	0.327	0.103	0.041	----	37.3	10.1

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Table 33. Flow of Air Through Schedule 40 Steel Pipes (continued)

FREE AIR Q'M	COMPRESSED AIR	PRESSURE DROP OF AIR IN PSI PER 100 FT OF SCHEDULE 40 PIPE FOR AIR AT 100 PSIG PRESSURE AND 60°F TEMPERATURE								
Ft³/min at 60°F and 14.7 psia	Ft³/min at 60°F and 100 psig	2-1/2 In.	3 In.	3-1/2 In.	4 In.	5 In.	6 In.	8 In.	10 In.	12 In.
1400	179.4	4.65	1.52	0.718	0.377	0.119	0.047			11.8
1500	192.2	5.31	1.74	0.824	0.431	0.136	0.054			13.5
1600	205.1	6.04	1.97	0.932	0.490	0.154	0.061			15.3
1800	230.7	7.65	2.50	1.18	0.616	0.193	0.075			19.3
2000	256.3	9.44	3.06	1.45	0.757	0.237	0.094	0.023		23.9
2500	320.4	14.7	4.76	2.25	1.17	0.366	0.143	0.035		37.3
3000	384.5	21.1	6.82	3.20	1.67	0.524	0.204	0.051	0.016	
3500	448.6	28.8	9.23	4.33	2.26	0.709	0.276	0.068	0.022	
4000	512.6	37.6	12.1	5.66	2.94	0.919	0.358	0.088	0.028	**12 In.**
4500	576.7	47.6	15.3	7.16	3.69	1.16	0.450	0.111	0.035	
5000	640.8	----	18.8	8.85	4.56	1.42	0.552	0.136	0.043	0.018
6000	769.0	----	27.1	12.7	6.57	2.03	0.794	0.195	0.061	0.025
7000	897.1	----	36.9	17.2	8.94	2.76	1.07	0.262	0.082	0.034
8000	1025	----	----	22.5	11.7	3.59	1.39	0.339	0.107	0.044
9000	1153	----	----	28.5	14.9	4.54	1.76	0.427	0.134	0.055
10,000	1282	----	----	35.2	18.4	5.60	2.16	0.526	0.164	0.067
11,000	1410	----	----	----	22.2	6.78	2.62	0.633	0.197	0.081
12,000	1538	----	----	----	26.4	8.07	3.09	0.753	0.234	0.096
13,000	1666	----	----	----	31.0	9.47	3.63	0.884	0.273	0.112
14,000	1794	----	----	----	36.0	11.0	4.21	1.02	0.316	0.129
15,000	1922	----	----	----	----	12.6	4.84	1.17	0.364	0.148
16,000	2051	----	----	----	----	14.3	5.50	1.33	0.411	0.167
18,000	2307	----	----	----	----	18.2	6.96	1.68	0.520	0.213
20,000	2563	----	----	----	----	22.4	8.60	2.01	0.642	0.260
22,000	2820	----	----	----	----	27.1	10.4	2.50	0.771	0.314
24,000	3076	----	----	----	----	32.3	12.4	2.97	0.918	0.371
26,000	3332	----	----	----	----	37.9	14.5	3.49	1.12	0.435
28,000	3588	----	----	----	----	----	16.9	4.04	1.25	0.505
30,000	3845	----	----	----	----	----	19.3	4.64	1.42	0.520

Extracted from Technical Paper No. 410, Flow of Fluids, with permission of Crane Co.

Conversions, Equivalents and Physical Data

Table 34. Average Properties of Propane

Formula	C_3H_8
Boiling Point, °F / °C	-44 / -42
Specific Gravity of Gas (Air = 1.00)	1.53
Lbs/Gal of Liquid at 60°F / 16°C	4.24
BTU/Gal of Gas at 60°F / 16°C	91,547
BTU/Lb of Gas	21,591
BTU/Ft^3 of Gas at 60°F / 16°C	2516
Ft^3 of Vapor at 60°F / 16°C per Gal. of Liquid at 60°F / 16°C	36.39
Ft^3 of Vapor at 60°F / 16°C per Lb. of Liquid at 60°F / 16°C	8.547
Latent Heat of Vaporization at Boiling Point, BTU per Gallon	785.0
Combustion Data	
Ft^3 of Air Required to Burn 1 Ft^3 of Gas	23.86
Flash Point, °F / °C	-156 / -104
Ignition Temperature in Air, °F / °C	920 to 1020 / 493 to 549
Maximum Flame Temperature in Air, °F / °C	3595 / 1979
Limits of Inflammability, Percentage of Gas in Air Mixture	
at Lower Limit	2.4%
at Upper Limit	9.6%
Octane Number (ISO Octane = 100)	Over 100

Table 35. Standard Domestic Propane Tank Specifications

CAPACITY		DIAMETER		LENGTH		TANK WEIGHT	
gal	l	in.	mm	in.	mm	lbs	kg
120	454	24	610	68	1727	288	131
150	568	24	610	84	2134	352	160
200	757	30	762	79	2007	463	210
250	946	30	762	94	2387	542	246
325	1230	30	762	119	3023	672	305
500	1893	37	940	119	3023	1062	482
1000	3785	41	1041	192	4877	1983	900

Table 36. Approximate Vaporization Capacities of Propane Tanks

BTU PER HOUR WITH 40% LIQUID IN DOMESTIC TANK SYSTEMS		
Tank Size Water Capacity	Prevailing Air Temperature	
	20°F / -7°C	60°F / 16°C
120	235,008	417,792
150	290,304	516,096
200	341,280	606,720
250	406,080	721,920
325	514,100	937,900
500	634,032	1,127,168
1000	1,088,472	1,978,051

Table 37. Orifice Capacities for Propane

ORIFICE OR DRILL SIZE	ORIFICE CAPACITY BTU PER HOUR, 11 IN. W.C.	ORIFICE OR DRILL SIZE	ORIFICE CAPACITY BTU PER HOUR, 11 IN. W.C.
0.008	519	51	36531
0.009	656	50	39842
0.010	812	49	43361
0.011	981	48	46983
0.012	1169	47	50088
80	1480	46	53296
79	1708	45	54641
78	2080	44	60229
77	2629	43	64369
76	3249	42	71095
75	3581	41	74924
74	4119	40	78029
73	4678	39	80513
72	5081	38	83721
71	5495	37	87860
70	6375	36	92207
69	6934	35	98312
68	7813	34	100175
67	8320	33	103797
66	8848	32	109385
65	9955	31	117043
64	10535	30	134119
63	11125	29	150366
62	11735	28	160301
61	12367	27	168580
60	13008	26	175617
59	13660	25	181619
58	14333	24	187828
57	15026	23	192796
56	17572	22	200350
55	21939	21	205525
54	24630	20	210699
53	28769	19	223945
52	32805	18	233466

BTU/ft^3 = 2516
Specific Gravity = 1.52
Pressure at orifice, in. w.c. = 11
Orifice Coefficient = 0.9

Table 38. Pipe and Tubing Sizing

PROPANE PIPE AND TUBING SIZING BETWEEN SINGLE OR SECOND STAGE LOW PRESSURE REGULATORS AND APPLIANCES												
Pipe or Tubing Length, Ft.	Copper Tubing Size, Outside Diameter (Inside Diameter), Type L					Pipe or Tubing Length, Ft.	Nominal Pipe Size, Outside Diameter (Inside Diameter), Schedule 40					
	3/8 / 0.315	1/2 / 0.430	5.8 / 0.545	3/4 / 0.666	7/8 / 0.785		1/2 / 0.622	3.4 / 0.824	1 / 1.049	1-1/4 / 1.380	1-1/2 / 1.610	2 / 2.067
10	49	110	206	348	536	10	291	608	1146	2353	3525	6789
20	34	76	151	239	368	20	200	418	788	1617	2423	4666
30	27	61	114	192	296	30	161	336	632	1299	1946	3747
40	23	52	97	164	253	40	137	282	541	1111	1665	3207
50	20	46	86	146	224	50	122	557	480	985	1476	2842
60	19	42	78	132	203	60	110	231	435	892	1337	2575
70	17	39	72	121	187	80	94	198	372	764	1144	2204
80	16	36	67	113	174	100	84	175	330	677	1014	1954
90	15	34	63	106	163	125	74	155	292	600	899	1731
100	14	32	59	100	154	150	67	141	265	544	815	1569
150	11	26	48	80	----	----	----	----	----	----	----	----

To convert to capacities in cubic feet per hour, divide by 2.5
Note: Maximum undiluted propane capacities listed are based on 11 in. w.c. setting and a 0.5 in. w.c. pressure drop - Capacities in 1000 BTU per hour.

Table 39. Vapor Pressures of Propane

TEMPERATURE		PRESSURE		TEMPERATURE		PRESSURE		TEMPERATURE		PRESSURE		TEMPERATURE		PRESSURE	
°F	°C	psig	bar	°F	°C	psig	bar	°F	°C	psig	bar	°F	°C	psig	bar
130	54	257	18	70	21	109	8	20	-7	40	2.8	-20	-29	10	0.69
120	49	225	16	65	18	100	6.9	10	-12	31	2	-25	-32	8	0.55
110	43	197	14	60	16	92	6	0	-17	23	2	-30	-34	5	0.34
100	38	172	12	50	10	77	5	-5	-21	20	1.4	-35	-37	3	0.21
90	32	149	10	40	4	63	4	-10	-23	16	1	-40	-40	1	0.069
80	27	128	9	30	-1	51	4	-15	-26	13	1	-44	-42	0	0

Table 40. Converting Volumes of Gas

CFH TO CFH OR CFM TO CFM		
Multiply Flow of	By	To Obtain Flow of
Air	0.707	Butane
	1.290	Natural Gas
	0.808	Propane
Butane	1.414	Air
	1.826	Natural Gas
	1.140	Propane
Natural Gas	0.775	Air
	0.547	Butane
	0.625	Propane
Propane	1.237	Air
	0.874	Butane
	1.598	Natural Gas

Table 41. BTU Comparisons

COMMON FUELS	PER GAL.	PER LB
Propane	91,547	21,591
Butane	102,032	21,221
Gasoline	110,250	20,930
Fuel Oil	134,425	16,960

Table 42. Capacities of Spuds and Orifices

DRILL DESIGNATION	DIAMETER, IN.	AREA, IN^2	CAPACITIES IN CFH OF 0.6 GRAVITY HIGH PRESSURE NATURAL GAS AND AN ORIFICE COEFFICIENT OF 1.0																		
			Upstream Pressure, psig																		
			1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	40	50
80	0.0135	0.000143	1.61	2.26	2.76	3.17	3.52	3.84	4.13	4.40	4.65	4.88	5.31	5.65	6.05	6.44	6.84	7.82	8.80	10.8	12.8
79	0.0145	0.000163	1.85	2.61	3.18	3.65	4.06	4.43	4.77	5.07	5.36	5.63	6.12	6.52	6.98	7.43	7.89	9.02	10.2	12.5	14.7
1/64"	0.0156	0.000191	2.14	3.02	3.68	4.23	4.70	5.13	5.52	5.87	6.20	6.51	7.09	7.55	8.08	8.61	9.13	10.5	11.8	14.4	17.1
78	0.0160	0.000201	2.26	3.18	3.88	4.45	4.94	5.40	5.81	6.18	6.53	6.85	7.46	7.95	8.50	9.05	9.61	11.0	12.4	15.2	17.9
77	0.0180	0.000234	2.85	4.02	4.90	5.62	6.25	6.82	7.34	7.81	8.25	8.66	9.42	10.1	10.8	11.5	12.2	13.9	15.7	19.2	22.7
76	0.0200	0.000314	3.53	4.97	6.05	6.95	7.72	8.43	9.07	9.65	10.2	10.8	11.7	12.5	13.3	14.2	15.0	17.2	19.4	23.7	28.0
75	0.0210	0.000346	3.89	5.48	6.67	7.65	8.51	9.29	10.0	10.7	12.3	11.8	12.9	13.7	14.7	15.6	16.6	19.0	21.3	26.1	30.9
74	0.0225	0.000398	4.47	7.08	7.67	8.80	9.78	10.7	11.5	12.4	13.0	13.6	14.8	15.8	16.9	18.0	19.1	21.8	24.5	30.0	35.5
73	0.0240	0.000452	5.08	7.16	8.71	10.0	11.2	12.2	13.1	13.9	14.7	15.4	16.8	17.9	19.1	20.4	21.6	24.7	27.6	34.1	40.3
72	0.0250	0.000491	5.52	7.78	9.46	10.9	12.1	13.2	14.2	15.1	16.0	16.8	18.3	19.4	20.8	22.1	23.5	26.9	30.3	37.0	43.8
71	0.0260	0.000531	5.97	8.41	10.3	11.8	13.1	14.3	15.4	16.4	17.3	18.1	19.7	21.0	22.5	23.9	25.4	29.1	32.7	40.0	47.3
70	0.0280	0.000616	6.92	9.75	11.9	13.7	15.2	16.6	17.8	19.0	20.0	21.0	22.9	24.4	26.1	27.8	29.5	33.8	38.0	46.4	54.9
69	0.0292	0.000670	7.53	10.6	13.0	14.9	16.5	18.0	19.4	20.0	21.8	22.9	24.9	26.5	28.4	30.2	32.1	36.7	41.3	50.5	59.7
68	0.0310	0.000735	8.48	12.0	14.6	16.7	18.6	20.3	21.9	23.2	24.5	25.8	28.0	29.9	32.0	34.0	36.1	41.3	46.5	56.9	67.3
1/32"	0.0313	0.000765	8.59	12.2	14.8	17.0	18.8	20.6	22.1	23.5	24.9	26.1	28.4	30.3	32.4	34.5	36.6	41.9	47.1	57.7	68.2
67	0.0320	0.000804	9.03	12.8	15.5	17.8	19.8	21.6	23.3	24.7	26.1	27.4	29.9	31.8	34.0	36.2	38.5	44.0	49.5	60.6	71.7
66	0.0330	0.000855	9.60	13.6	16.5	18.9	21.1	23.0	24.7	26.3	27.6	29.2	31.8	33.8	36.2	38.5	40.9	46.8	52.7	64.4	76.2
65	0.0350	0.000962	10.8	15.3	18.6	21.3	23.7	25.9	27.8	29.6	31.3	32.8	35.7	38.1	40.7	43.4	46.0	52.6	59.2	72.5	85.7
64	0.0360	0.001018	11.5	16.2	19.7	22.6	25.1	27.4	29.4	31.3	33.1	34.7	37.8	40.3	42.4	45.9	48.7	55.7	62.7	76.7	90.7
63	0.0370	0.001075	12.1	17.1	20.8	23.8	26.5	28.9	31.1	33.1	34.9	36.7	39.9	42.5	45.5	48.4	51.4	58.8	66.2	81.0	95.8
62	0.0380	0.001134	12.8	18.0	21.9	25.1	27.9	30.5	32.8	34.9	36.8	38.7	42.1	44.8	48.0	51.1	54.2	62.0	69.8	85.4	101
61	0.0390	0.001195	13.5	19.0	23.1	26.5	29.4	32.1	34.6	36.8	38.8	40.8	44.4	47.3	50.6	53.8	57.1	65.4	73.6	90.0	107
60	0.0400	0.001257	14.2	19.9	24.3	27.8	30.9	33.8	36.4	38.7	40.8	42.9	46.7	49.7	53.2	56.6	60.1	68.7	77.4	94.7	112
59	0.0410	0.001320	14.9	20.9	25.5	29.2	32.5	35.5	38.2	40.6	42.9	45.0	49.0	52.2	55.8	59.5	63.1	72.2	81.3	99.5	118
58	0.0420	0.001385	15.6	22.0	26.7	30.7	34.1	37.2	40.0	42.6	45.0	41.2	51.4	54.8	58.6	62.4	66.2	75.7	85.3	105	124
57	0.0430	0.001452	16.3	23.0	28.0	32.1	35.7	39.0	42.0	44.7	47.2	49.5	53.9	57.4	61.4	65.4	69.4	79.4	89.4	110	130
56	0.0465	0.001698	19.1	26.9	32.8	37.6	41.8	45.6	49.1	52.2	55.1	57.9	63.0	67.1	71.8	76.5	81.2	92.8	105	128	152
3/64"	0.0469	0.00173	19.5	27.4	33.4	38.3	42.6	46.5	50.0	53.2	56.2	59.0	64.2	68.4	73.2	77.9	82.7	94.6	107	131	155
55	0.0520	0.00212	23.8	33.6	40.9	46.9	52.1	57.0	61.3	65.2	68.8	72.3	78.7	83.8	89.6	95.5	102	116	131	160	189
54	0.0550	0.00238	26.8	37.7	45.9	52.7	58.5	63.9	68.8	73.2	77.3	81.1	88.3	94.1	101	108	114	132	147	180	212
53	0.0595	0.00278	31.1	44.0	53.6	61.5	68.4	74.7	80.3	85.4	90.3	94.7	104	110	118	126	133	152	172	210	248
1/16"	0.0625	0.00307	34.5	48.6	59.2	67.9	75.5	82.5	88.8	94.4	99.7	105	114	122	130	139	147	168	189	232	274
52	0.0635	0.00317	35.6	50.2	61.1	70.1	78.0	85.1	91.6	97.4	103	108	118	126	134	143	152	174	196	239	283
51	0.0670	0.00353	39.7	55.9	68.0	78.1	86.8	94.8	102	109	115	121	131	140	150	159	169	193	218	266	315
50	0.0700	0.00385	43.3	61.0	74.2	85.2	94.7	104	112	119	125	132	143	153	163	174	184	211	237	290	343
49	0.0730	0.00419	47.1	66.4	80.8	92.7	103	113	121	129	136	143	156	166	178	189	201	229	258	316	374
48	0.0760	0.00454	51.0	71.9	87.5	101	112	122	132	140	148	155	169	180	192	205	217	249	280	342	405
5/64"	0.0781	0.00479	53.8	75.9	92.3	106	118	129	134	148	156	164	178	190	203	216	229	262	295	361	427
47	0.0785	0.00484	54.4	76.6	93.3	107	119	130	140	149	158	165	180	192	205	218	232	265	298	365	432
46	0.0810	0.00515	57.9	81.6	99.2	114	127	139	149	159	168	176	191	204	218	232	246	282	317	388	459
45	0.0820	0.00528	59.3	83.6	102	117	130	141	153	163	172	180	196	209	224	238	253	289	325	398	471
44	0.0860	0.00582	65.3	92.1	113	129	143	157	169	179	189	199	216	230	246	262	278	319	359	439	519
43	0.0890	0.00622	69.9	98.5	120	138	153	167	180	192	202	212	231	246	263	280	298	340	383	469	555
42	0.0935	0.00687	77.2	109	133	152	169	185	199	212	223	234	255	272	291	310	329	376	423	518	612
3/32"	0.0937	0.00690	77.5	110	133	153	170	186	200	212	224	235	256	273	292	311	350	378	425	520	615
41	0.0960	0.00724	81.3	115	140	161	178	195	210	223	235	247	269	287	306	326	346	396	446	546	645
40	0.0980	0.00754	84.7	120	146	167	186	203	218	232	245	257	280	298	319	340	361	413	464	568	672
39	0.0995	0.00778	87.4	124	150	172	192	209	225	239	253	265	289	308	329	351	372	426	479	585	693
38	0.1015	0.00809	90.9	128	156	179	199	218	234	249	263	276	300	320	342	365	387	443	498	610	721
37	0.1040	0.00849	95.4	135	164	188	209	228	246	261	276	290	315	336	359	383	406	464	523	640	757

- continued -

Table 42. Capacities of Spuds and Orifices (continued)

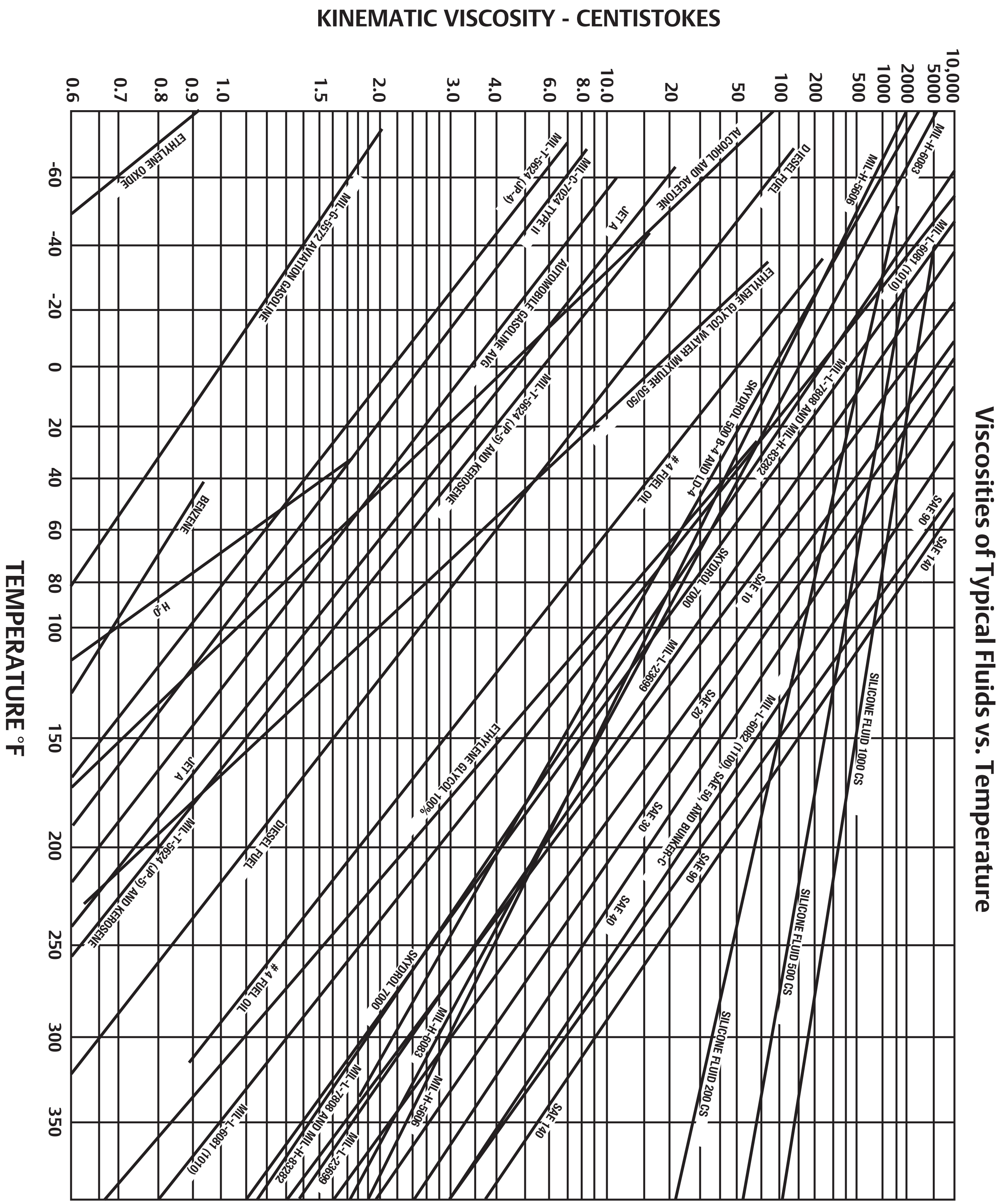
DRILL DESIGNATION	DIAMETER, IN.	AREA, IN^2	CAPACITIES IN CFH OF 0.6 GRAVITY HIGH PRESSURE NATURAL GAS AND AN ORIFICE COEFFICIENT OF 1.0																		
			Upstream Pressure, psig																		
			1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	40	50
36	0.1065	0.00891	100	141	172	197	219	240	258	274	290	304	331	352	377	402	426	487	549	671	794
7/64”	0.1094	0.00940	106	149	182	208	231	253	272	289	305	321	349	372	398	424	449	514	579	708	838
35	0.1100	0.00950	107	151	183	210	234	255	275	292	309	324	353	376	402	428	454	520	585	716	847
34	0.1110	0.00968	109	154	187	214	238	260	280	298	315	330	359	383	410	436	463	530	596	729	863
33	0.1130	0.01003	113	159	194	222	247	270	290	309	326	342	372	396	424	452	480	549	618	756	894
32	0.1160	0.01057	119	168	204	234	260	284	306	325	343	360	392	418	447	476	505	578	651	796	942
31	0.1200	0.01131	127	179	218	250	278	304	327	348	367	386	420	447	478	510	541	619	696	852	1010
1/8”	0.1250	0.01227	138	195	237	272	302	330	355	377	399	418	456	485	519	553	587	671	756	924	1100
30	0.1285	0.01296	146	206	250	287	319	348	375	399	421	442	481	512	548	584	620	709	798	976	1160
29	0.1360	0.01433	164	230	280	322	357	390	420	447	472	495	539	575	615	655	695	795	893	1100	1300
28	0.1405	0.01549	174	246	299	343	381	416	448	476	503	528	575	612	655	698	740	847	954	1170	1380
9/64”	0.1406	0.01553	175	246	300	344	382	417	449	478	504	529	576	614	657	700	742	849	956	1170	1390
27	0.1440	0.01629	183	258	314	361	401	438	471	501	529	555	605	644	689	734	779	891	1010	1230	1460
26	0.1470	0.01697	191	269	327	376	417	456	491	522	551	579	630	671	718	764	811	928	1050	1280	1520
25	0.1495	0.01755	197	278	339	388	432	472	507	540	570	598	651	694	742	790	839	960	1080	1330	1570
24	0.1520	0.01815	204	288	350	402	446	490	525	558	589	619	674	718	768	818	867	992	1120	1370	1620
23	0.1540	0.01863	210	295	359	412	458	501	539	573	605	635	691	737	788	839	890	1020	1150	1410	1660
5/32”	0.1562	0.01917	216	304	370	424	472	515	554	589	623	653	711	758	811	863	916	1050	1180	1450	1710
22	0.1570	0.01936	218	307	373	428	476	520	560	595	629	660	713	765	819	872	925	1060	1200	1460	1730
21	0.1590	0.01986	223	315	383	440	488	534	574	611	645	677	737	785	840	894	949	1090	1230	1500	1770
20	0.1610	0.02036	229	323	393	451	501	547	589	626	661	694	756	805	861	917	973	1120	1260	1540	1820
19	0.1660	0.02164	243	343	417	479	532	581	625	665	703	738	803	855	915	975	1040	1190	1340	1630	1930
18	0.1695	0.02256	254	358	435	499	555	606	652	694	733	769	837	892	954	1020	1080	1240	1390	1700	2010
11/64”	0.1719	0.02320	261	368	447	513	571	623	671	713	753	790	861	917	981	1050	1110	1270	1430	1750	2070
17	0.1730	0.02351	264	373	453	520	578	632	680	723	763	801	872	929	994	1060	1130	1290	1450	1770	2100
16	0.1770	0.02461	277	390	475	545	605	661	711	756	799	839	913	973	1040	1110	1180	1350	1520	1860	2200
15	0.1800	0.02345	286	403	491	563	626	684	736	782	826	868	944	1010	1080	1150	1220	1400	1570	1920	2270
14	0.1820	0.02602	293	412	502	576	640	699	752	800	845	887	965	1030	1100	1180	1250	1430	1610	1960	2320
13	0.1850	0.02688	302	426	518	595	661	722	777	826	873	916	997	1060	1140	1210	1290	1470	1660	2030	2400
3/16”	0.1875	0.02761	310	437	532	611	679	742	798	849	896	941	1030	1100	1170	1250	1320	1510	1700	2080	2460
12	0.1890	0.02806	315	445	541	621	690	754	811	862	911	956	1050	1110	1190	1270	1340	1540	1730	2120	2500
11	0.1910	0.02865	322	454	552	634	704	770	828	881	930	976	1070	1140	1220	1290	1370	1570	1770	2160	2560
10	0.1930	0.02940	331	466	567	650	723	790	850	904	955	1010	1090	1170	1250	1330	1410	1610	1810	2220	2620
9	0.1960	0.03017	339	478	582	667	742	810	872	927	980	1030	1120	1200	1270	1360	1450	1650	1860	2280	2690
8	0.1990	0.03110	350	493	600	688	765	835	899	956	1010	1060	1160	1230	1320	1400	1490	1700	1920	2350	2770
7	0.2010	0.03173	357	503	612	702	780	852	917	975	1030	1090	1180	1260	1350	1430	1520	1740	1960	2390	2830
13/64”	0.2031	0.03241	364	513	625	717	797	870	937	996	1060	1110	1210	1290	1370	1460	1550	1780	2000	2450	2890
6	0.2040	0.03269	367	518	630	723	804	878	945	1010	1070	1120	1220	1300	1390	1480	1570	1790	2020	2470	2920
5	0.2055	0.03317	373	525	639	734	816	891	959	1020	1080	1130	1230	1320	1410	1500	1590	1820	2050	2500	2960
4	0.2090	0.03431	386	543	661	739	844	921	991	1060	1120	1170	1280	1360	1450	1550	1640	1880	2120	2590	2770
3	0.2130	0.03563	400	564	687	788	876	959	1030	1100	1160	1220	1330	1410	1510	1610	1710	1950	2200	2690	2830
7/32”	0.2187	0.03758	422	595	724	831	924	1010	1090	1160	1220	1280	1400	1490	1590	1700	1800	2060	2320	2830	2890
2	0.2210	0.03836	431	608	739	849	943	1030	1110	1180	1250	1310	1430	1520	1630	1730	1840	2100	2370	2890	2920
1	0.2280	0.04083	459	647	787	903	1010	1100	1180	1260	1330	1400	1520	1620	1730	1840	1950	2240	2520	3080	2960
A	0.2340	0.04301	483	681	829	951	1060	1160	1250	1330	1400	1470	1600	1700	1820	1940	2060	2360	2650	3240	3060
15/64”	0.2344	0.04314	485	683	831	954	1060	1160	1250	1330	1400	1470	1600	1710	1830	1950	2070	2360	2660	3250	3180
B	0.2380	0.04449	500	705	857	984	1100	1200	1290	1370	1450	1520	1650	1760	1880	2010	2130	2440	2740	3350	3350
C	0.2420	0.04600	517	725	916	1020	1130	1240	1330	1420	1500	1570	1710	1820	1950	2080	2200	2520	2840	3470	3420
D	0.2460	0.04733	534	733	975	1060	1170	1280	1370	1460	1550	1620	1770	1880	2010	2140	2280	2600	2930	3580	3640
E=1/4”	0.2500	0.04909	552	777	946	1090	1210	1320	1420	1510	1600	1680	1830	1940	2080	2210	2350	2690	3030	3700	4380
F	0.2570	0.05187	583	821	1000	1150	1280	1400	1500	1600	1690	1770	1930	2050	2200	2340	2480	2840	3200	3910	4620
G	0.2610	0.05350	601	847	1040	1190	1320	1440	1550	1650	1740	1830	1990	2120	2270	2410	2560	2930	3300	4030	4770
17/64”	0.2656	0.05542	623	878	1070	1230	1370	1490	1610	1710	1810	1890	2060	2190	2350	2500	2650	3030	3410	4180	4940
H	0.2660	0.05557	624	880	1070	1230	1370	1500	1610	1710	1810	1900	2070	2200	2350	2510	2660	3040	3420	4190	4950

- continued -

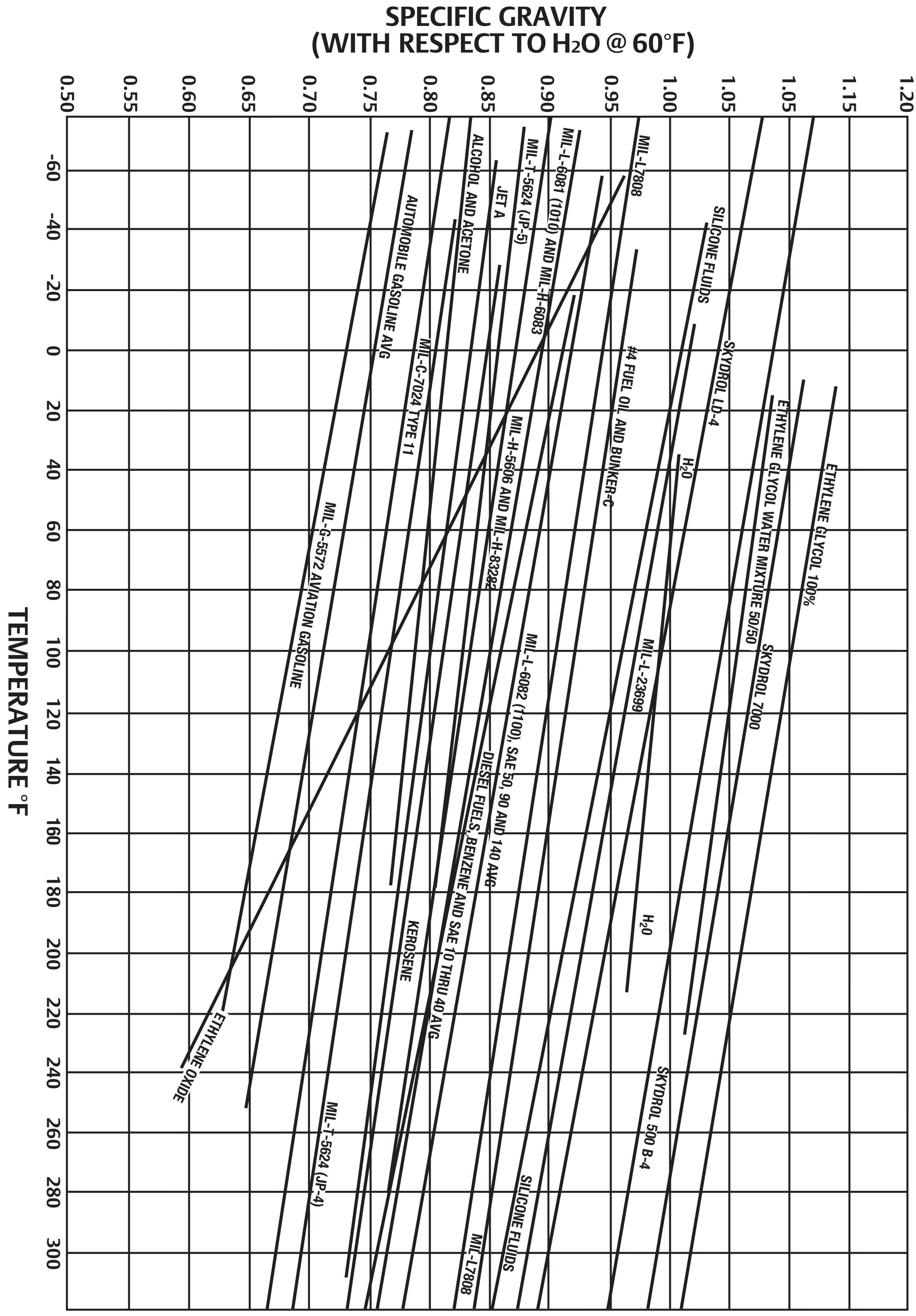
Table 42. Capacities of Spuds and Orifices (continued)

DRILL DESIGNATION	DIAMETER, IN.	AREA, IN²	CAPACITIES IN CFH OF 0.6 GRAVITY HIGH PRESSURE NATURAL GAS AND AN ORIFICE COEFFICIENT OF 1.0																		
			Upstream Pressure, psig																		
			1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	25	30	40	50
I	0.2720	0.005811	653	916	1120	1290	1430	1560	1680	1790	1890	1980	2160	2300	2460	2620	2780	3180	3580	4380	5180
J	0.2770	0.006026	677	957	1170	1340	1490	1620	1750	1860	1960	2060	2240	2390	2550	2720	2880	3300	3710	4540	5370
K	0.2810	0.006102	697	983	1200	1380	1530	1670	1800	1910	2020	2120	2300	2450	2630	2800	2970	3390	3820	4680	5530
9/32"	0.2812	0.006113	698	984	1200	1380	1530	1670	1800	1910	2020	2120	2310	2460	2630	2800	2970	3400	3830	4680	5540
L	0.2900	0.006605	742	1050	1280	1460	1630	1780	1910	2030	2150	2250	2450	2610	2800	2980	3160	3610	4070	4980	5890
M	0.2930	0.006835	768	1090	1320	1520	1680	1840	1980	2100	2220	2330	2540	2710	2890	3080	3270	3740	4210	5150	6090
19/64"	0.2969	0.006922	778	1100	1340	1530	1710	1860	2000	2130	2250	2360	2570	2740	2930	3120	3310	3790	4260	5220	6170
N	0.3020	0.007163	805	1140	1380	1590	1760	1930	2070	2210	2330	2440	2660	2830	3030	3230	3430	3920	4410	5400	6390
5/16"	0.3125	0.007670	862	1220	1480	1700	1890	2060	2220	2360	2490	2620	2850	3030	3250	3460	3670	4200	4720	5780	6840
O	0.3160	0.007843	881	1250	1520	1740	1930	2110	2270	2410	2550	2660	2910	3100	3320	3540	3750	4290	4830	5910	6990
P	0.3230	0.008194	920	1300	1580	1820	2020	2200	2370	2520	2660	2800	3040	3240	3470	3690	3920	4480	5050	6180	7300
21/64"	0.3281	0.008456	950	1340	1630	1870	2080	2270	2450	2600	2750	2890	3140	3350	3580	3810	4040	4630	5210	6370	7540
Q	0.3320	0.008657	972	1370	1670	1920	2130	2330	2500	2660	2810	2950	3210	3420	3660	3900	4140	4740	5330	6520	7720
R	0.3390	0.009026	1020	1430	1740	2000	2220	2430	2607	2780	2930	3080	3350	3570	3820	4070	4320	4940	5560	6800	8040
11/32"	0.3437	0.009281	1050	1470	1790	2060	2290	2500	2690	2860	3020	3170	3450	3670	3930	4180	4440	5080	5720	6990	8270
S	0.3480	0.09511	1070	1510	1840	2110	2340	2530	2750	2930	3090	3240	3530	3760	4020	4290	4550	5200	5860	7170	8480
T	0.3580	0.1006	1130	1600	1940	2230	2480	2710	2910	3100	3270	3430	3740	4000	4260	4530	4810	5500	6200	7580	8970
23/64"	0.3594	0.1014	1140	1610	1960	2250	2500	2730	2930	3120	3300	3460	3770	4010	4290	4570	4850	5550	6240	7640	9040
U	0.3680	0.1065	1200	1690	2050	2360	2620	2860	3080	3270	3460	3630	3950	4210	4500	4790	5050	5820	6550	8020	9480
3/8"	0.3750	0.1105	1240	1750	2130	2450	2720	2970	3200	3400	3590	3770	4100	4370	4670	4980	5280	6040	6800	8330	9850
V	0.3770	0.1116	1260	1770	2150	2470	2750	3000	3230	3430	3630	3810	4140	4410	4720	5030	5340	6100	6870	8410	9950
W	0.3860	0.1170	1320	1860	2260	2590	2900	3200	3380	3600	3800	3990	4340	4630	5000	5270	5590	6350	7200	8820	10,400
25/64"	0.3960	0.1198	1350	1900	2310	2650	2950	3220	3460	3680	3890	4090	4450	4740	5100	5400	5730	6550	7380	9030	10,700
X	0.3970	0.1238	1390	1960	2390	2740	3050	3330	3580	3810	4020	4220	4600	4900	5240	5580	5920	6770	7620	9330	11,100
Y	0.4040	0.1282	1440	2030	2470	2840	3150	3450	3710	3940	4160	4370	4760	5070	5420	5780	6130	7010	7890	9660	11,500
13/32"	0.4062	0.1295	1460	2060	2500	2870	3190	3480	3750	3990	4210	4420	4810	5120	5480	5840	6200	7090	7980	9760	11,600
Z	0.4130	0.1340	1510	2130	2590	2970	3300	3600	3870	4130	4350	4570	4970	5300	5670	6040	6400	7330	8250	10,100	12,000
27/64"	0.4219	0.1398	1570	2220	2700	3100	3440	3760	4040	4300	4540	4770	5190	5530	5910	6300	6680	7650	8610	10,600	12,500
7/16"	0.4375	0.1503	1690	2380	2900	3330	3700	4040	4350	4620	4880	5120	5580	5940	6360	6770	7200	8220	9250	11,400	13,400
29/64"	0.4531	0.1613	1820	2560	3110	3570	4000	4230	4660	5000	5140	5500	5990	6380	6820	7270	7700	8820	9930	12,200	14,400
15/32"	0.4687	0.1726	1940	2740	3330	3820	4250	4640	4990	5310	5610	5880	6410	6820	7300	7770	8300	9440	10,700	13,000	15,400
31/64"	0.4844	0.1843	2070	3280	3550	4080	4530	4950	5330	5670	5990	6280	6840	7280	7790	8300	8800	10,100	11,400	13,900	16,400
1/2"	0.5000	0.1964	2210	3110	3790	4350	4830	5280	5680	6340	6380	6690	7290	7760	8310	8850	9400	10,800	12,100	14,800	17,500
33/64"	0.5156	0.2088	2350	3310	4030	4620	5140	5610	6040	6420	6780	7120	7750	8250	8490	9400	10,000	11,500	12,900	15,800	18,600
17/32"	0.5313	0.2217	2490	3510	4280	4910	5450	5960	6410	6820	7200	7560	8230	8760	9370	9980	10,600	12,200	13,700	16,700	19,800
35/64"	0.5469	0.2349	2640	3720	4530	5200	5780	6310	6790	7220	7630	8010	8720	9290	9930	10,600	11,300	12,900	14,500	17,700	21,000
9/16"	0.5625	0.2485	2790	3940	4770	5500	6110	6680	7180	7640	8070	8470	9220	9820	10,500	11,200	11,900	13,600	15,300	18,800	22,000
37/64"	0.5781	0.2625	2950	4160	5060	5810	6450	7050	7590	8070	8520	8950	9740	10,370	11,100	11,900	12,600	14,400	16,200	19,800	23,400
19/32"	0.5938	0.2769	3110	4390	5340	6130	6810	7440	8000	8510	8990	9440	10,300	10,940	11,700	12,500	13,300	15,200	17,100	20,900	24,700
39/64"	0.6094	0.2917	3280	4620	5620	6450	7170	7830	8430	8970	9470	9940	10,900	11,600	12,400	13,200	14,000	16,000	18,000	22,000	26,000
5/8"	0.6250	0.3068	3450	4860	5910	6790	7540	8240	8870	9430	9960	10,500	11,400	12,200	12,700	13,900	14,700	16,800	18,900	23,100	27,400
41/64"	0.6406	0.3223	3620	5110	6210	7130	7920	8660	9310	9910	10,500	11,000	12,000	12,800	13,700	14,600	15,400	17,700	19,900	24,300	28,800
21/32"	0.6562	0.3382	3800	5360	6520	7480	8320	9080	9770	10,400	11,000	11,600	12,600	13,400	14,300	15,300	16,200	18,500	20,900	25,500	30,200
43/64"	0.6719	0.3545	3980	5620	6830	7840	8720	9520	10,300	10,900	11,500	12,100	13,200	14,000	15,000	16,000	17,000	19,400	21,900	26,700	31,600
11/16"	0.6875	0.3712	4170	5880	7150	8210	9130	9970	10,600	11,500	12,100	12,700	13,800	14,700	15,700	16,800	17,800	20,300	22,900	28,000	33,100
23/32"	0.7188	0.4057	4560	6430	7820	8970	9970	10,900	11,800	12,500	13,200	13,900	15,100	16,100	17,200	18,300	19,400	22,200	25,000	30,600	36,200
3/4"	0.7500	0.4418	4960	7000	8510	9770	10,900	11,900	12,800	13,600	14,400	15,100	16,400	17,500	18,700	19,900	21,200	24,200	27,200	33,300	39,400
25/32"	0.7812	0.4794	5390	7590	9240	10,600	11,800	12,900	13,900	14,800	15,600	16,400	17,800	19,000	20,300	21,600	22,900	26,200	29,500	36,100	42,800
13/16"	0.8125	0.5185	5830	8210	9990	11,500	12,800	14,000	15,000	16,000	16,900	17,700	19,300	20,500	22,000	23,400	24,800	28,400	32,000	39,100	46,200
27/32"	0.8438	0.5591	6280	8850	10,800	12,400	13,800	15,000	16,200	17,200	18,200	19,100	20,800	22,100	23,700	25,200	26,700	30,600	34,400	42,100	49,800
7/8"	0.8750	0.6013	6760	9520	11,600	13,300	14,800	16,200	17,400	18,500	19,600	20,500	22,300	23,800	25,500	27,100	28,800	32,900	37,000	45,300	53,600
29/32"	0.9062	0.6450	7250	10,200	12,400	14,300	15,900	17,400	18,700	19,000	21,000	22,000	24,000	25,500	26,400	29,100	30,900	35,300	39,700	48,600	57,500
15/16"	0.9375	0.6903	7750	10,900	13,300	15,300	17,000	18,600	20,000	21,200	22,400	23,600	25,600	27,500	29,200	31,100	33,000	37,800	42,500	52,000	61,500
31/32"	0.9688	0.7371	8280	11,700	14,200	16,300	18,200	19,800	21,300	22,700	24,000	25,100	27,400	29,200	31,200	33,200	35,300	40,300	45,400	55,600	65,700
1.0"	1.0000	0.7854	8820	12,400	15,100	17,400	19,300	21,100	22,700	24,200	25,500	26,800	29,200	31,100	33,200	35,400	37,600	43,000	48,400	59,200	70,000

Viscosities of Typical Fluids vs. Temperature



EMERSON



Specific Gravity of Typical Fluids vs. Temperature

Effect of Inlet Swage On Critical Flow C_g Requirements

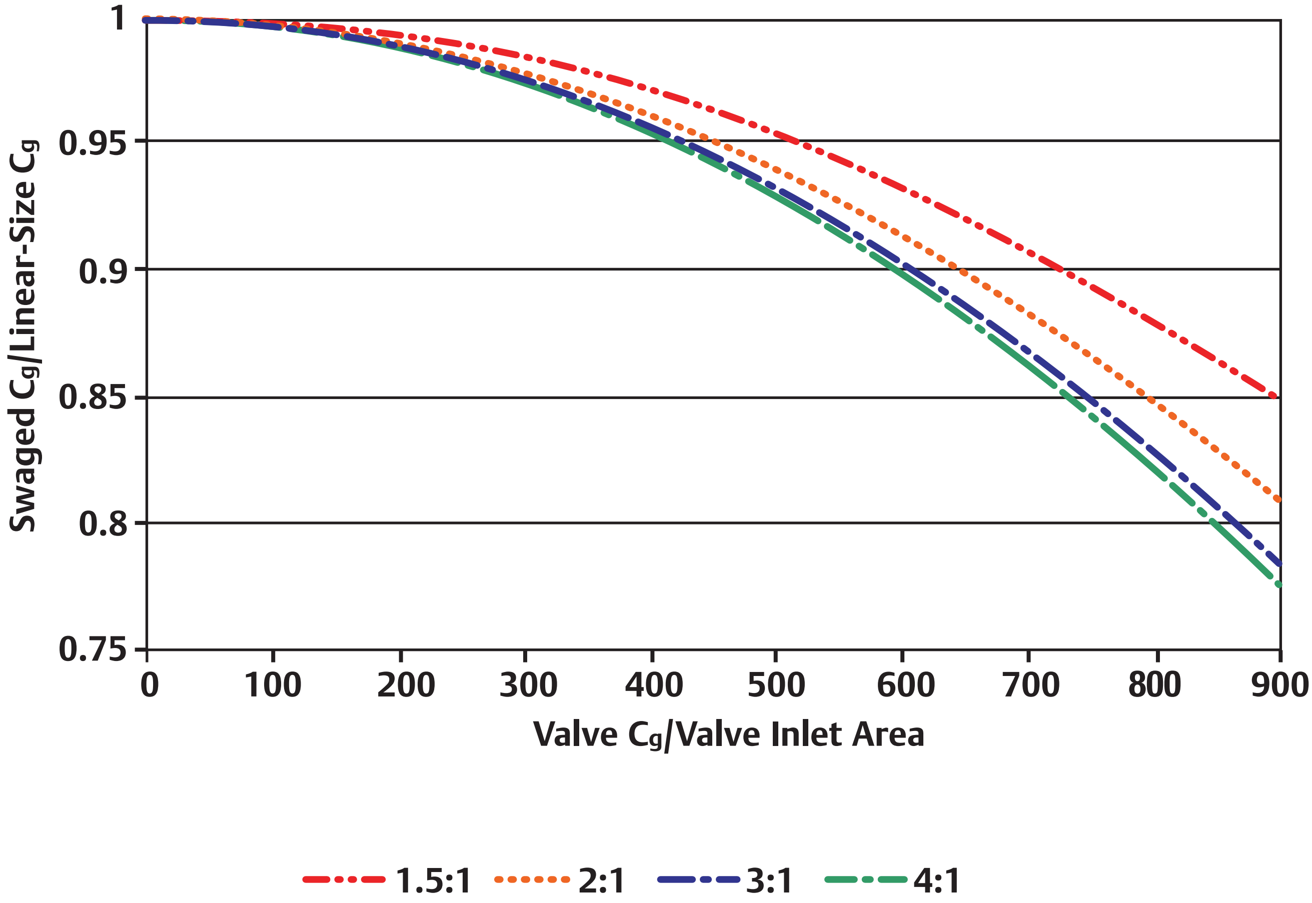


Table 43. Seat Leakage Classifications (In Accordance with ANSI/FCI 70-3-2004)

LEAKAGE CLASS DESIGNATION	DESCRIPTION	MAXIMUM LEAKAGE ALLOWABLE
I	A modification of any Class II, III or IV regulator where the design intent is the same as the basic class, but by agreement between user and supplier, no test is required.	- - - -
II	This class establishes the maximum permissible leakage generally associated with commercial double-seat regulators with metal-to-metal seats.	0.5% of maximum C_v
III	This class establishes the maximum permissible leakage generally associated with Class II, but with a higher degree of seat and seal tightness.	0.1% of maximum C_v
IV	This class establishes the maximum permissible leakage generally associated with commercial unbalanced single-seat regulators with metal-to-metal seats.	0.01% of maximum C_v
VI	This class establishes the maximum permissible seat leakage generally associated with resilient seating regulators either balanced or unbalanced with O-rings or similar gapless seals.	Leakage per following table as expressed in ml per minute versus seat diameter.
VII	This class establishes the maximum permissible seat leakage generally associated with Class VI, but with test performed at the maximum operating differential pressure.	Leakage per following table as expressed in ml per minute versus seat diameter.

Table 44. Nominal Port Diameter and Leak Rate

NOMINAL PORT DIAMETER		LEAK RATE	
mm	In.	Standard ml per Minute(3)	Bubbles per Minute(1)
≤25(2)	≤1(2)	0.15	1(2)
38	1.5	0.30	2
51	2	0.45	3
64	2.5	0.60	4
76	3	0.90	6
102	4	1.70	11
152	6	4.00	27
203	8	6.75	45
250	10	11.1	- - - -
300	12	16.0	- - - -
350	14	21.6	- - - -
400	16	28.4	- - - -

1. Bubbles per minute as tabulated are an easily measured suggested alternative based on a suitable calibrated measuring device in this case a 0.24 in. / 6 mm O.D. x 0.04 in. / 1 mm wall tube submerged in water to a depth of from 0.12 to 0.24 in. / 3 to 6 mm. The tube end shall be cut square and smooth with no chamfers or burrs and the tube axis shall be perpendicular to the surface of the water. Other apparatus may be constructed and the number of bubbles per minute may differ from those shown as long as they correctly indicate the flow in ml per minute.
2. If valve seat diameter differs by more than 0.08 in. / 2 mm from one of the valves listed, the leakage rate may be obtained by interpolation assuming that the leakage rate varies as the square of the seat diameter.
3. Standard millimeters based on 60°F / 16°C and 14.73 psia / 1.016 bar a.

Flange, Valve Size and Pressure-Temperature Rating Designations

Sizes of ASME flanges are designated as NPS (for “Nominal Pipe Size”). The nominal size is based on inches, but the units are not required in the designation. For example: NPS 2 is the size. Pressure ratings are designated by class. For example, CL150 is the rating. ASME designations replace ANSI designations.

Sizes of EN and ISO flanges are designated with DN (for “Nominal Diameter”). The nominal diameter is based on millimeters, but the units are not included in the designation. For example: DN 50 is the size. Pressure ratings are designated by PN (for “Nominal Pressure”). For example PN 40 is the pressure rating. EN and ISO designations replace DIN designations through PN 100.

ASME B16.5 flanges will mate with EN 1759 flanges but not with EN 1092 flanges (formerly DIN flanges). ASME B16.5 flanges will mate with most ISO 7005 flanges.

Common size designations in wide use are shown in the table below.

A summary of flange terminology is shown in the table below, and equivalency of flanges is shown in the table on the following page.

Pipe Thread Standards

There are three pipe thread standards that are accepted globally:

- NPT, ASME B1.20.1: General-purpose pipe threads (inches).
- G Series, ISO 228-1: Pipe threads for use where pressure-tight joints are not made on the threads. The internal and external threads are not tapered but are parallel or straight.
- R Series, ISO 7/1: Pipe threads for use where pressure-tight joints are made on the threads. The internal thread is parallel (straight) or tapered; external is always tapered.

Notes

Japanese (JIS) valves and flanges are designated according to JIS standards.

European Norm flange types, such as flat-face and raised-face are designated Type A, Type B, Type C. These types do not correspond to the DIN 2526 Form A, Form D, etc., designations.

Table 45. Common Size Designations

NPS	1/2	3/4	1	1-1/2	2	2-1/2	3	4	6	8	10	12	14	16	18	20	24
DN	15	20	25	40	50	65	80	100	150	200	250	300	350	400	450	500	600

Table 46. Summary of Flange Terminology

	ASME	EUROPEAN NORM	EXAMPLE OF PRINTED PRESENTATION
Pressure Rating	CLASS	PN	CL300 or CL300, PN 40
Size	NPS	DN	NPS 2, DN 50
Pipe Threads (Internal or External)	NPT	NPT, G (Straight), R (Tapered)	G 1/4, 1/4 NPT, 1/4 NPT Internal (or External)

Conversions, Equivalents and Physical Data

Table 47. Equivalency Table

	ISO	ASME	DIN	EUROPEAN NORM	LIMITATION
ASME and European Norm Only	- - - -	Class Flanges ASME B16.5	- - - -	EN 1759-1	Specifies ASTM materials but also permits European materials per EN 1092-1.
European Norm Only	- - - -			EN 1092	Through PN 100(1)
DIN Only	- - - -		DIN(2)	- - - -	Above PN 100(1)
ISO and ASME Only	ISO 7005	Class Flanges ASME B16.5	- - - -		A few sizes are compatible to previous DIN standards. An older version contained flange designations that do not appear in the current standard.

1. DIN is no longer used except for pressure ratings above PN 100.
2. DIN standards 2628, 2629, 2638, 2548, 2549, 2550 and 2551.

Table 48. Standard Pressure-Temperature Ratings for ASME CL150 Valve Bodies(1)

SERVICE TEMPERATURE		WORKING PRESSURE									
		LCB		LCC/WCC		WCB		CF8 or 304		CF8M/CF3M	
°F	°C	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
-20 to 100 200	-29 to 38 93	265 255	18.3 17.6	290 260	20.0 17.9	285 260	19.7 17.9	275 230	19.0 15.9	275 235	19.0 16.2
300 400	149 204	230 200	15.9 13.8	230 200	15.9 13.8	230 200	15.9 13.8	205 190	14.1 13.1	215 195	14.8 13.4
500 600	260 316	170 140	11.7 9.7	170 140	11.7 9.7	170 140	11.7 9.7	170 140	11.7 9.7	170 140	11.7 9.7
650 700	343 371	125 110	8.6 7.6	125 110	8.6 7.6	125 110	8.6 7.6	125 110	8.6 7.6	125 110	8.6 7.6

1. Table information is extracted from the Valve-Flanged, Threaded and Welding End, ASME Standard B16.34-2004. These tables must be used in accordance with the ASME standard.

Table 49. Standard Pressure-Temperature Ratings for ASME CL300 Valve Bodies(1)

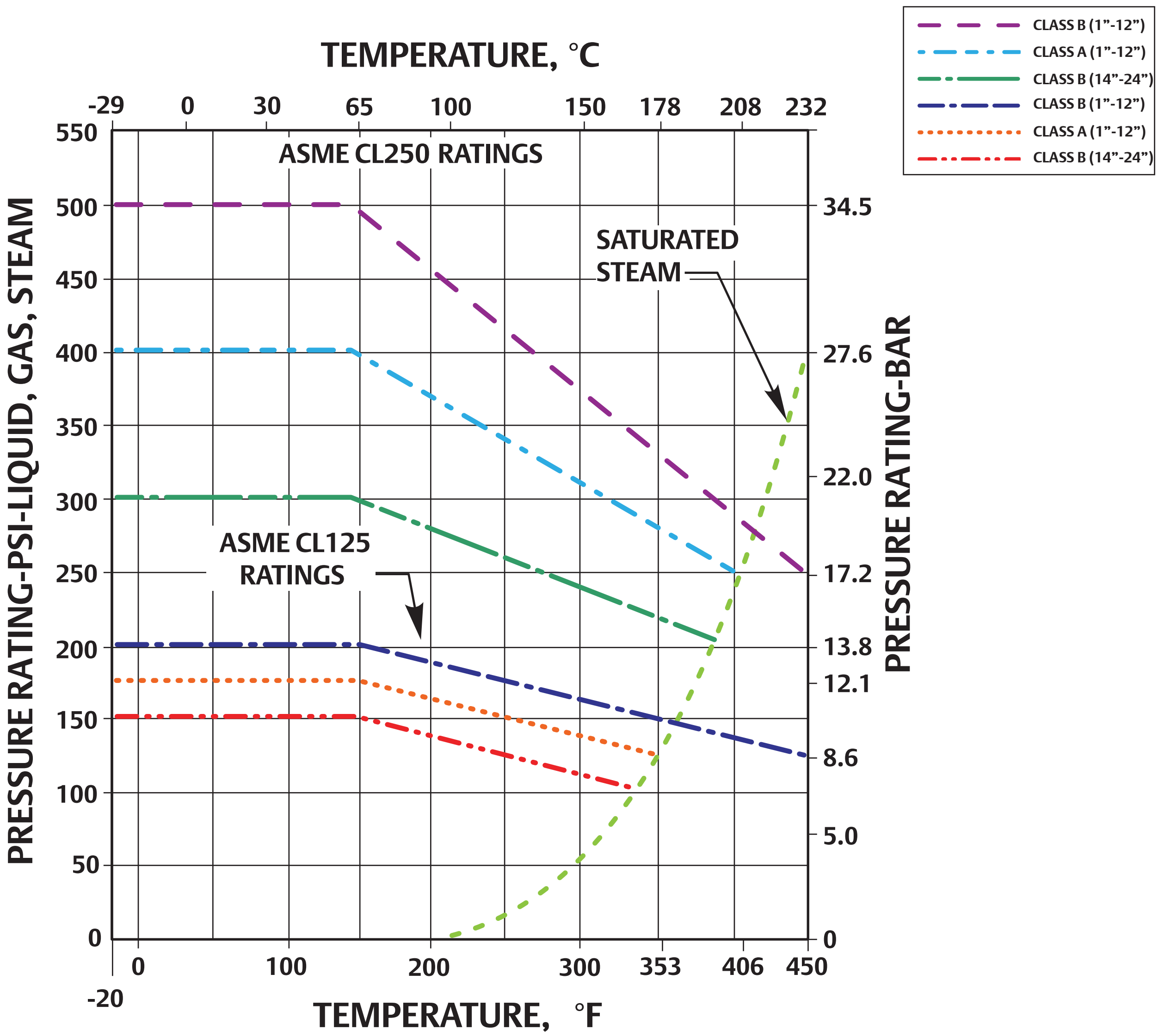
SERVICE TEMPERATURE		WORKING PRESSURE									
		LCB		LCC/WCC		WCB		CF8 or 304		CF8M/CF3M	
°F	°C	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
-20 to 100 200	-29 to 38 93	695 660	47.9 45.5	750 750	51.7 51.7	740 680	51.0 46.9	720 600	49.6 41.4	720 620	49.6 42.7
300 400	149 204	640 615	44.1 42.4	730 705	50.3 48.6	655 635	45.2 43.8	540 495	37.2 34.1	560 515	38.6 35.5
500 600	260 316	585 550	40.3 37.9	665 605	45.9 41.7	605 570	41.7 39.3	465 440	32.1 30.3	480 450	33.1 31.0
650 700	343 371	535 510	36.8 35.2	590 555	40.7 38.3	550 530	38.0 36.5	430 420	29.6 29.0	440 435	30.3 30.0

1. Table information is extracted from the Valve-Flanged, Threaded and Welding End, ASME Standard B16.34-2004. These tables must be used in accordance with the ASME standard.

Table 50. Standard Pressure-Temperature Ratings for ASME CL600 Valve Bodies[1]

SERVICE TEMPERATURE		WORKING PRESSURE									
		LCB		LCC/WCC		WCB		CF8 or 304		CF8M/CF3M	
°F	°C	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
-20 to 100	-29 to 38	1395	96.2	1500	103	1480	102	1440	99.3	1440	99.3
200	93	1320	91.0	1500	103	1360	93.7	1200	82.7	1240	85.5
300	149	1275	87.9	1455	100	1310	90.3	1075	74.1	1120	77.2
400	204	1230	84.8	1405	97.0	1265	87.2	995	68.6	1025	70.7
500	260	1175	81.0	1330	91.7	1205	83.1	930	64.1	955	65.8
600	316	1105	76.2	1210	83.4	1135	78.3	885	61.0	900	62.1
650	343	1065	73.4	1175	81.0	1100	75.8	865	59.6	885	61.0
700	371	1025	70.7	1110	76.5	1060	73.1	845	58.3	870	60.0

1. Table information is extracted from the Valve-Flanged, Threaded and Welding End, ASME Standard B16.34-2004. These tables must be used in accordance with the ASME standard.



Pressure/Temperature Ratings for ASTM A126 Cast Iron Valves

Conversions, Equivalents and Physical Data

Table 51. Diameter of Bolt Circle

NOMINAL PIPE SIZE, IN.	ASME CL125 (CAST IRON) OR CL150 (STEEL)[1]	ASME CL250 (CAST IRON) OR CL300 (STEEL)[2]	ASME CL600	ASME CL900	ASME CL1500	ASME CL2500
1	3.12	3.50	3.50	4.00	4.00	4.25
1-1/4	3.50	3.88	3.88	4.38	4.38	5.12
1-1/2	3.88	4.50	4.50	4.88	4.88	5.75
2	4.75	5.00	5.00	6.50	6.50	6.75
2-1/2	5.50	5.88	5.88	7.50	7.50	7.75
3	6.00	6.62	6.62	7.50	8.00	9.00
4	7.50	7.88	8.50	9.25	9.50	10.75
5	8.50	9.25	10.50	11.00	11.50	12.75
6	39.50	10.62	11.50	12.50	12.50	14.50
8	11.75	13.00	13.75	15.50	15.50	17.25
10	14.25	15.25	17.00	18.50	19.00	21.75
12	17.00	17.75	19.25	21.00	22.50	24.38
14	18.75	20.25	20.75	22.00	25.00	- - - -
16	21.25	22.50	23.75	24.25	27.75	- - - -
18	22.75	24.75	25.75	27.00	30.50	- - - -
20	25.00	27.00	28.50	29.50	32.75	- - - -
24	29.50	32.00	33.00	35.50	39.00	- - - -
30	36.00	39.25	- - - -	- - - -	- - - -	- - - -
36	42.75	46.00	- - - -	- - - -	- - - -	- - - -
42	49.50	52.75	- - - -	- - - -	- - - -	- - - -
48	56.00	60.75	- - - -	- - - -	- - - -	- - - -

1. Sizes 1 through 12 in. also apply to ASME CL150 bronze flanges.
2. Sizes 1 through 8 in. also apply to ASME CL300 bronze flanges.

Table 52. ASME Face-To-Face Dimensions for Flanged Regulators

BODY SIZE, IN.	ASME CLASS AND END CONNECTIONS (IN. DIMENSIONS ARE IN ACCORDANCE WITH ISA S4.01.1-1997)											
	CL125 FF (Cast Iron) CL150 RF (Steel)		CL250 RF (Cast Iron) CL300 RF (Steel)		CL150 RJT (Steel)		CL300 RJT (Steel)		CL600 RF (Steel)		CL600 RJT (Steel)	
	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm	In.	mm
1	7.25	184	7.75	197	7.75	197	8.25	210	8.25	210	8.25	210
1-1/4	7.88	200	8.38	213	8.38	213	8.88	226	9.00	229	9.00	229
1-1/2	8.75	222	9.25	235	9.25	235	9.75	248	9.88	251	9.88	251
2	10.00	254	10.50	267	10.50	267	11.12	282	11.25	286	11.38	289
2-1/2	10.88	276	11.50	292	11.38	289	12.12	308	12.25	311	12.38	314
3	11.75	298	12.50	317	12.25	311	13.12	333	13.25	337	13.38	340
4	13.88	353	14.50	368	14.38	365	15.12	384	15.50	394	15.62	397
6	17.75	451	18.62	473	18.25	464	19.25	489	20.00	508	20.12	511
8	21.38	543	22.38	568	21.88	556	23.00	584	24.00	610	24.12	613
10	26.50	673	27.88	708	27.00	686	28.50	724	29.62	752	29.75	756
12	29.00	737	30.50	775	29.50	749	31.12	790	32.25	819	32.38	822
16	40.00	1016	41.62	1057	40.50	1029	42.25	1073	43.62	1108	43.75	1111

FF—Flat-faced, RF—Raised-faced and RTJ—Ring Type Joint

Table 53. Wear and Galling Resistance Chart of Material Combinations

MATERIAL	304 STAINLESS STEEL	316 STAINLESS STEEL	BRONZE	INCONEL®	MONEL®	HASTELLOY® C	NICKEL
304 Stainless Steel	P	P	F	P	P	F	P
316 Stainless Steel	P	P	F	P	P	F	P
Bronze	F	F	S	S	S	S	S
Inconel®	P	P	S	P	P	F	F
Monel®	P	P	S	P	P	F	F
Hastelloy® C	F	F	S	F	F	F	F
Nickel	P	P	S	P	F	F	P
Alloy 20	P	P	S	F	F	F	P
Type 416 Hard	F	F	F	F	F	F	F
Type 440 Hard	F	F	F	F	F	F	F
17-4PH	F	F	F	F	F	F	F
ENC(1)	F	F	F	F	F	F	F
Cr Plate	F	F	F	F	F	S	S
Al Bronze	F	F	F	S	S	S	S

1. Electroless Nickel Coating
S - Satisfactory F - Fair P - Poor

- continued -

Table 53. Wear and Galling Resistance Chart of Material Combinations (continued)

MATERIAL	ALLOY 20	TYPE 416 HARD	TYPE 440 HARD	17-4PH	ENC(1)	Cr PLATE	Al BRONZE
304 Stainless Steel	P	F	F	F	F	F	F
316 Stainless Steel	P	F	F	F	F	F	F
Bronze	S	F	F	F	F	F	F
Inconel®	F	F	F	F	F	F	S
Monel®	F	F	F	F	F	F	S
Hastelloy® C	F	F	F	F	F	S	S
Nickel	P	F	F	F	F	F	S
Alloy 20	P	F	F	F	F	F	S
Type 416 Hard	F	F	F	F	S	S	S
Type 440 Hard	F	S	F	S	S	S	S
17-4PH	F	F	S	P	S	S	S
ENC(1)	F	S	S	S	P	S	S
Cr Plate	S	S	S	S	S	P	S
Al Bronze	S	S	S	S	S	S	P

1. Electroless Nickel Coating
S - Satisfactory F - Fair P - Poor

Table 54. Equivalent Lengths of Pipe Fittings and Valves

TYPE OF FITTING OR VALVE	LENGTHS IN FEET OF STANDARD PIPE																		
	Nominal Pipe Size in In.																		
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12	14 O.D.	16 O.D.	18 O.D.	20 O.D.	24 O.D.	30 O.D.
Standard tee with entry or discharge through side	3.4	4.5	5.5	7.5	9.0	12	14	17	22	33	43	55	65	78	85	105	115	135	170
Standard elbow or run(1) of tee reduced 1/2(2)	1.7	2.2	2.7	3.7	4.3	5.5	6.5	8	12	16	20	26	31	36	42	47	52	64	80
Medium sweep elbow or run(1) of tee reduced 1/4(2)	1.3	1.8	2.3	3.0	3.7	4.6	5.4	6.8	9.0	14	18	22	26	30	35	40	43	55	67
Long sweep elbow or run(1) of standard tee or butterfly valve	1	1.3	1.7	2.3	2.7	3.5	4.2	5.3	7	11	14	17	20	23	26	31	34	41	52
45° elbow	0.8	1.0	1.2	1.6	2.0	2.5	3.0	3.7	5.0	7.5	10	12	15	17	20	22	24	30	37
Close return bend	3.7	5.1	6.2	8.5	10	13	15	19	24	37	49	62	75	86	100	110	125	150	185
Globe valve, wide-open	0.6	22	27	40	43	45	65	82	120	170	240	290	340	400	440	500	550	680	850
Angle valve, wide-open	8.2	11	14	18	21	28	33	42	56	85	112	145	165	190	220	250	280	340	420
Swing check valve, wide-open	4.0	5.2	6.6	9.0	11	14	16	19	26	39	52	66	78	92	106	120	130	145	160
Gate valve, wide-open or slight bushing reduction	0.4	0.5	0.6	0.8	0.9	1.2	1.3	1.7	2.3	3.5	4.5	5.7	6.7	8.0	9.0	11	12	14	17

1. A fluid is said to flow through the run of a tee when the flow is straight through the tee with no change of direction.
2. A tee is said to be reduced 1/4 if the internal area of the smaller connecting pipe is 25% less than the internal area of the larger connecting pipe.

Table 55. Pipe Data: Carbon and Allow Steel—Stainless Steel

NOMINAL PIPE SIZE, IN.	OUTSIDE DIAMETER, IN.	IDENTIFICATION			WALL THICKNESS (t), IN.	INSIDE DIAMETER (d), IN.	AREA OF METAL, IN^2.	TRANSVERSE INTERNAL AREA		WEIGHT PIPE, LBS/FT	WEIGHT WATER, LBS/FT OF PIPE
		Steel		Stainless Steel Schedule No.				(a), In^2.	(A), Ft^2		
		Iron Pipe Size	Schedule No.								
1/8	0.405	----	----	10S	0.049	0.307	0.0548	0.0740	0.00051	0.19	0.032
		STD	40	40S	0.068	0.269	0.0720	0.0568	0.00040	0.24	0.025
		XS	80	80S	0.095	0.215	0.0925	0.0365	0.00025	0.31	0.016
1/4	0.540	----	----	10S	0.065	0.410	0.0970	0.1320	0.00091	0.33	0.057
		STD	40	40S	0.088	0.364	0.1250	0.1041	0.00072	0.42	0.045
		XS	80	80S	0.119	0.302	0.1574	0.0716	0.00050	0.54	0.031
3/8	0.675	----	----	10S	0.065	0.545	0.1246	0.2333	0.00162	0.42	0.101
		STD	40	40S	0.091	0.493	0.1670	0.1910	0.00133	0.57	0.083
		XS	80	80S	0.126	0.423	0.2173	0.1405	0.00098	0.74	0.061
1/2	0.840	----	----	5S	0.065	0.710	0.1583	0.3959	0.00275	0.54	0.172
		----	----	10S	0.083	0.674	0.1974	0.3568	0.00248	0.67	0.155
		STD	40	40S	0.109	0.622	0.2503	0.3040	0.00211	0.85	0.132
		XS	80	80S	0.147	0.546	0.3200	0.2340	0.00163	1.09	0.102
		----	160	----	0.187	0.466	0.3836	0.1706	0.00118	1.31	0.074
		XXS	----	----	0.294	0.252	0.5043	0.050	0.00035	1.71	0.022
3/4	1.050	----	----	5S	0.065	0.920	0.2011	0.6648	0.00462	0.69	0.288
		----	----	10S	0.083	0.884	0.2521	0.6138	0.00426	0.86	0.266
		STD	40	40S	0.113	0.824	0.3326	0.5330	0.00371	1.13	0.231
		XS	80	80S	0.154	0.742	0.4335	0.4330	0.00300	1.47	0.188
		----	160	----	0.219	0.612	0.5698	0.2961	0.00206	1.94	0.128
		XXS	----	----	0.308	0.434	0.7180	0.148	0.00103	2.44	0.064
1	1.315	----	----	5S	0.065	1.185	0.2553	1.1029	0.00766	0.87	0.478
		----	----	10S	0.109	1.097	0.4130	0.9452	0.00656	1.40	0.409
		STD	40	40S	0.133	1.049	0.4939	0.8640	0.00600	1.68	0.375
		XS	80	80S	0.065	0.957	0.6388	0.7190	0.00499	2.17	0.312
		----	160	----	0.250	0.815	0.8365	0.5217	0.00362	2.84	0.230
		XXS	----	----	0.358	0.599	1.0760	0.282	0.00196	3.66	0.122
1-1/4	1.660	----	----	5S	0.065	1.530	0.3257	1.839	0.01277	1.11	0.797
		----	----	10S	0.109	1.442	0.4717	1.633	0.01134	1.81	0.708
		STD	40	40S	0.140	1.380	0.6685	1.495	0.01040	2.27	0.649
		XS	80	80S	0.191	1.278	0.8815	1.283	0.00891	3.00	0.555
		----	160	----	0.250	1.160	1.1070	1.057	0.00734	3.76	0.458
		XXS	----	----	0.382	0.896	1.534	0.630	0.00438	5.21	0.273
1-1/2	1.900	----	----	5S	0.065	1.770	0.3747	2.461	0.01709	1.28	1.066
		----	----	10S	0.109	1.682	0.6133	2.222	0.01543	2.09	0.963
		STD	40	40S	0.145	1.610	0.7995	2.036	0.01414	2.72	0.882
		XS	80	80S	0.200	1.500	1.068	1.767	0.01225	3.63	0.765
		----	160	----	0.281	1.338	1.429	1.406	0.00976	4.86	0.608
		XXS	----	----	0.400	1.100	1.885	0.950	0.00660	6.41	0.42
2	2.375	----	----	5S	0.065	2.245	0.4717	3.958	0.02749	1.61	1.72
		----	----	10S	0.109	2.157	0.7760	3.654	0.02538	2.64	1.58
		STD	40	40S	0.154	2.067	1.075	3.355	0.02330	3.65	1.45
		XS	80	80S	0.218	1.939	1.477	2.953	0.02050	5.02	1.28
		----	160	----	0.344	1.687	2.190	2.241	0.01556	7.46	0.97
		XXS	----	----	0.436	1.503	2.656	1.774	0.01232	9.03	0.77

Identification, wall thickness and weights are extracted from ASME B36.10 and B39.19.
The notations STD, XS and XXS indicate Standard, Extra Strong and Double Extra Strong pipe, respectively.
Transverse internal area values listed in "square feet" also represent volume in cubic feet per foot of pipe length.

- continued -

Table 55. Pipe Data: Carbon and Allow Steel—Stainless Steel (continued)

NOMINAL PIPE SIZE, IN.	OUTSIDE DIAMETER, IN.	IDENTIFICATION			WALL THICKNESS (t), IN.	INSIDE DIAMETER (d), IN.	AREA OF METAL, IN².	TRANSVERSE INTERNAL AREA		WEIGHT PIPE, LBS/FT	WEIGHT WATER, LBS/FT OF PIPE
		Steel		Stainless Steel Schedule No.				(a), In².	(A), Ft².		
		Iron Pipe Size	Schedule No.								
2-1/2	2.875	----	----	5S	0.083	2.709	0.7280	5.764	0.04002	2.48	2.50
		----	----	10S	0.120	2.635	1.039	5.453	0.03787	3.53	2.36
		STD	40	40S	0.203	2.469	1.704	4.788	0.03322	5.79	2.07
		XS	80	80S	0.279	2.323	2.254	4.238	0.02942	7.66	1.87
		----	160	----	0.375	2.125	2.945	3.546	0.02463	10.01	1.54
		XXS	----	----	0.552	1.771	4.028	2.464	0.01710	13.69	1.07
3	3.500	----	----	5S	0.083	3.334	0.8910	8.730	0.06063	3.03	3.78
		----	----	10S	0.120	3.260	1.274	8.347	0.05796	4.33	3.62
		STD	40	40S	0.216	3.068	2.228	7.393	0.05130	7.58	3.20
		XS	80	80S	0.300	2.900	3.016	6.605	0.04587	10.25	2.86
		----	160	----	0.438	2.624	4.205	5.408	0.03755	14.32	2.35
		XXS	----	----	0.600	2.300	5.466	4.155	0.02885	18.58	1.80
3-1/2	4.000	----	----	5S	0.083	3.834	1.021	11.545	0.08017	3.48	5.00
		----	----	10S	0.120	3.760	1.463	11.104	0.07711	4.97	4.81
		STD	40	40S	0.226	3.548	2.680	9.886	0.06870	9.11	4.29
		XS	80	80S	0.318	3.364	3.678	8.888	0.06170	12.50	3.84
4	4.500	----	----	5S	0.083	4.334	1.152	14.75	0.10245	3.92	6.39
		----	----	10S	0.120	4.260	1.651	14.25	0.09898	5.61	6.18
		STD	40	40S	0.237	4.026	3.174	12.73	0.08840	10.79	5.50
		XS	80	80S	0.337	3.826	4.407	11.50	0.07986	14.98	4.98
		----	120	----	0.438	3.624	5.595	10.31	0.0716	19.00	4.47
		----	160	----	0.531	3.438	6.621	9.28	0.0645	22.51	4.02
		XXS	----	----	0.674	3.152	8.101	7.80	0.0542	27.54	3.38
5	5.563	----	----	5S	0.109	5.345	1.868	22.44	0.1558	6.36	9.72
		----	----	10S	0.134	5.295	2.285	22.02	0.1529	7.77	9.54
		STD	40	40S	0.258	5.047	4.300	20.01	0.1390	14.62	8.67
		XS	80	80S	0.375	4.813	6.112	18.19	0.1263	20.78	7.88
		----	120	----	0.500	4.563	7.953	16.35	0.1136	27.04	7.09
		----	160	----	0.625	4.313	9.696	14.61	0.1015	32.96	6.33
		XXS	----	----	0.750	4.063	11.340	12.97	0.0901	38.55	5.61
6	6.625	----	----	5S	0.109	6.407	2.231	32.24	0.2239	7.60	13.97
		----	----	10S	0.134	6.357	2.733	31.74	0.2204	9.29	13.75
		STD	40	40S	0.280	6.065	5.581	28.89	0.2006	18.97	12.51
		XS	80	80S	0.432	5.761	8.405	26.07	0.1810	28.57	11.29
		----	120	----	0.562	5.501	10.70	23.77	0.1650	36.39	10.30
		----	160	----	0.719	5.187	13.32	21.15	0.1469	45.35	9.16
		XXS	----	----	0.864	4.897	15.64	18.84	0.1308	53.16	8.16
9	8.625	----	----	5S	0.109	8.407	2.916	55.51	0.3855	9.93	24.06
		----	----	10S	0.148	8.329	3.941	54.48	0.3784	13.40	23.61
		----	20	----	0.250	8.125	6.57	51.85	0.3601	22.36	22.47
		----	30	----	0.277	8.071	7.26	51.16	0.3553	24.70	22.17
		STD	40	40S	0.322	7.981	8.40	50.03	0.3474	28.55	21.70
		----	60	----	0.406	7.813	10.48	47.94	0.3329	35.64	20.77
		XS	80	80S	0.500	7.625	12.76	45.66	0.3171	43.39	19.78
		----	100	----	0.594	7.437	14.96	43.46	0.3018	50.95	18.83
		----	120	----	0.719	7.187	17.84	40.59	0.2819	60.71	17.59
		----	140	----	0.812	7.001	19.93	38.50	0.2673	67.76	16.68
		XXS	----	----	0.875	6.875	21.30	37.12	0.2578	72.42	16.10
		----	160	----	0.906	6.813	21.97	36.46	0.2532	74.69	15.80
10	10.750	----	----	5S	0.134	10.482	4.36	86.29	0.5992	15.19	37.39
		----	----	10S	0.165	10.420	5.49	85.28	0.5922	18.65	36.95
		----	20	----	0.250	10.250	8.24	82.52	0.5731	28.04	35.76
		----	30	----	0.307	10.136	10.07	80.69	0.5603	34.24	34.96
		STD	40	40S	0.365	10.020	11.90	78.86	0.5475	40.48	34.20
		XS	60	80S	0.500	9.750	16.10	74.66	0.5185	54.74	32.35
		----	80	----	0.594	9.562	18.92	71.84	0.4989	64.43	31.13
		----	100	----	0.719	9.312	22.63	68.13	0.4732	77.03	29.53
		----	120	----	0.844	9.062	26.24	64.53	0.4481	89.29	27.96
		XXS	140	----	1.000	8.750	30.63	60.13	0.4176	104.13	26.06
		----	160	----	1.125	8.500	34.02	56.75	0.3941	115.64	24.59

Identification, wall thickness and weights are extracted from ASME B36.10 and B39.19.
The notations STD, XS and XXS indicate Standard, Extra Strong and Double Extra Strong pipe, respectively.
Transverse internal area values listed in "square feet" also represent volume in cubic feet per foot of pipe length.

Table 56. American Pipe Flange Dimensions

ASME CLASS FLANGE DIAMETER - IN., PER ASME B16.1, B16.5 AND B16.24						
Nominal Pipe Size	125 (Cast Iron) or 150 (Steel)(1)	250 (Cast Iron) or 300 (Steel)(2)	600	900	1500	2500
1	4.25	4.88	4.88	5.88	5.88	6.25
1-1/4	4.62	5.25	5.25	6.25	6.25	7.25
1-1/2	5.00	6.12	6.12	7.00	7.00	8.00
2	6.00	6.50	6.50	8.50	8.50	9.25
2-1/2	7.00	7.50	7.50	9.62	9.62	10.50
3	7.50	8.25	8.25	9.50	10.50	12.00
4	9.00	10.00	10.75	11.50	12.25	14.00
5	10.00	11.00	13.00	13.75	14.75	16.50
6	11.00	12.50	14.00	15.00	15.50	19.00
8	13.50	15.00	16.50	18.50	19.00	21.75
10	16.00	17.50	20.00	21.50	23.00	26.50
12	19.00	20.50	22.00	24.00	26.50	30.00
14	21.00	23.00	23.75	25.25	29.50	----
16	23.50	25.50	27.00	27.75	32.50	----
18	25.00	28.00	29.25	31.00	36.00	----
20	27.50	30.50	32.00	33.75	38.75	----
24	32.00	36.00	37.00	41.00	46.00	----
30	38.75	43.00	----	----	----	----
36	46.00	50.00	----	----	----	----
42	53.00	57.00	----	----	----	----
48	59.50	65.00	----	----	----	----

1. Sizes 1 through 12 in. also apply to ASME CL150 bronze flanges.
2. Sizes 1 through 8 in. also apply to ASME CL300 bronze flanges.

- continued -

Table 56. American Pipe Flange Dimensions (continued)

ASME CLASS, NUMBER OF STUD BOLTS AND HOLE DIAMETER IN IN., PER ASME B16.1, B16.5 AND B16.24												
Nominal Pipe Size	125 (Cast Iron) or 150 (Steel)(1)		250 (Cast Iron) or 300 (Steel)(2)		600		900		1500		2500	
	No.	Ø	No.	Ø	No.	Ø	No.	Ø	No.	Ø	No.	Ø
1	4	0.50	4	0.62	4	0.62	4	0.88	4	0.88	4	0.88
1-1/4	4	0.50	4	0.62	4	0.62	4	0.88	4	0.88	4	1.00
1-1/2	4	0.50	4	0.75	4	0.75	4	1.00	4	1.00	4	1.12
2	4	0.62	8	0.62	8	0.62	8	0.88	8	0.88	8	1.00
2-1/2	4	0.62	8	0.75	8	0.75	8	1.00	8	1.00	8	1.12
3	4	0.62	8	0.75	8	0.75	8	0.88	8	1.12	8	1.25
4	8	0.62	8	0.75	8	0.75	8	0.12	8	1.25	8	1.50
5	8	0.75	8	0.75	8	1.00	8	1.25	8	1.50	8	1.75
6	8	0.75	12	0.75	12	1.00	12	1.12	12	1.38	8	2.00
8	8	0.75	12	0.88	12	1.12	12	1.38	12	1.62	12	2.00
10	12	0.88	16	1.00	16	1.25	16	1.38	12	1.88	12	2.50
12	12	0.88	16	1.12	20	1.25	20	1.38	16	2.00	12	2.75
14	12	1.00	20	1.12	20	1.38	20	1.50	16	2.25	----	----
16	16	1.00	20	1.25	20	1.50	20	1.62	16	2.50	----	----
18	16	1.12	24	1.25	20	1.62	20	1.88	16	2.75	----	----
20	20	1.12	24	1.25	24	1.62	20	2.00	16	3.00	----	----
24	20	1.25	24	1.50	24	1.88	20	2.50	16	3.50	----	----
30	28	1.25	28	1.75	----	----	----	----	----	----	----	----
36	32	1.50	32	2.00	----	----	----	----	----	----	----	----
42	36	1.50	36	2.00	----	----	----	----	----	----	----	----
48	44	1.50	40	2.00	----	----	----	----	----	----	----	----

1. Sizes 1 through 12 in. also apply to ASME CL150 bronze flanges.
2. Sizes 1 through 8 in. also apply to ASME CL300 bronze flanges.

Table 57. EN 1092-1 Cast Steel Flange Standard-PN 16 (Nominal Pressure 16 bar)

NOMINAL BORE, mm	PIPE THICKNESS, mm	FLANGE, mm			BOLTING, mm		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	6	90	16	60	4	M12	14
15	6	95	16	65	4	M12	14
20	6.5	105	18	75	4	M12	14
25	7	115	18	85	4	M12	14
32	7	140	18	100	4	M16	18
40	7.5	150	18	110	4	M16	18
50	8	165	20	125	4	M16	18
65	8	185	18	145	4	M16	18
80	8.5	200	20	160	8	M16	18
100	9.5	220	20	180	8	M16	18
125	10	250	22	210	8	M16	18
150	11	285	22	240	8	M20	23
175	12	315	24	270	8	M20	23
200	12	340	24	295	12	M20	23
250	14	405	26	355	12	M24	27
300	15	460	28	410	12	M24	27
350	16	520	30	470	16	M24	27
400	18	580	32	525	16	M27	30
500	21	715	36	650	20	M30	33
600	23	840	40	770	20	M33	36
700	24	910	42	840	24	M33	36
800	26	1025	42	950	24	M36	39
900	27	1125	44	1050	28	M36	39
1000	29	1255	46	1170	28	M39	42
1200	32	1485	52	1390	32	M45	48
1400	34	1685	58	1590	36	M45	48
1600	36	1930	64	1820	40	M52	56
1800	39	2130	68	2020	44	M52	56
2000	41	2345	70	2230	48	M56	62
2200	43	2555	74	2440	52	M56	62

Table 58. EN 1092-1 Cast Steel Flange Standard-PN 25 (Nominal Pressure 25 bar)

NOMINAL BORE, mm	PIPE THICKNESS, mm	FLANGE, mm			BOLTING, mm		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	6	90	16	60	4	M12	14
15	6	95	16	65	4	M12	14
20	6.5	105	18	75	4	M12	14
25	7	115	18	85	4	M12	14
32	7	140	18	100	4	M16	18
40	7.5	150	18	110	4	M16	18
50	8	165	20	125	4	M16	18
65	8.5	185	22	145	8	M16	18
80	9	200	24	160	8	M16	18
100	10	235	24	190	8	M20	23
125	11	270	26	220	8	M24	27
150	12	300	28	250	8	M24	27
175	12	330	28	280	12	M24	27
200	12	360	30	310	12	M24	27
250	14	425	32	370	12	M27	30
300	15	485	34	430	16	M27	30
350	16	555	38	490	16	M30	33
400	18	620	40	550	16	M33	36
500	21	730	44	660	20	M33	36
600	23	845	46	770	20	M36	39
700	24	960	50	875	24	M39	42
800	26	1085	54	990	24	M45	48
900	27	1185	58	1090	28	M45	48
1000	29	1320	62	1210	28	M52	56
1200	32	1530	70	1420	32	M52	56
1400	34	1755	76	1640	36	M56	62
1600	37	1975	84	1860	40	M56	62
1800	40	2195	90	2070	44	M64	70
2000	43	2425	96	2300	48	M64	70

Table 59. EN 1092-1 Cast Steel Flange Standard–PN 40 (Nominal Pressure 40 bar)

NOMINAL BORE, mm	PIPE THICKNESS, mm	FLANGE, mm			BOLTING, mm		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	6	90	16	60	4	M12	14
15	6	95	16	65	4	M12	14
20	6.5	105	18	75	4	M12	14
25	7	115	18	85	4	M12	14
32	7	140	18	100	4	M16	18
40	7.5	150	18	110	4	M16	18
50	8	165	20	125	4	M16	18
65	8.5	185	22	145	8	M16	18
80	9	200	24	160	8	M16	18
100	10	235	24	190	8	M20	23
125	11	270	26	220	8	M24	27
150	12	300	28	250	8	M24	27
175	13	350	32	295	12	M27	30
200	14	375	34	320	12	M27	30
250	16	450	38	385	12	M30	33
300	17	515	42	450	16	M30	33
350	19	580	46	510	16	M33	36
400	21	660	50	585	16	M36	39
450	21	685	50	610	20	M36	39
500	21	755	52	670	20	M39	42
600	24	890	60	795	20	M45	48
700	27	995	64	900	24	M45	48
800	30	1140	72	1030	24	M52	56
900	33	1250	76	1140	28	M52	56
1000	36	1360	80	1250	28	M52	56
1200	42	1575	88	1460	32	M56	62
1400	47	1795	98	1680	36	M56	62
1600	54	2025	108	1900	40	M64	70

Table 60. EN 1092-1 Cast Steel Flange Standard–PN 63 (Nominal Pressure 63 bar)

NOMINAL BORE, mm	PIPE THICKNESS, mm	FLANGE, mm			BOLTING, mm		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	10	100	20	70	4	M12	14
15	10	105	20	75	4	M12	14
25	10	140	24	100	4	M16	18
32	12	155	24	110	4	M20	23
40	10	170	28	125	4	M20	22
50	10	180	26	135	4	M20	22
65	10	205	26	160	8	M20	22
80	11	215	28	170	8	M20	22
100	12	250	30	200	8	M24	26
125	13	295	34	240	8	M27	30
150	14	345	36	280	8	M30	33
175	15	375	40	310	12	M30	33
200	16	415	42	345	12	M33	36
250	19	470	46	400	12	M33	36
300	21	530	52	460	16	M33	36
350	23	600	56	525	16	M36	39
400	26	670	60	585	16	M39	42
500	31	800	68	705	20	M45	48
600	35	930	76	820	20	M52	56
700	40	1045	84	935	24	M52	56
800	45	1165	92	1050	24	M56	62
900	50	1285	98	1170	28	M56	62
1000	55	1415	108	1290	28	M64	70
1200	64	1665	126	1530	32	M72X6	78

Table 61. EN 1092-1 Cast Steel Flange Standard—PN 100 (Nominal Pressure 100 bar)

NOMINAL BORE, mm	PIPE THICKNESS, mm	FLANGE, mm			BOLTING, mm			NOMINAL BORE, mm	PIPE THICKNESS, mm	FLANGE, mm			BOLTING, mm		
		Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter			Outside Diameter	Thickness	Bolt Circle Diameter	Number of Bolts	Thread	Bolt Hole Diameter
10	10	100	20	70	4	M12	14	150	18	355	44	290	12	M30	33
15	10	105	20	75	4	M12	14	175	20	385	48	320	12	M30	33
25	10	140	24	100	4	M16	18	200	21	430	52	360	12	M33	36
32	12	155	24	110	4	M20	23	250	25	505	60	430	12	M36	39
40	10	170	28	125	4	M20	22	300	29	585	68	500	16	M39	42
50	10	195	30	145	4	M24	26	350	32	655	74	560	16	M45	48
65	11	220	34	170	8	M24	26	400	36	715	78	620	16	M45	48
80	12	230	36	180	8	M24	26	500	44	870	94	760	20	M52	56
100	14	265	40	210	8	M27	30	600	51	990	104	875	20	M56	62
125	16	315	40	250	8	M30	33	700	59	1145	120	1020	24	M64	70

Table 62. EN 1092-1 Pressure/Temperature Ratings for Cast Steel Flanges

PN	MATERIAL GROUP	MAXIMUM ALLOWABLE PRESSURE(1)															
		14 to 212°F / -10 to 100°C		302°F / 150°C		392°F / 200°C		482°F / 250°C		572°F / 300°C		662°F / 350°C		707°F / 375°C		752°F / 400°C	
		psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
16	1C1	232	16.0	226	15.6	219	15.1	209	14.4	194	13.4	186	12.8	180	12.4	157	10.8
	1C2	218	15.0	218	15.0	218	15.0	225	15.5	216	14.9	206	14.2	199	13.7	157	10.8
25	1C1	363	25.0	354	24.4	344	23.7	326	22.5	303	20.9	290	20.0	281	19.4	245	16.9
	1C2	363	25.0	363	25.0	363	25.0	363	25.0	338	23.3	322	22.2	310	21.4	245	16.9
40	1C1	580	40.0	567	39.1	550	37.9	522	36.0	486	33.5	463	31.9	451	31.1	392	27.0
	1C2	580	40.0	580	40.0	580	40.0	580	40.0	540	37.2	516	35.6	496	34.2	392	27.0
63	1C1	914	63.0	892	61.5	864	59.6	824	56.8	764	52.7	730	50.3	711	49.0	616	42.5
	1C2	914	63.0	914	63.0	914	63.0	914	63.0	851	58.7	812	56.0	780	53.8	616	42.5
100	1C1	1450	100	1417	97.7	1374	94.7	1307	90.1	1252	86.3	1157	79.8	1128	77.8	979	67.5
	1C2	1450	100	1450	100	1450	100	1450	100	1350	93.1	1289	88.9	1239	85.4	979	67.5

1. These ratings apply only for flange types 05, 11, 12, 13 and 21 having nominal sizes up and including DN 600.

Table 63. Drill Sizes for Pipe Taps

NOMINAL PIPE SIZE, IN.	TAP DRILL SIZE, IN.	NOMINAL PIPE SIZE, IN.	TAP DRILL SIZE, IN.
1/8	11/32	1-1/2	1-23/32
1/4	7/16	2	2-3/16
3/8	19/32	2-1/2	2-9/16
1/2	23/32	3	3-3/16
3/4	15/16	4	4-3/16
1	1-5/32	5	5-5/16
1-1/4	1-1/2	6	6-5/16

Table 64. Standard Twist Drill Sizes

DESIGNATION	DIAMETER, IN.	AREA, SQ. IN.	DESIGNATION	DIAMETER, IN.	AREA, SQ. IN.	DESIGNATION	DIAMETER, IN.	AREA, SQ. IN.
1/2	0.5000	0.1963	3	0.213	0.03563	3/32	0.0938	0.00690
31/64	0.4844	0.1843	4	0.209	0.03431	42	0.0935	0.00687
15/32	0.4688	0.1726	5	0.2055	0.03317	43	0.0890	0.00622
29/64	0.4531	0.1613	6	0.204	0.03269	44	0.0860	0.00581
7/16	0.4375	0.1503	13/64	0.2031	0.03241	45	0.0820	0.00528
27/64	0.4219	0.1398	7	0.201	0.03173	46	0.0810	0.00515
Z	0.413	0.1340	8	0.199	0.03110	47	0.0785	0.00484
13/32	0.4063	0.1296	9	0.196	0.03017	5/64	0.0781	0.00479
Y	0.404	0.1282	10	0.1935	0.02940	48	0.0760	0.00454
Z	0.397	0.1238	11	0.191	0.02865	49	0.0730	0.00419
25/64	0.3906	0.1198	12	0.189	0.02806	50	0.0700	0.00385
W	0.386	0.1170	3/16	0.1875	0.02861	51	0.0670	0.00353
V	0.377	0.1116	13	0.185	0.02688	52	0.0635	0.00317
3/8	0.375	0.1104	14	0.182	0.02602	1/16	0.0625	0.00307
U	0.368	0.1064	15	0.1800	0.02554	53	0.0595	0.00278
23/64	0.3594	0.1014	16	0.1770	0.02461	54	0.0550	0.00238
T	0.358	0.1006	17	0.1730	0.02351	55	0.0520	0.00212
S	0.348	0.09511	11/64	0.1719	0.02320	3/64	0.0473	0.00173
11/32	0.3438	0.09281	18	0.1695	0.02256	56	0.0465	0.001698
R	0.339	0.09026	19	0.1660	0.02164	57	0.0430	0.001452
Q	0.332	0.08657	20	0.1610	0.02036	58	0.0420	0.001385
21/64	0.3281	0.08456	21	0.1590	0.01986	59	0.0410	0.001320
P	0.323	0.08194	22	0.1570	0.01936	60	0.0400	0.001257
O	0.316	0.07843	5/32	0.1563	0.01917	61	0.039	0.001195
5/16	0.3125	0.07670	23	0.1540	0.01863	62	0.038	0.001134
N	0.302	0.07163	24	0.1520	0.01815	63	0.037	0.001075
19/64	0.2969	0.06922	25	0.1495	0.01755	64	0.036	0.001018
M	0.295	0.06835	26	0.1470	0.01697	65	0.035	0.000962
L	0.29	0.06605	27	0.1440	0.01629	66	0.033	0.000855
9/32	0.2813	0.06213	9/64	0.1406	0.01553	67	0.032	0.000804
K	0.281	0.06202	28	0.1405	0.01549	1/32	0.0313	0.000765
J	0.277	0.06026	29	0.1360	0.01453	68	0.031	0.000755
I	0.272	0.05811	30	0.1285	0.01296	69	0.0292	0.000670
H	0.266	0.05557	1/8	0.1250	0.01227	70	0.028	0.000616
17/64	0.2656	0.05542	31	0.1200	0.01131	71	0.026	0.000531
G	0.261	0.05350	32	0.1160	0.01057	72	0.025	0.000491
F	0.257	0.05187	33	0.1130	0.01003	73	0.024	0.000452
E 1/4	0.2500	0.04909	34	0.1110	0.00968	74	0.0225	0.000398
D	0.246	0.04753	35	0.1100	0.00950	75	0.021	0.000346
C	0.242	0.04600	7/64	0.1094	0.00940	76	0.020	0.000314
B	0.238	0.04449	36	0.1065	0.00891	77	0.018	0.000254
15/64	0.2344	0.04314	37	0.1040	0.00849	78	0.016	0.000201
A	0.234	0.04301	38	0.1015	0.00809	1/64	0.0156	0.000191
1	0.228	0.04083	39	0.0995	0.00778	79	0.0145	0.000165
2	0.221	0.03836	40	0.0980	0.00754	80	0.0135	0.000143
7/32	0.2188	0.03758	41	0.0960	0.00724	- - - -	- - - -	- - - -

Note: Designations are in fractions of an in., in standard twist drill letters or in standard twist drill numbers, the latter being the same as steel wire gauge numbers.

A

Absolute Pressure (abs press) - Gauge pressure plus barometric pressure. Absolute pressure can be zero only in a perfect vacuum.

Absolute Viscosity (abs visc) - The product of fluid kinematic viscosity times its density. Absolute viscosity is a measure of fluid tendency to resist flow, without regard to its density. Sometimes the term dynamic viscosity is used in place of absolute viscosity. Refer to Viscosity, Absolute.

Accuracy - A measure of how close a regulator can keep downstream pressure (P_2) to the setpoint. Regulator accuracy is expressed as percent droop or proportional band or offset in percent of setpoint or in units of pressure.

ACFH - Actual Cubic Feet per Hour. The actual volume of fluid measured by the meter. This is not SCFH (standard cubic feet per hour).

Active/Working Regulator - A regulator that is in service performing a control function.

Adjusting Screw - A screw used to change the compression setting of a loading spring.

AGA - The American Gas Association or Australian Gas Association.

Airsets - See Filter/Supply Regulators.

ALPGA - Australian Liquefied Petroleum Gas Association, Ltd.

ANSI - American National Standards Institute.

API - American Petroleum Institute.

Appliance (Equipment) - Any device that uses gas as a fuel or raw material to produce light, heat, power, refrigeration or air conditioning.

ASME - American Society of Mechanical Engineers.

Aspirator - Any device using fluid velocity effect to produce a low-pressure zone. Used in regulator control and combustion systems.

Atmospheric Pressure - The pressure exerted by the atmosphere at a given location and time. Sea level pressure is approximately 14.7 psia / 1.0 bar a.

Automatic Control System - A control system that operates without human intervention.

Automatic Cutoff - A device used on some regulators to close the main valve in the event of pressure deviation outside of a preset range. Must be reopened manually.

B

Backpressure Regulator - This is a device that controls and responds to changes in its upstream/inlet pressure. Functions the same as a relief valve in that it opens on increasing upstream pressure.

Barometer - An instrument for measuring atmospheric pressure, usually in inches, centimeters or millimeters of mercury column.

Barometric Pressure - The atmospheric pressure at a specific place according to the current reading of a barometer.

Bellows - A flexible, thin-walled cylinder made up of corrugations one next to the other that can expand or contract under changing pressures.

Bimetallic Thermal System - A device working on the difference in coefficient of expansion between two metals to produce the power to position a valve plug in response to temperature change.

Bleed - Removal of fluid from a higher pressure area to a lower pressure area in a regulator pilot system.

Bode Diagram - A plot of log amplitude ratio and phase values on a log frequency base for a transfer function. (It is a common form of graphically presenting frequency response data.)

Body - Pressure retaining shell enclosing the restricting element.

Boiler - A closed vessel in which a liquid is heated or vaporized.

Bonnet - The regulator component that connects the valve body to the actuator.

Boost - The increase in control pressure above setpoint as flow is increased from low flow to maximum flow. Some regulators exhibit droop instead of boost.

British Thermal Unit (BTU) - The quantity of heat required to raise the temperature of one pound of water from by 1 degree Fahrenheit.

Build-up - In a relief valve, the pressure increase above setpoint required to produce a given flow rate.

BSPT - British Standard Pipe Thread.

C

C_1 - A term used in a sizing equation. It is defined as the ratio of the gas sizing coefficient and the liquid sizing coefficient and provides a numerical indicator of the valve's recovery capabilities.

Cage - A hollow, cylindrical trim element that is a guide to align the movement of a valve plug with a seat ring and/or retains the seat ring in the valve body. The walls of the cage contain openings that usually determine the flow characteristic of the control valve.

Capacity, Flow - The amount of a specified fluid that will flow through a valve, specific length and configuration of tubing, a manifold, fitting or other component at a specified pressure drop in a fixed period of time. (SCFH, gpm, Nm^3/h, Lpm, bph).

Capacity, Rated - The rate of flow through the regulator specified by the manufacturer for a given inlet pressure, outlet pressure, offset and size.

Capacity, Wide-Open - If a wide-open failure occurs, this is the amount a regulator will flow.

Cavitation - A phenomenon whereby liquid flowing through a valve under reduced pressure will form gaseous bubbles that will collapse upon pressure recovery, producing potential trim damage. This is a concern when high-pressure drops exist across the valve.

Glossary of Terms

Centipoise - A unit for measurement of absolute viscosity. One centipoise is equal to one hundredth of a poise, the metric (cgs) unit of absolute viscosity. The absolute viscosity of water at 20°C is approximately one centipoise.

Centistoke - A unit for measurement of kinematic viscosity. One centistoke is equal to one hundredth of a stoke, the metric (cgs) unit of kinematic viscosity. The kinematic viscosity in centistokes times the density equals the absolute viscosity in centipoises.

CFH - Cubic Feet per Hour (ft^3/h). Volumetric measurement of gas flow per hour, generally at line conditions.

C_g (Flow Coefficient) - A term used in gas and steam valve sizing equations. The value of C_g is proportional to flow rate and is used to predict flow based on physical size or flow area.

CGA - Canadian Gas Association.

Coal/Coke Oven Gas - A gas with a high sulfur content that is produced from baking coal. It may also contain tar that can cause sticking in moving parts of a regulator. Regulators with brass or copper parts should not be used with this gas. Often this gas requires the use of fluorocarbon.

Compressibility Effect - The change in density of gas or air under conditions of compression.

Compression (Spring) - The action on a spring which decreases its length relative to the force to which it is subjected.

Condensate - The liquid resulting when a vapor is cooled and/or when its pressure is increased.

Control Line - The external piping which connects the regulator actuator or pilot to the point on the main line where control is required.

Control Valve - A mechanically, electrically or hydraulically operated valve, using an external power source to effect its operation, that modifies the fluid flow characteristics in a process. It consists of a valve connected to an actuator mechanism that is capable of changing the position of the flow controlling element or closure member in the valve in response to a signal from the controlling device.

Controller - A device that operates automatically to regulate a controlled variable.

Critical Flow - The rate at which a fluid flows through an orifice when the stream velocity at the orifice is equal to the velocity of sound in the fluid. Under such conditions, the rate of flow may be increased by an increase in upstream pressure, but it will not be affected by a decrease in downstream pressure. Critical flow occurs when P_2 is approximately 1/2 of P_1 absolute.

Critical Velocity - The velocity at critical flow. Also called sonic velocity.

CSA - Canadian Standards Association.

C_s (Flow Coefficient) - Steam valve sizing coefficient. At pressures below 1000 psig, a constant relationship exists between the gas sizing coefficient (C_g) and the steam coefficient (C_s). This relationship is expressed: $C_s = C_g \div 20$.

C_v (Flow Coefficient) - Liquid sizing coefficient. It is numerically equal to the number of U.S. Gallons of water at 60°F that will flow through the valve in one minute when the pressure differential across the valve is one pound per square inch.

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D

Dead Band - The range through which an input can be varied without initiating observable response.

Delta P (DP) (ΔP) (Pressure Drop) - The difference between the inlet and outlet pressures.

Demand - The rate at which fluid is delivered to or required by a system, part of a system or a piece of equipment, usually expressed in terms of volume per unit of time.

Density - The weight of a unit volume of a substance. Also called specific weight.

Diaphragm - A flexible membrane used in a regulator or relief valve to sense changes in downstream pressure or upstream pressure and respond to them, thus moving the restricting element or closure member to which it is attached.

Diaphragm Actuated Regulator - A regulator utilizing a diaphragm and actuator to position the valve plug.

Diaphragm Case - A housing used for supporting a diaphragm and establishing one or two pressure chambers.

Diaphragm Effect - The change in effective area of the diaphragm as the regulator strokes from low to high flow.

Diaphragm Plate - A plate used to transmit force in conjunction with a diaphragm and fluid pressure on a spring to the actuator stem or pusher post.

Differential Pressure - The difference in pressure between two points in a system.

Differential Pressure Regulator - A device that maintains a constant differential pressure between a reference pressure and the pressure of the controlled fluid.

Digester Gas - A gas produced by sewage treatment plants. This gas is used to power burners and engines. Because of its high methane content, stainless steel construction might be required.

Disk - A movable part that is positioned in the flow path to modify the rate of flow through the valve. It is often made of an elastomer material to improve shutoff capability.

Downstream - Any site beyond a reference point (often a valve or regulator) in the direction of fluid flow.

Drift - A change in setpoint over an extended period of time.

Droop - The amount a regulator deviates below its setpoint as flow increases. Some regulators exhibit boost instead of droop.

DVGW - Deutscher Verein des Gas - und Wasserfaches e.v. (German approval agency).

Dynamic Unbalance - The force exerted on a valve plug when fluid is flowing through the valve.

E

Effective Area - In a diaphragm actuator, the part of the diaphragm area that generates operating force. The effective area is less than the total area. (The effective area of a diaphragm might change as it is stroked, usually being a maximum at the start and a minimum at the end of the travel range. Molded diaphragms have less change in effective area than flat-sheet diaphragms.)

End Connection - The style of joint used to make a pressure tight connection between the valve body and the pipeline.

Entropy - A thermodynamic quantity that measures the fraction of the total energy of a system that is not available for doing work.

Enthalpy - Total heat content, expressed in BTU per pound, above an arbitrary set of conditions chosen as the base or zero point.

External Pressure Registration - A regulator with a control line. The actuator pressure is isolated from the body outlet pressure within the regulator.

External Static Line - The same as control line.

F

Face-to-Face Dimension - The dimension from the face of the inlet opening to the face of the outlet opening of the regulator.

Fail-Closed - In the event of a regulator failure, a condition wherein the valve port remains closed. All regulators can fail open or closed.

Fail-Open - In the event of a regulator failure, a condition wherein the valve port remains open. All regulators can fail open or closed.

Filter/Supply Regulators - Pressure reducing regulators used in air service to simultaneously filter and reduce pressure. Used to supply process control instruments pneumatic power. Also called airsets.

First-Stage Regulator - A regulator used to reduce inlet pressure to a set value being fed to another regulator in series.

Fixed Factor Measurement - The measurement of gas at a controlled elevated pressure without the use of an automatic correcting device to correct the volume for variation from base or contract pressure. This is accomplished by placing an accurate regulator upstream of the meter. Also known as PFM (Pressure Factor Measurement).

Fixed Restriction - A small diameter hole in the pilot or piloting system that determines gain.

Flange - End connections of regulator valve bodies used for bolting onto another fitting or pipe element.

Flange Facing - The finish on the end connection of valves.

Flashing - A condition when liquid changes to the vapor state caused by pressure reduction inside a valve.

Flow Capacity - The rated flow through a regulator under stated inlet, outlet and droop pressures.

Flow Characteristic - Relationship between flow through the valve and percent rated travel.

Flow Coefficient - See C_v, C_s, C_g, C_1.

Flow Rate - The amount (mass, weight or volume) of fluid flowing through a valve body per unit of time.

Fluid - Materials in a liquid, gas or vapor state, as opposed to a solid.

Fuel Gas - A commonly distributed gas used for fuel, such as natural gas, propane, landfill gas, etc.

Full Capacity Relief - A relief valve that has the capability of maintaining downstream pressure to within certain limits in the event of some type of failure, by venting the excess gas to the atmosphere.

G

Gage Pressure - (psig or bar g) The difference between atmospheric pressure and the pressure being measured. Also written as gauge pressure.

Gas - That state of matter which expands to fill the entire container which holds it. Gas is one of the forms of matter (solid, liquid and gas).

Gas Utilization Equipment - Any device which utilizes gas as a fuel or raw material or both.

Gauge Pressure - Pressure reading as shown on a gauge (psig or bar g). The difference between atmospheric pressure and the pressure the gauge is measuring. Also written as gauge pressure.

Glossary of Terms

Gauge, Pressure - An instrument that measures the pressure of a fluid.

Governor - An attachment to a machine for automatic control or limitation of speed. Also, an archaic term used for a low-pressure, direct-operated, pressure reducing gas regulator.

H

Hard Facing - A material harder than the surface to which it is applied. Used to resist galling or fluid erosion.

Header - A piping configuration where a number of pipes are combined at one location.

Hunting - A condition in which a regulator's outlet pressure slowly fluctuates on either side of a setpoint.

Hysteresis - A deviation from setpoint caused by friction and parts clearance.

I

Impulse Line - See control line.

Inch of Water Column - A unit of pressure measurement. The pressure required to support a column of water one inch high. Typically reported as inches w.c. (water column); 27.68 inches of water column is equal to one pound per square inch (psi).

Inlet Pressure - The pressure at the inlet opening of a valve (P_1).

Inlet Pressure Sensitivity - The increase or decrease in the outlet pressure caused by changes in the inlet pressure which results in differing degrees of force being applied to the seat disk and diaphragm.

Internal Relief Valve - A small, spring-loaded pressure relief valve contained within the regulator at the center of the diaphragm to prevent outlet pressure from exceeding a predetermined pressure.

Isolation Valve - Refer to Valve, Isolation.

I/O - Input/Output -- Electrical inputs and electrical outputs.

J - K

K_m - Value recovery coefficient - used in liquid sizing equations to determine ΔP allowable for cavitation.

Kinematic Viscosity (kin visc) - The relative tendency of fluids to resist flow. The value of the kinematic viscosity includes the effect of the density of the fluid. The kinematic viscosity is equal to the absolute viscosity divided by the density. Refer to Viscosity, Kinematic.

L

LCD - Liquid crystal display; readout panel which displays alphanumeric sequences in digital format.

Landfill Gas - A gas produced by decaying organic matter in a garbage landfill. This gas is used to power burners and engines. This gas has a high methane content and may contain other gases; therefore, stainless steel construction is usually required.

Liquid Expansion Thermal System - A closed system containing liquid whose expansion and contraction in response to temperature changes provides the power to position a valve member.

Liquefied Petroleum Gas (LPG) - Butane, propane or a mixture of the two, obtained from oil or gas wells or as a by-product from the refining of gasoline. It is sold in metal bottles under pressure as a liquid; hence, sometimes called bottled gas.

Loading Element - In a regulator, the means for placing a measured amount of force against the regulator's diaphragm. The loading element is commonly a spring.

Loading Pressure - The pressure employed to position a pneumatic actuator. (This is the pressure that actually works on the actuator diaphragm or piston to change the position of the valve plug.)

Lockup Pressure - Increase over setpoint when the regulator is at no-flow condition.

M

Maximum Allowable Operating Pressure (MAOP) - The maximum pressure that the system may be operated at as determined by its components, taking into account function and a factor of safety based on yield of parts or fracture.

Maximum Operating Pressure - The maximum pressure existing in a piping system during normal operation.

Measuring Element - A diaphragm that senses (measures) changes in downstream pressure and causes the regulator restricting element to move toward the open or closed position.

Meters Cubed per Hour (Normal or Standard) - Refer to Nm^3/h or Sm^3/h.

Minimum Controllable Flow - The lowest flow at which a steady regulated condition of the controlled variable can be maintained.

Modbus - Protocol used for communications between electronic devices developed by Gould Modicon.

N

NACE - National Association of Corrosion Engineers

Natural Gas - A hydrocarbon gas consisting mainly of methane.

Needle Valve - Refer to Valve, Needle.

Nm^3/h - meters cubed per hour (normal); measurement of volume rate of a gas at atmospheric pressure and 0°C. Also refer to Sm^3/h.

NPT - National Pipe Thread, a standard for tapered thread used on pipes and pipe fittings.

O

Offset - The deviation from setpoint for a given flow. Negative offset is equivalent to droop.

Operating Pressure - The actual pressure at which a device operates under normal conditions. This pressure may be positive or negative with respect to atmospheric pressure.

Orifice - A fixed opening, normally the inside diameter of a seat ring, through which fluid passes. The term can also refer to the inlet or outlet of a regulator or pilot valve. Also called a port.

Outlet Pressure (Reduced Pressure) - The pressure leaving the outlet opening of a valve (P_2).

Over-Pressure Cut-Off Device - A mechanical device incorporated in a gas pipework system to shutoff the supply of gas when the pressure at the sensing point rises to a predetermined value.

P

P_1 - Inlet or upstream pressure.

P_2 - Outlet or downstream pressure.

PFM (Pressure Factor Measurement) - The measurement of gas at a controlled elevated pressure without the use of an automatic correcting device to correct the volume for variation from base or contract pressure. This is accomplished by placing an accurate regulator upstream of the meter. Also known as Fixed Factor Measurement

PID - Proportional/Intergral/Derivative device. Usually used as a controller.

Pilot (Amplifier) - A relatively small controlling regulator that operates the main regulator. They are used to increase accuracy.

Piston Actuated Regulator - A regulator utilizing a piston rather than a diaphragm actuator.

Pitot Tube - A hollow tube that connects the area beneath the regulator diaphragm with the vena contracta area of gas flow. The pitot tube causes the diaphragm to sense a pressure lower than that which exists downstream of the regulator and thus allows the regulator to open more for any given change in downstream pressure. The result is increased regulator accuracy.

P_L - Loading pressure. Pressure of fluid on the main diaphragm that is controlled by a pilot regulator.

Plug - Piece that throttles against an orifice to increase and decrease flow.

Poise - A metric unit for measuring absolute viscosity. One poise equals one dynesecond per square centimeter or one gram per centimeter second.

Port - A fixed opening, normally the inside diameter of a seat ring, through which fluid passes. The term can also refer to the inlet or outlet of a regulator or pilot valve. Also called an orifice.

Powder Paint Coating - A paint process that uses dry powder with no solvents for surface finish. Dry powder can be reused, thereby reducing waste and pollutants. The powder coating over a clean surface provides better corrosion resistance than liquid coat.

Pressure - Force per unit area.

Pressure Buildup - In a relief valve, the pressure increase above setpoint required to produce a given flow rate.

Pressure Differential - The difference in pressure between two points in a system.

Pressure Drop - The difference between the inlet and outlet pressures.

Pressure Reducing Regulator - A valve that satisfies downstream demand while maintaining a constant reduced pressure. As the pressure decreases, the valve opens to increase flow.

Pressure Relief Valve - A valve that opens and closes to ensure that pressure does not rise above a predetermined value.

Propane - An easily liquefiable hydrocarbon gas. Propane is one of the components of raw natural gas and it is also derived from petroleum refining processes. Its chemical formula is C_3H_8.

Proportional Band (Amount of Deviation) - The amount a regulator deviates from setpoint as the flow increases from minimum to maximum. Also referred to as droop or offset.

psia - pounds per square inch, absolute - The pressure above a perfect vacuum, calculated from the sum of the pressure gauge reading and the (local or ambient) atmospheric pressure (approximately 14.7).

psid - Pounds per square inch, differential.

psig - Pounds per square inch, gauge. The pressure above atmospheric pressure. Near sea level the atmospheric pressure is approximately 14.7 pounds per square inch.

Q - R

Range - The region between the limits within which a quantity is measured, received or transmitted, expressed by stating the lower and upper range values (Example: 3 to 15 psi; -40 to 212°F / -40 to 100°C).

Rangeability - The ratio of maximum rated capacity to the minimum controllable flow within the specified accuracy band.

Rate of Flow - The volume of material passing a given point in a system per unit of time.

Rated Working Pressure - The maximum allowable pressure specified by the manufacturer.

Reduced Pressure - The pressure leaving the outlet opening of a valve (P_2). More commonly called outlet pressure.

Regulator, Direct-Operated - See Pressure Reducing Regulator.

Regulator, Pilot-Operated - Two regulators connected so that one increases the effect of downstream pressure changes on the other. This arrangement is used to provide increased accuracy and flow capacity compared to direct-operated regulators.

Relief Valve - See Pressure Relief Valve.

Relief Valve, Pilot-Operated - Two relief valves connected so that one increases the effect of inlet pressure changes on the other. This arrangement is used to provide increased capacity and reduced buildup compared to other relief valve types.

Relief Valve, Pop Type - A spring-loaded poppet type relief valve.

Repeatability - The closeness of agreement of a regulated value when returned to the same steady-state conditions after upset(s).

Reseat Point - In a relief/backpressure valve which is opened by an increase in inlet pressure, the point where the valve closes.

Restricting Element - The element that restricts and controls fluid flow in a system. In a regulator this element is typically a disk and orifice combination or plug and cage assembly.

RTD - Resistance Temperature Detector. A resistance device used to measure temperature.

RTU - Remote Terminal Unit or Remote Telemetry Unit.

S

SAE Number Viscosity - Refer to Viscosity, SAE Number.

Saybolt Furol - A scale used for measuring the viscosity of heavy oils. The instrument has a larger orifice and is used at a higher temperature than the Saybolt Universal instrument used for lighter oils.

Saybolt Universal - A scale used for measuring the viscosity of oil, expressed in seconds required for a specified amount of oil to flow through an orifice; hence, the larger the number of seconds, Saybolt Universal (SSU), the more viscous the oil.

SCFH - Standard cubic feet per hour. Volumetric gas measurement of flow per hour at standard or at base conditions.

Seat - The portion of the seat ring or valve body which a closure member contacts for shutoff.

Seat Leakage - Flow of fluid past a seat or seal when in the closed position.

Seat Ring - A separate piece inserted in a valve body to form a valve body port. It generally provides a seating surface for a plug or disk.

Self-Contained Regulator - Pressure control device that is powered by the process media pressure and does not require outside energy.

Setpoint - The pressure at which the regulator or relief valve is set to control.

Set Pressure Range - The range of pressures, specified by the manufacturer, within which the device can be adjusted.

Sm^3/h - meters cubed per hour (standard); measurement of volume rate of a gas at atmospheric pressure and 60°F. Also refer to Nm^3/h.

Soft Seat - An elastomeric, plastic or other readily deformable material used either in the valve plug or seat ring to provide tight shutoff with minimal force.

Sonic Velocity - The speed of sound for a particular gas at a given inlet pressure and temperature.

Sour Gas - Gaseous fuel that contains a relatively large proportion of sulfur or sulfur compounds. See the discussion on Sulfide Stress Cracking in the Technical Section.

Specific Gravity - The ratio of weight of a given volume of fluid to the weight of an equal volume of liquid/gas at stated temperature.

Speed of Response (Stroking Speed) - The amount of time it takes the valve plug or disk to travel from completely closed to completely open (0 to 100%).

Spring - Part used as the loading element in a regulator. Length is adjusted to establish setpoint.

Spring Adjustment Screw - A screw used to compress the spring to establish the regulator setpoint.

Spring Rate (K) - Spring rate is defined by the amount of force required to compress a spring a given distance. Spring rate is given in force/length (for example, lbf/in).

Stability - The ability to hold a steady controlled variable within the limits of stated accuracy of regulation.

Standard Atmosphere - The accepted normal atmospheric pressure at sea level, equal to 14.696 pounds per square inch.

Standard Barometer - The reading of a barometer for standard atmospheric pressure; equal to 29.92 inches of mercury column.

Standard Gravity - Standard accepted value for the force of gravity. It is equal to the force which will produce an acceleration of 32.17 feet per second per second.

Standard Pressure - The same as standard atmosphere; equal to a pressure of 14.696 pounds per square inch.

Static Line - See Control Line.

Static Pressure - The pressure in a fluid at rest.

Static Unbalance - The force exerted on a valve plug due to fluid pressure in the non-flowing condition.

Stoke - The cgs unit of kinematic viscosity. One stoke equals one centimeter squared per second.

Supercompressibility - Many gases are more compressible under high pressure at ordinary temperatures than indicated by Boyle's Law. These gases, measured at the high pressures, will occupy a greater volume when the pressure is reduced to near atmospheric pressure.

SUS (or SSU) Viscosity - Refer to Viscosity, SUS (or SSU).

T - U

Therm - 100,000 BTU.

Thermostat - A device that automatically maintains a predetermined temperature in an appliance or component.

Travel - The amount of linear movement of the valve closure member from the closed position to the rated full-open position.

Travel Indicator - An external, visible device used to indicate the travel of the valve plug.

Trim - The replaceable internal parts of a regulator, usually made up of a seat ring or orifice, valve plug or disk and disk holder and stem; other replaceable internal parts may be considered trim.

Under-Pressure Cut-Off Device - A mechanical device incorporated in a gas pipe work system to shutoff the supply of gas when the pressure at the sensing point falls to a predetermined figure.

V

Vacuum Breaker - A valve used to limit an increase in vacuum. An increase in vacuum (decrease in absolute pressure) beyond a certain value registers on the diaphragm. The valve disk will open permitting atmospheric, positive pressure or an upstream vacuum that has a higher absolute pressure than the downstream vacuum, to enter the system and restore to setpoint.

Vacuum Regulator - A device that maintains a vacuum at a setpoint. A decrease in this vacuum (increase in absolute pressure) beyond this value registers underneath the diaphragm and opens the valve. This permits the downstream vacuum of lower absolute pressure than the upstream vacuum to restore the upstream vacuum to its original pressure setting.

Valve - A device used for the control of fluid. It consists of a fluid retaining assembly, one or more parts between end openings and a movable closure member which opens, restricts or closes the port(s).

Valve Body - A pressure retaining housing for internal parts having inlet and outlet flow connections.

Valve Closure Member - The movable part which is positioned in the flow path to modify the rate of flow through the valve, often made of an elastomer material to improve shutoff.

Valve Linkage - A lever or levers connecting the diaphragm to the valve plug or valve plug stem.

Valve Plug - A movable part which provides a variable restriction in a port.

Valve, Needle - A small, adjustable valve in which the position of a pointed plug or needle relative to an orifice or tapered orifice permits or restricts fluid flow.

Valve, Isolation - Simple valves located in the piping system used to isolate individual equipment. They are designed to be operable by hand and installed to be readily accessible to the consumer.

VDC - Volts direct current.

Vena Contracta - The location where cross-sectional area of the flow stream is at its minimum size, where fluid velocity is at its highest level and fluid pressure is at its lowest level. (The vena contracta normally occurs just downstream of the actual physical restriction in a regulator.)

Vent - An opening in the regulator spring case to allow atmospheric pressure access to the diaphragm, thus allowing free movement of the diaphragm during operation.

Viscosity - The tendency of a fluid to resist flow.

Viscosity, Absolute - The product of a fluid's kinematic viscosity times its density. Absolute viscosity is a measure of a fluid's tendency to resist flow, without regard to its density. Sometimes the term dynamic viscosity is used in place of absolute viscosity.

Viscosity, Kinematic - The relative tendency of fluids to resist flow. The value of the kinematic viscosity includes the effect of the density of the fluid. The kinematic viscosity is equal to the absolute viscosity divided by the density.

Viscosity, SAE Number - The Society of Automotive Engineers' arbitrary numbers for classifying fluids according to their viscosities. The numbers in no way indicate the viscosity index of fluids.

Viscosity, SUS (or SSU) - Saybolt Universal Seconds (SUS), which is the time in seconds for 60 milliliters of oil to flow through a standard orifice at a given temperature (ASTM Designation D88.56).

Volume Corrected - The volume metered times metering pressure plus atmospheric pressure/base pressure equals volume corrected.

W

Water Column - A unit of measurement. The pressure required to support a column of water one inch high. Typically reported as in. w.c. (water column); 27.68 inches of water is equal to one pound per square inch (psi).

Weight, Specific - The weight per unit volume of a substance. The same as density.

X - Y - Z

Yoke - A structure by which the diaphragm case or cylinder assembly is supported rigidly on the bonnet assembly.

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Notes

Worldwide Contact Information

Emerson sales, service and technical support are as close as your telephone or on the web, anywhere in the world. Our distribution network offers a full complement of expert sales and support staff and more than 2,000 technical experts strategically located across nearly 200 offices worldwide.

Internet:
www.Emerson.com

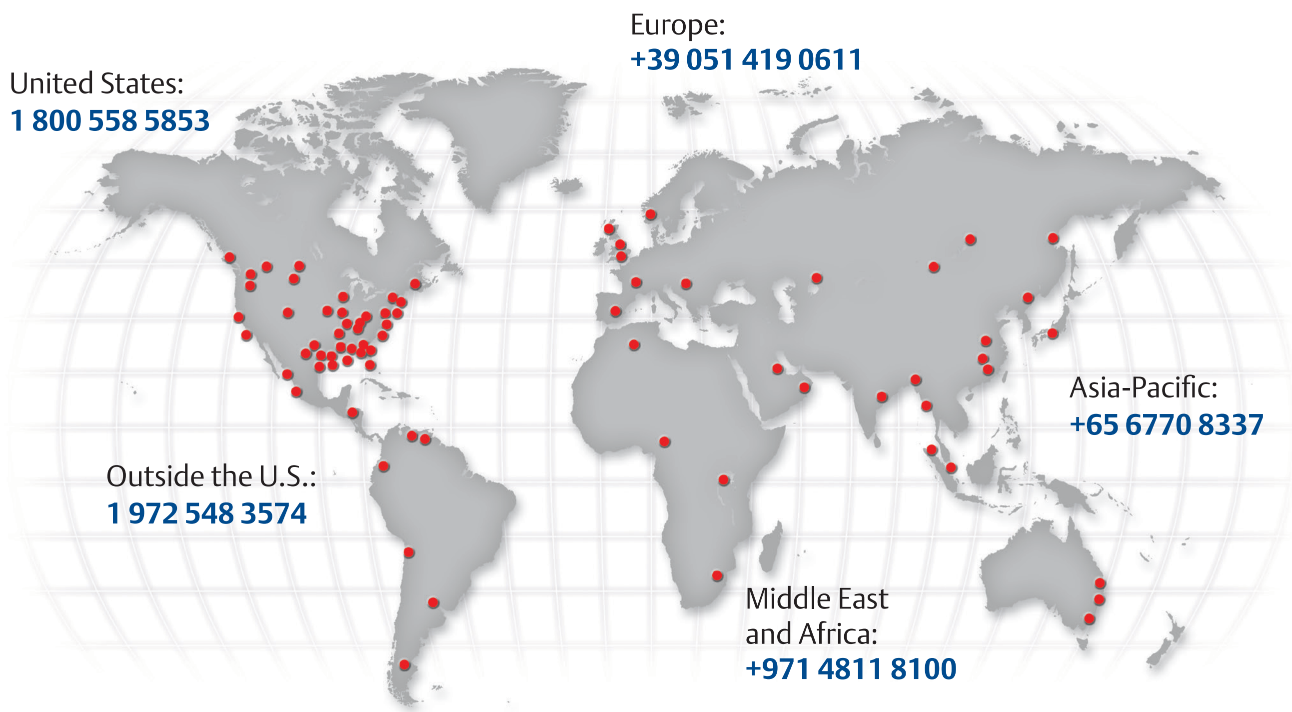
Information available:
- Local Sales Office contacts
- New technology and products
- Technical information library

E-mail:
WebAdmin.Regulators@Emerson.com

Write:
Emerson Automation Solutions
3200 Emerson Way
McKinney, TX 75070
USA

Telephone:
Call one of the numbers listed below to be directed to your local Sales Office.

United States 1 800 558 5853
Outside the U.S. 1 972 548 3574
Asia-Pacific .... +65 6770 8337
Europe .... +39 051 419 0611
Middle East and Africa ...... +971 4811 8100



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All the information in this
Industrial Regulators Application Guide
can be found on Emerson.com.

For quicker access to product information,
download our Regulator Toolkit
at www.emerson.com/regulatortoolkit
that contains:

- Bulletins
- Instruction Manuals
- Schematics
- Animations

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